ACS880 Cooling Tower Drive (ACS880+N5350)

10/14 User's Guide MN799UG

Important:

Be sure to check www.baldor.com for the latest software, firmware and drivers for your drive product. Also, you can download the latest version of this manual in Adobe Acrobat PDF format.

NOTE: Correct counter EMF data is critcal for motor operation success. Please use the template below to record EMF voltage from the nameplate and the serial number of your motor in case you need to reference this in the future.

Counter EMF: _____

Motor Serial Number: _____

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Appendix D
Mechanical Installation

Chapter 1
Introduction

This manual provides information needed for planning the installation, start-up, operating and servicing the ACS880+N5350 Cooling Tower Drive. The +N5350 control is designed specifically for Baldor Interior Permanent Magnet Cooling Tower Motor Control. Control is intended for operating cooling tower fans through a 10:1 variable speed range as well as providing torque control to minimize mechanical stress on the system.

The information in this users guide supports firmware version 1.82.

This manual is a quick start guide and contains information on:
- Safety Instructions
- Installation and Wiring of the ACS880+N5350
- Programming the drive
- Reference to related manuals

The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

The information supplied in this guide is intended to provide abbreviated information commonly needed to install and commission the ACS880+N5350 for Cooling Tower Applications. For complete details please reference the full Hardware and Software Manuals on the enclosed CD and available on www.abb.com.

1.1 Getting Assistance from ABB

For technical assistance, contact your local ABB representative. Contact phone numbers are located on the inside back cover of this guide. Before calling, review the troubleshooting section later in this guide. You will be asked for the drive model number or catalog number that is located on the nameplate along with the drive serial number.

1.2 Safety Notices

This chapter contains the safety instructions which you must follow when installing, operating and servicing the drive. If ignored, physical injury or death may follow, or damage may occur to the drive, motor or driven equipment. Read the safety instructions before you work on the unit.

USE of WARNINGS:

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment and advise on how to avoid the danger. The following warning symbols are used in this manual:

Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.

General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

Electrostatic sensitive devices warning warns of electrostatic discharge which can damage the equipment.

1.2.1 Safety in Installation and Maintenance

Electrical Safety -These warnings are intended for all who work on the drive, motor cable or motor.

WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Only qualified electricians are allowed to install and maintain the drive.
- Never work on the drive, motor cable or motor when main power is applied. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.

Always ensure by measuring with a multimeter (impedance at least 1Mohm) that:

- voltage between drive input phases L1, L2 and L3 and the frame is close to 0V.
- voltage between terminals UDC+ and UDC- and the frame is close to 0V.
- Do not work on the control cables when power is applied to the drive or to the external control circuits. Externally supplied control circuits may cause dangerous voltages inside the drive even when the main power on the drive is switched off.

- Do not make any insulation or voltage withstand tests on the drive.
- Do not connect the drive to a voltage higher than what is marked on the type designation label. Higher voltage can activate the brake chopper and lead to brake resistor overload, or activate the overvoltage controller what can lead to motor rushing to maximum speed.

Note:

- The motor cable terminals on the drive are at a dangerously high voltage when the input power is on, regardless of whether the motor is running or not.
- The DC terminals (UDC+, UDC-) carry a dangerous DC voltage (over 500V) when internally connected to the intermediate DC circuit.
- Depending on the external wiring, dangerous voltages (115V, 220V or 230V) may be present on the terminals of relay outputs (XRO1, XRO2 and XRO3).
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is ineffective against deliberate sabotage or misuse.

Grounding - These instructions are intended for all who are responsible for the grounding of the drive.

WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Ground the drive, motor and adjoining equipment to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and interference.
- Make sure that grounding conductors are adequately sized as required by safety regulations.
- In a multiple-drive installation, connect each drive separately to protective earth (PE).
- Where EMC emissions must be minimized, make a 360° high frequency grounding of cable entries in order to suppress electromagnetic disturbances. In addition, connect the cable shields to protective earth (PE) in order to meet safety regulations.
- Do not install a drive with EMC filter option +E200 or +E202 on an ungrounded power system or a high-resistance-grounded (over 30ohms) power system.

Note:

- Power cable shields are suitable for equipment grounding conductors only when adequately sized to meet safety regulations.
- Standard EN 61800-5-1 (section 4.3.5.5.2.) requires that as the normal touch current of the drive is higher than 3.5mA AC or 10mA DC, you must use a fixed protective earth connection and
- a cross-section of the protective earthing conductor of at least 10 mm^2 Cu or 16 mm^2 Al,

or

- automatic disconnection of the supply in case of discontinuity of the protective earthing conductor,

or

- a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor.

Permanent Magnet Motor Drives - These are additional warnings concerning permanent magnet motor drives.

WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Do not work on the drive when the permanent magnet motor is rotating. Also, when the supply power is switched off and the inverter is stopped, a rotating permanent magnet motor feeds power to the intermediate circuit of the drive and the supply connections become live.

Before installation and maintenance work on the drive:

- Stop the motor.
- Ensure that there is no voltage on the drive power terminals according to step 1 or 2, or if possible, according to the both steps.

  1. Disconnect the motor from the drive with a safety switch or by other means. Check by measuring that there is no voltage present on the drive input or output terminals (L1, L2, L3, U/T1, V/T2, W/T3, UDC+, UDC-).

  2. Stray wind currents can rotate the motor and generate electric potentials. Ensure that the motor is not rotating or is disconnected from the drive during work. Shorting and isolation contactors can be used to short the motor leads and isolate the drive from the motor.

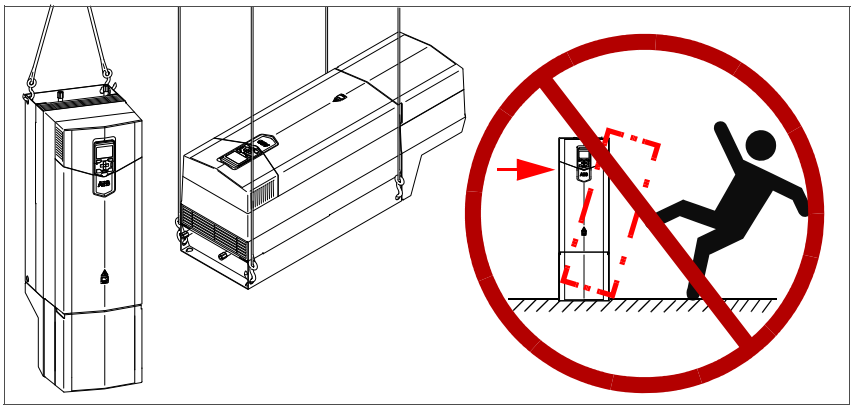
1.2.2 General Safety

These instructions are intended for all who install and service the drive.

WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Handle the unit carefully.
- Frame sizes R6 to R9: Lift the drive using the lifting eyes of the unit. Do not tilt the drive. The drive is heavy and its center of gravity is high. An overturning unit can cause physical injury.

Figure 1-1



- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Ensure that debris from borings and grindings does not enter the drive when installing. Electrically conductive debris inside the unit may cause damage or malfunction.
- Ensure sufficient cooling.
- Do not attach the drive by riveting or welding.

Printed Circuit Boards

WARNING: Ignoring the following instructions can cause damage to the printed circuit boards.

- Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily. The printed circuit boards contain components sensitive to electrostatic discharge.

1.2.3 Safe Start-Up and Operation

General Safety -These warnings are intended for all who plan the operation of the drive or operate the drive.

WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Before you connect voltage to the drive, make sure that the drive covers are on. Keep the covers on during the operation.
- Before adjusting the drive and putting it into service, make sure that the motor and all driven equipment are suitable for operation throughout the speed range provided by the drive. The drive can be adjusted to operate the motor at speeds above and below the speed provided by connecting the motor directly to the power line.
- Do not activate any automatic fault reset functions of the drive control program if dangerous situations can occur. When activated, these functions will reset the drive and resume operation after a fault.
- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.
- Make sure that any safety circuits (for example, emergency stop and Safe torque off) are validated in start-up. See chapter Start-up for reference of the validation instructions.

Note:

- If an external source for start command is selected and it is ON, the drive will start immediately after an input voltage break or fault reset unless the drive is configured for 3-wire (a pulse) start/stop.
- When the control location is not set to local, the stop key on the control panel will not stop the drive.

Permanent Magnet Motor Drives

WARNING: Do not run the motor over the rated speed. Motor overspeed leads to overvoltage which may damage or explode the capacitors in the intermediate circuit of the drive.

Chapter 2
Product Familiarization

2.1 Overview

The ACS880+N5350 is designed to provide variable speed control for a cooling tower fan. This is accomplished much like traditional variable frequency drives, but with unique capabilities specific to the type motor used and the type of application for which the control is being employed.

The +N5350 control is designed specifically for Baldor Interior Permanent Magnet Cooling Tower Motor Control. Control is intended for operating cooling tower fans through a 10:1 variable speed range as well as providing torque control to minimize mechanical stress on the system. The motor drive systems are designed for direct drive applications and eliminate the need for right angle gearboxes. The ACS880 is available for Cooling Tower applications in frame sizes R1 through R9. Frame size specific information can be found in the ratings section.

2.2 Standards

ACS880+N5350 drives have been designed and tested to comply with the following standards.

2.2.1 Applicable Standards

The compliance with the European Low Voltage Directive is verified according to standard EN61800-5-1.

Table 2-1

EN 60204-1:2006 + A1 2009	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. Provisions for compliance: The final assembler of the machine is responsible for installing - emergency-stop device - supply disconnecting device.
IEC/EN 60529:1991 + A1 2000	Degrees of protection provided by enclosures (IP code)
IEC 60664-1:2007	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.
EN 61800-3:2004	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
EN 61800-5-1:2007	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy
EN 61800-5-2:2007	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional
UL 508C:2002	UL Standard for Safety, Power Conversion Equipment, third edition
NEMA 250:2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
CSA C22.2 No. 14-10	Industrial control equipment
GOST R 51321-1:2007	Low-voltage switchgear and control gear assemblies. Part 1 - Requirements for type-tested and partially type-tested assemblies - General technical requirements and methods of tests

2.2.2 CE Marking

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage, EMC and RoHS Directives. The CE marking also verifies that the drive, in regard to its safety functions (such as Safe torque off), conforms with the Machinery Directive as a safety component.

2.2.3 UL Marking

cULus Listed UL Type 1 (IP21) drives:

- frames R1 to R3 of voltage range 208…240V
- frames R1 to R9 of voltage ranges 380…415V and 380…500V
- frames R5 to R9 of voltage range 525…600V

cULus Listed UL Type 12 (IP55) drives:

- frames R1 to R3 of voltage range 208…240V
- frames R1 to R5 of voltage ranges 380…415V and 380…500V
- frames R5 of voltage range 525…600V

The listing is pending for the other types. The approval is valid with rated voltages.

(See also Appendix C for recommendations for CE compliance and UL marking.)

2.3 Usage

The ACS880+N5350 can only be used with Baldor RPM AC Interior Permanent Magnet Cooling Tower Motors. If the motor you need to control is of any other type, contact your local Baldor District Office for support.

2.4 Enclosure

The ACS880+N5350 is provided in an enclosure that meets UL Type 1, IP21 ratings. This provides protection against incidental contact with live electrical circuits and from falling dirt. The drive must be mounted in a clean, dry environment and in a vertical position with at least a 2” clearance on the top, bottom, and both sides. Conductive particles or corrosive gases must not be present in the atmosphere where the drive is mounted. It is not for use outdoors and should be protected from direct sunlight. See Appendix A for complete environmental information.

2.4.1 Layout (IP21, UL Type 1)

The components of the standard IP21 drive are shown below (view of frame R5).

Figure 2-1

2.4.2 Control Panel

The control panel can be removed by pulling it forward from the top edge and reinstalled in reverse order. For the use of the control panel, see the firmware manual or ACS-AP assistant control panels user's manual (3AUA0000085685 [English]).

Figure 2-2

2.5 Connections

The connections of the ACS880+N5350 are segmented into the two groups classified as Power Connections and Control Connections. Conduit mounting holes are provided on the enclosure for each group of connections. See Appendix B for conduit hole sizes so that proper planning can be accomplished for routing conduits to the control.

Access to all connections can be gained by the removal of the front cover.

WARNING: Do not remove the control cover for at least five (5) minutes after AC power is disconnected to allow capacitors to discharge. Dangerous voltages are present inside the equipment. Electrical shock can cause serious or fatal injury.

The power connections are grouped separately from the control connections and may be separated by a protective plate depending on the size of the control. The installer must maintain separation between power connections and control connections so that electrical noise does not interfere with proper operation. This dictates separate conduits for each group of wires. See subsequent sections on power and control wiring for details of the required connections.

2.5.1 Main Circuit

The main circuit of the drive is shown below.

Figure 2-3

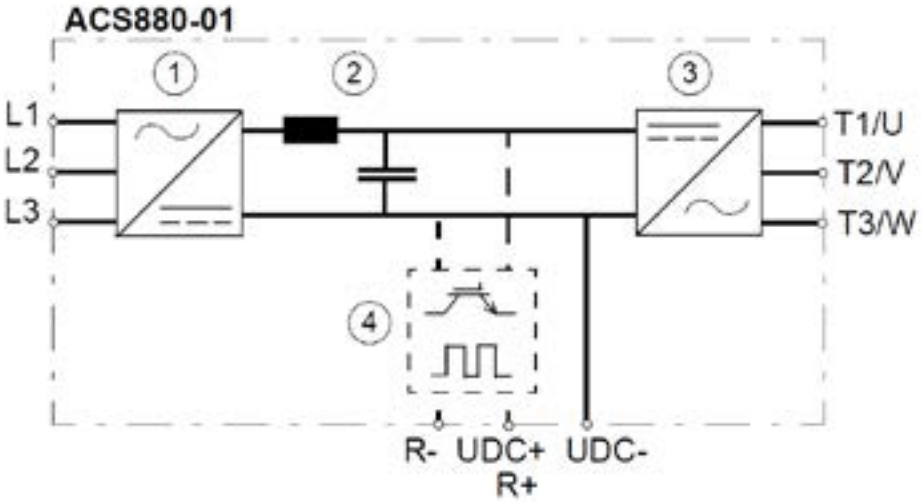


Table 2-2

1	Rectifier. Converts alternating current and voltage to direct current and voltage.
2	DC link. DC circuit between rectifier and inverter.
3	Inverter. Converts direct current and voltage to alternating current and voltage.
4	Brake chopper. Conducts the surplus energy from the intermediate DC circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor. User obtains and installs the brake resistor when needed.

2.5.2 Overview of Power and Control Connections

The diagram shows the power connections and control interfaces of the drive.

Figure 2-4

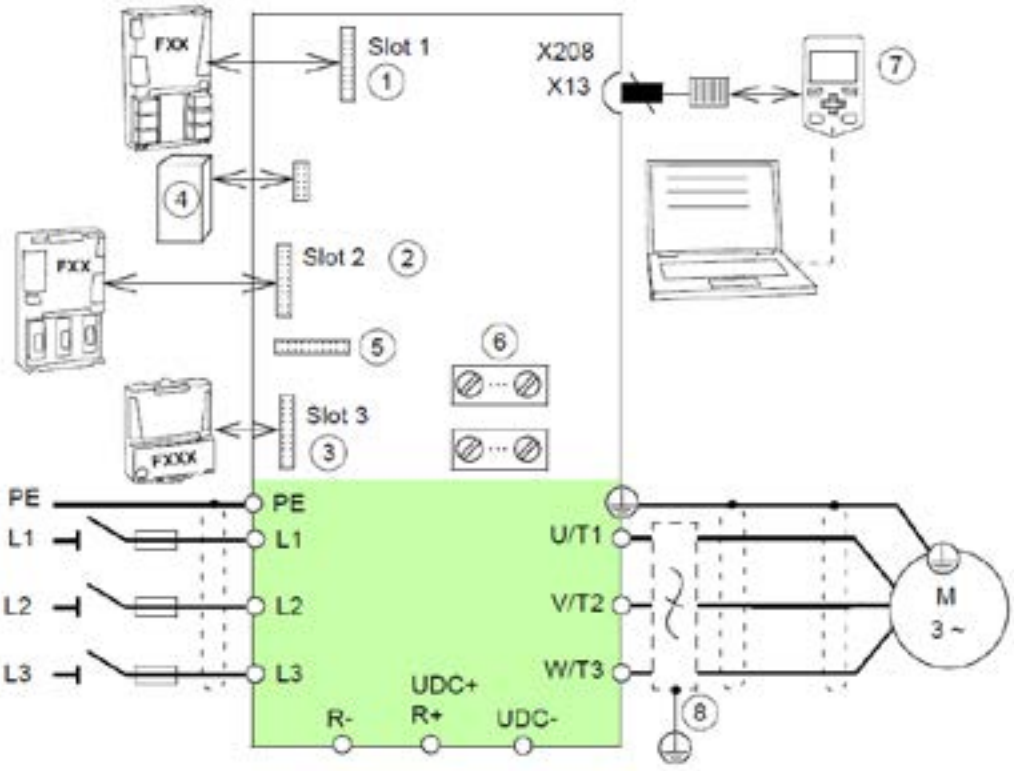


Table 2-3

1	Option modules can be inserted into slots 1, 2 and 3 as follows:
2	**Modules** **Into slots**
3	Analog and digital I/O extension modules except FDIO 1, 2, 3
	Feedback interface modules 1, 2, 3
	Fieldbus communication modules and FDIO 1, 2, 3
	Safety functions modules 2
	See section Type designation key
4	Memory unit
5	Connector for safety functions modules (alternative to Slot 2)
6	Default I/O connection diagram and Control unit (ZCU-12) connection data
7	See Control panel
8	du/dt, common mode or sine filter (optional)

2.5.3 External Control Connection Terminals

The layout of external control connection terminals of the drive is shown below.

Figure 2-5

	Description
XPOW	External power input
XAI	Analog inputs
XAO	Analog outputs
XD2D	Drive-to-drive link
XRO1	Relay output 1
XRO2	Relay output 2
XRO3	Relay output 3
XD24	Start interlock connection (DIIL) and +24 V output
XDIO	Digital input/outputs
XDI	Digital inputs
XSTO	Safe torque off connection
X12	Connector for safety functions modules (optional)
X13	Control panel / PC connection
X202	Option slot 1
X203	Option slot 2
X204	Option slot 3
X205	Memory unit connection
X208	Auxiliary cooling fan connection
J1, J2	Voltage/Current selection jumpers (J1, J2) for analog inputs
J3, J6	Drive-to-drive link termination jumper (J3), common digital input ground selection jumper (J6)

2.6 Type Designation Label

The type designation label includes an IEC and NEMA rating, appropriate markings, a type designation and a serial number, which allow identification of each unit. The type designation label is located on the front cover. An example label is shown below.

Figure 2-6

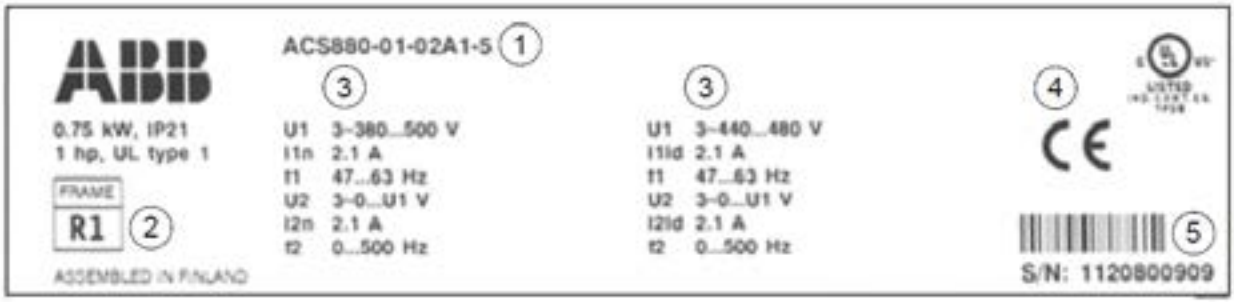


Table 2-4

No.	Description
1	Type designation
2	Frame size
3	Ratings in the supply voltage range
4	Valid markings
5	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.

2.7 Type Designation Key

The type designation contains information on the specifications and configuration of the drive. The first digits from left express the basic configuration, eg, ACS880-01-12A6-3 The optional selections are given thereafter, separated by plus signs, eg, +L519. The main selections are described below. Not all selections are available for all types. For more information, refer to ACS880-01 Ordering Information (3AXD10000014923), available on request.

Table 2-5

Code	Description
Basic codes	
ACS880	Product series
01	When no options are selected: Wall mounted drive, IP21 (UL Type 1), ACS-AP-I assistant control panel, no EMC filter, DC choke, ACS880 primary control program, Safe torque off function, cable entry box, brake chopper in frames R1 to R4, coated boards, printed multilingual quick guides and CD containing all manuals.
Size	
xxxx	Refer to the rating tables
Voltage range	
2	208…240V
3	380…415V
5	380…500V
7	525…690V
Option codes (plus codes)	
Degree of protection	
B056	IP55 (UL Type 12)
Construction	
C131	Vibration dampers
Resistor braking	
D150	Brake chopper for frame R5 and up.
Filters	
E200	EMC filter for second environment TN (grounded) system, category C3.
E201	EMC filter for second environment IT (ungrounded) system, category C3. Available for 380…500V frames R6 to R9.
E202	EMC filter for first environment TN (grounded) system, category C2.
Cable entry box	
H358	UK cable entry box
Fieldbus adapters	
K451	FDNA-01 DeviceNet™ adapter module
K452	FLON-01 LonWorks® adapter module
K454	FPBA-01 PROFIBUS DP adapter module
K457	FCAN-01 CANopen adapter module
K458	FSCA-01 RS-485 adapter module
K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCAT adapter module
K470	FEPL-01 Ethernet POWERLINK adapter module
K473	FENA-11 high performance Ethernet/IP™, Modbus/TCP and PROFINET adapter module

Table 2-5 Continued

Code	Description
I/O extensions and feedback interfaces	
L500	FIO-11 analog I/O extension module
L501	FIO-01 digital I/O extension module
L502	FEN-31 HTL incremental encoder interface module
L503	FDCO-01 optical DDCS communication adapter module
L508	FDCO-02 optical DDCS communication adapter module
L515	FEA-03 I/O extension adapter
L516	FEN-21 resolver interface module
L517	FEN-01 TTL incremental encoder interface module
L518	FEN-11 absolute encoder interface module
L525	FAIO-01 analog I/O extension module
L526	FDIO-01 digital I/O extension module
Specialties	
P904	Extended warranty
ATEX-certified function	
Q971	ATEX-certified Safe motor disconnection function using the Safe torque off function
Safety functions modules	
Q973	FSO-11 safety functions module
Full set of printed manuals in selected language. **Note:** The delivered manual set may include manuals in English if the translation is not available.	
R700	English
R701	German
R702	Italian
R703	Dutch
R704	Danish
R705	Swedish
R706	Finnish
R707	French
R708	Spanish
R709	Portuguese
R711	Russian
R712	Chinese
R713	Polish
R714	Turkish

Chapter 3
Ratings

3.1 Ratings

The ACS880+N5350 product line includes models to support each motor designed for cooling tower direct drive applications. The following table provides the electrical ratings of each of the standard available models. If your need is for a rating not listed below, contact your local ABB representative for support. (Symbols are described below the table.)

Table 3-1 Drive Ratings, Model Numbers and Frame Sizes with 50 and 60 Hz Supply

Catalog Number ACS880-01-	Frame Size	Input Rating	Max Current	Output Ratings		
				Light-Overload Use		
		I_{1N}	I_{max}	I_{LD}	P_{LD}	
		A	A	A	kW	hp
U_N = 208…240V						
24A3-2+N5350	R2	24.3	28.6	23.1	5.5	7.5
031A-2+N5350	R3	31	41	29.3	7.5	10
046A-2+N5350	R4	46	64	44	11	15
061A-2+N5350	R4	61	76	58	15	20
075A-2+N5350	R5	75	104	71	18.5	25
087A-2+N5350	R5	87	122	83	22	30
115A-2+N5350	R6	115	148	109	30	40
145A-2+N5350	R6	145	178	138	37	50
170A-2+N5350	R7	170	247	162	45	60
206A-2+N5350	R7	206	287	196	55	75
274A-2+N5350	R8	274	362	260	75	100
U_N = 380…415V						
12A6-3+N5350	R1	12.6	16	12	5.5	7.5
017A-3+N5350	R2	17	21	16	7.5	10
025A-3+N5350	R2	25	29	24	11	15
032A-3+N5350	R3	32	42	30	15	20
038A-3+N5350	R3	38	54	36	18.5	25
045A-3+N5350	R4	45	64	43	22	30
061A-3+N5350	R4	61	76	58	30	40
072A-3+N5350	R5	72	104	68	37	50
087A-3+N5350	R5	87	122	83	45	60
105A-3+N5350	R6	105	148	100	55	75
145A-3+N5350	R6	145	178	138	75	100
169A-3+N5350	R7	169	247	161	90	125
206A-3+N5350	R7	206	287	196	110	150
246A-3+N5350	R8	246	350	234	132	200
293A-3+N5350	R8	293	418	278	160	225
363A-3+N5350	R9	363	498	345	200	275
430A-3+N5350	R9	430	545	400	200	350

Table 3-1 Drive Ratings, Model Numbers and Frame Sizes with 50 and 60 Hz Supply Cont.

Catalog Number ACS880-01-	Frame Size	Input Rating	Max Current	Output Ratings		
				Light-Overload Use		
		I_{1N}	I_{max}	I_{LD}	P_{LD}	
		A	A	A	kW	hp
U_N = 440…480V						
11A0-5+N5350	R1	11	16	11	5.5	7.5
014A-5+N5350	R2	14	21	14	7.5	10
021A-5+N5350	R2	21	29	21	11	15
027A-5+N5350	R3	27	42	27	15	20
034A-5+N5350	R3	34	54	34	18.5	25
040A-5+N5350	R4	40	64	40	22	30
052A-5+N5350	R4	52	76	52	30	40
065A-5+N5350	R5	65	104	65	37	50
077A-5+N5350	R5	77	122	77	45	60
096A-5+N5350	R6	96	148	96	55	75
124A-5+N5350	R6	124	178	124	75	100
156A-5+N5350	R7	156	247	156	90	125
180A-5+N5350	R7	180	287	180	110	150
240A-5+N5350	R8	240	350	240	132	200
260A-5+N5350	R8	260	418	260	132	200
302A-5+N5350	R9	302	498	302	200	250
361A-5+N5350	R9	361	542	361	200	300
414A-5+N5350	R9	414	542	414	250	350
U_N = 660…690V						
07A3-7+N5350	R5	7.3	12.2	6.9	5.5	7.5
09A8-7+N5350	R5	9.8	18	9.3	7.5	10
14A2-7+N5350	R5	14.2	22	13.5	11	15
018A-7+N5350	R5	18	30	17	15	20
022A-7+N5350	R5	22	44	21	18.5	25
026A-7+N5350	R5	26	54	25	22	30
035A-7+N5350	R5	35	64	33	30	40
042A-7+N5350	R5	42	74	40	37	50
049A-7+N5350	R5	49	76	47	45	60
061A-7+N5350	R6	61	104	58	55	75
084A-7+N5350	R6	84	124	80	75	100
098A-7+N5350	R7	98	168	93	90	125
119A-7+N5350	R7	119	198	113	110	150
142A-7+N5350	R8	142	250	135	132	200
174A-7+N5350	R8	174	274	165	160	225
210A-7+N5350	R9	210	384	200	200	275
271A-7+N5350	R9	271	411	257	250	350

Table 3-2 Definitions

U_N	Supply voltage range
I_{1N}	Nominal rms input current
I_N	Nominal output current (available continuously with no over-loading)
P_N	Typical motor power in no-overload use
I_{LD}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{LD}	Typical motor power in light-overload use
I_{max}	Maximum output current. Available for 10 seconds at start. then as long as allowed by drive temperature.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes.
	* Continuous rms output current allowing 30% overload for 1 minute every 5 minutes.
	** Continuous rms output current allowing 25% overload for 1 minute every 5 minutes.
P_{Hd}	Typical motor power in heavy-duty use

Notes:

1. The ratings apply at an ambient temperature of 40°C (104°F).
2. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.

The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.

3.2 Losses, Cooling Data and Noise

Table 3-3

Catalog Number ACS880-01-	Frame Size	Air Flow		Heat Dissipation	Noise
		m^3/h	ft^3/min	(Watts)	dB(A)
U_N = 208…240V					
24A3-2+N5350	R2	88	52	337	51
031A-2+N5350	R3	134	79	457	57
046A-2+N5350	R4	134	79	500	62
061A-2+N5350	R4	280	165	630	62
075A-2+N5350	R5	280	165	680	62
087A-2+N5350	R5	280	165	730	62
115A-2+N5350	R6	435	256	840	67
145A-2+N5350	R6	435	256	940	67
170A-2+N5350	R7	450	265	1260	67
206A-2+N5350	R7	450	265	1500	67
274A-2+N5350	R8	550	324	2100	65
U_N = 380…415V					
12A6-3+N5350	R1	44	26	172	46
017A-3+N5350	R2	88	52	232	51
025A-3+N5350	R2	88	52	337	52
032A-3+N5350	R3	134	79	457	57
038A-3+N5350	R3	134	79	562	57
045A-3+N5350	R4	134	79	667	62
061A-3+N5350	R4	280	165	907	62
072A-3+N5350	R5	280	165	1117	62
087A-3+N5350	R5	280	165	1120	62
105A-3+N5350	R6	435	256	1295	67
145A-3+N5350	R6	435	256	1440	67
169A-3+N5350	R7	450	265	1940	67
206A-3+N5350	R7	450	265	2310	67
246A-3+N5350	R8	550	324	3300	65
293A-3+N5350	R8	550	324	3900	65
363A-3+N5350	R9	1150	677	4800	68
430A-3+N5350	R9	1150	677	6000	68

Table 3-3 Continued

Catalog Number ACS880-01-	Frame Size	Air Flow		Heat Dissipation	Noise
		m^3/h	ft^3/min	(Watts)	dB(A)
U_N = 440…480V					
11A0-5+N5350	R1	44	26	172	46
014A-5+N5350	R2	88	52	232	51
021A-5+N5350	R2	88	52	337	51
027A-5+N5350	R3	134	79	457	57
034A-5+N5350	R3	134	79	562	57
040A-5+N5350	R4	134	79	667	62
052A-5+N5350	R4	280	165	907	62
065A-5+N5350	R5	280	165	1117	62
077A-5+N5350	R5	280	165	1120	62
096A-5+N5350	R6	435	256	1295	67
124A-5+N5350	R6	435	256	1440	67
156A-5+N5350	R7	450	265	1940	67
180A-5+N5350	R7	450	265	2310	67
240A-5+N5350	R8	550	324	3300	65
260A-5+N5350	R8	550	324	3900	65
302A-5+N5350	R9	1150	677	4200	68
361A-5+N5350	R9	1150	677	4800	68
414A-5+N5350	R9	1150	677	6000	68
U_N = 660…690V					
07A3-7+N5350	R5	280	165	217	62
09A8-7+N5350	R5	280	165	284	62
14A2-7+N5350	R5	280	165	399	62
018A-7+N5350	R5	280	165	490	62
022A-7+N5350	R5	280	165	578	62
026A-7+N5350	R5	280	165	660	62
035A-7+N5350	R5	280	165	864	62
042A-7+N5350	R5	280	165	998	62
049A-7+N5350	R5	280	165	1120	62
061A-7+N5350	R6	435	256	1295	67
084A-7+N5350	R6	435	256	1440	67
098A-7+N5350	R7	450	265	1940	67
119A-7+N5350	R7	450	265	2310	67
142A-7+N5350	R8	550	324	3300	65
174A-7+N5350	R8	550	324	3900	65
210A-7+N5350	R9	1150	677	4200	68
271A-7+N5350	R9	1150	677	4800	68

Chapter 4

Terminal Specifications

Terminal specifications provided in this section should be followed during the installation of the ACS880+N5350 control. The following tables provide the wire gauge ranges and terminal tightening torques for each group of terminals within the control.

4.1 Power Wire Gauge Range Specifications

Use copper conductors only.

Table 4-1 Power Wire Gauge Specification

Catalog Number ACS880-01-	Frame Size	Metric [1]		US [2]	
		Cu Cable Type Typical	Al Cable Type Typical	Cu Cable Type Typical	Al Cable Type Typical
		mm^2	mm^2	AWG/kcmil	AWG/kcmil
208…240V					
04A6-2+N5350	R1	3 x 1.5	-	14	-
06A6-2+N5350	R1	3 x 1.5	-	14	-
07A5-2+N5350	R1	3 x 1.5	-	14	-
10A6-2+N5350	R1	3 x 1.5	-	14	-
16A8-2+N5350	R2	3 x 6	-	10	-
24A3-2+N5350	R2	3 x 6	-	10	-
031A-2+N5350	R3	3 x 10	-	8	-
046A-2+N5350	R4	3 x 16	3 x 35	6	-
061A-2+N5350	R4	3 x 25	3 x 35	4	-
075A-2+N5350	R5	3 x 35	3 x 50	3	-
087A-2+N5350	R5	3 x 35	3 x 70	3	-
115A-2+N5350	R6	3 x 50	3 x 70	1	-
145A-2+N5350	R6	3 x 95	3 x 120	2/0	-
170A-2+N5350	R7	3 x 120	3 x 150	3/0	-
206A-2+N5350	R7	3 x 150	3 x 240	250 MCM	-
274A-2+N5350	R8	-	-	-	-
380…415V					
02A4-3+N5350	R1	3 x 1.5	-	14	-
03A3-3+N5350	R1	3 x 1.5	-	14	-
04A0-3+N5350	R1	3 x 1.5	-	14	-
05A6-3+N5350	R1	3 x 1.5	-	14	-
07A2-3+N5350	R1	3 x 1.5	-	14	-
09A4-3+N5350	R1	3 x 1.5	-	14	-
12A6-3+N5350	R1	3 x 1.5	-	14	-
017A-3+N5350	R2	3 x 6	-	10	-
025A-3+N5350	R2	3 x 6	-	10	-
032A-3+N5350	R3	3 x 10	-	8	-
038A-3+N5350	R3	3 x 10	-	8	-
045A-3+N5350	R4	3 x 16	3 x 35	6	-
061A-3+N5350	R4	3 x 25	3 x 35	4	-
072A-3+N5350	R5	3 x 35	3 x 50	3	-
087A-3+N5350	R5	3 x 35	3 x 70	3	-
105A-3+N5350	R6	3 x 50	3 x 70	1	-
145A-3+N5350	R6	3 x 95	3 x 120	2/0	-
169A-3+N5350	R7	3 x 120	3 x 150	3/0	-
206A-3+N5350	R7	3 x 150	3 x 240	250 MCM	-
246A-3+N5350	R8	2 x (3x70) [3]	2 x (3x95)	300 MCM	-
293A-3+N5350	R8	2 x (3x95) [3]	2 x (3x120)	2 x 3/0	-
363A-3+N5350	R9	2 x (3x120)	2 x (3x185)	2 x 4/0	-
430A-3+N5350	R9	2 x (3x150)	2 x (3x240)	2 x 250 MCM	-

Table 4-1 Power Wire Gauge Specification (Cont.)

Catalog Number ACS880-01-	Frame Size	Metric [1]		US [2]	
		Cu Cable Type Typical	Al Cable Type Typical	Cu Cable Type Typical	Al Cable Type Typical
		mm^2	mm^2	AWG/kcmil	AWG/kcmil
440…480V					
02A1-5+N5350	R1	3 x 1.5	-	14	-
03A0-5+N5350	R1	3 x 1.5	-	14	-
03A4-5+N5350	R1	3 x 1.5	-	14	-
04A8-5+N5350	R1	3 x 1.5	-	14	-
05A2-5+N5350	R1	3 x 1.5	-	14	-
07A6-5+N5350	R1	3 x 1.5	-	14	-
11A0-5+N5350	R1	3 x 1.5	-	14	-
014A-5+N5350	R2	3 x 6	-	10	-
021A-5+N5350	R2	3 x 6	-	10	-
027A-5+N5350	R3	3 x 10	-	8	-
034A-5+N5350	R3	3 x 6	-	8	-
040A-5+N5350	R4	3 x 16	3 x 25	6	-
052A-5+N5350	R4	3 x 25	3 x 25	4	-
065A-5+N5350	R5	3 x 35	3 x 35	3	-
077A-5+N5350	R5	3 x 35	3 x 50	3	-
096A-5+N5350	R6	3 x 50	3 x 70	1	-
124A-5+N5350	R6	3 x 95	3 x 95	2/0	-
156A-5+N5350	R7	3 x 120	3 x 150	3/0	-
180A-5+N5350	R7	3 x 150	3 x 185	250 MCM	-
240A-5+N5350	R8	2 x (3x70) [3]	2 x (3x95)	300 MCM	-
260A-5+N5350	R8	2 x (3x70) [3]	2 x (3x95)	2 x 3/0	-
302A-5+N5350	R9	2 x (3x95)	2 x (3x120)	2 x 3/0	-
361A-5+N5350	R9	2 x (3x120)	2 x (3x185)	2 x 250 MCM	-
414A-5+N5350	R9	2 x (3x150)	2 x (3x240)	2 x 250 MCM	-
660…690V					
07A3-7+N5350	R5	3 x 1.5	-	14	12
09A8-7+N5350	R5	3 x 1.5	-	14	12
14A2-7+N5350	R5	3 x 2.5	-	14	12
018A-7+N5350	R5	3 x 4	-	12	10
022A-7+N5350	R5	3 x 6	-	10	8
026A-7+N5350	R5	3 x 10	3 x 25	8	6
035A-7+N5350	R5	3 x 10	3 x 25	8	6
042A-7+N5350	R5	3 x 16	3 x 25	6	4
049A-7+N5350	R5	3 x 16	3 x 25	6	4
061A-7+N5350	R6	3 x 25	3 x 35	4	3
084A-7+N5350	R6	3 x 35	3 x 50	3	2
098A-7+N5350	R7	3 x 50	3 x 70	2	1/0
119A-7+N5350	R7	3 x 70	3 x 95	1/0	3/0
142A-7+N5350	R8	3 x 95 [3]	3 x 120	2/0	4/0
174A-7+N5350	R8	3 x 120 [3]	2 x (3x70)	4/0	300 MCM
210A-7+N5350	R9	3 x 185	2 x (3x95)	300 MCM	2 x 3/0
271A-7+N5350	R9	3 x 240	2 x (3x120)	400 MCM	2 x 4/0

1) The cable sizing is based on max. 9 cables laid on a cable ladder side by side, three ladder type trays one on top of the other, ambient temperature 30°C, PVC insulation, surface temperature 70°C (EN60204-1 and IEC60364-5-52/2001). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive. Refer to Hardware Manual 3AUA0000078093 for accepted cable sizes of the drive.

2) The cable sizing is based on NEC Table 310-16 for copper wires, 75°C (167°F) wire insulation at 40°C (104°F) ambient temperature. Not more than three current-carrying conductors in raceway or cable or earth (directly buried). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive. Refer to Hardware Manual 3AUA0000078093 for accepted cable sizes of the drive.

3) The biggest cable size accepted by the connection terminals of frame R8 is 2 × (3×150). Biggest possible cable size is 3x240 or 400 MCM if the terminal type is changed and the cable entry box is not used.

4.2 Power Tightening Torque Specifications

Table 4-2 Power Tightening Torque Specifications

Catalog Number ACS880-01-	Frame Size	Tightening Torque													
		L1, L2, L3, T1/U, T2/V, T3/W						R-, R+/UDC+, UDC						Ground ⏚	
		T (Wire Screw)			*T* (Terminal Nut)			*T* (Wire Screw)			*T* (Terminal Nut)			*T*	
		lbf-ft	M...	N-M	lbf-ft	M...	N-M	lbf-ft	M...	N-M	lbf-ft	M...	N-M	lbf-ft	N-M
208…240V															
24A3-2+N5350	R2	0.4		0.6				0.4		0.6				1.3	1.8
031A-2+N5350	R3	1.3		1.7				1.3		1.7				1.3	1.8
046A-2+N5350	R4	2.4		3.3				2.4		3.3				2.1	2.9
061A-2+N5350	R4	2.4		3.3				2.4		3.3				2.1	2.9
075A-2+N5350	R5	11.0		15				11.0		15				2.1	2.9
087A-2+N5350	R5	11.0		15				11.0		15				2.1	2.9
115A-2+N5350	R6	22.1	M10	30		M8	24	14.8	M8	20		M8	20	7.2	9.8
145A-2+N5350	R6	22.1	M10	30		M8	24	14.8	M8	20		M8	20	7.2	9.8
170A-2+N5350	R7	29.5 (22.1*)	M10	40 (30*)		M8	24	14.8	M10	30		M10	30	7.2	9.8
206A-2+N5350	R7	29.5 (22.1*)	M10	40 (30*)		M8	24	14.8	M10	30		M10	30	7.2	9.8
274A-2+N5350	R8	29.5	M10	40	17.7	M10	24	29.5	M10	40	17.7	M8	24	7.2	9.8
380…415V															
12A6-3+N5350	R1	0.4		0.6				0.4		0.6				1.3	1.8
017A-3+N5350	R2	0.4		0.6				0.4		0.6				1.3	1.8
025A-3+N5350	R2	0.4		0.6				0.4		0.6				1.3	1.8
032A-3+N5350	R3	1.3		1.7				1.3		1.7				1.3	1.8
038A-3+N5350	R3	1.3		1.7				1.3		1.7				1.3	1.8
045A-3+N5350	R4	2.4		3.3				2.4		3.3				2.1	2.9
061A-3+N5350	R4	2.4		3.3				2.4		3.3				2.1	2.9
072A-3+N5350	R5	11.0		15				11.0		15				2.1	2.9
087A-3+N5350	R5	11.0		15				11.0		15				2.1	2.9
105A-3+N5350	R6	22.1	M10	30		M8	24	14.8	M8	20		M8	20	7.2	9.8
145A-3+N5350	R6	22.1	M10	30		M8	24	14.8	M8	20		M8	20	7.2	9.8
169A-3+N5350	R7	29.5 (22.1*)	M10	40 (30*)		M8	24	14.8	M10	30		M10	30	7.2	9.8
206A-3+N5350	R7	29.5 (22.1*)	M10	40 (30*)		M8	24	14.8	M10	30		M10	30	7.2	9.8
246A-3+N5350	R8	29.5	M10	40	17.7	M10	24	29.5	M10	40	17.7	M8	24	7.2	9.8
293A-3+N5350	R8	29.5	M10	40	17.7	M10	24	29.5	M10	40	17.7	M8	24	7.2	9.8
363A-3+N5350	R9	51.6	M12	70	17.7	M10	24	51.6	M12	70	17.7	M8	24	7.2	9.8
430A-3+N5350	R9	51.6	M12	70	17.7	M10	24	51.6	M12	70	17.7	M8	24	7.2	9.8

Table 4-2 Power Tightening Torque Specifications (Cont.)

Catalog Number ACS880-01-	Frame Size	Tightening Torque													
		L1, L2, L3, T1/U, T2/V, T3/W						R-, R+/UDC+, UDC						Ground ⏚	
		T (Wire Screw)			*T* (Terminal Nut)			*T* (Wire Screw)			*T* (Terminal Nut)			*T*	
		lbf-ft	M...	N-M	lbf-ft	M...	N-M	lbf-ft	M...	N-M	lbf-ft	M...	N-M	lbf-ft	N-M
440…480V															
11A0-5+N5350	R1	0.4		0.6				0.4		0.6				1.3	1.8
014A-5+N5350	R2	0.4		0.6				0.4		0.6				1.3	1.8
021A-5+N5350	R2	0.4		0.6				0.4		0.6				1.3	1.8
027A-5+N5350	R3	1.3		1.7				1.3		1.7				1.3	1.8
034A-5+N5350	R3	1.3		1.7				1.3		1.7				1.3	1.8
040A-5+N5350	R4	2.4		3.3				2.4		3.3				2.1	2.9
052A-5+N5350	R4	2.4		3.3				2.4		3.3				2.1	2.9
065A-5+N5350	R5	11.0		15				11.0		15				2.1	2.9
077A-5+N5350	R5	11.0		15				11.0		15				2.1	2.9
096A-5+N5350	R6	22.1	M10	30		M8	24	14.8	M8	20		M8	20	7.2	9.8
124A-5+N5350	R6	22.1	M10	30		M8	24	14.8	M8	20		M8	20	7.2	9.8
156A-5+N5350	R7	29.5 (22.1*)	M10	40 (30*)		M8	24	14.8	M10	30		M10	30	7.2	9.8
180A-5+N5350	R7	29.5 (22.1*)	M10	40 (30*)		M8	24	14.8	M10	30		M10	30	7.2	9.8
240A-5+N5350	R8	29.5	M10	40	17.7	M10	24	29.5	M10	40	17.7	M8	24	7.2	9.8
302A-5+N5350	R9	51.6	M12	70	17.7	M10	24	51.6	M12	70	17.7	M8	24	7.2	9.8
361A-5+N5350	R9	51.6	M12	70	17.7	M10	24	51.6	M12	70	17.7	M8	24	7.2	9.8
414A-5+N5350	R9	51.6	M12	70	17.7	M10	24	51.6	M12	70	17.7	M8	24	7.2	9.8
660…690V															
07A3-7+N5350	R5	11.0		15				11.0		15				2.1	2.9
09A8-7+N5350	R5	11.0		15				11.0		15				2.1	2.9
14A2-7+N5350	R5	11.0		15				11.0		15				2.1	2.9
018A-7+N5350	R5	11.0		15				11.0		15				2.1	2.9
022A-7+N5350	R5	11.0		15				11.0		15				2.1	2.9
026A-7+N5350	R5	11.0		15				11.0		15				2.1	2.9
035A-7+N5350	R5	11.0		15				11.0		15				2.1	2.9
042A-7+N5350	R5	11.0		15				11.0		15				2.1	2.9
049A-7+N5350	R5	11.0		15				11.0		15				2.1	2.9
061A-7+N5350	R6	22.1	M10	30		M8	24	14.8	M8	20		M8	20	7.2	9.8
084A-7+N5350	R6	22.1	M10	30		M8	24	14.8	M8	20		M8	20	7.2	9.8
098A-7+N5350	R7	29.5 (22.1*)	M10	40 (30*)		M8	24	14.8	M10	30		M10	30	7.2	9.8
119A-7+N5350	R7	29.5 (22.1*)	M10	40 (30*)		M8	24	14.8	M10	30		M10	30	7.2	9.8
142A-7+N5350	R8	29.5	M10	40	17.7	M10	24	29.5	M10	40	17.7	M8	24	7.2	9.8
174A-7+N5350	R8	29.5	M10	40	17.7	M10	24	29.5	M10	40	17.7	M8	24	7.2	9.8
210A-7+N5350	R9	51.6	M12	70	17.7	M10	24	51.6	M12	70	17.7	M8	24	7.2	9.8
271A-7+N5350	R9	51.6	M12	70	17.7	M10	24	51.6	M12	70	17.7	M8	24	7.2	9.8

* For **660…690V** volt drives.

Figure 4-1 Cable Conduit Installation R1, R2 and R3

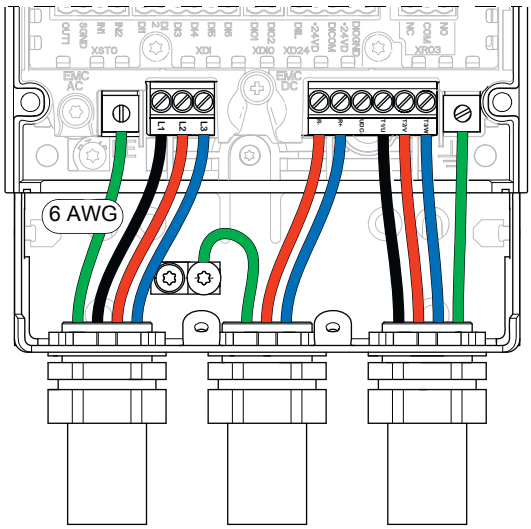


Figure 4-2 Cable Conduit Installation R4, R5

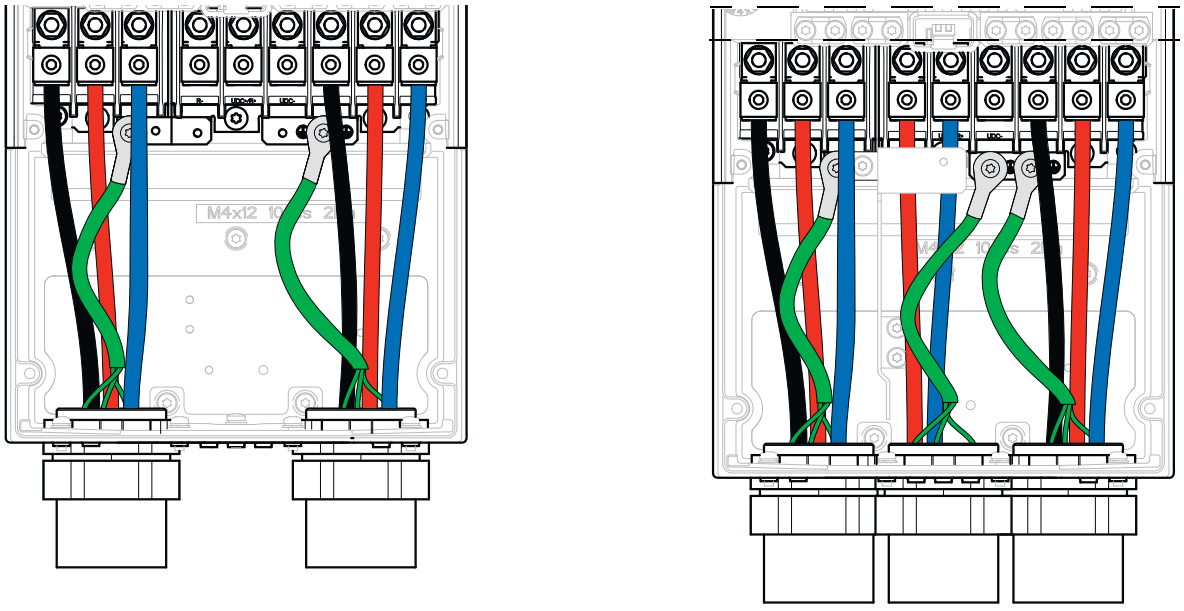
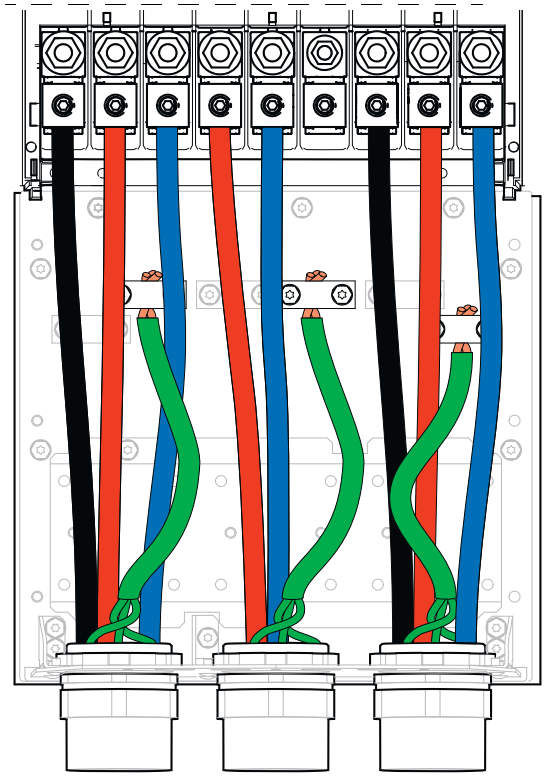
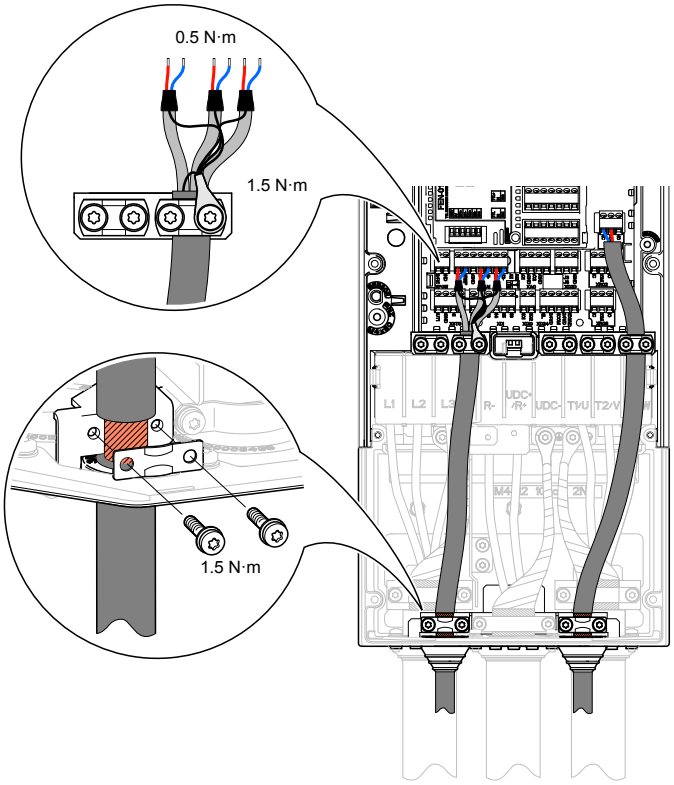


Figure 4-3 Cable Conduit Installation R6, R7, R8, R9



4.3 Control Wire Gauge and Tightening Torque

Figure 4-4 Control Wire Gauge Specification and Tightening Torque



Wire sizes: 0.5 … 2.5mm^2 (24…12AWG)
Tightening torques: 0.5 N·m (5lbf·in) for both stranded and solid wiring.

Chapter 5
Power Wiring

This section outlines the basics of the power wiring for the ACS880+N5350. Sample wiring diagrams are shown later in this guide.

5.1 Grounding the Control

WARNING: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.

To ensure a safe and trouble-free installation, the ACS880+N5350 must be properly grounded. Symmetrical voltage on all three phases relative to ground is optimum and thus it is recommended that the control be supplied from a 4-wire wye connected source. The center tap of the supply transformer secondary should be solidly grounded per local code. A ground wire must be pulled in the same conduit with the L1, L2, and L3 connections from the source ensuring that the ground wire is terminated on the ACS880+N5350 power terminal block.

5.2 Incoming Power

The ACS880+N5350 is designed for the incoming power ratings listed below. If your installation does not meet these ratings, contact your local ABB representative for support.

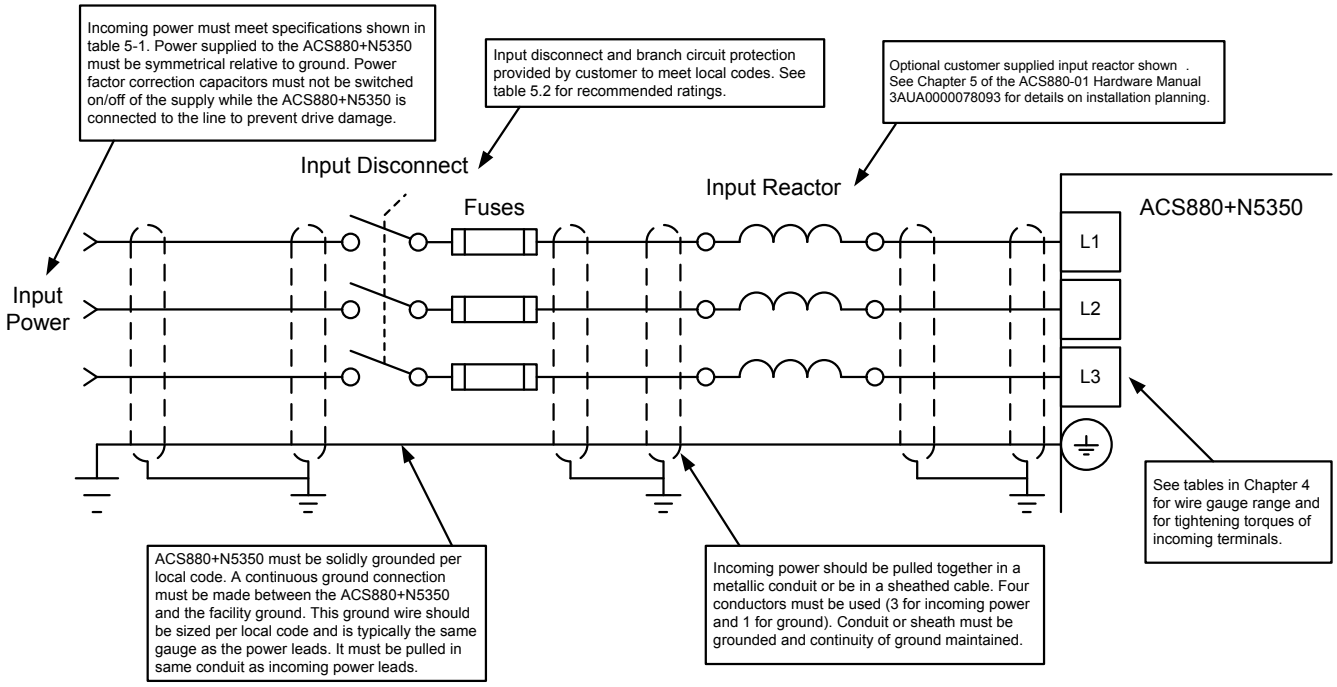
Table 5-1 Incoming Power

Description	Rating
Voltage (U_1)	ACS880-01-xxxx-2 units: 208 … 240VAC 3-phase +10%…-15%
	ACS880-01-xxxx-3 units: 380 … 415VAC 3-phase +10%…-15%
	ACS880-01-xxxx-5 units: 380 … 500VAC 3-phase +10%…-15%
	ACS880-01-xxxx-7 units: 525 … 690VAC 3-phase +10%…-15%
Network type	TN (grounded) and IT (ungrounded) systems.
Rated conditional short-circuit current (IEC 61439-1)	65 kA when protected by fuses given in the fuse tables
Short-circuit current protection (UL508C,CSA C22.2 No. 14-05)	US and Canada: The drive is suitable for use on a circuit capable of delivering not more than 100 kA symmetrical amperes (rms) at 600V maximum when protected by fuses given in the fuse table
Frequency	47 to 63 Hz, maximum rate of change 17%/s
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Fundamental power factor (cosphi$_1$)	0.98 (at nominal load)

As stated in the grounding section, the three incoming power wires must be pulled together in a single conduit with the grounding conductor. These connections are to be made to L1, L2, and L3.

CAUTION: Do not connect AC power to the drive output terminals T1/U, T2, V and T3/W. These terminals are for supplying power to the motor. Connecting AC power to these terminals may result in damage to the control.

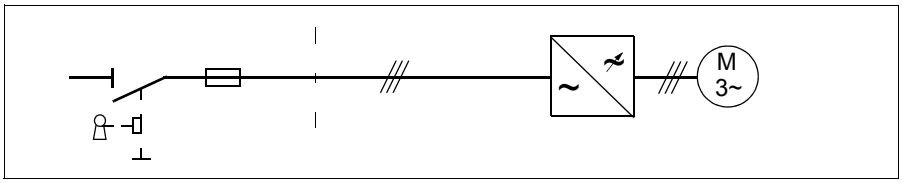
Figure 5-1 Incoming Power Diagram



5.3 Protecting the Drive and Input Power Cable in Short-Circuits

Protect the drive and input cable with fuses as follows:

Figure 5-2



Size the fuses at the distribution board according to Table 5-2. The fuses will protect the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Note: Circuit breakers must not be used without fuses. For more information, contact ABB.

5.4 Wire Sizing and Fuses

It is the responsibility of the installer to ensure that the ACS880+N5350 is installed in accordance with local electrical codes. This includes, but is not limited to a proper disconnect, branch circuit protection, and wire size.

The following tables can be used as a guide to select wire gauge and input fuses. Recommendations are based upon the maximum continuous current of the control. This table assumes 75°C wire.

Table 5-2 Wire Sizing

Control Rating					Wire Gauge (AWG)
Catalog Number	Frame	kW	HP	Input Amps	
ACS880-01-24A3-2+N5350	R2	5.5	7.5	24.3	10
ACS880-01-031A-2+N5350	R3	7.5	10	31	8
ACS880-01-046A-2+N5350	R4	11	15	46	6
ACS880-01-061A-2+N5350	R4	15	20	61	4
ACS880-01-075A-2+N5350	R5	18.5	25	75	3
ACS880-01-087A-2+N5350	R5	22	30	87	3
ACS880-01-115A-2+N5350	R6	30	40	115	1
ACS880-01-145A-2+N5350	R6	37	50	145	2/0
ACS880-01-170A-2+N5350	R7	45	60	170	3/0
ACS880-01-206A-2+N5350	R7	55	75	206	250 MCM
ACS880-01-274A-2+N5350	R8	75	100	274	-
ACS880-01-12A6-3+N5350	R1	5.5	7.5	12.6	14
ACS880-01-017A-3+N5350	R2	7.5	10	17	10
ACS880-01-025A-3+N5350	R2	11	15	25	10
ACS880-01-032A-3+N5350	R3	15	20	32	8
ACS880-01-038A-3+N5350	R3	18.5	25	38	8
ACS880-01-045A-3+N5350	R4	22	30	45	6
ACS880-01-061A-3+N5350	R4	30	40	61	4
ACS880-01-072A-3+N5350	R5	37	50	72	3
ACS880-01-087A-3+N5350	R5	45	60	87	3
ACS880-01-105A-3+N5350	R6	55	75	105	1
ACS880-01-145A-3+N5350	R6	75	100	145	2/0
ACS880-01-169A-3+N5350	R7	90	125	169	3/0
ACS880-01-206A-3+N5350	R7	110	150	206	250 MCM
ACS880-01-246A-3+N5350	R8	132	200	246	300 MCM
ACS880-01-293A-3+N5350	R8	160	225	293	2 x 3/0
ACS880-01-363A-3+N5350	R9	200	275	363	2 x 4/0
ACS880-01-430A-3+N5350	R9	200	350	430	2 x 250 MCM

Table 5-2 Wire Sizing Continued

Control Rating					Wire Gauge (AWG)
Catalog Number	Frame	HP	kW	Input Amps	
ACS880-01-11A0-5+N5350	R1	5.5	7.5	11	14
ACS880-01-014A-5+N5350	R2	7.5	10	14	10
ACS880-01-021A-5+N5350	R2	11	15	21	10
ACS880-01-027A-5+N5350	R3	15	20	27	8
ACS880-01-034A-5+N5350	R3	18.5	25	34	8
ACS880-01-040A-5+N5350	R4	22	30	40	6
ACS880-01-052A-5+N5350	R4	30	40	52	4
ACS880-01-065A-5+N5350	R5	37	50	65	3
ACS880-01-077A-5+N5350	R5	45	60	77	3
ACS880-01-096A-5+N5350	R6	55	75	96	1
ACS880-01-124A-5+N5350	R6	75	100	124	2/0
ACS880-01-156A-5+N5350	R7	90	125	156	3/0
ACS880-01-180A-5+N5350	R7	110	150	180	250 MCM
ACS880-01-240A-5+N5350	R8	132	200	240	300 MCM
ACS880-01-260A-5+N5350	R8	132	200	260	2 x 3/0
ACS880-01-302A-5+N5350	R9	200	250	302	2 x 3/0
ACS880-01-361A-5+N5350	R9	200	300	361	2 x 250 MCM
ACS880-01-414A-5+N5350	R9	250	350	414	2 x 250 MCM
ACS880-01-07A3-7+N5350	R5	5.5	7.5	7.3	14
ACS880-01-09A8-7+N5350	R5	7.5	10	9.8	14
ACS880-01-14A2-7+N5350	R5	11	15	14.2	14
ACS880-01-018A-7+N5350	R5	15	20	18	12
ACS880-01-022A-7+N5350	R5	18.5	25	22	10
ACS880-01-026A-7+N5350	R5	22	30	26	8
ACS880-01-035A-7+N5350	R5	30	40	35	8
ACS880-01-042A-7+N5350	R5	37	50	42	6
ACS880-01-049A-7+N5350	R5	45	60	49	6
ACS880-01-061A-7+N5350	R6	55	75	61	4
ACS880-01-084A-7+N5350	R6	75	100	84	3
ACS880-01-098A-7+N5350	R7	90	125	98	2
ACS880-01-119A-7+N5350	R7	110	150	119	1/0
ACS880-01-142A-7+N5350	R8	132	200	142	2/0
ACS880-01-174A-7+N5350	R8	160	225	174	4/0
ACS880-01-210A-7+N5350	R9	200	275	210	300 MCM
ACS880-01-271A-7+N5350	R9	250	350	271	400 MCM

The table below assumes 150% rated fast acting fuses.

Table 5-3 Fuses

Catalog Number	Frame	Input Current Amps	Fuse (one fuse per phase)				
			A	V	Manufacturer	Type	UL Class
ACS880-01-24A3-2+N5350	R2	24.3	40	600	Bussmann	JJS-40	T
ACS880-01-031A-2+N5350	R3	31	50	600	Bussmann	JJS-50	T
ACS880-01-046A-2+N5350	R4	46	80	600	Bussmann	JJS-80	T
ACS880-01-061A-2+N5350	R4	61	100	600	Bussmann	JJS-100	T
ACS880-01-075A-2+N5350	R5	75	125	600	Bussmann	JJS-125	T
ACS880-01-087A-2+N5350	R5	87	125	600	Bussmann	JJS-125	T
ACS880-01-115A-2+N5350	R6	115	150	600	Bussmann	JJS-150	T
ACS880-01-145A-2+N5350	R6	145	200	600	Bussmann	JJS-200	T
ACS880-01-170A-2+N5350	R7	170	250	600	Bussmann	JJS-250	T
ACS880-01-206A-2+N5350	R7	206	300	600	Bussmann	JJS-300	T
ACS880-01-274A-2+N5350	R8	274	400	600	Bussmann	JJS-400	T
ACS880-01-11A0-5+N5350	R1	11	20	600	Bussmann	JJS-20	T
ACS880-01-014A-5+N5350	R2	14	25	600	Bussmann	JJS-25	T
ACS880-01-021A-5+N5350	R2	21	35	600	Bussmann	JJS-35	T
ACS880-01-027A-5+N5350	R3	27	40	600	Bussmann	JJS-40	T
ACS880-01-034A-5+N5350	R3	34	50	600	Bussmann	JJS-50	T
ACS880-01-040A-5+N5350	R4	40	60	600	Bussmann	JJS-60	T
ACS880-01-052A-5+N5350	R4	52	80	600	Bussmann	JJS-80	T
ACS880-01-065A-5+N5350	R5	65	90	600	Bussmann	JJS-90	T
ACS880-01-077A-5+N5350	R5	77	110	600	Bussmann	JJS-110	T
ACS880-01-096A-5+N5350	R6	96	150	600	Bussmann	JJS-150	T
ACS880-01-124A-5+N5350	R6	124	200	600	Bussmann	JJS-200	T
ACS880-01-156A-5+N5350	R7	156	225	600	Bussmann	JJS-225	T
ACS880-01-180A-5+N5350	R7	180	300	600	Bussmann	JJS-300	T
ACS880-01-240A-5+N5350	R8	240	350	600	Bussmann	JJS-350	T
ACS880-01-260A-5+N5350	R8	260	400	600	Bussmann	JJS-400	T
ACS880-01-302A-5+N5350	R9	302	400	600	Bussmann	JJS-400	T
ACS880-01-361A-5+N5350	R9	361	500	600	Bussmann	JJS-500	T
ACS880-01-414A-5+N5350	R9	414	600	600	Bussmann	JJS-600	T

Note: For -3 and -7 drives, consult 3AUA0000078093 Hardware Manual for fuse information.

5.5 Motor Connections

The wiring between the drive and the motor must consist of 3 wires plus a ground routed in the same conduit. The ground wire must be continuous and terminated in the motor connection box as well as on the drive ground terminal. The output power wiring is terminated in the drive on terminals T1, T2, and T3 (see Figure 5-3 Motor Connections).

Note that a direct connection between the drive and motor without any other device is an acceptable means of controlling the motor, but local safety regulations may require the use of a motor isolation switch or contactor to provide a way to ensure that power is removed from the motor prior to servicing the tower.

The following warnings illustrate the things to consider when using a permanent magnet motor over an induction motor. Please review these warnings carefully before operating the permanent magnet cooling tower motor.

WARNING: Motor circuit may have high voltage present whenever AC power is applied, even when motor is not rotating. Electrical shock can cause serious or fatal injury.

WARNING: RPM AC permanent magnet motors can induce voltage and current in the motor leads by rotating the motor shaft. Electrical shock can cause serious or fatal injury. Therefore, do not couple the load to the motor shaft until all motor connections have been made. During any maintenance inspections, be sure the motor shaft will not rotate.

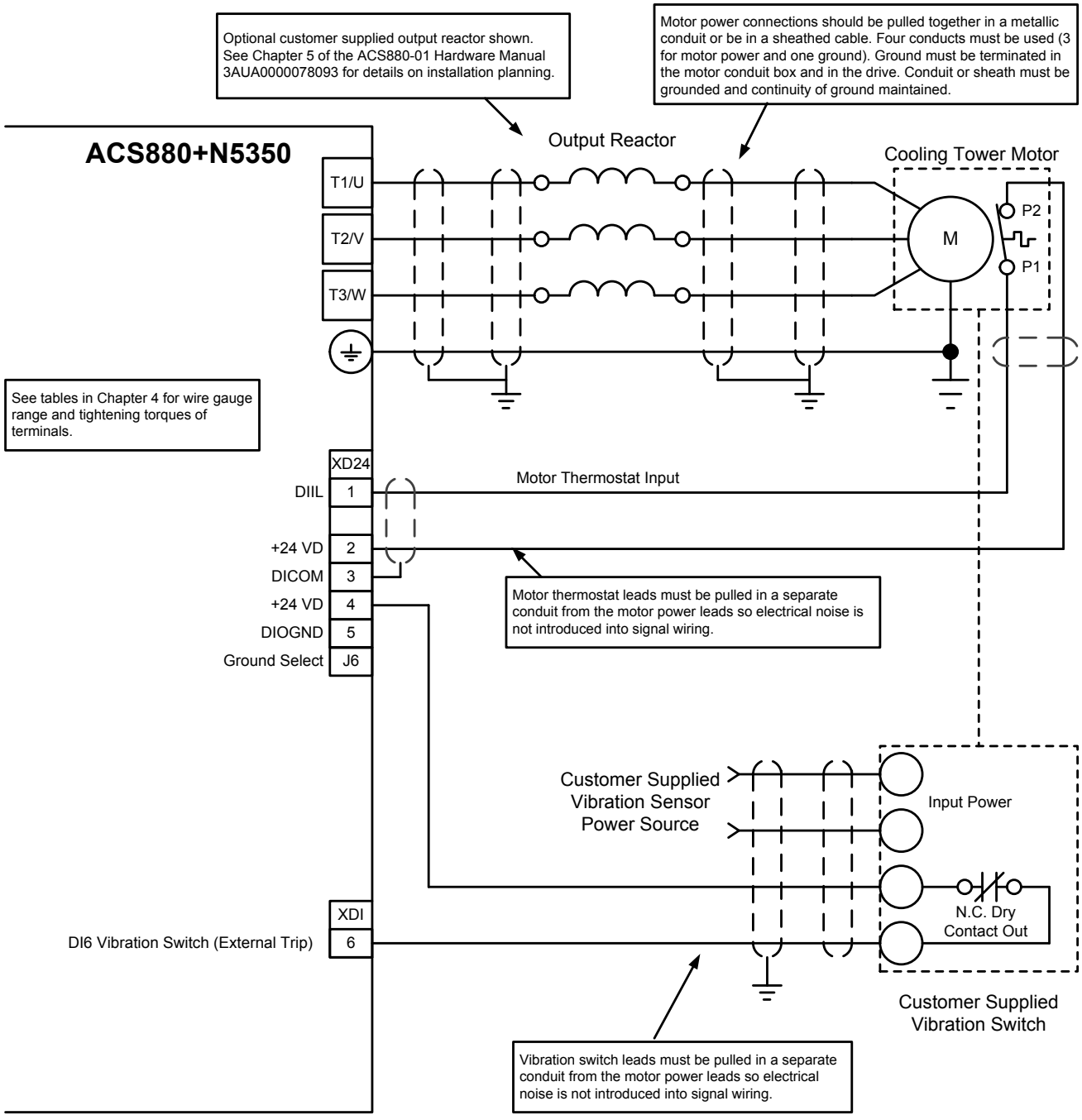
WARNING: If an output motor isolation contactor is installed, the control must be disabled for at least 200mSec before the contactor is opened. If the contactor is opened while the control is supplying voltage and current to the motor, the control may be damaged. Before the control is enabled, the contactor must be closed for at least 200mSec.

WARNING: If an output motor isolation disconnect switch is installed, the control must be disabled for at least 200mSec before the switch is opened. If the switch is opened while the control is supplying voltage and current to the motor, the control may be damaged. Before the control is enabled, the switch must be closed for at least 200mSec.

Example connection diagrams are shown later in this guide.

The wire leads that connect the motor to the control are critical in terms of sizing, shielding and the cable characteristics.

Figure 5-3 Motor Connections



5.5.1 Protecting the Motor Insulation and Bearings

The drive employs modern IGBT inverter technology. Regardless of frequency, the drive output comprises pulses of approximately the drive DC bus voltage with a very short rise time. The pulse voltage can almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This can cause additional stress on the motor and motor cable insulation. Modern variable speed drives with their fast rising voltage pulses and high switching frequencies can generate current pulses that flow through the motor bearings. This can gradually erode the bearing races and rolling elements. Optional du/dt filters protect motor insulation system and reduce bearing currents. Optional common mode filters mainly reduce bearing currents. Insulated N-end (non-drive end) bearings protect the motor bearings. Cooling tower motors are also available with optional grounding brushes and insulated bearings, which also reduce bearing currents.

Chapter 6
Control Wiring

This section outlines the basics of the control wiring for the ACS880+N5350. Sample wiring diagrams are shown later in this guide.

6.1 Motor Thermostat

RPM AC permanent magnet cooling tower motors are provided with thermostats in the stator windings that operate should the motor overheat. The thermostats are dry contacts designed to provide a closed (short) circuit when the motor is at a safe temperature and an open circuit should the motor overheat. Dedicated connections are provided for a series connection of these leads within the ACS880+N5350. All ACS880+N5350 drives must be used with motor overtemperature sensing by correctly connecting the RPM AC cooling tower motor thermostats to the XD24-1 and XD24-2 terminals. The terminal designations for the motor thermostat connections are XD24-1 and XD24-2 within the ACS880+N5350. The thermostat wiring between the motor and the control must be run in a conduit separate from the motor power leads to avoid noise related problems with the system.

6.2 Digital Inputs

The ACS880+N5350 is supplied with 9 digital inputs for controlling the cooling tower fan. The connections for these digital inputs are made on terminals XD24, XD10 and XDI. XDIO-1 & 2 terminals are dedicated to trickle current and de-ice enable inputs and cannot be changed. XDI-6 is shipped as an External Trip input as discussed in the next section and it is recommended that this not be changed. The definitions of inputs on XDI-1 through XDI-5 are determined by the selected operating mode of the drive. Operating mode selection is used to easily select a pre-configured setup of the drive thus minimizing the programming required to commission the control. The available operating modes are described later in this guide.

The digital inputs are shipped as “active high” (NPN) inputs. This means that an input signal is true when it is connected to XD24-4 (Internal 24VDC Source). Conversely, the digital inputs can be set up to be “active high” inputs. In this case, an input signal is true or when it is connected to the +24VDC power of a customer provided power source that is being used to control the digital inputs.

Switch J6 on the control board are used to set up the digital inputs. If the inputs are to be controlled as “active high” signals utilizing the internal supply of the ACS880+N5350, then no changes to the jumpers will be required. To set up the digital inputs for other methods of control, reference Figure 6-2 for the jumper settings and the connections required to the customer supplied inputs and power source.

Figure 6-1 Ground Isolation Diagram

Ground isolation diagram

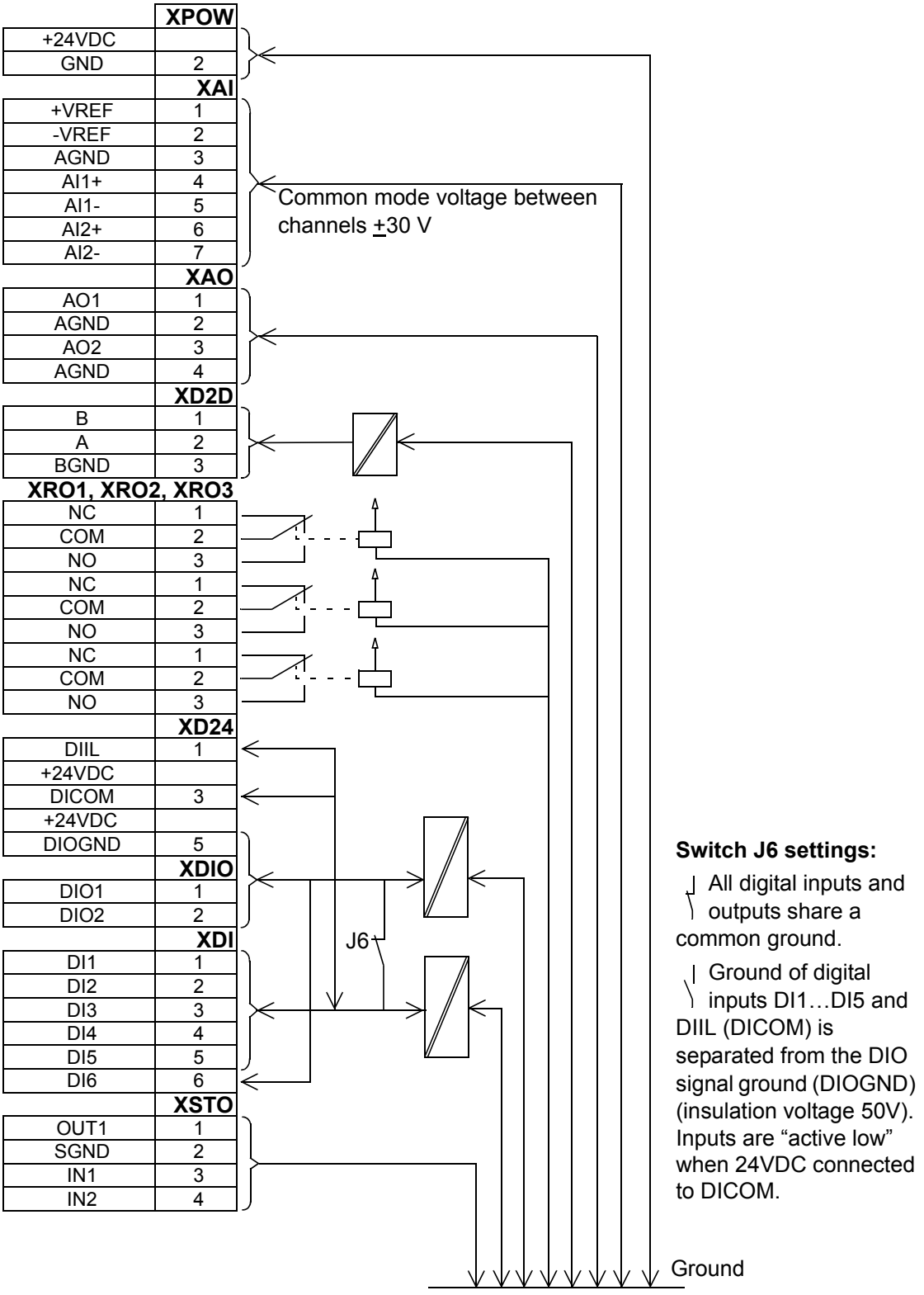
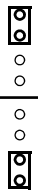


Table 6-1 Jumpers and Switches

Jumper/ Switch	Description	Positions	
J1 (AI1)	Determines whether analog input AI1 is used as a current or voltage input.		Current (I)
			Voltage (U) (Default)
J2 (AI2)	Determines whether analog input AI2 is used as a current of voltage input.		Current (I) (Default)
			Voltage (U)
J3	Drive-to-drive link termination. Must be set to terminated position when the drive is the last unit on the link.		Bus is terminated.
			Bus is not terminated.
J6	Common digital input ground selection switch. Determines whether DICOM is separated from DIOGND (i.e.,common reference for digital inputs floats). See Ground isolation diagram in Appendix A.		DICOM and DIOGND connected (Default),
			DICOM and DIOGND separated.

Notes:

1. Current [0(4)…20mA, R_{in} > 100ohm] or voltage [0(2)…10V, R_{in} > 200kohm] input selected with jumper J1. Change of setting requires reboot of control unit.
2. Current [0(4)…20mA, R_{in} > 100ohm] or voltage [0(2)…10V, R_{in} > 200kohm] input selected with jumper J2. Change of setting requires reboot of control unit.
3. Total load capacity of these outputs is 4.8W (200mA / 24V) minus the power taken by DIO1 and DIO2.
4. 0 = open, 1 = closed

DI3	Ramp times according to
0	Parameters 23.12 and 23.13
1	Parameters 23.14 and 23.15

Further information on the usage of the connectors and jumpers is given in the sections below.

6.2.1 Vibration Switch / External Trip

An input is provided within the ACS880+N5350 that forces the drive to fault should the circuit connected to this input open. The intent for this input is to interrupt the operation of the drive should a customer supplied circuit open. A typical use for this input is the connection of a vibration sensor. The input is for a dry contact type device. Power is not supplied to the external device from the ACS880+N5350 and power from the device must not be supplied to the drive terminals. If the external device requires power (e.g. 120VAC) then the installer must make provisions for this power from an alternate source.

Make the connections for the dry contacts of this external device between terminals XDI6 and XD24-4 when using the factory default active low configuration. The wiring for this device must be run in a conduit separate from the motor leads to avoid noise related problems with the system.

6.2.2 Other Digital Inputs

Remaining digital inputs that may be required for operating the ACS880+N5350 are specific to the selected operating mode and are outlined later in this guide.

6.3 Analog Inputs

An analog input is provided standard in the ACS880+N5350 for controlling the speed of the cooling tower fan if desired.

6.3.1 Analog Input 1

Analog Input 1 is capable of accepting a single-ended voltage signal on terminal XAI4 with respect to the analog common on terminal XAI3. Should the customer desire to control the speed of the fan with a potentiometer, a +10V reference signal is provided on terminal XAI1 is provided. It is recommended that a potentiometer with a resistance value > 200kΩ be used.

See Table 6-2 for jumper settings. See parameter 12.15 (AI1 Unit Selection Command) to select Analog Input 1 as the speed reference and parameters 12.17 through 12.20 to customize the scaling and filtering for this input.

Note: This signal can be ±10VDC or 0 to 20mA. The mode (voltage or current) is selected by jumper J1. For detailed information on hardware settings and software see manual.

Figure 6-2 depicts a potentiometer connection to Analog Input 1.

XAI	Reference voltage and analog inputs	
1	+VREF	10VDC , R_L 1...10 kohm
2	-VREF	-10VDC , R_L 1...10 kohm
3	AGND	Ground
4	AI1+	**Speed reference**
5	AI1-	0(2)...10V, R_{in} > 200 kohm
6	AI2+	By default not in use
7	AI2-	0(4)...20mA, R_{in} > 200 kohm

Table 6-2 Analog Input 1 Technical Data

Reference voltage for analog inputs +VREF and -VREF (XAI:1)	Connector pitch 5mm, wire size 2.5mm^2
	10V ±1% and –10V ±1%, R_{load} 1…10kohm
Analog inputs AI1 (XAI:4…XAI:7) Current/voltage input mode selection by jumpers.	Connector pitch 5mm, wire size 2.5mm^2
	Current input: –20…20mA, R_{in}: 100ohm
	Voltage input: –10…10V, R_{in}: > 200kohm
	Differential inputs, common mode range ±30V
	Sampling interval per channel: 0.25ms
	Hardware filtering: 0.25ms, adjustable digital filtering up to 8ms
	Resolution: 11 bit + sign bit
	Inaccuracy: 2% of full scale range

Note: XAI6-7 is available as a second analog input for PID or Custom mode. This signal can be ±10VDC or 0 to 20mA. The mode (voltage or current) is selected by jumper J2. For detailed information on hardware settings and software see manual.

6.4 ACS880+N5350 Relay Outputs

The ACS880+N5350 has the ability of reporting multiple internal states to the user by the use of relay outputs. For example, a relay can be set up to illuminate an external indicator light should the drive fault.

Three Form-C relay outputs are provided in the ACS880+N5350.

The functions of the relay outputs are selected by parameters 10.24 RO1 Source, 10.27 RO2 Source and 10.30 RO3 Source. For details on setting the Relay Output function see the ACS880 software manual.

Figure 6-3 depicts connections to the digital outputs for the various ways they can be used.

XR01, XR02, XR03 Relay outputs

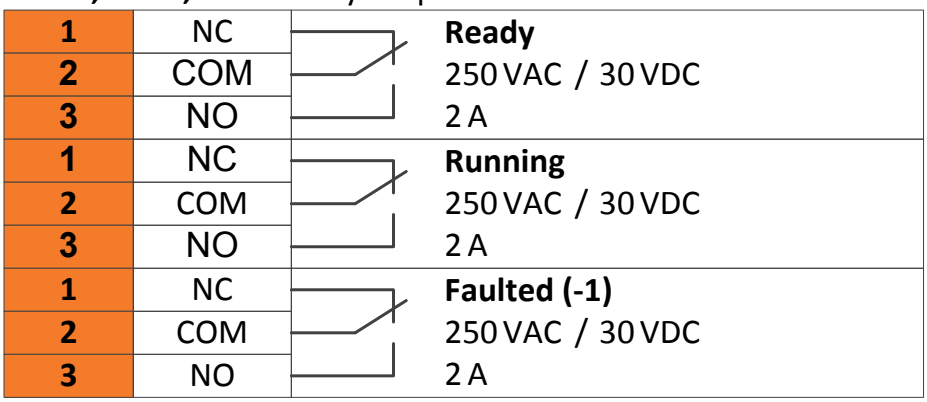


Table 6-3 Relay Output Technical Data

Relay outputs RO1…RO3 (XRO1…XRO3)	Connector pitch 5mm, wire size 2.5mm^2
	250VAC / 30VDC, 2A
	Protected by varistors
+24V output (XD24:2 and XD24:4)	Connector pitch 5mm, wire size 2.5mm^2
	Total load capacity of these outputs is 4.8W (200mA / 24V) minus the power taken by DIO1 and DIO2.

6.5 ACS880+N5350 Analog Outputs

Two analog outputs are provided in the ACS880+N5350 that can be used by the customer to indicate the value of various signals within the drive. An example of usage of these signals is to use them to indicate motor speed and torque on remote meters or to a building control computer system.

Table 6-4 Analog Output Technical Data

Analog outputs AO1 and AO2 (XAO)	Connector pitch 5mm, wire size 2.5mm^2
	0…20mA, R_{load} < 500ohm
	Frequency range: 0…300Hz
	Resolution: 11 bit + sign bit
	Inaccuracy: 2% of full scale range

Figure 6-4 Analog Outputs

XAO Analog outputs

1	A01	**Motor speed rpm**
2	AGND	0...20mA, R_L > 500ohm
3	A02	**Motor torque**
4	AGND	0...20mA, R_L > 500ohm

Current is proportional to torque on the Baldor Interior Permanent Magnet Cooling Tower Motor.

Chapter 7
Applying Power Quick Install Guide

This guide instructs briefly how to install the drive. For more detailed instructions, engineering guide lines, technical data and complete safety instructions, see the hardware manual.

Follow the safety listed instructions in Chapter 1.

WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

WARNING: The floor material below the drive must be non-flammable.

7.1 Select the Power Cables

Select the power cables according to local regulations to carry the nominal current given on the type designation label of your drive.

7.2 Ensure Proper Cooling

See Table 3-3 for the losses and the cooling air flow through the drive. The allowed operating temperature range of the drive without derating is -5°F to +104°F.

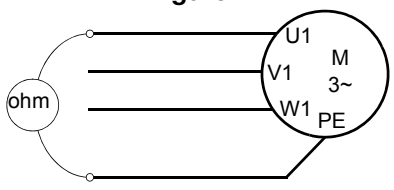
7.3 Protect the Drive and Input Power Cable

See Table 5-2. Check that the operating time of the fuse is below 0.5 seconds.

7.4 Check the Insulation of the Input and Motor Cables and the Motor

Check the insulation of the input cable according to local regulations before connecting it to the drive. Check the insulation of the motor cable and motor when the cable is disconnected from the drive. Measure the insulation resistance between each phase conductor and the Protective Earth conductor using a measuring voltage of 1000VDC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25°C or 77°F). For the insulation resistance of other motors, consult the manufacturer's instructions. Note: Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.

Figure 7-1



7.5 Connect the Power Cables

See Figures 5-1 and 5-3.

1. Undo the two mounting screws at the sides of the front cover.
2. Remove the cover by sliding it forward.
3. Attach the residual voltage warning sticker in the local language to the control panel mounting platform.
4. Remove the rubber grommets from the lead-through plate for the cables to be connected.
5. Fasten the cable conduits to the cable lead-through plate holes. Strip the cable ends. Slide the cables through the connectors.
6. Connect the grounding conductors to the grounding terminals.
7. Connect the phase conductors of the input and motor cables. Tighten the screws.
8. Units with option +D150: Connect the brake resistor cable conductors to the R+ and R- terminals.
9. Install the control cable grounding shelf in the cable entry box.
10. Connect the motor cable at the motor end.

7.6 Connect the Control Cables

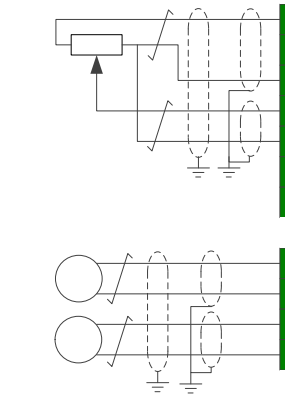
See Figure 4-4.

1. Fasten the cable conduits to the cable lead-through plate holes. Slide the cables through the connectors.
2. Strip the cable ends and cut to suitable length (note the extra length of the grounding conductors).
3. Ground the outer shields of all control cables 360 degrees at a grounding clamp in the cable entry box.
4. Ground the pair-cable shields to the grounding clamp. Leave the other end of the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, eg, 3.3nF / 630V.
5. Connect the conductors to the appropriate terminals of the control board.
6. Wire the optional modules if included in the delivery.
7. Reinstall the front cover.

7.7 Default I/O Connections

The default I/O connections of the 2-wire mode of the ACS880+N5350 primary control program are shown below.

Figure 7-2



XP0W	External power input	
1	+24VI	24 VDC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 VDC, R_L 1...10 kohm
2	-VREF	-10 VDC, R_L 1...10 kohm
3	AGND	Ground
4	AI1+	**Speed reference**
5	AI1-	0(2)...10 V, R_{in} > 200 kohm
6	AI2+	By default not in use
7	AI2-	0(4)...20 mA, R_{in} > 200 kohm
XAO	Analog outputs	
1	A01	**Motor speed rpm**
2	AGND	0...20 mA, R_L > 500 ohm
3	A02	**Motor torque %**
4	AGND	0...20 mA, R_L > 500 ohm
XD2D	Drive-to-drive link	
1	B	Drive-to-drive link
2	A	
3	BGND	
XR01, XR02, XR03	Relay outputs	
1	NC	**Ready**
2	COM	250 VAC / 30 VDC
3	NO	2 A
1	NC	**Running**
2	COM	250 VAC / 30 VDC
3	NO	2 A
1	NC	**Faulted (-1)**
2	COM	250 VAC / 30 VDC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Digital Interlock, Thermostat, Ramp Stop
2	+24VD	+24 VDC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 VDC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DI01	Trickle current enable
2	DI02	De-Ice mode enable
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1)
2	DI2	By default, not in use
3	DI3	Acc/Dec time set 1 (0) / set 2 (1)
4	DI4	Constant speed 2 (1 = On)
5	DI5	Reset Fault
6	DI6	External Event, Vibration Switch / External Trip
XSTO	Safe torque off circuits must be closed for the drive to start. See Hardware manual of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

Wire sizes: 0.5 … 2.5mm^2 (24…12AWG)
Tightening torques: 0.5 N·m (5lbf·in) for both stranded and solid wiring.

Total load capacity of these outputs is 4.8W (200mA / 24V) minus the power taken by DIO1 and DIO2.

Must be Closed for the drive to Start.

Must be Closed for the drive to Start.

7.8 UL Checklist

- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust. See the hardware manual.
- The maximum ambient air temperature is 40°C (104°F) at rated current. The current is derated for 40°C to 55°C (104°F to 131°F).
- The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 500V maximum. The ampere rating is based on tests done according to UL 508C.
- The cables located within the motor circuit must be rated for at least 75°C (167°F) in UL-compliant installations.
- The input cable must be protected with fuses. Circuit breakers must not be used without fuses in the USA. Suitable IEC (class aR) fuses and UL (class T) fuses are listed in the hardware manual. For suitable circuit breakers, contact your local ABB representative.
- For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, use the UL classified fuses.
- For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfill this requirement, use the UL classified fuses.
- The drive provides overload protection in accordance with the National Electrical Code (NEC).

Chapter 8
Keypad and Programming

The ACS880+N5350 is supplied with a display combined with a keypad so that the status of the control can be monitored and parameters can be programmed. Additionally, the keypad can be used to control the cooling tower fan locally. This keypad can be left on the front cover of the drive, but is not required to operate the drive in the remote mode where control is accomplished using the drive terminal strip or via a network communications card.

8.1 Installation and Start-Up

This section describes how to install and start up the Assistant control panel for the first time.

8.1.1 Installation

You can attach the control panel directly to the drive or use a separate mounting kit (for example, for cabinet door mounting).
To attach the control panel,
1. place its bottom end into the bottom of the slot in the drive (A),
2. pivot the control panel and push the upper part (B) until you hear a click.

To detach the control panel,
1. release the control panel by pressing the clip (B),
2. pull the upper end of the control panel out of the slot in the drive.

Figure 8-1

8.1.2 First Start-Up

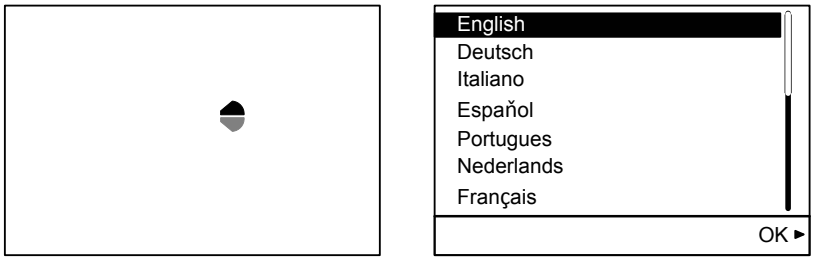
The following instructions explain how to start up the control panel for the first time.

1. Make sure that all drive-specific safety precautions have been taken into account.
2. Install the control panel as instructed in Installation.
3. Power up the drive.

The control panel start-up begins automatically. Wait until the control panel enters the language selection view.

Note: The language selection view only appears during the first start-up of the control panel, but it is possible to change the language later in the Settings menu (see parameter 96.01) or with the set-up assistant.

Figure 8-2



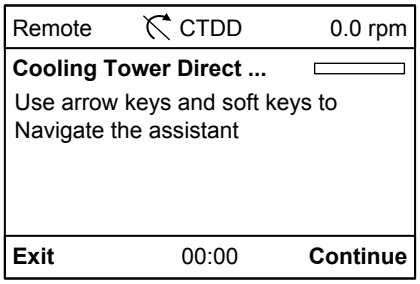
4. Use ▲ or ▼ to select a language.
5. Press (OK) to confirm your selection.

Wait until the control panel completes uploading the language file. Its progress is indicated by a progress bar.

Figure 8-3

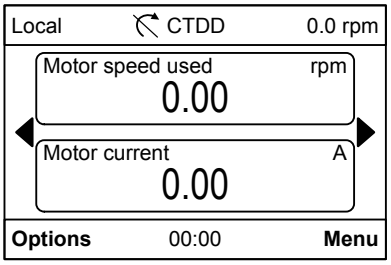
There is a Basic set-up assistant in the drive that the control panel prompts to begin the Cooling Tower Assistant. Details on the assistant are contained in Chapter 12 of this manual.

Figure 8-4



Completing the assistant or Exiting returns you to the Home view. Once you are in the Home view, the control panel is ready for use.

Figure 8-5



To return to the assistant screen, select Menu → Assistants → CTDD Setup.
Press Select to launch the assistant.

8.2 Control Panel Overview

This section describes the display, keys and main parts of the Assistant control panel.

Figure 8-6 Display, Keys and Parts

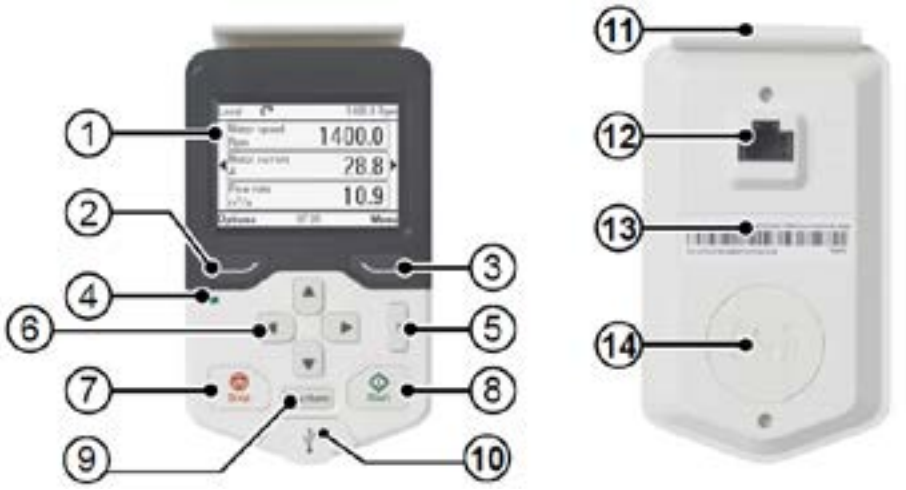


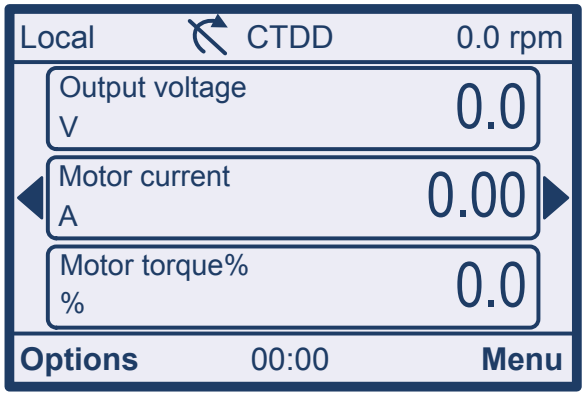
Table 8-1

1	Display		8	Start (see Start and Stop)
2	Left softkey		9	Local/Remote (see Loc/Rem)
3	Right softkey		10	USB connector
4	Status LED		11	Clip
5	Help		12	RJ-45 connector
6	Arrow keys		13	Type code label
7	Stop (see Start and Stop)		14	Battery cover

8.2.1 Display

In most views, the following elements are shown on the display:

Figure 8-7



1. **Control location:** Indicates how the drive is controlled:
- Local: The drive is in local control, ie, controlled from the control panel.
- Remote: The drive is in remote control, ie, controlled through I/O or fieldbus.
- (Remote): The drive is in remote control (as above), but some commands (such as start, stop, direction change or reference) are configured to be controlled by the control panel.

2. **Status icon:** Indicates the status of the drive and the motor. The direction of the arrow indicates forward (clockwise) or reverse (counter-clockwise) rotation.

Table 8-2

Status Icon	Animation	Drive Status
	-	Stopped
	-	Stopped, start inhibited
	Blinking	Stopped, start command given but start inhibited
	Blinking	Faulted
	Blinking	Running, at reference, but the reference value is 0
	Rotating	Running, not at reference
	Rotating	Running, at reference

Note: For non-rotating driven equipment, the numbers 1 and 0 are used to indicate that the drive is running or stopped, respectively.

3. **Drive name:** If a name has been given, it is displayed in the top pane. By default, it is blank. You can change the name in the Settings menu.

4. **Reference value:** Speed, frequency, etc. is shown with its unit.

5. **Content area:** The actual content of the view is displayed in this area. The content varies from view to view. The example view above is the main view of the control panel which is called the Home view.

6. **Softkey selections:** Displays the functions of the softkeys (and) in a given context.

7. **Clock:** The clock displays the current time. The time can be changed through the Settings menu.

You can adjust the display contrast and backlight functionality in the Settings menu.

8.2.2 Keys

The keys of the control panel are described below.

Figure 8-8

8.2.2.1 Left Softkey

The left softkey ( ) is usually used for exiting and canceling. Its function in a given situation is shown by the softkey selection in the bottom left corner of the display.

Holding down exits each view in turn until you are back in the Home view. This function does not work in special screens.

8.2.2.2 Right Softkey

The right softkey ( ) is usually used for selecting, accepting and confirming. The function of the right softkey in a given situation is shown by the softkey selection in the bottom right corner of the display.

8.2.2.3 Arrow Keys

The up and down arrow keys (and) are used to highlight selections in menus and selection lists, to scroll up and down on text pages, and to adjust values when, for example, setting the time, entering a passcode or changing a parameter value.

The left and right arrow keys (and) are used to move the cursor left and right in parameter editing and to move forward and backward in assistants. In menus, and function the same way as and , respectively.

8.2.2.4 Help

The help key ( ) opens a help page. The help page is context-sensitive, in other words, the content of the page is relevant to the menu or view in question.

8.2.2.5 Start and Stop

In local control, the start key ( ) and the stop key ( ) start and stop the drive, respectively.

8.2.2.6 Loc/Rem

The location key (Loc/Rem) is used for switching the control between the control panel (Local) and remote connections (Remote). When switching from Remote to Local while the drive is running, the drive keeps running at the same speed. When switching from Local to Remote, the status of the remote location is adopted. See the drive-specific firmware manual for more details.

8.2.2.7 Key Shortcuts

The table below lists key shortcuts and combinations. Simultaneous key presses are indicated by the plus sign (+).

Table 8-3

Shortcut	Available in	Effect
+ +	Any view	Save a screenshot. Up to fifteen images may be stored in the control panel memory. For instructions on how to transfer the images into a PC, see section the ACS-AP-X assistant control panel manual.
+ +	Any view	Adjust backlight brightness.
+ +	Any view	Adjust display contrast.
or	Home view	Adjust reference.
+	Parameter edit views	Revert an editable parameter to its default value.
+	Any view	Show/hide parameter index and parameter group numbers.
(keep down)	Any view	Return to Home view by pressing down the key until Home view is shown.

8.2.3 Status LED

The control panel has a status LED that indicates if there are any faults or warnings present. The table below shows the meaning of the LED indications.

Table 8-4 LED Indications

Green, Continuous		The drive is functioning normally.
Green, Flickering		Data is transferred between the PC tool and drive through the USB connection of the control panel.
Green, Blinking		There is an active warning in the drive.
Red, Continuous		There is an active fault in the drive.

For further information on fault and warning indications, see Chapter 13, Troubleshooting.

8.2.4 USB Connector

The USB connector is used for connecting the control panel to a PC. When connected, the control panel acts as an USB adapter for data transfer between the PC tool and the drive. It is also possible to transfer data between the PC and the control panel through the USB connection.

8.2.5 RJ-45 Connector

The RJ-45 connector is used to electrically connect the control panel to the drive. Mechanical connection is achieved with the clip on the top.

8.2.6 Type Code Label

The type code label contains revision information. The revision letter and the software version of the control panel are highlighted in the image below.

Figure 8-9

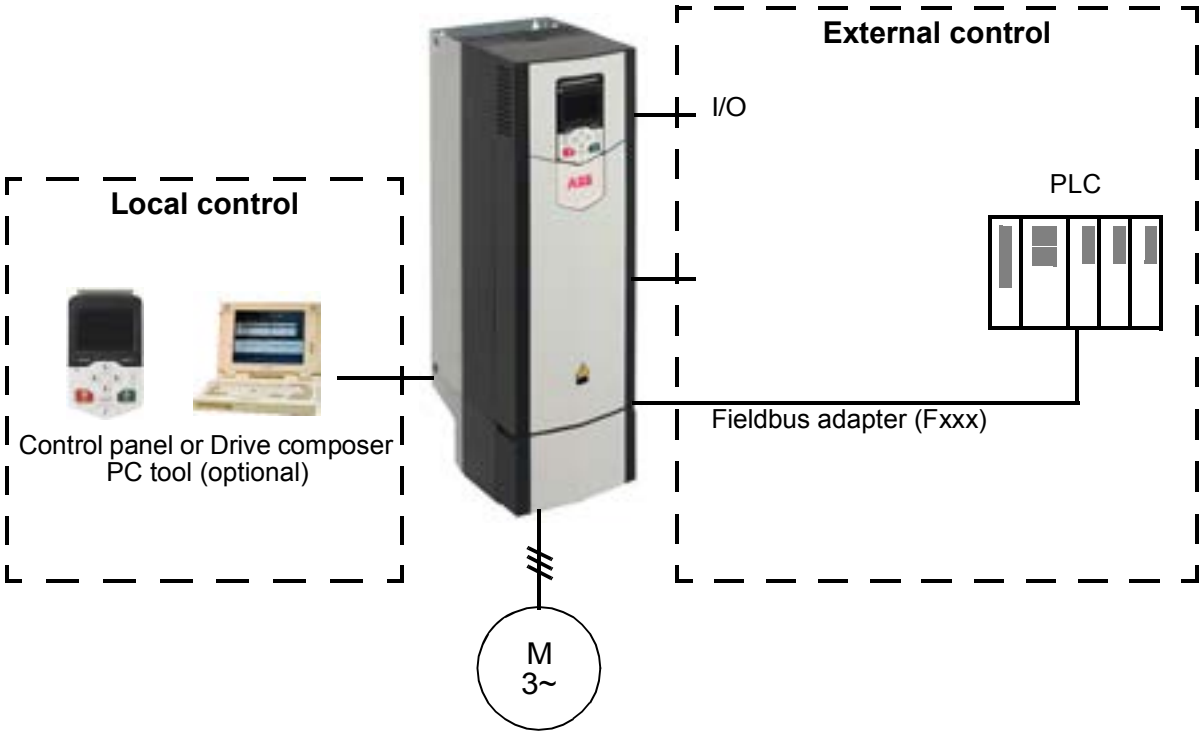
8.2.7 Battery Cover

Underneath the cover there is a compartment for the battery that powers the real-time clock of the control panel.

8.3 Local Control vs. Remote Control

The ACS880+N5350 is designed so that it can be run via keypad control (Local) or via the terminal strip or network communications (Remote). The Local/Remote Control can be changed by using the Local/Remote key on the keypad.

Figure 8-10 ACS880



8.3.1 Local Control

The control commands are given from the control panel keypad or from a PC equipped with Drive composer when the drive is set to local control. Speed control is available for local control.

Local control is mainly used during commissioning and maintenance. The control panel always overrides the external control signal sources when used in local control. Thermal and Vibration signals are still active.

By default the drive will fault if there is a control panel or PC tool communication break. See software manual if desired function is to be changed in parameter 49.05 (communication loss action).

8.3.2 Remote Control

When the drive is in remote control, control commands are given through:

- the I/O terminals (digital and analog inputs), or optional I/O extension modules

or

- an optional fieldbus adapter module

The source for the Start/Stop and Speed Reference commands is selected using control operating modes. See Chapter 9 for available operating mode configurations.

8.4 Basic Operation

This section describes the basic operations and components of the user interface, lists common user tasks and gives short instructions on how to complete them.

8.4.1 User Interface Overview

The user interface has the following main components:

- The Home view through which you can monitor signals.
- The main Menu through which you can access most functions of the control panel. The Menu functions are described in detail in chapter Functions in the main Menu.
- The Options menu through which you can set a reference, change the motor direction, select the drive, edit Home view pages, and see the fault and warning status.
- The Help view which provides advice in many situations.
- Faults and warnings view which appear when the drive or the control panel experiences an error.

8.4.2 Control Panel Navigation

Use the arrow keys and softkeys for navigation. Follow the choices on the screen.

Figure 8-11

8.4.2.1 Navigation Memory

The Assistant control panel has a navigation memory that allows you to backtrack your steps through the user interface with the arrow keys ◄ and ► . The path you have last accessed remains in the memory for 10 minutes.

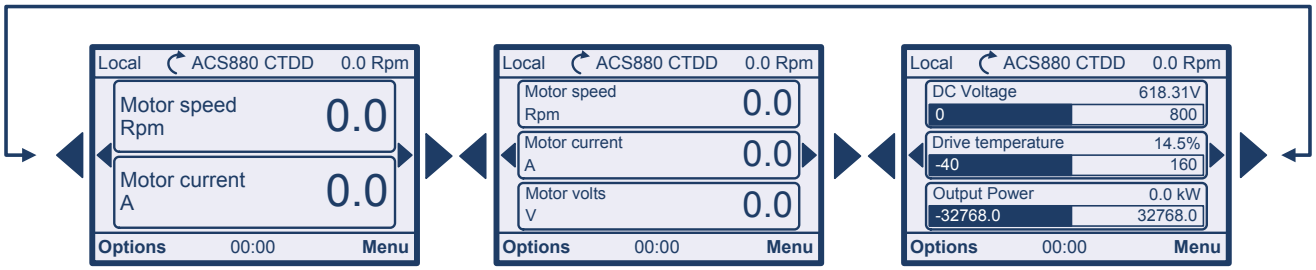
- The left arrow key (◄) moves you backwards in the menu structure. If you press ◄ repeatedly, you return back to the Home view.
- The right arrow key (►) moves you forward in the menu structure. If you press ► repeatedly, you move forward along the path in the menu structure you had previously accessed.

8.4.3 Home View

The main view of the control panel is called the Home view. In the Home view, you can monitor the status of the drive, such as its speed, torque or power. The Home view has nine pages, each of which can display a set of signals.

In the example below, three Home view pages are used, showing different display formats.

Figure 8-12



The Home view opens automatically when you power up the drive. The Home view is also displayed from the Options menu or the main Menu if no key is pressed for 10 minutes.

Tip: You can return to the Home view from any view except special screens by holding down the left softkey .

8.4.3.1 Navigating in the Home View

- Use and to move between the different pages of the Home view. The page numbers are shown while you scroll between pages.
- Use or to adjust the reference (visible in the top right corner).
- Press (Menu) to open the main Menu.
- Press (Options) to open the Options menu.

8.4.4 Help

You can open a context-sensitive help page in all menus and views by pressing . The help page provides information on the use of the current view or menu, or on possible problems associated with it.

On the help page, you can:

•Press again or (Exit) to exit.

8.4.5 Common User Tasks

This following tables list common user tasks and describes how to complete them.

8.4.5.1 Basic Operation of the Drive

Table 8-5

Task	Actions
Start and stop the drive.	In local control, press to start the drive and to stop the drive.
Set the reference (for example, speed) in the Home view.	In local control, go to Options > Reference. Set the reference with the arrow keys.
Switch between local and remote control.	Press Loc/Rem .
Change the direction of motor rotation.	In local control, go to the Home view, press (Options) to open the Options menu and select Direction change.

8.4.5.2 Parameters

Table 8-6

Task	Actions
Choose parameters displayed on the Favorites list.	Go to Menu > Parameters > Favorites > Edit.
View/edit parameters.	Go to Menu > Parameters to view parameters.
Add parameters to the Home view.	See assistant panel manual.
Show/hide parameter index and group numbers.	Press ◄ + ►.
Restore parameter default value.	In the editing mode, press ▲ + ▼. To save the default value, press (Save).
View parameters that differ from Application defaults.	Go to Menu > Parameters > Modified.

8.4.5.3 System Information and Help

Table 8-7

Task	Actions
How to get help.	Press ? to open the context-sensitive help.
View control panel version.	Go to Menu > System into > Control panel.
View drive information.	Go to Menu > System into > Drive.

8.4.5.4 Faults and Warnings

See Fault tracing in Chapter 13 for detailed information on faults and warnings.

Table 8-8

Task	Actions
Hide/view an active fault.	Faults are automatically displayed. If you hide a fault by pressing (Hide), it automatically reappears after 60 seconds of no key presses. You can also view the fault through Options > Fault status.
Open help page on a fault.	Press ? to view the help page.
Reset an active fault.	Press (Reset) to reset an active fault.
View tripping faults.	Go to Menu > Event log > Primary faults.
Hide/view and active warning.	Warnings are automatically displayed. If you hide a warning by pressing (Hide), it automatically reappears if the warning is still active after 60 seconds of no key presses.
Open help page on a warning.	Press (How to fix) or ? to view the help page.
Reset an active warning.	Warnings disappear automatically once the condition that has triggered it goes away.
View past warnings and faults.	Go to Menu > Event log > Other events.

8.4.5.5 Basic Settings and Assistants

Table 8-9

Task	Actions
Adjust backlight brightness.	Press + ▲ or ▼
Adjust display contrast.	Press + ▲ or ▼
Change language.	Go to Menu > Settings > Language.
Change time and date, and related settings.	Go to Menu > Settings > Date & time.
Launch an assistant.	Go to Menu > Assistants and select an assistant to launch.

Chapter 9
Operating Modes

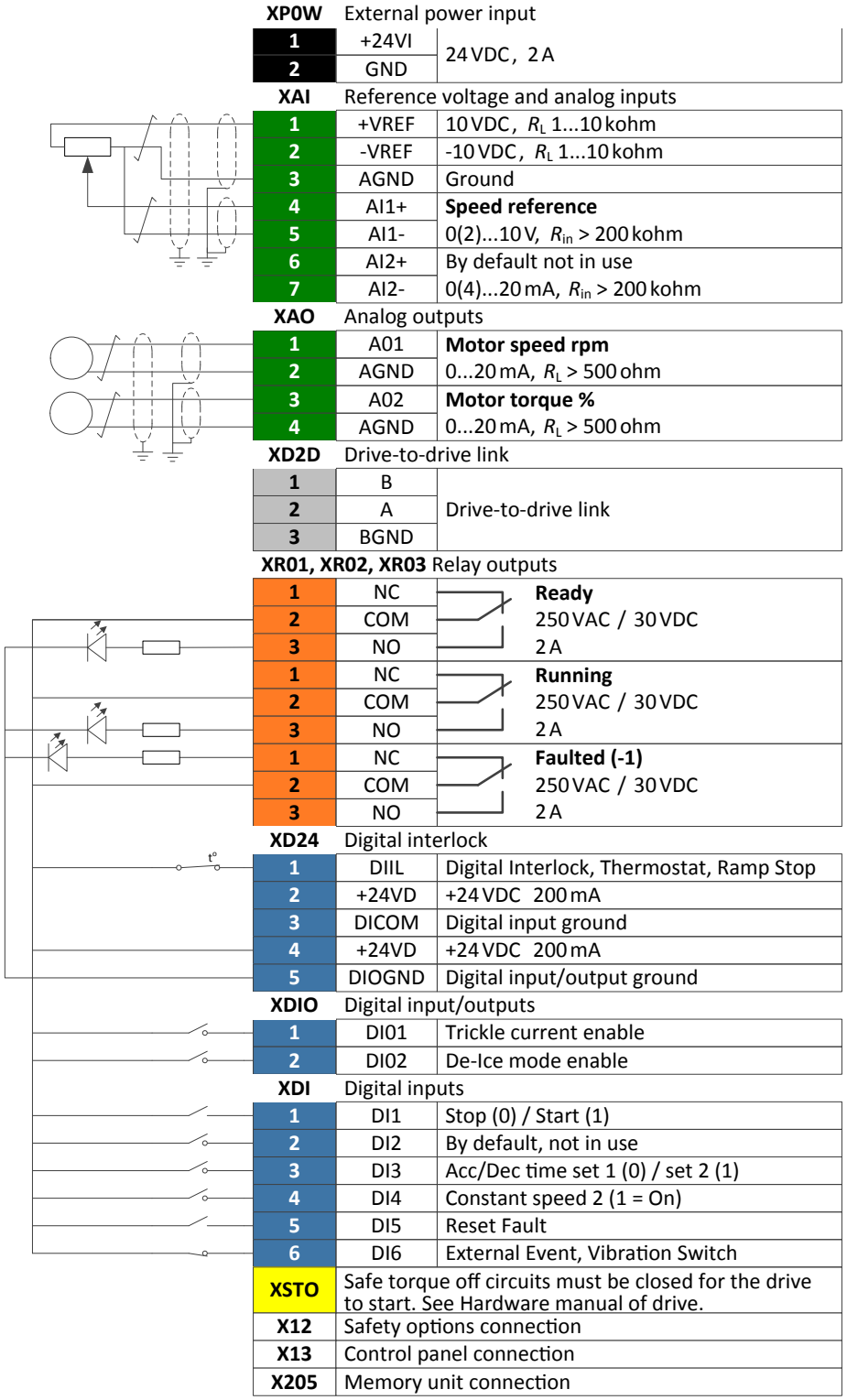
The ACS880+N5350 can be placed in any one of 5 different operating modes. These modes are used to quickly set up the drive to operate from the drive terminal strip or from a network communications card. Many inputs are still programmable.

NOTE: Stop drive and place drive in “Local” before changing mode. Cycle power or reboot drive after changing mode.

CAUTION: Drive may start unexpectedly on changing mode.

9.1 2Wire Operating Mode (Default)

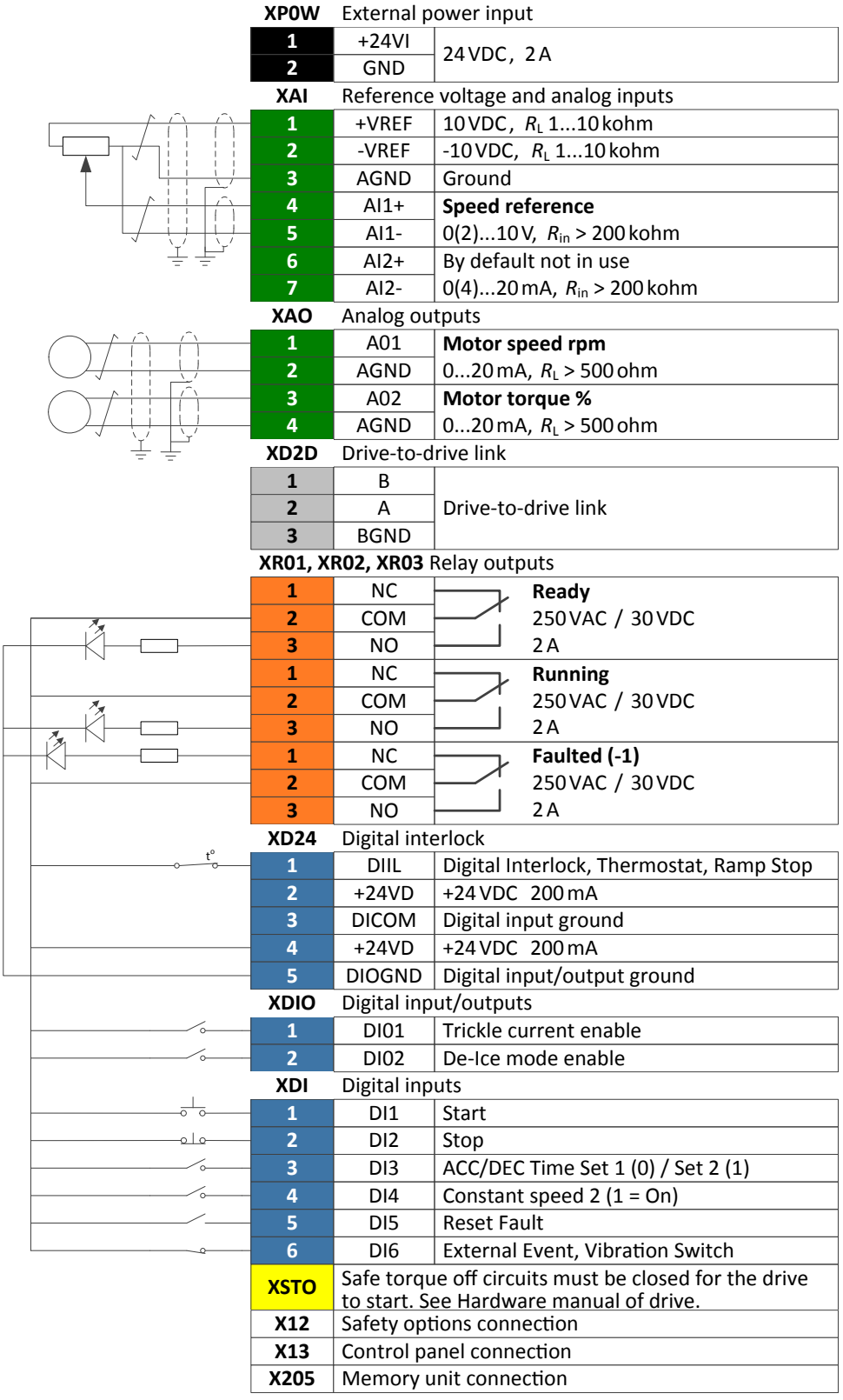
Figure 9-1 ACS880+N5350 2Wire Operating Mode Connection Diagram (76.03 = 1)



XP0W	External power input	
1	+24VI	24 VDC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 VDC, R_L 1...10 kohm
2	-VREF	-10 VDC, R_L 1...10 kohm
3	AGND	Ground
4	AI1+	**Speed reference**
5	AI1-	0(2)...10 V, R_{in} > 200 kohm
6	AI2+	By default not in use
7	AI2-	0(4)...20 mA, R_{in} > 200 kohm
XAO	Analog outputs	
1	A01	**Motor speed rpm**
2	AGND	0...20 mA, R_L > 500 ohm
3	A02	**Motor torque %**
4	AGND	0...20 mA, R_L > 500 ohm
XD2D	Drive-to-drive link	
1	B	Drive-to-drive link
2	A	
3	BGND	
XR01, XR02, XR03	Relay outputs	
1	NC	**Ready**
2	COM	250 VAC / 30 VDC
3	NO	2 A
1	NC	**Running**
2	COM	250 VAC / 30 VDC
3	NO	2 A
1	NC	**Faulted (-1)**
2	COM	250 VAC / 30 VDC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Digital Interlock, Thermostat, Ramp Stop
2	+24VD	+24 VDC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 VDC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DI01	Trickle current enable
2	DI02	De-Ice mode enable
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1)
2	DI2	By default, not in use
3	DI3	Acc/Dec time set 1 (0) / set 2 (1)
4	DI4	Constant speed 2 (1 = On)
5	DI5	Reset Fault
6	DI6	External Event, Vibration Switch
XSTO	Safe torque off circuits must be closed for the drive to start. See Hardware manual of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

9.2 3Wire Operating Mode

Figure 9-2 ACS880+N5350 3Wire Operating Mode Connection Diagram (76.03 = 2)



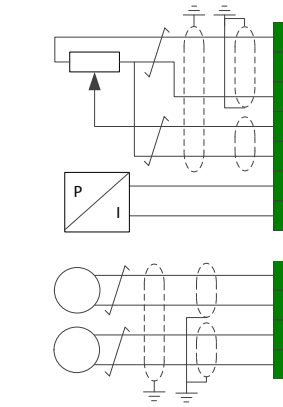
XP0W	External power input	
1	+24VI	24 VDC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 VDC, R_L 1...10 kohm
2	-VREF	-10 VDC, R_L 1...10 kohm
3	AGND	Ground
4	AI1+	**Speed reference**
5	AI1-	0(2)...10 V, R_{in} > 200 kohm
6	AI2+	By default not in use
7	AI2-	0(4)...20 mA, R_{in} > 200 kohm
XAO	Analog outputs	
1	A01	**Motor speed rpm**
2	AGND	0...20 mA, R_L > 500 ohm
3	A02	**Motor torque %**
4	AGND	0...20 mA, R_L > 500 ohm
XD2D	Drive-to-drive link	
1	B	Drive-to-drive link
2	A	
3	BGND	
XR01, XR02, XR03	Relay outputs	
1	NC	**Ready**
2	COM	250 VAC / 30 VDC
3	NO	2 A
1	NC	**Running**
2	COM	250 VAC / 30 VDC
3	NO	2 A
1	NC	**Faulted (-1)**
2	COM	250 VAC / 30 VDC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Digital Interlock, Thermostat, Ramp Stop
2	+24VD	+24 VDC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 VDC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DI01	Trickle current enable
2	DI02	De-Ice mode enable
XDI	Digital inputs	
1	DI1	Start
2	DI2	Stop
3	DI3	ACC/DEC Time Set 1 (0) / Set 2 (1)
4	DI4	Constant speed 2 (1 = On)
5	DI5	Reset Fault
6	DI6	External Event, Vibration Switch
XSTO	Safe torque off circuits must be closed for the drive to start. See Hardware manual of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

9.3 Process Control (PID) Operating Mode

The process control mode provides an auxiliary closed loop general purpose PID set point control. The process control loop may be configured in various ways.

For details on setting parameters and adjusting PID configuration see the ACS880 software manual. Default I/O configurations are shown in the figure below.

Figure 9-3 Process Control Operating Mode Connection Diagram (76.03 = 3)



XP0W	External power input	
1	+24VI	24 VDC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 VDC, R_L 1...10 kohm
2	-VREF	-10 VDC, R_L 1...10 kohm
3	AGND	Ground
4	AI1+	**Process or Speed reference**
5	AI1-	0(2)...10 V, R_{in} > 200 kohm
6	AI2+	**Process feedback**
7	AI2-	0(4)...20 mA, R_{in} > 200 kohm
XAO	Analog outputs	
1	A01	**Motor speed rpm**
2	AGND	0...20 mA, R_L > 500 ohm
3	A02	**Motor torque %**
4	AGND	0...20 mA, R_L > 500 ohm
XD2D	Drive-to-drive link	
1	B	Drive-to-drive link
2	A	
3	BGND	
XR01, XR02, XR03	Relay outputs	
1	NC	**Ready**
2	COM	250 VAC / 30 VDC
3	NO	2 A
1	NC	**Running**
2	COM	250 VAC / 30 VDC
3	NO	2 A
1	NC	**Faulted (-1)**
2	COM	250 VAC / 30 VDC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Digital Interlock, Thermostat, Ramp Stop
2	+24VD	+24 VDC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 VDC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DI01	Trickle current enable
2	DI02	De-Ice mode enable
XDI	Digital inputs	
1	DI1	Stop (0)/ Start (1) – Speed or Process Control
2	DI2	Speed control (0) / Process Control (1)
3	DI3	ACC/DEC Time Set 1(0)/Set 2(1)
4	DI4	Constant Speed 2 (1=ON)
5	DI5	Fault Reset
6	DI6	External Event, Vibration Switch
XSTO	Safe torque off circuits must be closed for the drive to start. See Hardware manual of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

9.4 Fieldbus Operating Mode

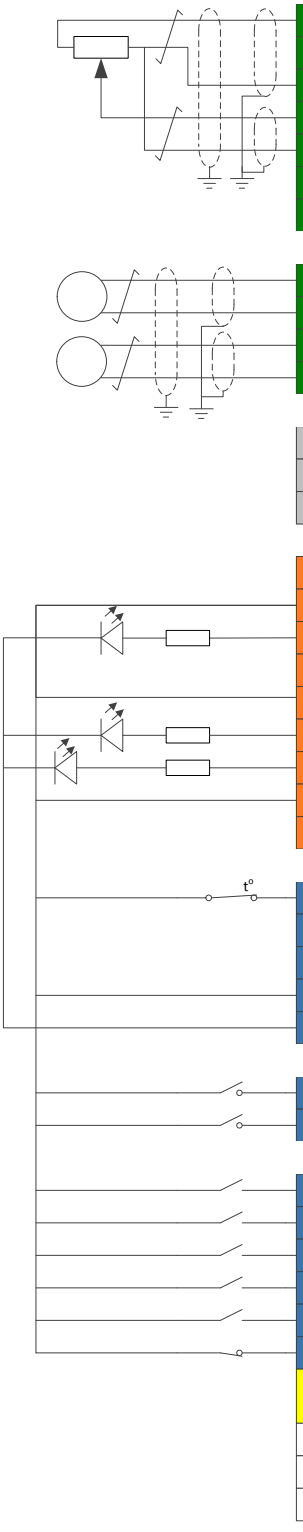
The drive can be connected to an external control system through an optional fieldbus adapter mounted onto the control unit of the drive. When Fieldbus Operating Mode is selected, the drive Starts and Stops using the CTD Command Word, (09.01) bit 2, if DI2 is on for Remote FBA. DI2(1) also selects FBA Ref1 a the speed reference. The drive actually has two independent interfaces for fieldbus connection called “fieldbus adapter A” (FBA A) and “fieldbus adapter B” (FBA B). The drive can be configured to receive all of its control information through the fieldbus interface(s), or the control can be distributed between the fieldbus interface(s) and other available sources such as digital and analog inputs, by configuring EXT1 in “Custom Mode”.

Fieldbus adapters are available for various communication systems and Industrial Protocols, for example:

- PROFIBUS DP (FPBA-01 adapter)
- CANopen (FCAN-01 adapter)
- DeviceNet (FDNA-01 adapter)
- EtherNet/IPTM (FENA-11 adapter)
- EtherCAT® (FECA-01 adapter)

Reference software manual for configuration Network parameter settings. See Figure 9-4 on next page.

Figure 9-4 Fieldbus Operating Mode Connection Diagram (76.03 = 4)



XP0W	External power input	
1	+24VI	24 VDC, 2A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 VDC, R_L 1...10 kohm
2	-VREF	-10 VDC, R_L 1...10 kohm
3	AGND	Ground
4	AI1+	**Speed reference Local Reference**
5	AI1-	0(2)...10V, R_{in} > 200 kohm
6	AI2+	By default not in use
7	AI2-	0(4)...20mA, R_{in} > 200 kohm
XAO	Analog outputs	
1	A01	**Motor speed rpm**
2	AGND	0...20mA, R_L > 500 ohm
3	A02	**Motor torque %**
4	AGND	0...20mA, R_L > 500 ohm
XD2D	Drive-to-drive link	
1	B	Drive-to-drive link
2	A	
3	BGND	
XR01, XR02, XR03	Relay outputs	
1	NC	**Ready**
2	COM	250 VAC / 30 VDC
3	NO	2A
1	NC	**Running**
2	COM	250 VAC / 30 VDC
3	NO	2A
1	NC	**Faulted**
2	COM	250 VAC / 30 VDC
3	NO	2A
XD24	Digital interlock	
1	DIIL	Digital Interlock, Thermostat, Ramp Xtop
2	+24VD	+24 VDC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 VDC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DI01	Trickle current enable
2	DI02	De-Ice mode enable
XDI	Digital inputs	
1	DI1	Local Stop (0) / Start (1)
2	DI2	Local/Remote Local(0)/FBA(1)+(bit2)*
3	DI3	Run enable
4	DI4	Constant Speed 2 (1 = On)
5	DI5	Reset Fault
6	DI6	External Event, Vibration Switch
XSTO	Safe torque off circuits must be closed for the drive to start. See Hardware manual of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

*Remote reference is FBA REF1

Note: To initiate De-ice function while using the Keypad mode, the CTDD drives must be placed in remote operation.

9.5 Custom Mode

Custom Mode is only for those experienced in setting up the Standard ACS880 drive. In Custom Mode, Drive Run, Trickle, and De-Ice operate on a “First On” priority basis. I.E. Trickle must be off before the drive will run. The drive must be stopped before Trickle or De-Ice will run.

Chapter 10
Additional Setup

Once the motor has been identified to the drive and the operating mode chosen, the drive is ready to operate. Additional setup may be desired to enable trickle current heating when not running, for set up of skip frequencies during operation, and/or enabling de-ice control function.

10.1 Trickle Current Heating

Trickle Current Heating is a feature of the ACS880+N5350 that can be used by the customer to maintain a small amount of power going to the motor from the drive while the fan is not being used. This feature will not cause fan rotation and aids in eliminating moisture in the motor. This eliminates the need for motor space heaters which are normally specified when a motor is placed in a humid environment.

Trickle Current Heating is disabled as a factory default since it depends on motor related information. Once enabled, trickle current will start flowing in the motor windings after the fan has been stopped. Note that the drive trickle current enable signal on XDIO1 must be present for trickle current to flow and (74.01) Trickle Current Enable = 1.

The below chart has traditionally been used to size space heaters for various frame motors and is equally applicable to deciding how much trickle current to the motor.

Table 10-1

Motor Frame Size	Wattage
FL250	75
FL280	100
FL320	125
FL360	150
FL400	175
FL440	225
FL5800	400

In addition to the wattage from the above table, the motor stator resistance value is needed. The stator resistance is taken from parameter 98.09 Rs user SI after ID run is complete.

Utilize the below calculation to check the trickle current value:

$$\text{Trickle Current} = \sqrt{\frac{\text{Wattage from Table 10-1}}{3 \times \text{Stator R}}}$$

The wattage from the above table can then be programmed into parameter 74.02 (Trickle Power). This will enable trickle current to flow in the motor after it has been stopped for time set in parameter 74.03 Trickle Delay Time.. Note that the customer is limited to a current value that is no more than 100% of the motor rated current so that there is no danger in overheating the motor.

Should the motor be restarted at any time (before or after the timer has expired) trickle current will immediately stop and the motor will start normally.

Trickle current will not work while the motor is in Local, Trickle must be stopped before motor will start in Custom mode.

10.1.1 Parameter Settings

Trickle Current Enable (74.01)	Default: 0 (Disable) Range: 0 - 2
0 (Disable)	Disable trickle current
1 (Enable)	Enable trickle current
2 (Fieldbus)	Fieldbus CTD cmd Word bit 0 (P 9.1)
	Software enable or disable of trickle current. A hardware input is also required for operation.

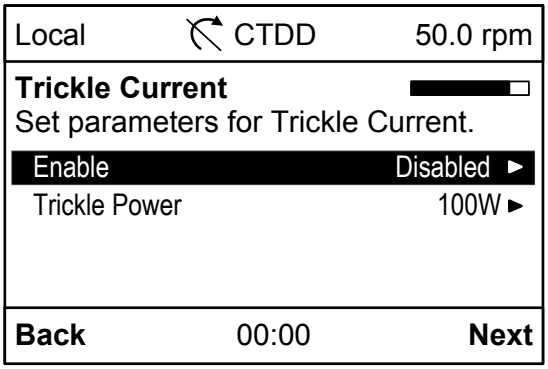
Trickle Power (74.02)	Default: 100W Range: 0 to 1000W
	The level of trickle current is determined by frame size of the motor.

Trickle Current Delay (74.03)	Default: 1 Min Range: 0 - 10 Min
	The time delay before trickle current starts. This delay ensures the motor has ramped down and stopped prior to trickle current beginning.

10.1.2 CTDD Assistant Access

In addition to programming changes in group 74, Trickle Current is an option under the CTDD startup assistant:

Figure 10-1 Trickle Current



10.2 Critical Speed Function

When applying a variable speed control to a cooling tower fan, mechanical resonances may occur at various points of operation. The ACS880+N5350 provides for up to three frequency avoidance bands that are used to prohibit continuous operation at the points of mechanical resonance.

While in LOCAL control, the keypad can be used to start and stop the drive and to locally adjust the speed.

Use the “UP” arrow key to slowly increase the speed of the motor. Should the cooling tower fan start to resonate, record the RPM. Continue this process until you have tested the motor at all points between minimum speed and maximum speed. The parameters that are used to provide for the critical speeds are located in the Speed Reference Selection Block (parameter numbers 22.51 through 22.57). Program a band around each point of resonance using parameter settings critical speed low and high.

For a more detailed description of these parameters see Chapter 12.

10.3 De-Ice Function

This is a cooling tower function to run at low speed in the opposite direction than standard. This function is for prevention of ice build up in colder climates.

Set De-Ice Speed (75.02) to a value under 30% base motor speed.
Set the De-Ice Run Time (75.03) to the time desired for operation in this function.
Set De-Ice Enable (75.01) to 1 (Enable).

When De-Ice is enabled with XDIO2 terminal Closed, the drive will enter De-Ice mode for the Run Time set in 75.03. If the drive was running, it will return to the original condition until enable is cycled.

NOTE: De-Ice in Keypad Operation or Custom Mode
The Keypad operates the CTDD drive in local control. To initiate de-ice while using the Keypad, the drive must first be placed in remote control. If the drive is running in Custom mode, the drive must be stopped before De-Ice will run.

10.3.1 De-Ice Parameter Settings

De-Ice Enable (75.01)	Default: 0 (Disable) Range: 0 - 2
0	Disable De-ice function
1	Enable De-ice function
2	Fieldbus CTD cmd Word bit 1 (P 9.1)
	Software enable or disable of De-ice function. A hardware input is also required for operation.

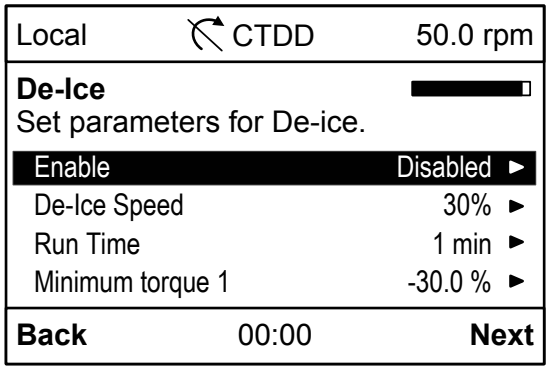
De-Ice Speed (75.02)	Default: 30% Range: 0 to 100%
	Minimum value can't be set lower than 30% of motor base speed. Preset Speed 1 is used to hold the De-Ice Speed value in the CTDD drive.

De-Ice Run Time (75.03)	Default: 1 Min. Range: 0 to 60 Minutes
	With a software and hardware enable active, a valid start command will initiate de-ice run. After run time set in 75.03 the drive will stop.

10.3.2 CTDD Assistant Access

In addition to programming changes in group 75, De-Ice function setup is an option under the CTDD startup assistant:

Figure 10-2 De-Ice Function



10.4 Advanced Drive Settings

See ACS880 Software Manual, 3AUA0000085967, for information on advanced drive functions such as PID and Fieldbus control.

10.4.1 Access Levels

Access levels are based on CTDD USER, Fieldbus or Expert Commissioner. Selection for access level is contained in the 96.02 passcode parameter; accessible in the programming window (but not the startup assistant, passcode changes are for expert users only). Changing modes will automatically set access level.

There is no default setting for 96.02. Setting access level to 13 (Fieldbus) opens all Fieldbus applicable parameters. Expert Commissioner enables all parameters in the drive by setting 96.02 = 12.
Expert Commissioner is set in PID and Custom modes.

Fieldbus operating mode opens up all parameters in groups 50 to 56 and monitoring parameters 3.05, 3.06, 6.01 and 6.11.

CTDD User Default Access Level

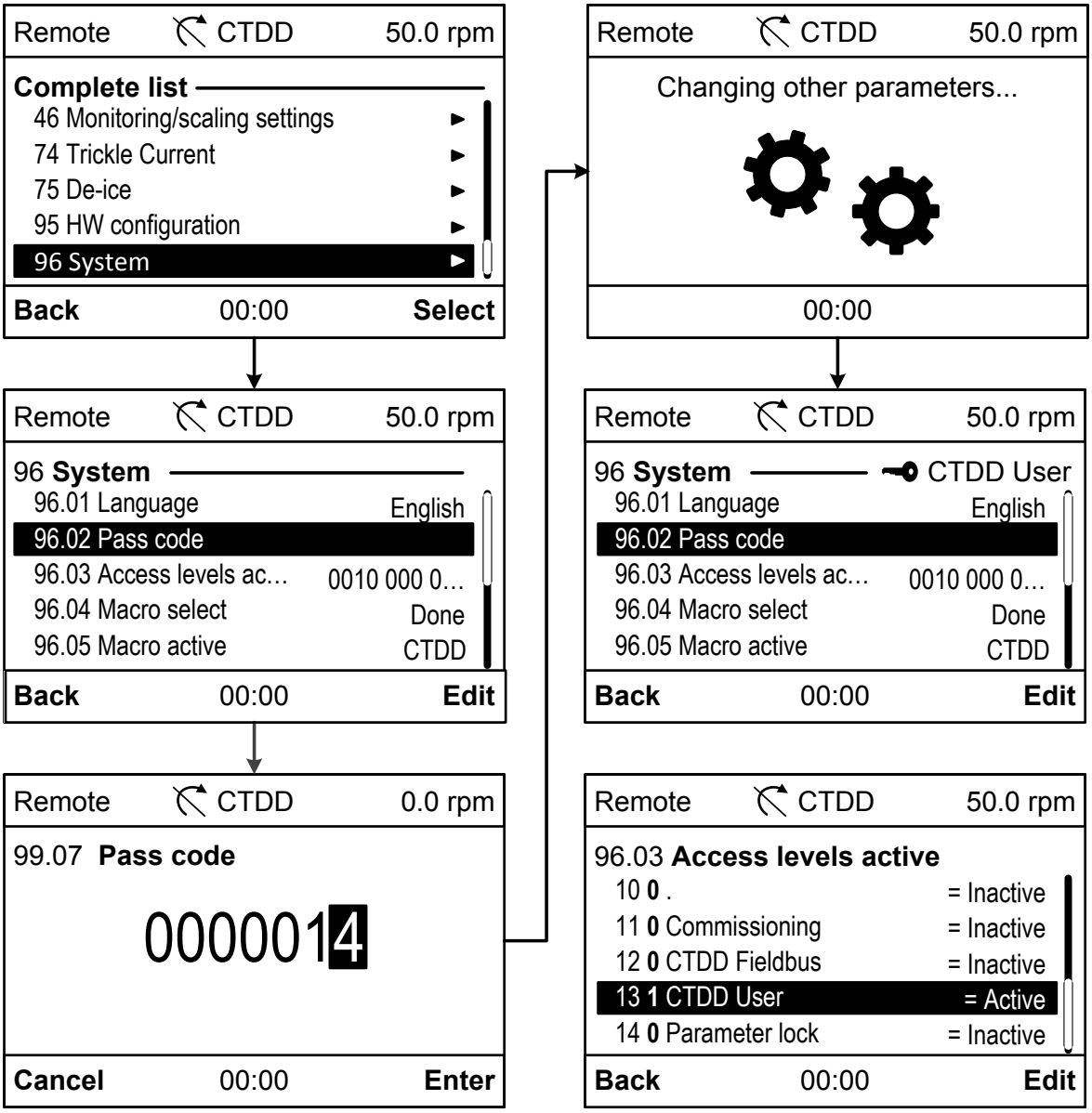
Pass Code (96.02)	Default: - Set to values below for access level
14	CTDD User
13	Fieldbus
12	Expert Commissioner

Parameter 96.03 shows the current access level setting, note ABB default will show active with the addition of the set level shown below. Value is offset by one from the password entered.

Access Level (96.03)	Default: **Read Only** Range: -
11	Expert Commissioner
12	Fieldbus
13	CTDD User

10.4.2 Access Level Flow Diagram

Figure 10-3 Access Level Flow Diagram



10.4.3 Access Level Indication

The display will indicate the access level with a key symbol and access level:

Figure 10-4

If no symbol is present, the ABB default access level is active.

Chapter 11
Example Connection Diagrams

The installation of the ACS880+N5350 is ultimately the responsibility of the user to ensure that it is installed in a manner that will provide a safe and trouble-free system that meets local safety and electrical codes. The information provided in this section is not intended to specifically dictate how the ACS880+N5350 is to be wired or even to imply that all safety factors have been considered since these may vary from one installation to another. These diagrams are provided so that the installer may visualize several possible ways the drive can be connected based upon the 2Wire Operating Mode as well as the 3Wire Operating Mode.

The devices external to the ACS880+N5350 and the RPM AC Cooling Tower Motor depicted in the following diagrams are considered user supplied unless they are ordered as a packaged drive from ABB or as separate line items. Contact your local ABB representative for support regarding the additional equipment or a packaged drive.

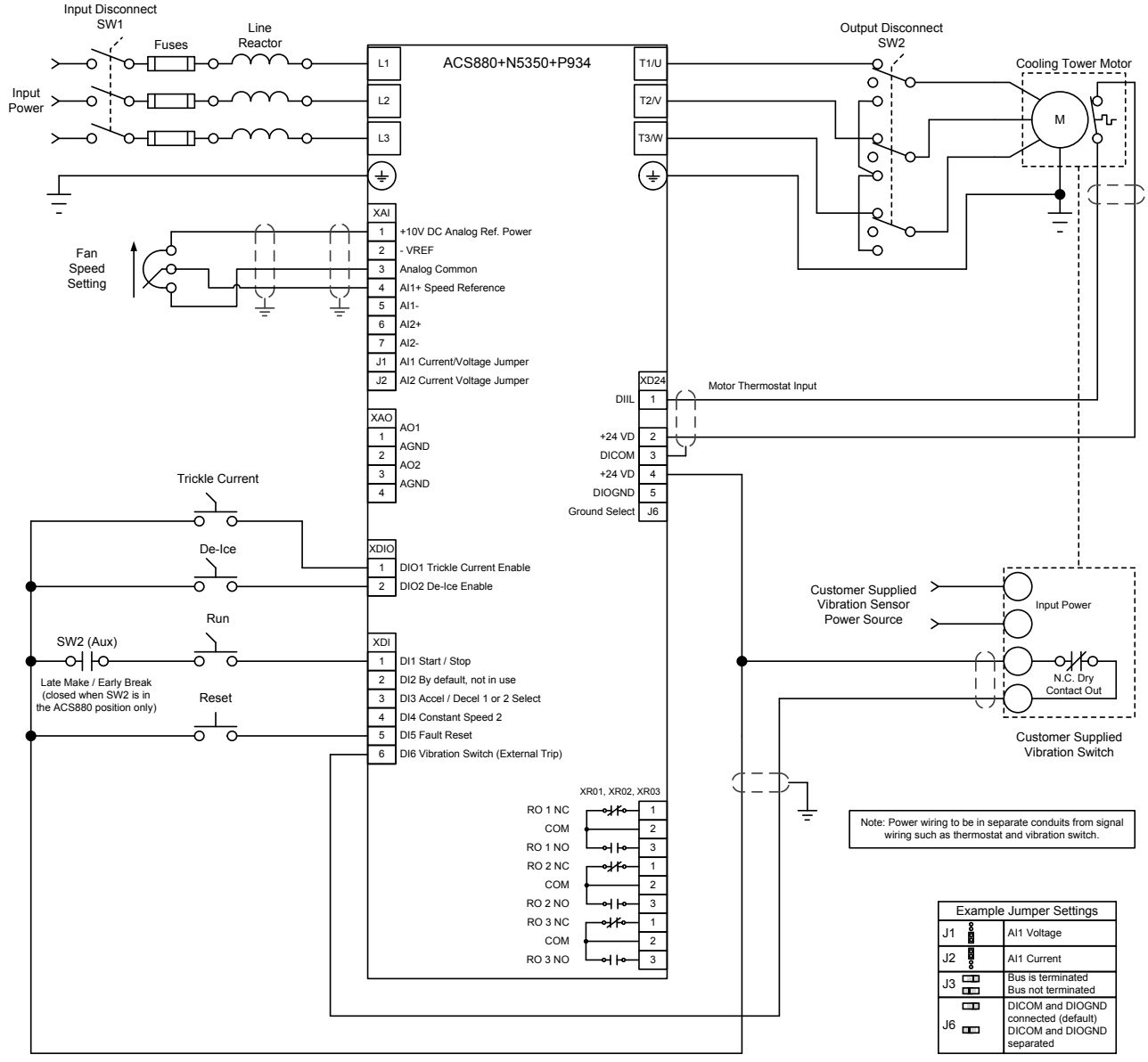
11.1 ACS880+N5350 2Wire Operating Mode Example

The 2Wire Operating Mode is provided for those customers that wish to control their cooling tower fan using what is traditionally called “2-Wire Control”. This method of control utilizes a single “Off – On” selector switch to stop / run the fan. On power loss to the drive, the drive will restart automatically when power is restored.

11.1.1 Manual Motor Disconnect Switch

This diagram depicts an example of using the 2Wire Operating Mode along with a manual disconnect switch between the drive and the motor. The disconnect switch used in this diagram is a 3 position switch. The intent here is to provide one position that is used when the fan is actually being run by the ACS880+N5350. There is a neutral position where the motor leads are open circuit, and also a position which shorts the motor leads together. The position that shorts the leads together is used to prohibit hazardous voltages from being present on the motor leads when it is disconnected from the drive should the fan rotate. This could occur since the motor includes permanent magnets in its rotor thus giving it the characteristics of being a generator when not connected to a drive. Another benefit of this position is that it will cause the motor to resist windmilling. Note that it is required to provide an auxiliary contact on the disconnect switch that is open any time the motor is not connected to the drive. This contact needs to be of the “Late Make / Early Break” style such that the contacts on the auxiliary open before the power contacts open. Additionally, when the disconnect switch is closed, the power contacts of the disconnect switch must close prior to the closure of the auxiliary contact.

Figure 11-1 ACS880+N5350 2Wire Manual Motor Disconnect Switch



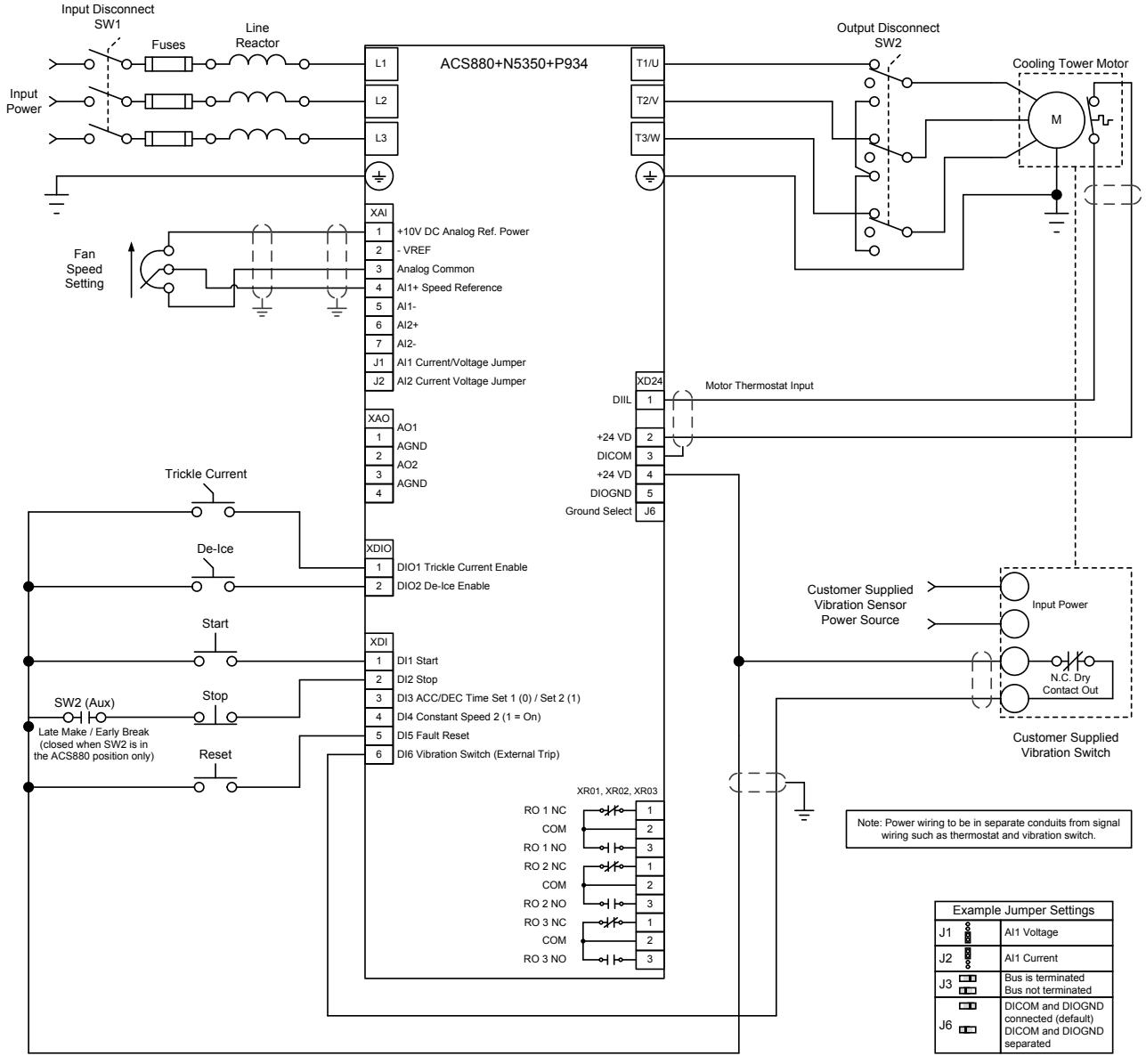
11.2 ACS880+N5350 3Wire Operating Mode Example

The 3Wire Operating Mode is provided for those customers that wish to control their cooling tower fan using what is traditionally called “3-Wire Control”. This method of control utilizes a momentary normally open “Start” pushbutton to run the fan and a momentary normally closed “Stop” pushbutton to stop the fan. On power loss to the drive, the “start” pushbutton will restart the drive when power is restored.

11.2.1 Manual Motor Disconnect Switch

This diagram depicts an example of using the CTD 3Wire Operating Mode along with a manual disconnect switch between the drive and the motor. The disconnect switch used in this diagram is a 3 position switch. The intent here is to provide one position that is used when the fan is actually being run by the ACS880+N5350. There is a neutral position where the motor leads are open circuit, and also a position which shorts the motor leads together. The position that shorts the leads together is used to prohibit hazardous voltages from being present on the motor leads when it is disconnected from the drive should the fan rotate. This could occur since the motor includes permanent magnets in its rotor thus giving it the characteristics of being a generator when not connected to a drive. Another benefit of this position is that it will cause the motor to resist windmilling. Note that it is required to provide an auxiliary contact on the disconnect switch that is open any time the motor is not connected to the drive. This contact needs to be of the “Late Make / Early Break” style such that the contacts on the auxiliary open before the power contacts open. Additionally, when the disconnect switch is closed, the power contacts of the disconnect switch must close prior to the closure of the auxiliary contact.

Figure 11-2 ACS880+N5350 3Wire Manual Motor Disconnect Switch



11.3 Motor Contactor or Shorting Contactor Examples

The following configurations are intended as examples on providing a manual motor disconnect or a power off fail safe shorting contactor. These approaches can be used independent of the drive starting mode or reference source and are not tied directly to the drive controller. Figure 11-3 depicts the preferred usage of a shorting contactor and a motor disconnect when used with the ACS880+N5350 drive.

11.3.1 Manual Motor Disconnect Switch

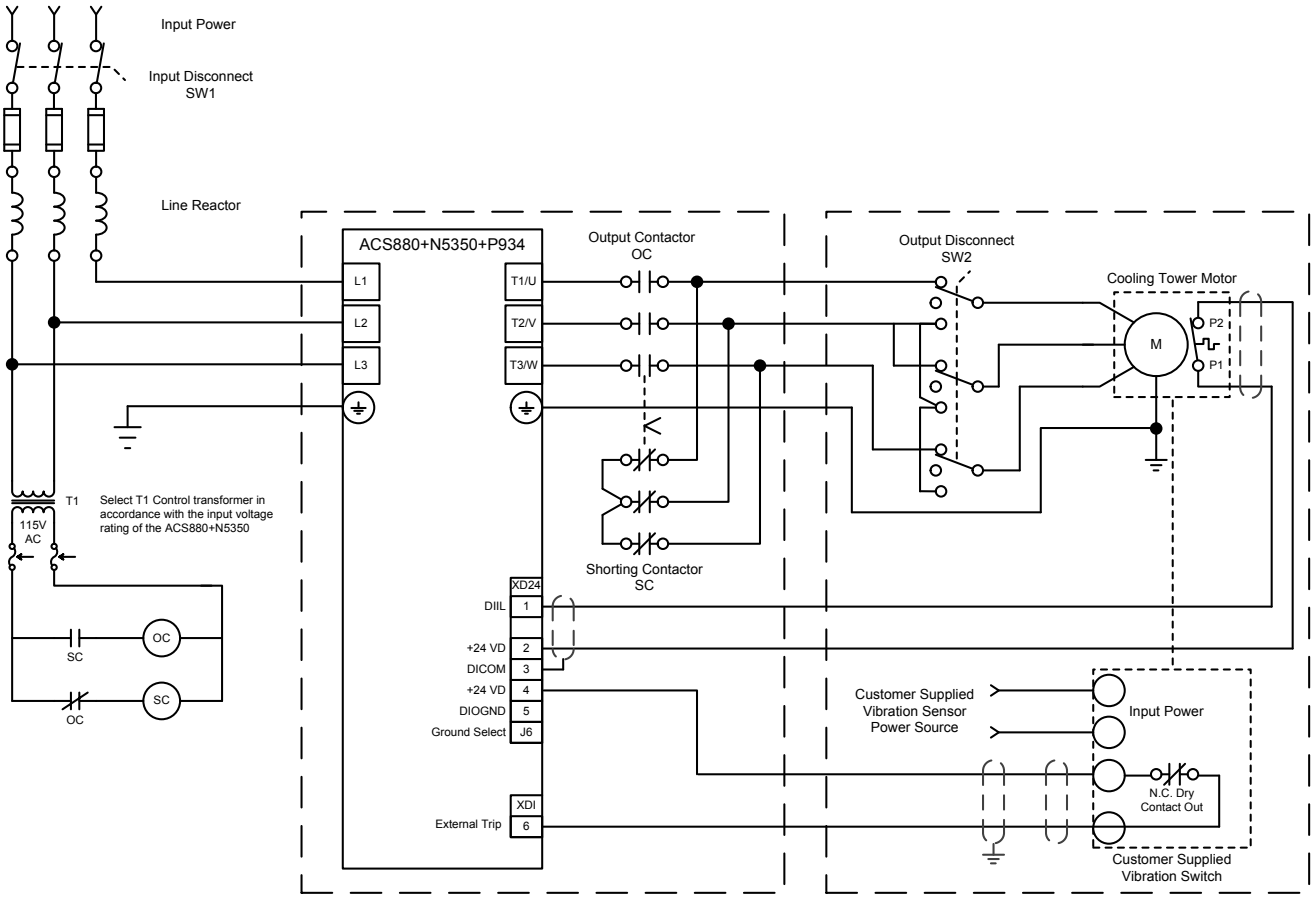
The motor disconnect should be located remotely from the drive panel, within site of the direct drive RPM AC motor and driven load. This is in compliance with National Electric Code Sections 420.102 to 430.109. The switch should only be shorted after the ACS880+N5350 drive has been powered down or de-activated by opening the enable input.

11.3.2 Shorting Contactor

The intent of the Shorting Contactor is to provide one position (open) that is used when the fan is being run by the ACS880+N5350. This is the normal power on state. The other power off position (closed) shorts the motor leads together.

For both the options, the position that shorts the leads together is used to prohibit hazardous voltages from being present on the motor leads when it is disconnected from the drive should the fan rotate. This could occur since the motor includes permanent magnets in its rotor thus giving it the characteristics of being a generator when not connected to a drive. Another benefit of this position is that it will cause the motor to resist wind-milling.

Figure 11-3 Motor Contactor Example



Chapter 12
Startup Assistant & Parameters

12.1 Startup Assistants Guide for ACS880+N5350

This chapter describes the basic start-up assistants for motor data and ID run; and setting up the ACS880 drive equipped with +N5350 cooling tower program. In this guide, the drive is set up using the ACS-AP-I control panel. Complete documentation of the drive firmware can be found in Firmware manual, 3AUA0000085967.

Never work on the drive, the braking chopper circuit, the motor cable or the motor when power is applied to the drive. Always ensure by measuring that no voltage is actually present.

Note: Before you start ensure that the drive has been mechanically and electrically installed as described in the appropriate sections of this manual.

WARNING: All electrical installation and maintenance work on the drive should be carried out by qualified electricians.

12.1.1 Motor Data and ID Run

On initial startup, the drive automaticlly goes into the Motor data setup.

Table 12-1 Initial Start-up / Motor Data and ID Run

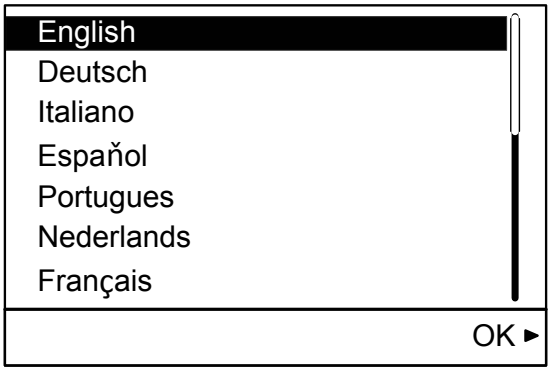
Safety		
	The start-up may only be carried out by a qualified electrician. The safety instructions must be followed during the start-up procedure. See the safety instructions on the first pages of the appropriate Hardware manual.	
☐	Check the installation. See the installation checklist in the appropriate Hardware manual.	
☐	Check that the starting of the motor does not cause any danger. De-couple the driven machine if there is a risk of damage in case of an incorrect direction of rotation.	
Power-Up, Date and Time Settings		
☐	Power up the drive. On initial power up the cooling tower drive requests a language selection for the setup process.	
☐	Select language using ▼ and ▲ and press (continue) to accept. The drive will load the selected language; this may take a few minutes. ABB loading screen will appear after the language selection completes.	

Table 12-1 Initial Start-up / Motor Data and ID Run

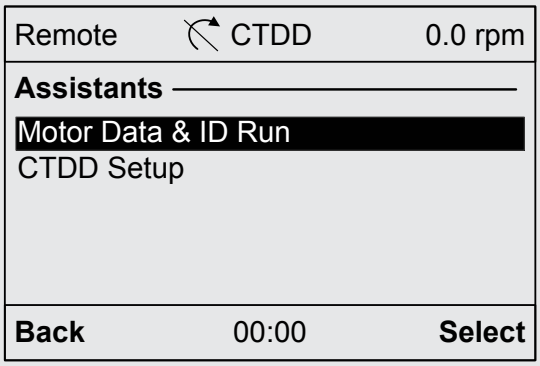
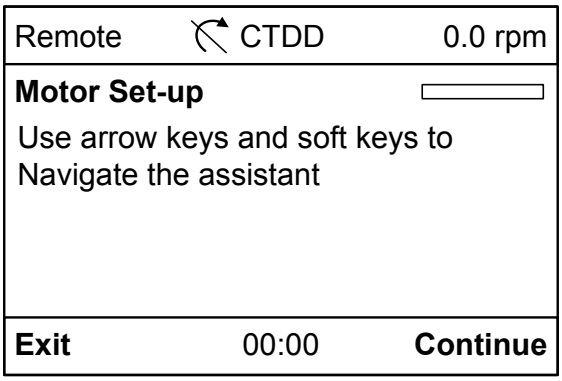
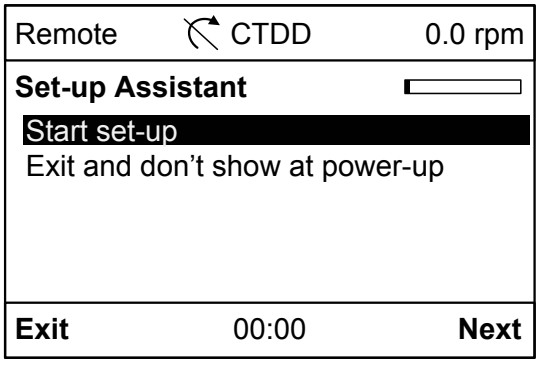
On initial startup, the drive goes into the Motor data setup. and this screen will not be shown. **Note: This screen will not show on first startup.** On subsequent startups, select “Motor Data and ID Run” from the Assistants menu, which is located off of the main menu.		
☐	Motor Data and ID Run Assistant will load. Press (continue) to begin the cooling tower startup assistant.	
☐	Press (next) to start the set-up assistant.	

Table 12-1 Initial Start-up / Motor Data and ID Run

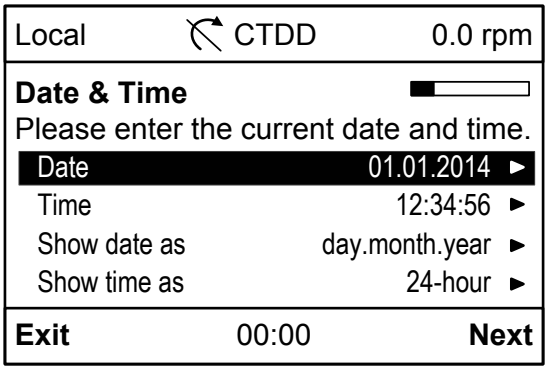
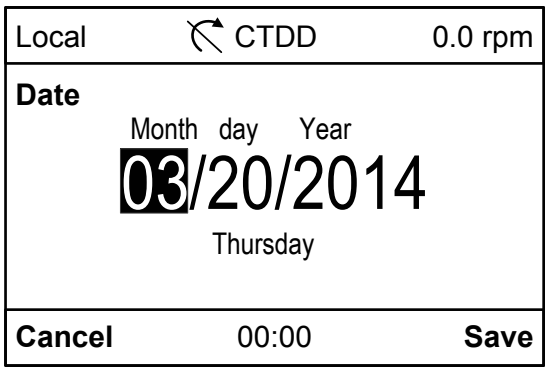
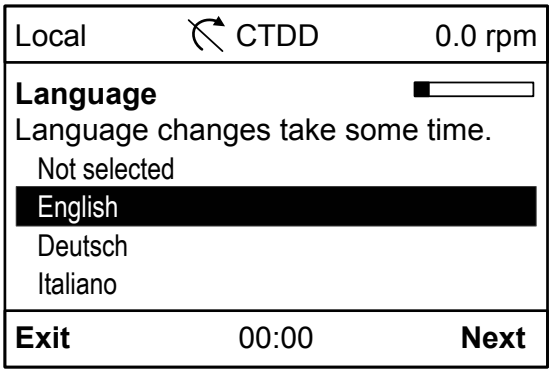
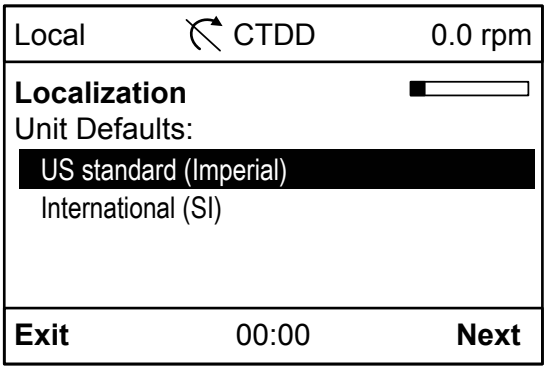
☐	In the Date & Time menu, use the ▲ ▼ to highlight the value to edit. It is recommended to set the current date & time so that faults & alarms can provide accurate time stamps. Highlight date and press ► to edit or ↵ (next) to continued. In the month screen use ◄ ► to select the value for editing. Use ▲ ▼ to modify the value. Pressing ↵ (save) returns to the date & time menu. This screen is only visible the first time the Motor Data assistant is run.	 
☐	Confirm language selection. Highlight the language with the ▲ ▼ and press ↵ (continue).	
	Unit Selection	
☐	Confirm local units. Highlight selection with the ▲ ▼ and press ↵ (next).	

Table 12-1 Initial Start-up / Motor Data and ID Run

☐	Highlight the desired unit with the ▲▼ and press (next). Use ▲ ▼ to move between the units. Use ► to select the value for editing. Pressing (save) returns to the unit selection menu.	Local CTDD 0.0 rpm **Units** Change the display units if needed. Unit Selection 0000 0000 0001 00011 ► Tariff currency unit USD ► AI1 unit selection V ► **Back** 00:00 **Next**
Supply Voltage Settings		
☐	Press ► to edit the supply voltage input to the CTDD drive. **Note:** For 460...480 V, it is recommended that supply voltage is set to 500 V.	Local CTDD 0.0 rpm **Supply voltage** Set supply voltage. Supply voltage 500 V ► **Back** 00:00 **Next**
Motor Data Settings		
Refer to the motor nameplate for the following parameter settings. Whenever possible, enter the values exactly as shown on the motor nameplate.		
Example of a nameplate of a Back-EMF motor: WARNING PERMANENT MAGNET MOTOR WHEN SHAFT IS ROTATED, VOLTAGE WILL BE GENERATED AT THE MOTOR TERMINALS. MEASURED OPEN CIRCUIT VOLTAGE IS _____VOLTS AT _____RPM. MOTOR PHASE CURRENT SHOULD NOT EXCEED _____AMPS RMS PEAK TO AVOID DEMAGNETIZATION. patent US 7,385,328 000692-000VY	Example of a nameplate of a permanent magnet motor: BALDOR · RELIANCE RPMAC™ INVERTER DUTY BALDOR ELECTRIC CO ◦ FT SMITH, AR. MFG. IN U.S.A. DUTY / HP / RPM / AMPS / VOLTS / HZ LR40567 CAT NO. / SPEC NO. SER. NO. / FR. / INSUL PH. / MAX. SAFE SPEED / AMB. °C / MIN. AMB. °C DESIGN NO. / TYPE / ENCL. S.F. / D.E. BRG. ENCL. MOD. / O.D.E. BRG. MINIMUM AIRFLOW VELOCITY FT. PER MINUTE PATENT US 7,880,348 B2 PLANT 15 000613-006AAP

Table 12-1 Initial Start-up / Motor Data and ID Run

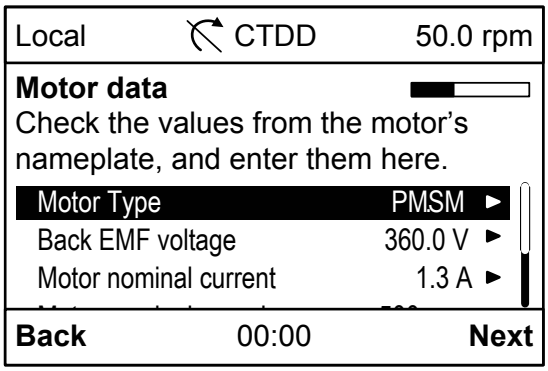
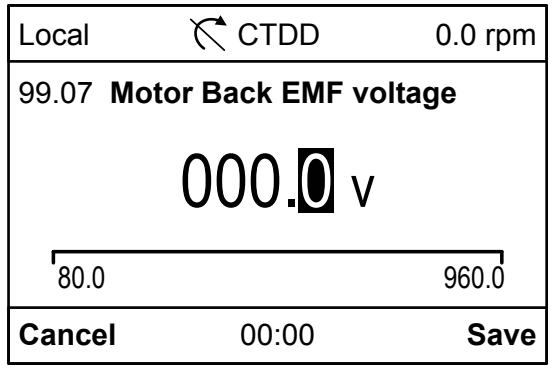
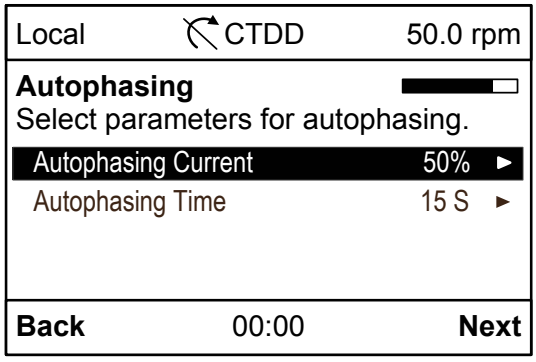
☐	Highlight the motor value to be edited using ▲ ▼ keys. Use ► to edit the values. Use ▲ and ▼ to change the value of a digit. Use ◄ and ► to move the curser left and right. Press (save) to enter the value. **Important!** Motor Back EMF voltage (located on the motor nameplate) is critical to the successful operation of the cooling tower motor. Please record this data here for future reference. Back EMF Voltage: _____ Motor Serial Number: _____ **Note: Back EMF Voltage is referrred to as Measured Open Circuit Voltage on the motor nameplate.**	 
	Motor ID Run	
☐	Autophasing The drive is now ready to run the motor identification routine (ID run). During the ID run, the motor is injected with DC current. Autophase stops the rotor prior to the ID run. **Note:** Autophase time has a default of 15 seconds. It is best to observe the time it takes the fan to stop moving and use this as an accurate autophase time. Use the ▲ ▼ keys to move between selections. Use ► to select the value to edit.	

Table 12-1 Initial Start-up / Motor Data and ID Run

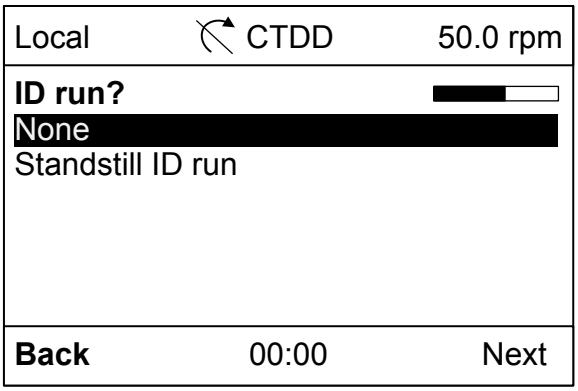
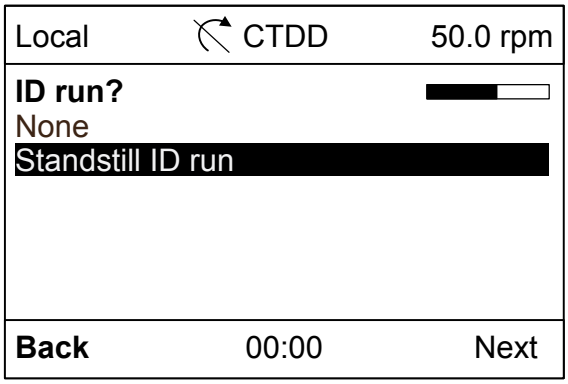
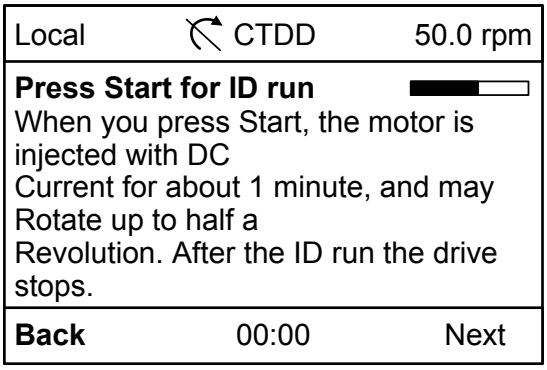
☐	Motor ID Run The drive is now ready to run the motor identification routine (ID run). The motor is injected with DC current.	
	Use the ▼ key to select Standstill ID run and then press (next). **Note:** On initial startup, an ID run must be performed and Next will not advance to next step.	
☐	Motor ID Run No command rotation is given, however with a permanent magnet motor the shaft could rotate up to half a revolution. You must press Local Keypad START to activate ID Run. **Note: ID Run requires Local control, press Loc/Rem if the Keypad does not indicated local control is active.** Next is not visible until ID run is performed once.	

Table 12-1 Initial Start-up / Motor Data and ID Run

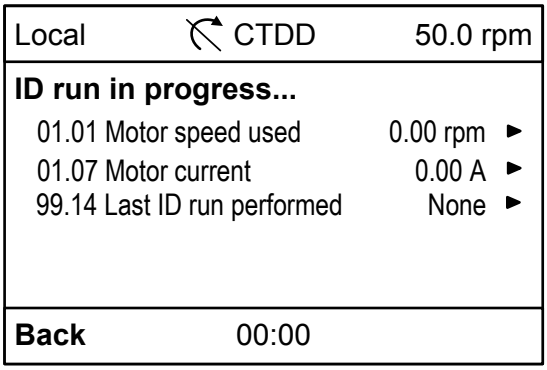
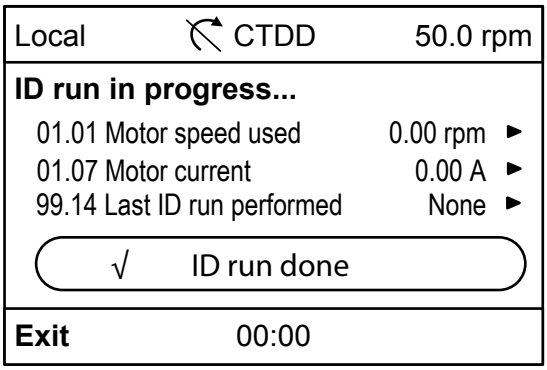
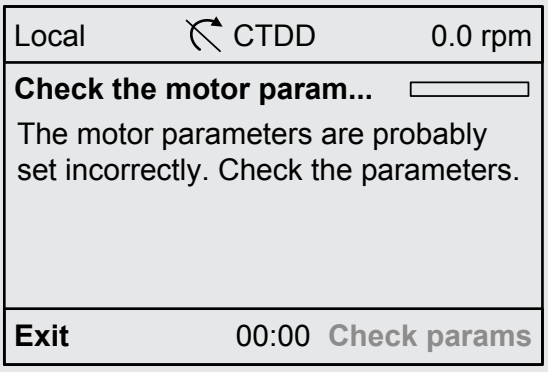
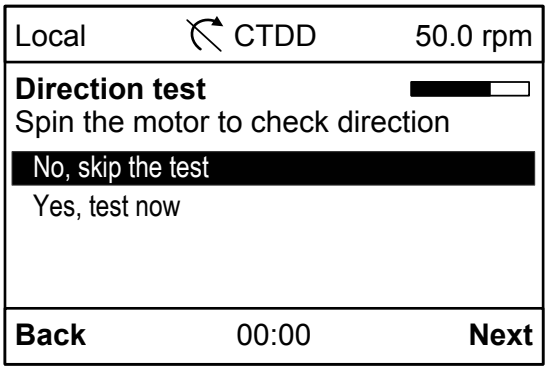
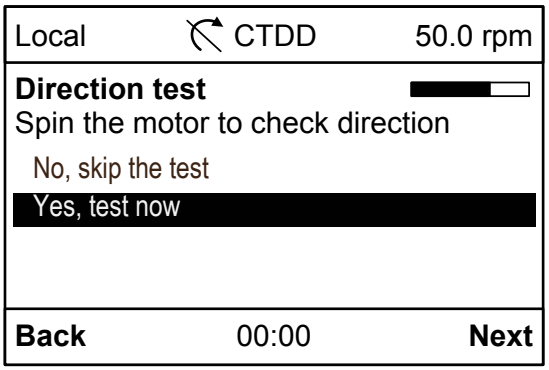
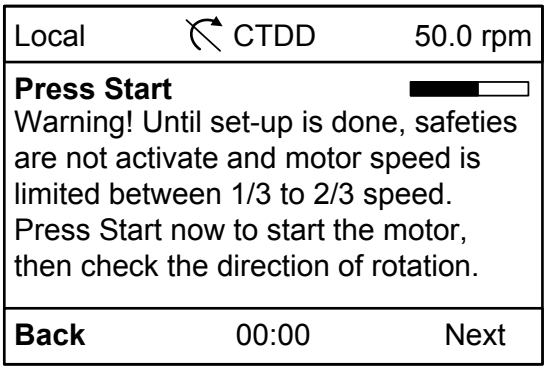
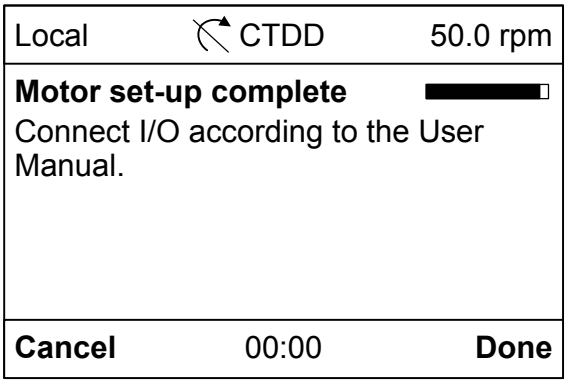
☐	The ID run in progress screen will automatically display showing speed and amps. The screen will also indicate if an ID run has been completed before. If not, it will read “none”. If a run has been completed, it will read “Standstill”. When ID run is complete, the next screen will be displayed.	 
NOTE: If the motor data is incorrect, after pressing , the display will indicate check motor parameters. Press (exit) and check that the motor information is correct.		

Table 12-1 Initial Start-up / Motor Data and ID Run

☐	Direction Test NOTE: The Autophasing delay occurs everytime the motor starts, including direction testing. Use the ▼ key to perform a direction test of the rotation of the motor. Then press (next).	 
☐	The following warning message will appear. Press START to check direction of the motor. A screen will appear next asking if the motor is running in the correct direction.	
☐	Motor set-up is complete. To exit and save all data, select (Done). To exit without saving data, select (cancel).	

NOTE: After initial startup sequencing a new power-up will initiate the standard CTDD startup mode (see Table 12-2).

12.1.2 Drive Assistant

Selecting drive assistant (CTDD) will display the cooling tower application assistant. After motor data start-up, the applicaiton is only capable of 2-wire functionality with no options.

Table 12-2 Drive Assistant

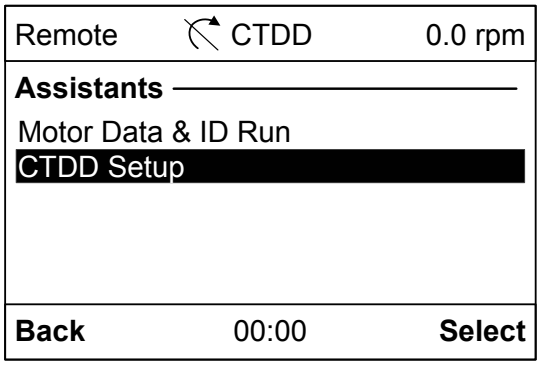
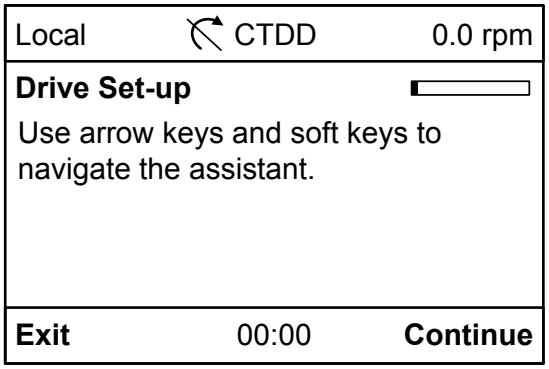
Safety		
⚠	The start-up may only be carried out by a qualified electrician. The safety instructions must be followed during the start-up procedure. See the safety instructions on the first pages of the appropriate Hardware manual.	
☐	Check the installation. See the installation checklist in the appropriate Hardware manual.	
☐	Check that the starting of the motor does not cause any danger. De-couple the driven machine if there is a risk of damage in case of an incorrect direction of rotation.	
Power-Up, Date and Time Settings		
☐	Power up the drive. Main Menu Screen appears. Select “Assistants” from the main menu.	
☐	Select assistant to run. Selecting the CTDD Setup will display the cooling tower application assistant.	
☐	In the assistant view, press (continue) to enter the Startup Assistant. Note: To leave the assistant, press (exit) and go back to the Home screen.	

Table 12-2 Drive Assistant

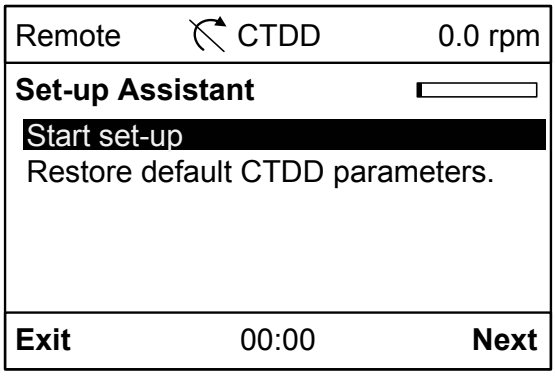
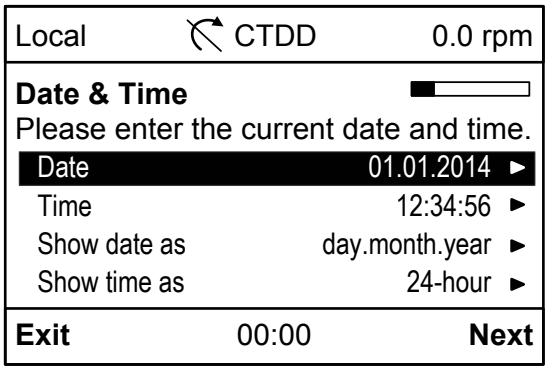
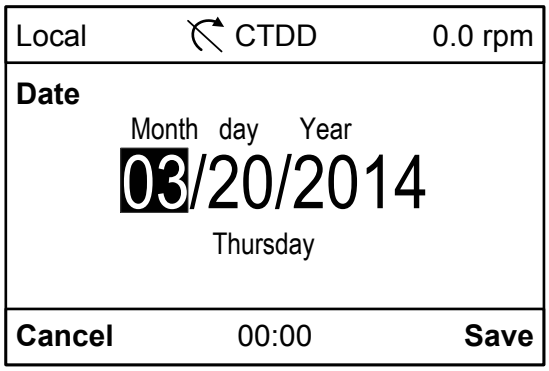
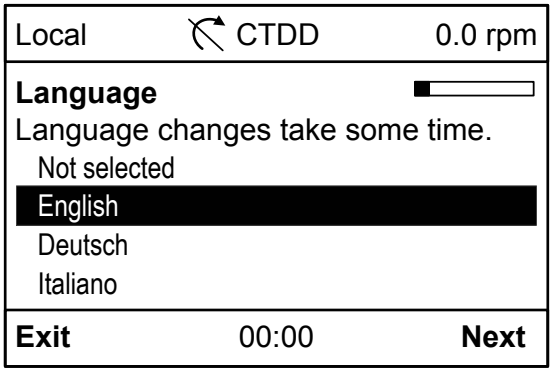
☐	Press (next) to start the set-up assistant. "Restore ...." will reload all default parameters except for motor data.	
☐	In the Date & Time menu, use the to highlight the value to edit. It is recommended to set the current date & time so that faults & alarms can provide accurate time stamps. Highlight date and press to edit or (next) to continued. In the month screen use to select the value for editing. Use to modify the value. Pressing (save) returns to the date & time menu. (See Motor Data)	 
☐	Highlight the language with the and press (continued).	
NOTE: After editing all desired date & time values, press (next) to continue.		

Table 12-2 Drive Assistant

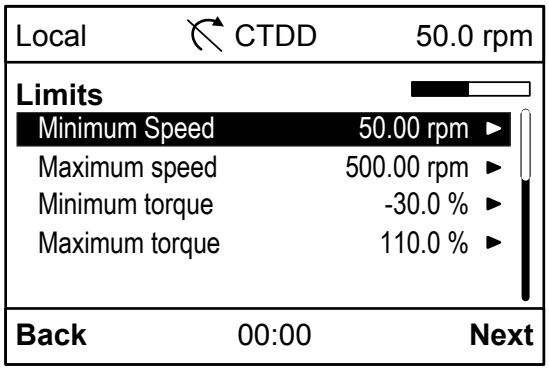
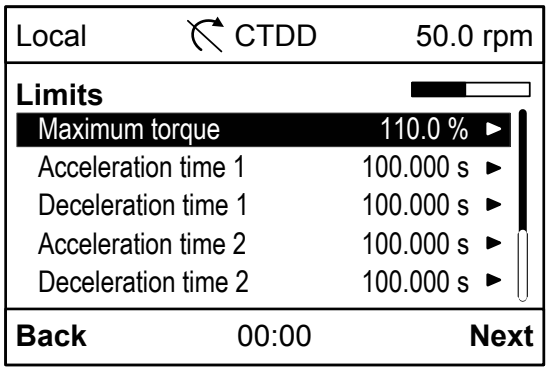
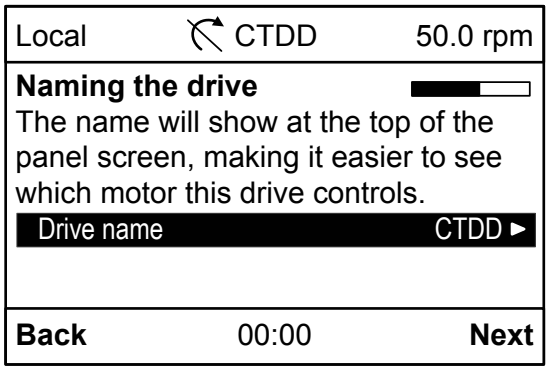
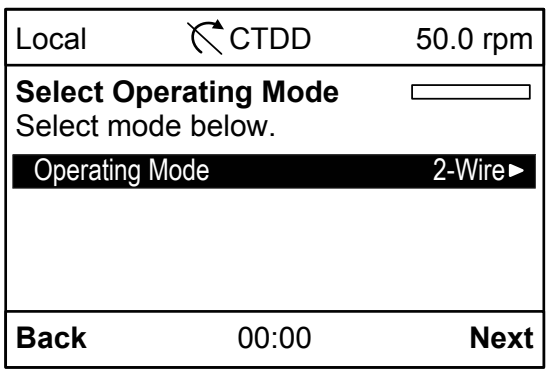
Drive Limit Settings		
☐	The CTDD will automatically set limits according to motor data entered. For most CTDD applications, the default values are acceptable. However, values are adjustable within Limits: Minimum Speed ≥ 10% Motor Speed Maximum Speed ≤ Motor Speed Minimum Torque set to -30% (adjustable) Maximum Torque set to 110% (adjustable)	
	Use the ▼ ▲ to highlight the ramp rate to be adjusted. Press ► to enter the edit screen once highlighted or (next) if the default value is acceptable.	
☐	Naming the Drive The default drive name is CTDD. Use ► to edit the drive name or (next) to continue.	
Selecting Operating Mode		
☐	Select Operating Mode Operating modes are sets of default wire and parameters suitable for most CTDD applications. The active operating mode is displayed, (2-wire) default. If this is correct, press (next). To edit the operating mode press ►. Caution: Ensure drive is stopped and in Local before changing mode. Drive could unexpectedly start when changing mode.	

Table 12-2 Drive Assistant

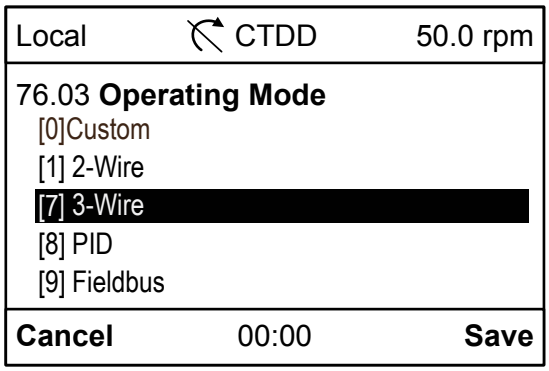
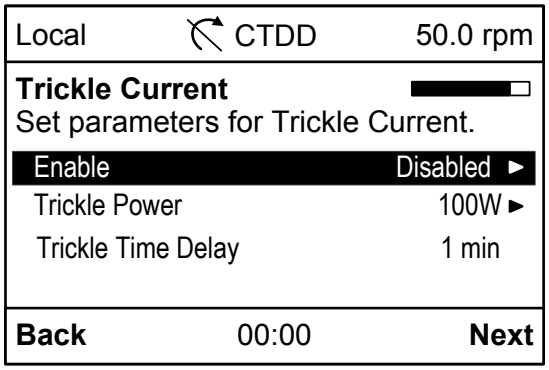
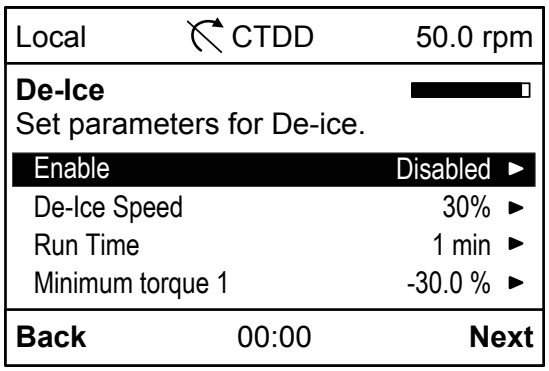
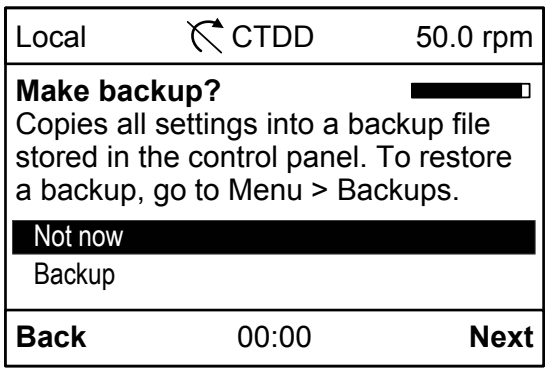
☐	Highlight the operating mode suitable to the application and press save. Press (save) to select. If mode was changed, cycle power to drive after setup is complete.	
	Additional Settings & Parameter Backup	
☐	Trickle Current Function Primary purpose is to prevent fan rotation during standby condition and to prevent condensation in the motor. Use the to enable the function in software. Highlight enable or fieldbus and press (save). Use to highlight trickle power and to set the level. Refer to Chapter 10 or parameter group 74 for proper setup of this function. When finished, press (next) to continue.	
☐	De-Ice This is a Cooling Tower mode to run the tower in reverse at a slow speed to prevent ice build up. Use the to highlight the setting and to access level values. Refer to Chapter 10 or parameter group 75 for proper setup. When finished, press (next) to continue.	
☐	Backup Copies all settings into a backup file stored in the control panel. Press to highlight Backup and to begin the Backup.	

Table 12-2 Drive Assistant

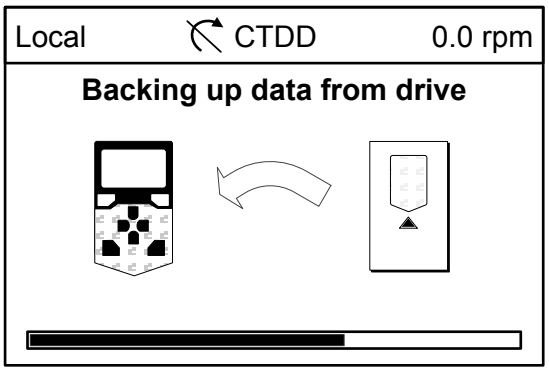
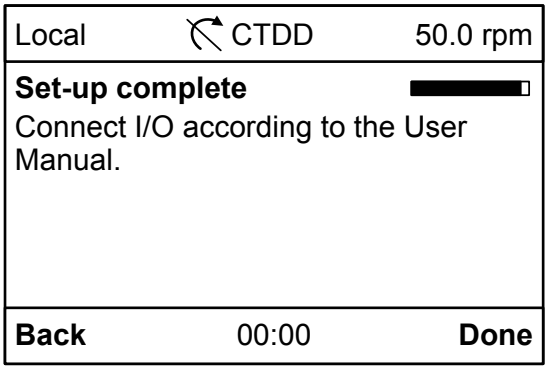
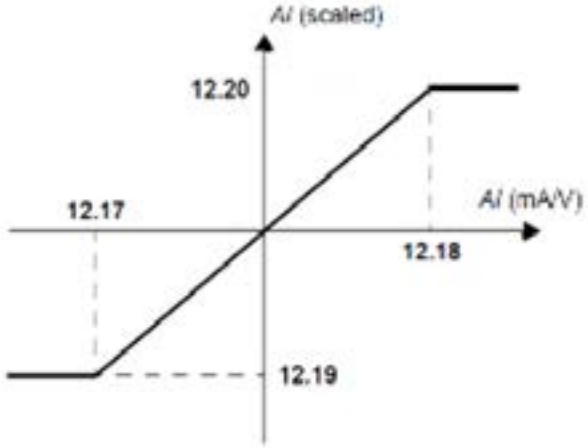
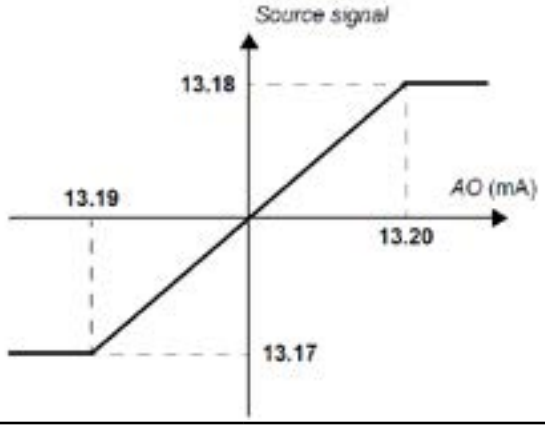
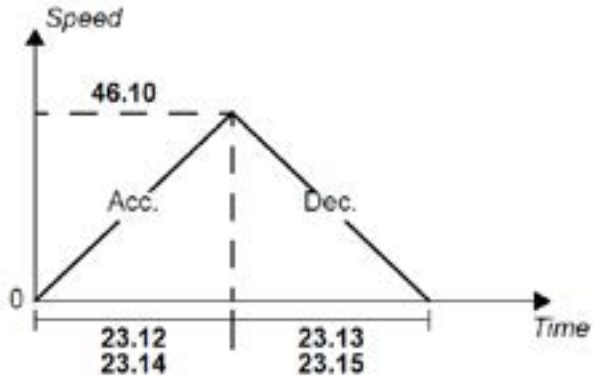
☐	Backup Status A status screen indicates progress.	
☐	Press (back) to backout and exit to home menu.	
	Control Signal Settings	
☐	Check the positions of jumpers J1 and J2 on the control unit of the drive. These jumpers determine whether analog inputs AI1 and AI2 are current or voltage.	
Check/adjust the following parameters.		
☐	**12.15 AI1 unit selection** Set this to either mA or V corresponding to the setting of jumper J1.	
☐	**12.17 AI1 min** **12.18 AI1 max** **12.19 AI1 scaled at AI1 min** **12.20 AI1 scaled at AI1 max** The default input for speed reference is analog input AI1. (This is controlled by the parameters in group 22.) Parameters 12.17 and 12.18 set the low and high limits of the analog input signal. Scaling parameters 12.19 and 12.20 define the internal signal levels that correspond to these limits as follows:  The corresponding parameters for analog input AI2 are 12.27…12.30. Analog input 2 is only available in “Custom” mode as a speed reference.	

Table 12-2 Drive Assistant

☐	**13.12 AO1 source** **13.17 AO1 source min** **13.18 AO1 source max** **13.19 AO1 out at AI1 src min** **13.20 AO1 out at AI1 src max** Parameter 13.12 selects the source for analog output AO1 (by default, motor speed in rpm). Parameters 13.17 and 13.18 set low and high source signal values that correspond to the actual analog output values defined by parameters 13.19 and 13.20. 
☐	**46.10 Speed scaling** **23.11 Ramp set selection** **23.12 Acceleration time 1** **23.13 Deceleration time 1** **23.14 Acceleration time 2** **23.15 Deceleration time 2** You can define two different sets of acceleration/deceleration ramps. The source that switches between the two sets is selected by parameter 23.11. Each acceleration/deceleration time set in parameters 23.12…23.15 refers to the time it takes for the drive to accelerate or decelerate between 0 and scaling speed (parameter 46.10). 
☐	**30.11 Minimum speed** **30.12 Maximum speed** **30.17 Maximum current** **30.19 Minimum torque** **30.20 Maximum torque** Check, and set if necessary, the limits for motor speed, current and torque.
☐	Start the drive with a positive (forward) speed reference: • From control panel (Local control): In the Home view,press (**Options**), select **Reference**, adjust the reference using the , , , and keys, press **Save**, and press the **Start** button. • From I/O: In Remote control, adjust analog input AI1 (reference), switch digital input DI1 to 1 (start). DI2 for reverse is only available in “Custom” mode.

The ACS880+N5350 utilizes various parameters to determine its operation. Many of these parameters will not need adjusting for most applications, but are provided to allow for a user to customize the operation of the control if desired.

Table 12-3 Terms and Abbreviations

Term	Definition
Actual Signal	Type of parameter that is the result of a measurement or calculation by the drive, or contains status information. Most actual signals are read-only, but some (especially counter-type actual signals) can be reset.
Def	(In the following table, shown on the same row as the parameter name) The default value of a parameter when used in the CTDD macro.
FbEq16	(In the following table, shown on the same row as the parameter range, or for each selection) A dash (-) indicates that the parameter is not accessible in 16-bit format.
Other	The value is taken from another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter.
Other [bit]	The value is taken from a specific bit in another parameter. Choosing “Other” displays a parameter list in which the user can specify th esource parameter and bit.
Parameter	Either a user-adjustable operating instruction for the drive, or an actual signal.
p.u.	Per unit

12.2 Level 1 Parameters (Advanced Prog, Level 1 Blocks)

Table 12-4 Level 1 Parameter Block Definitions

Block Title	Parameter (Number) Selection (Value)	Descriptions
ACTUAL VALUES	Basic signals for monitoring the drive. All parameters in this group are read-only unless otherwise noted.	
	MOTOR SPEED USED (01.01)	Default: **Read Only** Range: -30000.00 to +30000.00 RPM
		Measured or estimated motor speed.
	MOTOR SPEED ESTIMATED (01.02)	**Read Only** Range: -30000.00 to +30000.00 RPM
		Estimated motor speed in rpm.
	OUTPUT FREQUENCY (01.06)	Default: **Read Only** Range: -500.00 to +500.00 Hz
		Estimated drive output frequency in Hz.
	MOTOR CURRENT (01.07)	Default: **Read Only** Range: 0.00 to 30000.00 A
		Measured (absolute) motor current in A.
	MOTOR TORQUE % (01.10)	Default: **Read Only** Range: -1600.0 to 1600.0 %
		Motor torque in percent of the nominal motor torque.
	DC VOLTAGE (01.11)	Default: **Read Only** Range: 0.00 - 2000.00 V
		Measured DC link voltage.
	OUTPUT VOLTAGE (01.13)	Default: **Read Only** Range: 0 - 2000 V
		Calculated motor voltage in V AC. Fieldbus Equivalent: 10 = 1 V
	OUTPUT POWER (01.14)	Default: **Read Only** Range: -32768 to +32767 HP
		Drive output power. The unit is selected by parameter 96.16 Unit selection.
	INVERTER GWh COUNTER (01.18)	Default: **Read Only** Range: 0 - 65535 GWh
		Energy in GWh - Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero.
	INVERTER MWh COUNTER (01.19)	Default: **Read Only** Range: 0 - 999 MWh
		Energy in MWh - Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, 01.18 Inverter GWh counter is incremented.The minimum value is zero.
	INVERTER kWh COUNTER (01.20)	Default: **Read Only** Range: 0 - 999 kWh
		Energy in kWh - Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, 01.19 Inverter MWh counter is incremented.The minimum value is zero. Fieldbus Equivalent: 10 = 1kWh

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
ACTUAL VALUES (Continued)	**NOMINAL TORQUE SCALE** (01.30)	Default: **Read Only** Range: 0.0000 - lb-ft
		Nominal Torque - Torque that corresponds to 100% of nominal motor torque. The unit is selected by parameter 96.16 Unit selection. **Note:** This value is copied from parameter 99.12 Motor nominal torque if entered. Otherwise the value is calculated from other motor data.
	AMBIENT TEMPERATURE (01.31)	Default: **Read Only** Range: -32768 to +32767 ^{0}C or ^{0}F
		Measured temperature of incoming cooling air. The unit is selected by parameter 96.16 Unit selection.
INPUT REFERENCES	Values of references received from various sources. All parameters in this group are read-only unless otherwise noted. **These parameters are for Fieldbus only.**	
	FB A REFERENCE 1 (03.05) "Fieldbus" mode reference	Default: **Read Only** Range: -100000.00 - 100000.00
		Reference 1 received through fieldbus adapter A.
	FB A REFERENCE 2 (03.06)	Default: **Read Only** Range: -100000.00 - 100000.00
		Reference 2 received through fieldbus adapter A.
WARNINGS AND FAULTS	Information on warnings and faults that occurred last. All parameters in this group are read-only unless otherwise noted.	
	TRIPPING FAULT (04.01)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 1st active fault (the fault that caused the current trip).
	ACTIVE FAULT 2 (04.02)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 2nd active fault.
	ACTIVE FAULT 3 (04.03)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 3rd active fault.
	ACTIVE FAULT 4 (04.04)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 4th active fault.
	ACTIVE FAULT 5 (04.05)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 5th active fault.
	ACTIVE WARNING 1 (04.06)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 1st active warning.
	ACTIVE WARNING 2 (04.07)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 2nd active warning.
	ACTIVE WARNING 3 (04.08)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 3rd active warning.
	ACTIVE WARNING 4 (04.09)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 4th active warning.

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
WARNINGS AND FAULTS (Continued)	**ACTIVE WARNING 5** (04.10)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 5th active warning.
	LATEST FAULT (04.11)	**Read Only** Range: 0000h - FFFFh
		Code of the 1st stored (non-active) fault.
	2ND LATEST FAULT (04.12)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 2nd stored (non-active) fault.
	3RD LATEST FAULT (04.13)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 3rd stored (non-active) fault.
	4TH LATEST FAULT (04.14)	Default: **Read Only** Range:
		Code of the 4th stored (non-active) fault.
	5TH LATEST FAULT (04.15)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 5th stored (non-active) fault.
	LATEST WARNING (04.16)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 1st stored (non-active) warning.
	2ND LATEST WARNING (04.17)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 2nd stored (non-active) warning.
	3RD LATEST WARNING (04.18)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 3rd stored (non-active) warning.
	4TH LATEST WARNING (04.19)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 4th stored (non-active) warning.
	5TH LATEST WARNING (04.20)	Default: **Read Only** Range: 0000h - FFFFh
		Code of the 5th stored (non-active) warning.
DIAGNOSTICS	Various run-time-type counters and measurements related to drive maintenance. All parameters in this group are read-only unless otherwise noted.	
	ON-TIME COUNTER (05.01)	Default: **Read Only** Range: 0 - 65535 d
		On-time counter - The counter runs when the drive is powered.
	RUN-TIME COUNTER (05.02)	Default: **Read Only** Range: 0 - 65535 d
		Motor run-time counter - The counter runs when the inverter modulates.
	FAN ON-TIME COUNTER (05.04)	Default: **Read Only** Range: 0 - 65535 d
		Cooling fan run-time counter - Running time of the drive cooling fan. Can be reset from the control panel by keeping Reset depressed for over 3 sec.

Table 12-4 Level 1 Parameter Block Definitions Continued

<table>
<tr><th>Block Title</th><th>Parameter (Number)
Selection (Value)</th><th>Descriptions</th></tr>
<tr><td rowspan="4">DIAGNOSTICS
(Continued)</td><td rowspan="2">INVERTER TEMPERATURE
(05.11)</td><td>Default: Read Only
Range: -40.0 to +160.0 %</td></tr>
<tr><td>Drive temperature in percent - Estimated drive temperature in percent of fault limit. The fault limit varies according to the type of the drive.
0.0% = 0°C (32°F); 100.0% = Fault limit</td></tr>
<tr><td>DIAGNOSTIC WORD 3
(05.22)</td><td>Default: Read Only
Range: 0000h - FFFFh</td></tr>
<tr><td>Diagnostic word 3.
<table>
<tr><th>Bit</th><th>Name</th><th>Value</th></tr>
<tr><td>0 - 10</td><td colspan="2">Reserved</td></tr>
<tr><td>11</td><td>Fan command</td><td>1 = Drive fan is rotating above idle speed.</td></tr>
<tr><td>12 - 15</td><td colspan="2">Reserved</td></tr>
</table></td></tr>
<tr><td>CONTROL AND
STATUS WORDS</td><td colspan="2">All parameters in this group are read-only unless otherwise noted.
These parameters are for Fieldbus only. Main Control Word only used in “Custom” mode.</td></tr>
<tr><td></td><td>MAIN CONTROL WORD
(06.01)</td><td>Default: Read Only
Range: 0 - 15</td></tr>
<tr><td></td><td>0 (Off1 control)</td><td>1 - Proceed to READY TO OPERATE.
0 - Stop along currently active deceleration ramp. Proceed to OFF1 ACTIVE; proceed to READY TO SWITCH ON unless other interlocks (OFF2, OFF3) are active.</td></tr>
<tr><td></td><td>1 (Off2 control)</td><td>1 - Continue operation (OFF2 inactive).
0 - Emergency OFF, coast to a stop.
Proceed to OFF2 ACTIVE, proceed to SWITCH-ON INHIBITED.</td></tr>
<tr><td></td><td>2 (Off3 control)</td><td>1 - Continue operation (OFF3 inactive).
0 - Emergency stop, stop within time defined by drive parameter.
Proceed to OFF3 ACTIVE; proceed to SWITCH-ON INHIBITED.</td></tr>
<tr><td></td><td>3 (Run)</td><td>1 - Proceed to OPERATION ENABLED.
Note: Run enable signal must be active; see drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
0 - Inhibit operation. Proceed to OPERATION INHIBITED.</td></tr>
<tr><td></td><td>4 (Ramp out zero)</td><td>1 - Normal operation. Proceed to RAMP FUNCTION GENERATOR: OUTPUT ENABLED.
0 - Force Ramp function generator output to zero. The drive will immediately decelerate to zero speed (observing the torque limits).</td></tr>
<tr><td></td><td>5 (Ramp hold)</td><td>1 - Enable ramp function. Proceed to RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED.
0 - Halt ramping (Ramp Function Generator output held).</td></tr>
<tr><td></td><td>6 (Ramp in zero)</td><td>1 - Normal operation. Proceed to OPERATING.
Note: This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
0 - Force Ramp function generator input to zero.</td></tr>
<tr><td></td><td>7 (Reset)</td><td>0=>1 - Fault reset if an active fault exists. Proceed to SWITCH-ON INHIBITED.
Note: This bit is effective only if the fieldbus interface is set as the source of the reset signal by drive parameters.
0 - Continue normal operation.</td></tr>
<tr><td></td><td>8 (Inching 1)</td><td>1 - Accelerate to inching (jogging) setpoint 1.
Notes: Bits 4…6 must be 0.
0 - Inching (jogging) 1 disabled.</td></tr>
<tr><td></td><td>9 (Inching 2)</td><td>1 - Accelerate to inching (jogging) setpoint 2. See notes at bit 8.
0 - Inching (jogging) 2 disabled.</td></tr>
</table>

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
CONTROL AND STATUS WORDS (Continued)	**MAIN CONTROL WORD** (06.01) (Cont.)	Default: **Read Only** Range: 0 - 15
	10 (Remote cmd)	1 - Fieldbus control enabled. 0 - Control word and reference not getting through to the drive, except for bits 0…2.
	11 (Ext ctrl loc)	1 - Select External Control Location EXT2. Effective if control location is parameterized to be selected from fieldbus. 0 - Select External Control Location EXT1. Effective if control location is parameterized to be selected from fieldbus.
	12 - 15 (Reserved)	
		The main control word of the drive. This parameter shows the control signals as received from the selected sources (such as digital inputs, the fieldbus interfaces and the application program). **Note:** Bits 12 - 15 can be used to carry additional control data, and used as a signal source by any binary-source selector parameter.
	MAIN STATUS WORD (06.11)	Default: **Read Only** Range: 0 - 15
	0 (Ready to switch ON)	1 - Ready to switch On. 0 - Not ready to switch On.
	1 (Ready run)	1 - Ready to operate. 0 - Off1 Active.
	2 (Ready ref)	1 - Operation enabled. 0 - Operation inhibited.
	3 (Tripped)	1 - Fault. 0 - No fault.
	4 (Off 2 inactive)	1 - Off2 inactive. 0 - Off2 active.
	5 (Off 3 inactive)	1 - Off3 inactive. 0 - Off3 active.
	6 (Switch-on inhibited)	1 - Switch-On inhibited. 0 -
	7 (Warning)	1 - Warning active. 0 - No warning active.
	8 (At setpoint)	1 - OPERATING. Actual value equals reference = is within tolerance limits 0 - Actual value differs from reference = is outside tolerance limits.
	9 (Remote)	1 - Drive control location: REMOTE (EXT1 or EXT2). 0 - Drive control location: LOCAL.
	10 (Above Limit)	-
	11 - 14 (User bit 0 - 3)	CTD Status repeated here (see P 9.02)
	15 (Reserved)	-
		Main status word of the drive.
SYSTEM INFO	Drive hardware and firmware information. All parameters in this group are read-only.	
	DRIVE RATING ID (07.03)	Default: **Read Only** Range: 0 - 999
		Type of the drive/inverter unit.
	FIRMWARE NAME (07.04)	Default: **Read Only** Range: -
		Firmware identification.

Table 12-4 Level 1 Parameter Block Definitions Continued

<table>
<tr><th>Block Title</th><th>Parameter (Number)
Selection (Value)</th><th>Descriptions</th></tr>
<tr><td rowspan="4">SYSTEM INFO
(Continued)</td><td rowspan="2">FIRMWARE VERSION (07.05)</td><td>Default: Read Only
Range: -</td></tr>
<tr><td>Version number of the firmware.</td></tr>
<tr><td rowspan="2">LOADING PACKAGE NAME (07.06)</td><td>Default: Read Only
Range: -</td></tr>
<tr><td>Name of the firmware loading package.</td></tr>
<tr><td rowspan="2">LOADING PACKAGE VERSION (07.07)</td><td>Read Only
Range: -</td></tr>
<tr><td>Version number of the firmware loading package.</td></tr>
<tr><td rowspan="4">CTD FBA WDS</td><td rowspan="2">CTD CMD WD (09.01)</td><td>Default: Read Only
Range: -
<table><tr><th>Bit</th><th>CTD Command Word</th></tr><tr><td>0</td><td>Trickle Enable</td></tr><tr><td>1</td><td>De-ice Enable</td></tr><tr><td>2</td><td>CTD Run</td></tr></table></td></tr>
<tr><td>When “Fieldbus” is selected in parameter 74.1, Trickle Current is enabled by setting parameter 9.1, “bit 0” High.
When “Fieldbus” is selected in parameter 75.1, De-ice is enabled by setting parameter 9.1, “bit 1” High.
When “Fieldbus” mode is selected in parameter 76.3 and DI2 is on, the drive will run by setting parameter 9.1, “bit 2” High.

To get this CTD Command Word to work, FBA A data out 1, parameter 53.1 must point to parameter 9.1. Other fieldbus settings are made based on the type of fieldbus used.</td></tr>
<tr><td rowspan="2">CTD STATUS WD (09.02)</td><td>Default: Read Only
Range: -
<table><tr><th>Bit</th><th>CTD Status Word</th></tr><tr><td>0</td><td>Trickle On</td></tr><tr><td>1</td><td>De-ice Run</td></tr><tr><td>2</td><td>CTD Run</td></tr><tr><td>3</td><td>CTD Hold
(This bit is high when the drive is injecting DC to hold the rotor before it starts moving.)</td></tr></table></td></tr>
<tr><td>To get this CTD Status Word to work, FBA A data in 1, parameter 52.1 must point to parameter 9.2. Other fieldbus settings are made based on the type of fieldbus used.</td></tr>
<tr><td rowspan="4">STANDARD DI,
RO</td><td rowspan="2">DI STATUS (10.01)</td><td>Default: Read Only
Range: 0 - 15</td></tr>
<tr><td>Displays the electrical status of digital inputs DIIL and DI6 - DI1. The activation/deactivation delays of the inputs (if any are specified) are ignored.
Bits 0 - 5 reflect the status of DI1 - DI6; bit 15 reflects the status of the DIIL input. Example: 1000000000010011b = DIIL, DI5, DI2 and DI1 are on, DI3, DI4 and DI6 are off.</td></tr>
<tr><td rowspan="2">RO STATUS (10.21)</td><td>Default: Read Only
Range: 0000h - FFFFh</td></tr>
<tr><td>Status of relay outputs RO8 - RO1. Example: 00000001b = RO1 is energized, RO2 - RO8 are de-energized.</td></tr>
</table>

Table 12-4 Level 1 Parameter Block Definitions Continued

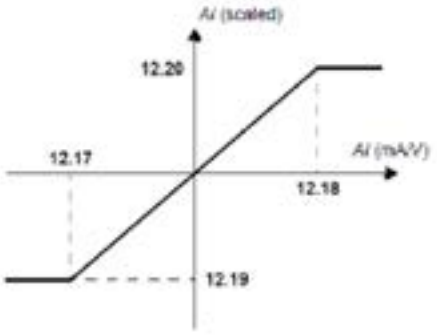
Block Title	Parameter (Number) Selection (Value)	Descriptions
STANDARD DIO, FI, FO	**DIO STATUS** (11.01)	Default: **Read Only** Range: 0000h - FFFFh
		Displays the status of digital input/outputs DIO8 - DIO1. The activation/deactivation delays (if any are specified) are ignored. Example: 0000001001b = DIO1 and DIO4 are on, remainder are off.
STANDARD AI	**AI1 ACTUAL VALUE** (12.11)	Default: **Read Only** Range: -22.000 to +22.000mA or V
		Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting).
	AI1 SCALED VALUE (12.12)	Default: **Read Only** Range: -32768.000 to +32767.000
		Displays the value of analog input AI1 after scaling. See parameters 12.19 AI1 scaled at AI1 min and 12.20 AI1 scaled at AI1 max.
	AI1 UNIT SELECTION (12.15)	Default: V Range: V or mA
	V	Volts
	mA	Milliamperes
		Selects the unit for readings and settings related to analog input AI1. **Note:** This setting must match the corresponding hardware setting on the drive control unit (see the hardware manual of the drive). Control board reboot (either by cycling the power or through parameter 96.08 Control board boot) is required to validate any changes in the hardware settings.
	AI1 MIN (12.17)	Default: 0.000mA or V Range: -22.000 to +22.000mA or V
		Defines the minimum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.
	AI1 MAX (12.18)	Default: 20.000mA or 10.000V Range: -22.000 to +22.000mA or V
		Defines the maximum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.
	AI1 SCALED AT AI1 MIN (12.19)	Default: 0.000 Range: -32768.000 to +32767.000
		Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter 12.17 AI1 min. (Changing the polarity settings of 12.19 and 12.20 can effectively invert the analog input.) 

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
STANDARD AI (Continued)	**AI1 SCALED AT AI1 MAX** (12.20)	Default: **Read Only** Range: -32768.000 to +32767.000
		Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter 12.18 AI1 max. 12.20 is set to the value entered in 30.12 (max speed) and is read only. See the drawing at parameter 12.19 AI1 scaled at AI1 min.
STANDARD AO	**AO1 ACTUAL VALUE** (13.11)	Default: **Read Only** Range: 0.000 - 22.000mA
		Displays the value of AO1 in mA.
	AO1 SOURCE (13.12)	Default: 1 (Motor Speed Used) Range: 0 - 21
	0	Zero
	1	Motor speed used
	3	Output frequency
	4	Motor current
	6	Motor torque
	7	DC voltage
	8	Power inu out
	10	Speed ref ramp in
	11	Speed ref ramp out
	12	Speed ref used
	13	Torq ref used
	14	Freq ref used
	16	Process PID out
	17	Process PID fbk
	18	Process PID act
	19	Process PID dev
	20	Force PT100 excitation
	21	Force KTY84 excitation
		Selects a signal to be connected to analog output AO1. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.

Table 12-4 Level 1 Parameter Block Definitions Continued

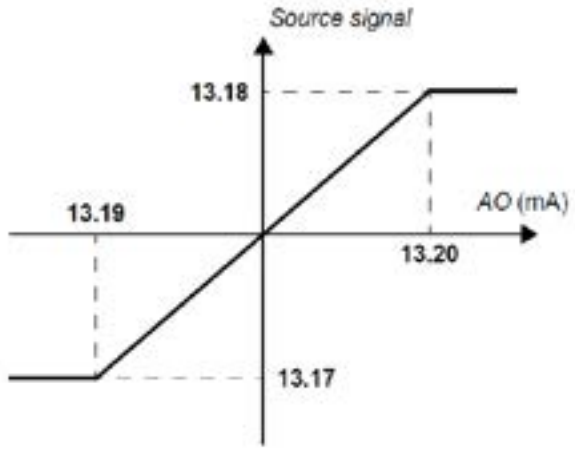
Block Title	Parameter (Number) Selection (Value)	Descriptions
STANDARD AO (Continued)	**AO1 SOURCE MIN** (13.17)	Default: 0.0 Range: -32768.0 to +32767.0
		Defines the real minimum value of the signal (selected by parameter 13.12 AO1 source) that corresponds to the minimum required AO1 output value (defined by parameter 13.19 AO1 out at AO1 src min). Programming 13.17 as the maximum value and 13.18 as the minimum value inverts the output. 
	AO1 SOURCE MAX (13.18)	Default: **Read Only** Range: -32768.0 to +32767.0
		Defines the real maximum value of the signal (selected by parameter 13.12 AO1 source) that corresponds to the maximum required AO1 output value (defined by parameter 13.20 AO1 out at AO1 src max). See parameter 13.17 AO1 source min. 13.18 is set to the value entered in 30.12 (max speed) and is read only.
	AO1 OUT AT AO1 SRC MIN (13.19)	Default: 0.000mA Range: 0.000 - 22.000mA
		Defines the minimum output value for analog output AO1. See also drawing at parameter 13.17 AO1 source min.
	AO1 OUT AT AO1 SRC MAX (13.20)	Default: 20.000mA Range: 0.000 - 22.000mA
		Defines the maximum output value for analog output AO1. See also drawing at parameter 13.17 AO1 source min.
	AO2 ACTUAL TIME (13.21)	Default: **Read Only** Range: 0.000 - 22.000mA
		Displays the value of AO2 in mA.
	AO2 SOURCE (13.22)	Default: 6 (Motor Torque) Range: 0 - 21
		Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter 13.12 AO1 source.

Table 12-4 Level 1 Parameter Block Definitions Continued

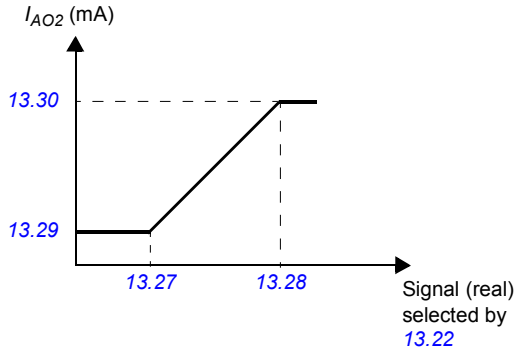
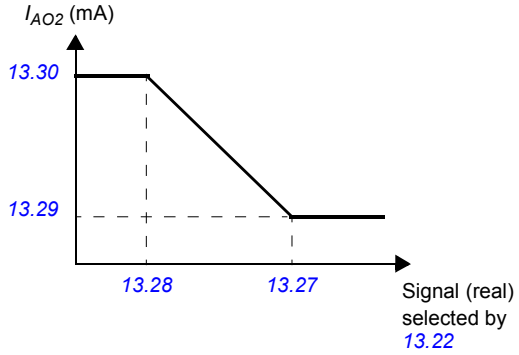
Block Title	Parameter (Number) Selection (Value)	Descriptions
STANDARD AO (Continued)	**AO2 SOURCE MIN** (13.27)	Default: 0.0 Range: -32768.0 to +32767.0
		Defines the real minimum value of the signal (selected by parameter 13.22 AO2 source) that corresponds to the minimum required AO2 output value (defined by parameter 13.29 AO2 out at AO2 src min).  Programming 13.27 as the maximum value and 13.28 as the minimum value inverts the output. 
	AO2 SOURCE MAX (13.28)	Default: 100.0 Range: -32768.0 to +32767.0
		Defines the real maximum value of the signal (selected by parameter 13.22 AO2 source) that corresponds to the maximum required AO2 output value (defined by parameter 13.30 AO2 out at AO2 src max). See parameter 13.27 AO2 source min.
	AO2 OUT AT AO2 SRC MIN (13.29)	Default: 0.000mA Range: 0.000 - 22.000mA
		Defines the minimum output value for analog output AO2. See also drawing at parameter 13.27 AO2 source min.
	AO2 OUT AT AO2 SRC MAX (13.30)	Default: 20.000mA Range: 0.000 - 22.000mA
		Defines the maximum output value for analog output AO2. See also drawing at parameter 13.27 AO2 source min.
START/ STOP MODE	**STOP MODE** (21.03)	Default: 1 (Ramp) Range: 0 - 1
	0 (Coast)	Stop by switching off the output semiconductors of the drive. The motor coasts to a stop. **WARNING:** If a mechanical brake is used, ensure it is safe to stop the drive by coasting.
	1 (Ramp)	Stop along the active deceleration ramp. See parameter group 23 Speed reference ramp.
		Selects the way the motor is stopped when a stop command is received.

Table 12-4 Level 1 Parameter Block Definitions Continued

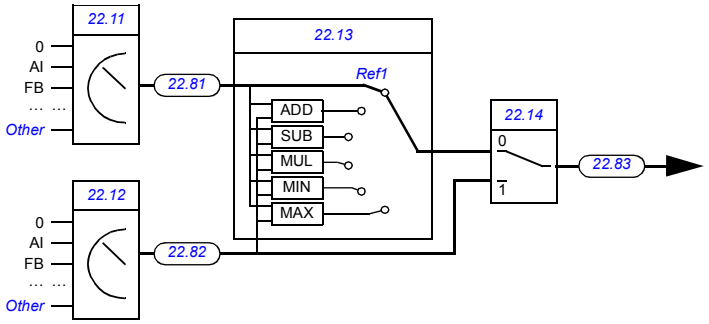
Block Title	Parameter (Number) Selection (Value)	Descriptions
START/ STOP MODE (Continued)	**AUTO RESTART TIME** (21.18)	Default: 5.0s Range: 0.0 - 5.0s
	0.0s	Automatic restarting disabled.
	0.1 - 5.0s	Maximum power failure duration.
		The motor can be automatically started after a short supply power failure using the automatic restart function. See section Automatic restart. When this parameter is set to 0.0 seconds, automatic restarting is disabled. Otherwise, the parameter defines the maximum duration of the power failure after which restarting is attempted. This time also includes the DC pre-charging delay.
SPEED REFERENCE SELECTION Only available in “Custom” mode	**SPEED REF2 SOURCE** (22.12)	Default: 0 (Zero) Range: 0 - 16
	0 (Zero)	None
	1 (AI1 scaled)	12.12 AI1 scaled value
	2 (AI2 scaled)	12.22 AI2 scaled value
	4 (FB A ref1)	03.05 FB A reference 1
	5 (FB A ref2)	03.06 FB A reference 2
	10 (DDCS ctrl ref1)	03.11 DDCS controller ref 1
	11 (DDCS ctrl ref2)	03.12 DDCS controller ref 2
	12 (D2D or M/F reference 1)	03.13 M/F or D2D ref1
	13 (D2D or M/F reference 2)	03.14 M/F or D2D ref2
	15 (Motor potentiometer)	22.80 Motor potentiometer ref act (output of the motor potentiometer)
	16 (PID)	40.01 Process PID output actual (output of the process PID controller)
	Other	Source selection
		Selects speed reference source 2. Two signal sources can be defined by this parameter and 22.12 Speed ref2 source. A digital source selected by 22.14 Speed ref1/2 selection can be used to switch between the two sources, or a mathematical function (22.13 Speed ref1 function) applied to the two signals to create the reference. 

Table 12-4 Level 1 Parameter Block Definitions Continued

<table>
<tr><th>Block Title</th><th>Parameter (Number)
Selection (Value)</th><th>Descriptions</th></tr>
<tr><td rowspan="15">SPEED REFERENCE SELECTION (Continued)</td><td>CONSTANT SPEED SEL2 (22.23)</td><td>Default: 5 (DI4)
Range: 0 - 11</td></tr>
<tr><td>0 (Not Selected)</td><td>Always off.</td></tr>
<tr><td>1 (Selected)</td><td>Always on.</td></tr>
<tr><td>2 (DI1)</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td></tr>
<tr><td>3 (DI2)</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td></tr>
<tr><td>4 (DI3)</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td></tr>
<tr><td>5 (DI4)</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td></tr>
<tr><td>6 DI5)</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td></tr>
<tr><td>7 (DI6)</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td></tr>
<tr><td>10 (DIO1)</td><td>Digital input/output DIO1 (11.02 DIO delayed status, bit 0).</td></tr>
<tr><td>11 (DIO2)</td><td>Digital input/output DIO2 (11.02 DIO delayed status, bit 1).</td></tr>
<tr><td>Other [bit]</td><td>Source selection</td></tr>
<tr><td colspan="2">When bit 0 of parameter 22.21 Constant speed function is 0 (Separate), selects a source that activates constant speed 2.When bit 0 of parameter 22.21 Constant speed function is 1 (Packed), this parameter and parameters 22.22 Constant speed sel1 and 22.24 Constant speed sel3 select three sources that are used to activate constant speeds. See table at parameter 22.22 Constant speed sel1. For the selections, see parameter 22.22 Constant speed sel1.
<table>
<tr><th>Source defined by par. 22.22</th><th>Source defined by par. 22.23</th><th>Source defined by par. 22.24</th><th>Constant speed active</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>None</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Constant speed 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Constant speed 2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Constant speed 3</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Constant speed 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Constant speed 5</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Constant speed 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Constant speed 7</td></tr>
</table></td></tr>
<tr><td rowspan="2">CONSTANT SPEED SEL3 (22.24)</td><td>Default: 0 (Not Selected)
Range: 0 - 11</td></tr>
<tr><td>When bit 0 of parameter 22.21 Constant speed function is 0 (Separate), selects a source that activates constant speed 3.When bit 0 of parameter 22.21 Constant speed function is 1 (Packed), this parameter and parameters 22.22 Constant speed sel1 and 22.23 Constant speed sel2 select three sources that are used to activate constant speeds. See table at parameter 22.22 Constant speed sel1. For the selections, see parameter 22.22 Constant speed sel1.</td></tr>
<tr><td rowspan="2">CONSTANT SPEED 2 (22.27)</td><td>Default: 0.00 RPM
Range: -30000.00 to +30000.00 RPM</td></tr>
<tr><td>Defines constant speed 2 (the speed the motor will turn when constant speed 2 is selected).</td></tr>
<tr><td rowspan="2">CONSTANT SPEED 4 (22.29)</td><td>Default: 0.00 RPM
Range: -30000.00 to +30000.00 RPM</td></tr>
<tr><td>Defines constant speed 4 (the speed the motor will turn when constant speed 4 is selected).</td></tr>
</table>

Table 12-4 Level 1 Parameter Block Definitions Continued

<table>
<tr><th>Block Title</th><th>Parameter (Number)
Selection (Value)</th><th>Descriptions</th></tr>
<tr><td rowspan="14">SPEED REFERENCE SELECTION (Continued)</td><td rowspan="2">CONSTANT SPEED 6 (22.31)</td><td>Default: 0.00 RPM
Range: -30000.00 to +30000.00 RPM</td></tr>
<tr><td>Defines constant speed 6 (the speed the motor will turn when constant speed 6 is selected).</td></tr>
<tr><td rowspan="2">CRITICAL SPEED FUNCTION
(22.51)</td><td>Default: 00b
Range: 0000h - FFFFh</td></tr>
<tr><td>Enables/disables the critical speeds function. Also determines whether the specified ranges are effective in both rotating directions or not.
See also section Critical speeds/frequencies.
<table>
<tr><th>Bit</th><th>Name</th><th>Information</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">Enabled</td><td>1 = Enable: Critical speeds enabled.</td></tr>
<tr><td>0 = Disable: Critical speeds disabled.</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Sign Mode</td><td>1 = Signed: The signs of parameters 22.52 - 22.57 are taken into account.</td></tr>
<tr><td>0 = Absolute: Parameters 22.52 - 22.57 are handled as absolute values.
Each range is effective in both directions of rotation.</td></tr>
<tr><td>2 - 15</td><td colspan="2">Reserved</td></tr>
</table></td></tr>
<tr><td rowspan="2">CRITICAL SPEED 1 LOW
(22.52)</td><td>Default: 0.00 RPM
Range: -30000.00 to +30000.00 RPM</td></tr>
<tr><td>Defines the low limit for critical speed range 1.
Note: This value must be less than or equal to the value of 22.53 Critical speed 1 high.</td></tr>
<tr><td rowspan="2">CRITICAL SPEED 1 HIGH
(22.53)</td><td>Default: 0.00 RPM
Range: -30000.00 to +30000.00 RPM</td></tr>
<tr><td>Defines the high limit for critical speed range 1.
Note: This value must be greater than or equal to the value of 22.52 Critical speed 1 low.</td></tr>
<tr><td rowspan="2">CRITICAL SPEED 2 LOW
(22.54)</td><td>Default: 0.00 RPM
Range: -30000.00 to +30000.00 RPM</td></tr>
<tr><td>Defines the low limit for critical speed range 2.
Note: This value must be less than or equal to the value of 22.55 Critical speed 2 high.</td></tr>
<tr><td rowspan="2">CRITICAL SPEED 2 HIGH
(22.55)</td><td>Default: 0.00 RPM
Range: -30000.00 to +30000.00 RPM</td></tr>
<tr><td>Defines the high limit for critical speed range 2.
Note: This value must be greater than or equal to the value of 22.54 Critical speed 2 low.</td></tr>
<tr><td rowspan="2">CRITICAL SPEED 3 LOW
(22.56)</td><td>Default: 0.00 RPM
Range: -30000.00 to +30000.00 RPM</td></tr>
<tr><td>Defines the low limit for critical speed range 3.
Note: This value must be less than or equal to the value of 22.57 Critical speed 3 high.</td></tr>
<tr><td rowspan="2">CRITICAL SPEED 3 HIGH
(22.57)</td><td>Default: 0.00 RPM
Range: -30000.00 to +30000.00 RPM</td></tr>
<tr><td>Defines the high limit for critical speed range 3.
Note: This value must be greater than or equal to the value of 22.56 Critical speed 3 low.</td></tr>
</table>

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
SPEED REFERENCE RAMP	**RAMP SET SELECTION** (23.11)	Default: 5 (DI4) Range: 0 - 18
	0 (Acc/Dec time 1)	0
	1 (Acc/Dec time 2)	1
	2 (DI1)	Digital input DI1 (10.02 DI delayed status, bit 0).
	3 (DI2)	Digital input DI2 (10.02 DI delayed status, bit 1).
	4 (DI3)	Digital input DI3 (10.02 DI delayed status, bit 2).
	5 (DI4)	Digital input DI4 (10.02 DI delayed status, bit 3).
	6 (DI5)	Digital input DI5 (10.02 DI delayed status, bit 4).
	7 (DI6)	Digital input DI6 (10.02 DI delayed status, bit 5).
	10 (DIO1)	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).
	11 (DIO2)	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).
	18 (FBA A)	Bit 11 (selection of external control location) of the control word received from fieldbus interface A.
	Other	Source selection
		Selects the source that switches between the two sets of acceleration/ deceleration ramp times defined by parameters 23.12…23.15.0 = Acceleration time 1 and deceleration time 1 are active1 = Acceleration time 2 and deceleration time 2 are active
	ACCELERATION TIME 1 (23.12)	Default: s = Motor Nom Spd/10 Range: 5.000 - 1800.000 s
		Defines acceleration time 1 as the time required for the speed to change from zero to the speed defined by parameter 46.01 Speed scaling (this value is set automatically to 99.09 motor nominal speed). If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.
	DECELERATION TIME 1 (23.13)	Default: 60s Range: 0.000 - 1800.000 s
		Defines deceleration time 1 as the time required for the speed to change from the speed defined by parameter 46.01 Speed scaling (set automatically to the value entered in 99.09 motor nominal speed) to zero. If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference. If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. If the deceleration rate is set too short, the drive will automatically prolong the deceleration in order not to exceed drive torque limits (or not to exceed a safe DC link voltage). If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control is on (parameter 30.30 Overvoltage control). **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.
	ACCELERATION TIME 2 (23.14)	Default: s = Motor Nom Spd/10 Range: 0.000 - 1800.000s
		Defines acceleration time 2. See parameter 23.12 Acceleration time 1.

Table 12-4 Level 1 Parameter Block Definitions Continued

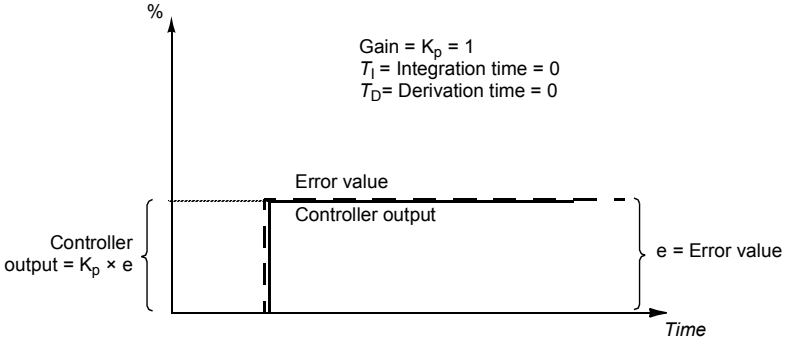
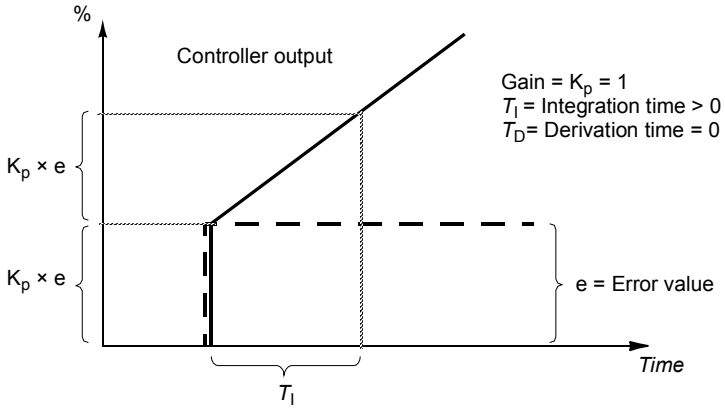
Block Title	Parameter (Number) Selection (Value)	Descriptions
SPEED REFERENCE RAMP (Continued)	**DECELERATION TIME 2** (23.15)	Default: 60s Range: 0.000 - 1800.000s
		Defines deceleration time 2. See parameter 23.13 Deceleration time 1.
SPEED CONTROL	**SPEED PROPORTIONAL GAIN** (25.02)	Default: 0.85 Range: 0.00 - 250.00
		Defines the proportional gain (Kp) of the speed controller. Too high a gain may cause speed oscillation. The figure below shows the speed controller output after anerror step when the error remains constant.  If gain is set to 1, a 10% change in error value (reference - actual value) causes the speed controller output to change by 10%, ie. the output value is input × gain.
	SPEED INTEGRATION TIME (25.03)	Default: 0.50s Range: 0.00 to 1000.00s
		Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. This time constant must be set to the same order of magnitude as the time constant (time to respond) of the actual mechanical system being controlled, otherwise instability will result.Setting the integration time to zero disables the I-part of the controller. This is useful to do when tuning the proportional gain; adjust the proportional gain first, then return the integration time.Anti-windup (the integrator just integrates up to 100%) stops the integrator if the controller output is limited.The figure below shows the speed controller output after an error step when the error remains constant. 

Table 12-4 Level 1 Parameter Block Definitions Continued

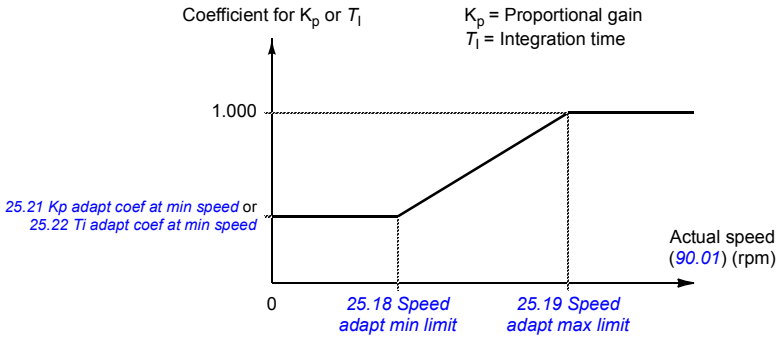
Block Title	Parameter (Number) Selection (Value)	Descriptions
SPEED CONTROL (Continued)	**SPEED DERIVATION TIME** (25.04)	Default: 0.000s Range: 0.000 to 1000.00s
		Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. For simple applications (especially those without a pulse encoder), derivative time is not normally required and should be left at zero. The speed error derivative must be filtered with a low pass filter to eliminate disturbances. The figure below shows the speed controller output after an error step when the error remains constant.
	SPEED ADAPT MIN LIMIT (25.18)	Default: 0 RPM Range: 0 - 30000 RPM
		Minimum actual speed for speed controller adaptation.Speed controller gain and integration time can be adapted according to actual speed (90.01 Motor speed for control). This is done by multiplying the gain (25.02 Speed proportional gain) and integration time (25.03 Speed integration time) by coefficients at certain speeds. The coefficients are defined individually for both gain and integration time. When actual speed is below or equal to 25.18 Speed adapt min limit, the gain and integration time are multiplied by 25.21 Kp adapt coef at min speed and 25.22 Ti adapt coef at min speed respectively.When actual speed is equal to or above 25.19 Speed adapt max limit, no adaptation takes place (the coefficient is 1). When actual speed is between 25.18 Speed adapt min limit and 25.19 Speed adapt max limit, the coefficients for the gain and integration time are calculated linearly on the basis of the breakpoints. 
	SPEED ADAPT MAX LIMIT (25.19)	Default: 0 RPM Range: 0 - 30000 RPM
		Maximum actual speed for speed controller adaptation. See parameter 25.18 Speed adapt min limit.
	KP ADAPT COEF AT MIN SPEED (25.21)	Default: 1.000 Range: 0.000 to 10.000
		Proportional gain coefficient at minimum actual speed. See parameter 25.18 Speed adapt min limit.
	TI ADAPT COEF AT MIN SPEED (25.22)	Default: 1.000 Range: 0.000 to 10.000
		Integration time coefficient at minimum actual speed. See parameter 25.18 Speed adapt min limit.

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
LIMITS	**MINIMUM SPEED** (30.11)	Default: Motor Nominal Range: -30000.00 to +30000.00 RPM
		Defines the minimum allowed speed. Value is adjustable from 10% of 99.09 motor nominal speed and higher. **WARNING:** This value must not be higher than 30.12 Maximum speed and could interfere with De-Ice operation.
	MAXIMUM SPEED (30.12)	Default: 0.00 RPM Range: -30000.00 to +30000.00 RPM
		Defines the maximum allowed speed. Value is adjustable from 99.09 motor nominal speed or lower. **WARNING:** This value must not be lower than 30.11 Minimum speed.
	MAXIMUM CURRENT (30.17)	Default: 120% of rated current Range: 0.00 to 30000.00 A
		Sets the maximum allowed motor current; set to 120% of 99.06 motor nominal current.
	MINIMUM TORQUE (30.19)	Default: -50.00% Range: -1600.00 to 0.00%
		Defines a minimum torque limit for the drive (in percent of nominal motor torque). This value is used by the drive for reverse operation only in de-ice mode.
	MAXIMUM TORQUE (30.20)	Default: 110.0% Range: 0.0 to 1600.0%
		Defines a maximum torque limit for the drive (in percent of nominal motor torque).
MOTOR THERMAL PROTECTION	**MOTOR ESTIMATED TEMPERATURE** (35.01)	Default: **Read Only** Range: -60 to 1000°C or °F
		Displays the motor temperature as estimated by the internal motor thermal protection model (see parameters 35.50…35.55). The unit is selected by parameter 96.16 Unit selection.
	MOTOR AMBIENT TEMPERATURE (35.50)	Default: 20°C or 68°F Range: -60 to 100°C or -75 to 212°F
		Defines the ambient temperature of the motor for the motor thermal protection model. The unit is selected by parameter 96.16 Unit selection. The motor thermal protection model estimates the motor temperature on the basis of parameters 35.50…35.55. The motor temperature increases if it operates in the region above the load curve, and decreases if it operates in the region below the load curve. **WARNING: The model cannot protect the motor if the motor does not cool properly because of dust, dirt, etc.**

Table 12-4 Level 1 Parameter Block Definitions Continued

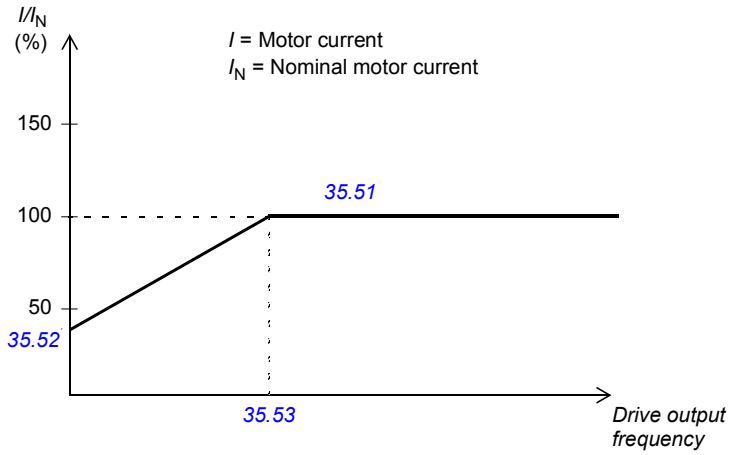
Block Title	Parameter (Number) Selection (Value)	Descriptions
MOTOR THERMAL PROTECTION (Continued)	**MOTOR LOAD CURVE** (35.51)	Default: 100% Range: 50 to 150%
		Defines the motor load curve together with parameters 35.52 Zero speed load and 35.53 Break point. The load curve is used by the motor thermal protection model to estimate the motor temperature. When the parameter is set to 100%, the maximum load is taken as the value of parameter 99.06 Motor nominal current (higher loads heat up the motor). The load curve level should be adjusted if the ambient temperature differs from the nominal value set in 35.50 Motor ambient temperature. 
	ZERO SPEED LOAD (35.52)	Default: 100% Range: 50 to 150%
		Defines the motor load curve together with parameters 35.51 Motor load curve and 35.53 Break point. Defines the maximum motor load at zero speed of the load curve. A higher value can be used if the motor has an external motor fan to boost the cooling. See the motor manufacturer's recommendations.See parameter 35.51 Motor load curve.
	BREAK POINT (35.53)	Default: 45.00 Hz Range: 1.00 to 500.00 Hz
		Defines the motor load curve together with parameters 35.51 Motor load curve and 35.52 Zero speed load. Defines the break point frequency of the load curve i.e. the point at which the motor load curve begins to decrease from the value of parameter 35.51 Motor load curve towards the value of parameter 35.52 Zero speed load. See parameter 35.51 Motor load curve.

Table 12-4 Level 1 Parameter Block Definitions Continued

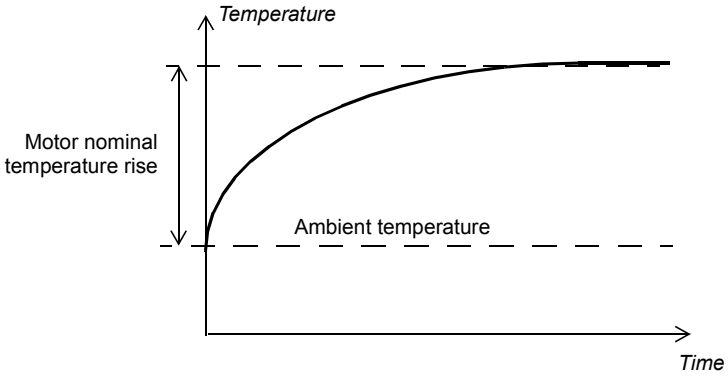
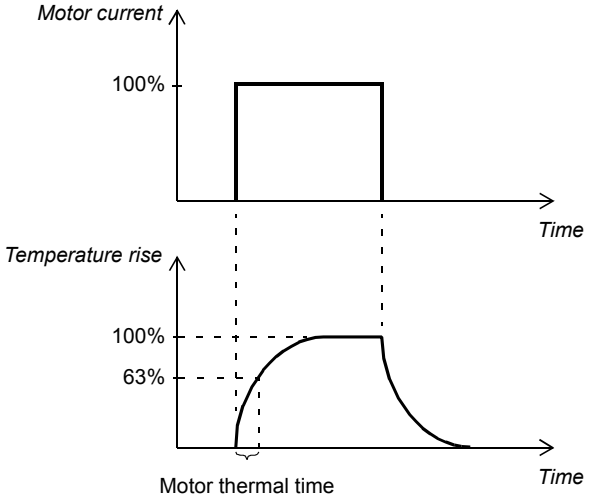
Block Title	Parameter (Number) Selection (Value)	Descriptions
MOTOR THERMAL PROTECTION (Continued)	**MOTOR NOMINAL TEMPERATURE RISE** (35.54)	Default: 80°C or 176°F Range: 0 to 300°C or 32 to 572°F
		Defines the temperature rise of the motor above ambient when the motor is loaded with nominal current. See the motor manufacturer's recommendations.The unit is selected by parameter 96.16 Unit selection. 
	MOTOR THERMAL TIME CONST (35.55)	Default: 256s Range: 100 to 10000s
		Defines the thermal time constant for use with the motor thermal protection model, defined as the time to reach 63% of the nominal motor temperature. See the motor manufacturer's recommendations. 
BRAKE CHOPPER	**BRAKING RESISTOR TEMPERATURE** (43.01)	Default: **Read Only** Range: 0.0 - 120.0%
		Displays the estimated temperature of the brake resistor, or how close the brake resistor is to being too hot.The value is given in percent where 100% is the temperature the resistor would reach if the maximum continuous braking power (43.09 Brake resistor Pmax cont) is applied to the resistor for 100% rated time. The thermal time constant (43.08 Brake resistor thermal tc) defines the rated time to achieve 63% temperature. 100% would be reached when 100% time has elapsed.

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
BRAKE CHOPPER (Continued)	**BRAKE CHOPPER ENABLE** (43.06)	Default: 0 (Disabled) Range: 0 - 2
	0 (Disabled)	Brake chopper control disabled.
	1 (Enabled with thermal model)	Brake chopper enabled with resistor overload protection.
	2 (Enabled without thermal model)	Brake chopper control enabled without resistor overload protection. This setting can be used, for example, if the resistor is equipped with a thermal circuit breaker that is wired to stop the drive if the resistor overheats.
		Enables brake chopper control.Note: Before enabling brake chopper control, ensure that • a brake resistor is connected • overvoltage control is switched off (parameter 30.30 Overvoltage control) • the supply voltage range (parameter 95.01 Supply voltage) has been selected correctly.
	BRAKE CHOPPER RUNTIME ENABLE (43.07)	Default: 1 (On) Range: 0, 1
	0 (Off)	0
	1 (On)	1
	(Other [bit])	Source selection
		Selects the source for quick brake chopper on/off control. 0 = Brake chopper IGBT pulses are cut off 1 = Normal brake chopper IGBT modulation. This parameter can be used to program the chopper control to function only when the supply is missing from a drive with a regenerative supply unit.
	BRAKE RESISTOR THERMAL TC (43.08)	Default: 0s Range: 0 to 10000s
		Defines the thermal time constant of the brake resistor for overload protection.
	BRAKE RESISTOR P_{MAX} CONT (43.09)	Default: 0.00 kW Range: 0.00 to 10000.00 kW
		Defines the maximum continuous braking power of the resistor (in kW) which will raise the resistor temperature to the maximum allowed value. The value is used in the overload protection.
	BRAKE RESISTANCE (43.10)	Default: 0.0 ohm Range: 0.0 to 1000.0 ohm
		Defines the resistance value of the brake resistor. The value is used for brake chopper protection.
	BRAKE RESISTOR FAULT LIMIT (43.11)	Default: 105% Range: 0 to 150%
		Selects the fault limit for the brake resistor temperature protection function. When the limit is exceeded, the drive trips on fault 7183 BR excess temperature.The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter 43.09 Brake resistor P_{max} cont.

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
BRAKE CHOPPER (Continued)	**BRAKE RESISTOR WARNING LIMIT** (43.12)	Default: 95% Range: 0 to 150%
		Selects the warning limit for the brake resistor temperature protection function. When the limit is exceeded, the drive generates a A793 BR excess temperature warning.The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter 43.09 Brake resistor P_{max} cont.
ENERGY EFFICIENCY	**SAVED GW HOURS** (45.01)	Default: **Read Only** Range: 0 - 65535 GWh
		Energy saved in GWh compared to direct-on-line motor connection. This parameter is incremented when 45.02 Saved MW hours rolls over. See parameter 45.21 Energy calculations reset.
	SAVED MW HOURS (45.02)	Default: **Read Only** Range: 0 - 999 MWh
		Energy saved in MWh compared to direct-on-line motor connection. This parameter is incremented when 45.03 Saved kW hours rolls over. When this parameter rolls over, parameter 45.01 Saved GW hours is incremented.
	SAVED kW HOURS (45.03)	Default: **Read Only** Range: 0.0 - 999.9 kWh
		Energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat, but the calculation still records savings made by controlling the speed. If the chopper is disabled, then regenerated energy from the motor is also recorded here. When this parameter rolls over, parameter 45.02 Saved MW hours is incremented. Fieldbus Equivalent: 10 = 1 kWh
	SAVED MONEY X1000 (45.05)	Default: **Read Only** Range: 0 - 294967295 thousands
		Monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when 45.06 Saved money rolls over. The currency is defined by parameter 45.17 Tariff currency unit.
	SAVED MONEY (45.06)	Default: **Read Only** Range: 0.00 - 999.99 units
		Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (45.14 Tariff selection). When this parameter rolls over, parameter 45.05 Saved money x1000 is incremented. The currency is defined by parameter 45.17 Tariff currency unit.
	CO2 REDUCTION IN KILOTONS (45.08)	Default: **Read Only** Range: 0 - 65535 metric kilotons
		Reduction in CO2 emissions in metric kilotons compared to direct-on-line motor connection. This value is incremented when parameter 45.09 CO2 reduction in tons rolls over.

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
ENERGY EFFICIENCY (Continued)	**CO2 REDUCTION IN TONS** (45.09)	Default: **Read Only** Range: 0.0 - 999.9 metric tons
		Reduction in CO2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter 45.18 CO2 conversion factor (by default, 0.5 metric tons/MWh). When this parameter rolls over, parameter 45.08 CO2 reduction in kilotons is incremented.
	ENERGY TARIFF 1 (45.12)	Default: 1.000 units Range: 0.000 - 4294967.295 units
		Defines energy tariff 1 (price of energy per kWh). Depending on the setting of parameter 45.14 Tariff selection, either this value or 45.13 Energy tariff 2 is used for reference when monetary savings are calculated. The currency is defined by parameter 45.17 Tariff currency unit. **Note:** Tariffs are read only at the instant of selection, and are not applied retroactively.
	ENERGY TARIFF 2 (45.13)	Default: 2.000 units Range: 0.000 - 4294967.295 units
		Defines energy tariff 2 (price of energy per kWh). See parameter 45.12 Energy tariff 1.
	TARIFF CURRENCY UNIT (45.17)	Default: 101 (EUR) Range: 100, 101, 102
	100 (Local currency)	Local currency
	101 (EUR)	Euro
	102 (USD)	US dollar
		Specifies the currency used for the savings calculations.
	CO2 CONVERSION FACTOR (45.18)	Default: 0.500 tn/MWh Range: 0.000 - 65.535 tn/MWh
		Defines a factor for conversion of saved energy into CO_2 emissions (kg/kWh or tn/MWh).
	COMPARISON POWER (45.19)	Default: 0.0 kW Range: 0.0 - 100000.0 kW
		Actual power that the motor absorbs when connected direct-on-line and operating the application. The value is used for reference when energy savings are calculated. **Note:** The accuracy of the energy savings calculation is directly dependent on the accuracy of this value. If nothing is entered here, then the nominal motor power is used by the calculation, but that may inflate the energy savings reported as many motors do not absorb nameplate power.
	ENERGY CALCULATIONS RESET (45.21)	Default: 0 (Done) Range: 0, 1
	0 (Done)	Reset not requested (normal operation), or reset complete.
	1 (Reset)	Reset the savings counter parameters. The value reverts automatically to Done.
		Resets the savings counter parameters 45.01 - 45.09.

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
MONITORING/ SCALING SETTINGS	**SPEED SCALING** (46.01)	Default: Max Speed (P 30.12) Range: 0.10 to 30000.00 RPM
		Defines the maximum speed value used to define the acceleration ramp rate and the initial speed value used to define the deceleration ramp rate (see parameter group 23 Speed reference ramp). The speed acceleration and deceleration ramp times are therefore related to this value (not to parameter 30.12 Maximum speed). Also defines the 16-bit scaling of speed-related parameters. The value of this parameter corresponds to 20000 in fieldbus, master/follower etc. communication.
	FILTER TIME MOTOR SPEED (46.11)	Default: 10 ms Range: 2 - 20000 ms
		Defines a filter time for signals 01.01 Motor speed used, 01.02 Motor speed estimated, 01.04 Encoder 1 speed filtered and 01.05 Encoder 2 speed filtered.
	FILTER TIME MOTOR TORQUE (46.13)	Default: 10 ms Range: 2 - 20000 ms
		Defines a filter time for signal 01.10 Motor torque %.
FIELDBUS ADAPTER	**Parameters 50 - 56 are for FIELDBUS ONLY and are adapter module-specific. For more information, see the documentation of the fieldbus adapter module. Note that not all of these parameters are necessarily in use.**	
TRICKLE CURRENT	Trickle currrent prevents rotation of fan during standby condition (anti wind mill feature). This can be caused by exterior wind conditions or by adjacent tower airflow that can act on the fan blades. Trickle current will produce a low level dc voltage across the windings of the direct drive motor. The dc voltage when applied to a permanent magnet motor will inhibit rotation of the fan blades. As a secondary benefit the voltage will produce enough heating in the motor windings to inhibit condensation in the motor caused by humidity. Operation will be while the tower is in a power on but standby mode.	
	TRICKLE CURRENT ENABLE (74.01)	Default: 0 (Disable) Range: 0 - 2
	0 (Disable)	Disable trickle current.
	1 (Enable)	Enable trickle current.
	2 (Fieldbus)	Fieldbus CTD cmd Word bit 0
		Software Enable (1) or Disable (0) trickle current parameter setting. A hardware enable on DIO1 is also required to activate trickle current.
	TRICKLE CURRENT LEVEL (74.02)	Default: 100W Range: 0 - 500W
		The level of trickle current is determined by frame size of the motor and input to the drive power level, no decimal required. Formula for how current value is determined: Frame Size Family Motor — Wattage FL2800 — 72 FL4400 — 119 FL5800 — 500 $\text{Trickle Current} = \sqrt{\frac{* \text{Wattage}}{3 * \text{Stator R}}}$ Setting is entered as a power level.
	TRICKLE DELAY TIME (74.03)	Default: 1 Min Range: 0 - 10 Min
		The time delay before trickle current starts. This delay ensures the motor has ramped down and stopped prior to trickle current beginning.

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
DE-ICE FUNCTION	This is a cooling tower function to run at a low speed but in the opposite direction than standard. Primarily this function is to prevent ice buildup in towers for colder climates. De-ice function consists of a setting for the speed and a time value.	
	DE-ICE ENABLE (75.01)	Default: 0 (Disable) Range: 0 - 1
	0 (Disable)	Disable De-ice function
	1 (Enable)	Enable De-ice function
	2 (Fieldbus)	Fieldbus CTD cmd Word bit1
		Software Enable (1) or Disable (0) De-ice function. A hardware enable on DIO2 is also required to activate de-ice function.
	DE-ICE SPEED (75.02)	Default: 30% Range: 0 - 100%
		The minimum value should not be allowed to be programmed at less than 30% motor base speed.
	DE-ICE RUN TIME (75.03)	Default: 1 Min. Range: 0 - 60 Mins.
		Value of time to run in de-ice function when Software Enable is active, and a hardware input is present. Drive will run at De-Ice function speed for the set run time and then shut down.
CTD MOTOR CONTROL	**AUTOPHASING CURRENT** (76.01)	Default: 50% Current Range: 0 to 150% Current
		The Autophasing current is the DC current level the drive puts out to line up the rotor.
	AUTOPHASING TIME (76.02)	Default: 100 Seconds Range: 0 to 100 Seconds
		The Autophasing time is how long the rotor can take to settle out before rotation is started. Because of the high inertia of the large fans, it could take 100 seconds to settle out.
	OPERATING MODE (76.03)	Default: 1 (2-Wire) Range: 0 - 4
	0	Custom
	1	2-Wire
	2	3-Wire
	3	PID control
	4	Fieldbus
		Operating Mode sets the method to start the drive for normal operation. Mode 1-4 configures DI1 and DI2 for EXT2 control. Custom mode allows custom programming of EXT1 control. Trickle and De-Ice always use EXT2. In modes 1-4, De-Ice has priority and Trickle will automatically start when drive is in standby. In Custom mode drive must be stopped before De-Ice will start. Trickle must be stopped before normal run. The CTDD application requires a limited set of operating modes. It is envisioned that the selection for this will be through CTDD Setup assistant programmed.

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
HW CONFIGURATION	**SUPPLY VOLTAGE** (95.01)	Default: - Range: 0 - 6
	0 (Not Given)	No voltage range selected. The drive will not start modulating before a range is selected.
	1 (208…240V)	208…240V
	2 (380…415V)	380…415V (Default for Demo Unit)
	3 (440…480V)	440…480V
	4 (500V)	500V (Default for normal drive)
	5 (525…600V)	525…600V
	6 (660…690V)	660…690V
		Selects the supply voltage range. This parameter is used by the drive to determine the nominal voltage of the supply network. The parameter also affects the current ratings and the DC voltage control functions (trip and brake chopper activation limits) of the drive. ⚠ **WARNING:** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload. **Note:** The selections shown depend on the hardware of the drive. If only one voltage range is valid for the drive in question, it is selected by default.
SYSTEM	**LANGUAGE** (96.01)	Default: English Range: -
	Not selected	None
	English	English
	Deutsch	German
	Italiano	Italian
	Español	Spanish
	Portugues	Portuguese
	Nederlands	Dutch
	Français	French
	Dansk	Danish
	Suomi	Finnish
	Svenska	Swedish
	Russki	Russian
	Polski	Polish
	Czech	Czech
	Türkçe	Turkish
		Selects the language of the parameter interface and other displayed information when viewed on the control panel. **Notes:** • Not all languages listed below are necessarily supported. • This parameter does not affect the languages visible in the Drive composer PC tool. (Those are specified under View – Settings.)

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
SYSTEM (Continued)	**PASS CODE** (96.02)	Default: - Range: 0 to 99999999
	14	CTDD User
	13	Fieldbus
	12	Expert Commissioner
		Does not default. Setting access level to 13 (Fieldbus) opens all Fieldbus applicable parameters (groups 50 to 56 and monitoring parameters 3.05, 3.06, 6.01 and 6.11). Expert commissioner enables all parameters in the drive by setting 96.02 = 12.
	ACCESS LEVELS STATUS (96.03)	Default: **Read Only** Range: -
	11	Expert Commissioner
	12	Fieldbus
	13	CTDD User
		Shows which access levels have been activated by pass codes entered into parameter 96.02 Pass code. Parameter 96.03 shows the current access level setting, note ABB default will show active with the addition of the set level shown above. Value is offset by one from the password entered.
	MACRO SELECT (96.04)	Default: CTDD Range:
		CTDD
		Done
		Selects the application macro. Only CTDD macro is available. After a selection is made, the parameter reverts automatically to Done. **NOTE:** Selecting 96.04 will cause a reset to factory default (selecting CTDD).
	MACRO ACTIVE (96.05)	Default: **Read Only** Range: CTDD
		CTDD
		Defaults to CTDD. To change the macro, use parameter 96.04 Macro select.

Table 12-4 Level 1 Parameter Block Definitions Continued

<table>
<tr><th>Block Title</th><th>Parameter (Number)
Selection (Value)</th><th>Descriptions</th></tr>
<tr><td rowspan="10">SYSTEM
(Continued)</td><td>PARAMETER RESTORE
(96.06)</td><td>Default: 0 (Done)
Range: 0, 8, 62</td></tr>
<tr><td>0 (Done)</td><td>Restoring is completed.</td></tr>
<tr><td>8 (Restore defaults)</td><td>All editable parameter values are restored to default values, except
• motor data and ID run results
• control panel/PC communication settings
• I/O extension module settings
• fieldbus adapter settings
• encoder configuration data
• parameter 95.20 HW options word 1 and the differentiated defaults implemented by it.</td></tr>
<tr><td>62 (Clear all)</td><td>All editable parameter values are restored to default values, except
• control panel/PC communication settings
• fieldbus adapter settings
• parameter 95.20 HW options word 1 and the differentiated defaults implemented by it.
PC tool communication is interrupted during the restoring.</td></tr>
<tr><td></td><td>Restores the original settings of the control program (parameter default values).
Note: This parameter cannot be changed while the drive is running.</td></tr>
<tr><td>PARAMETER SAVE MANUALLY (96.07)</td><td>Default: 0 (Done)
Range: 0, 1</td></tr>
<tr><td>0 (Done)</td><td>Save completed.</td></tr>
<tr><td>1 (Save)</td><td>Save in progress.</td></tr>
<tr><td></td><td>Saves the valid parameter values to permanent memory. This parameter should be used to store values sent from a fieldbus, or when using an external power supply to the control board as the supply might have a very short hold-up time when powered off.
Note: A new parameter value is saved automatically when changed from the PC tool or control panel but not when altered through a fieldbus adapter connection.</td></tr>
<tr><td>UNIT SELECTION (96.16)</td><td>Default: 0001 0001
Range: 0000h - FFFFh</td></tr>
<tr><td></td><td>Selects the unit of parameters indicating power, temperature and torque. Default setting is HP, °F and lb-ft.
<table>
<tr><th>Bit</th><th>Name</th><th>Information</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">Power unit</td><td>0 = kW</td></tr>
<tr><td>1 = hp default</td></tr>
<tr><td>1</td><td colspan="2">Reserved</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Temperature unit</td><td>0 = C (°C) default</td></tr>
<tr><td>1 = F (°F)</td></tr>
<tr><td>3</td><td colspan="2">Reserved</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Torque unit</td><td>0 = Nm (N·m)</td></tr>
<tr><td>1 = lbft (lb·ft) default</td></tr>
<tr><td>5 - 15</td><td colspan="2">Reserved</td></tr>
</table></td></tr>
</table>

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
MOTOR DATA	**MOTOR TYPE** (99.03)	Default: 1 (PMSM) Range: 0, 1
	0	Training Demo
	1	Permanent magnet synchronous motor. Three-phase AC synchronous motor with permanent magnet rotor and sinusoidal Back EMF voltage.
		Selects the motor type. **Note:** This parameter cannot be changed while the drive is running.
	MOTOR NOMINAL CURRENT (99.06)	Default: 0.0 A Range: 0.0 - 6400.0 A
		Defines the nominal motor current. Must be equal to the value on the motor rating plate. If multiple motors are connected to the drive, enter the total current of the motors. **Note:** This parameter cannot be changed while the drive is running.
	BACK EMF VOLTAGE (99.07)	Default: Back EMF Range: 0.0 - 800.0
		Defines the motor Back EMF voltage. This setting must match the value on the auxiliary rating plate of the motor. **Notes:** • With permanent magnet motors, the nominal voltage is the Back EMF voltage at nominal speed of the motor. • The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than that of the drive and the supply. • This parameter cannot be changed while the drive is running.
	MOTOR NOMINAL FREQUENCY (99.08)	Default: 0.0 Hz Range: 0.0 - 500.0 Hz
		Defines the nominal motor frequency. This setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.
	MOTOR NOMINAL SPEED (99.09)	Default: 0 RPM Range: 0 - 650 RPM
		Defines the nominal motor speed. The setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.
	MOTOR NOMINAL POWER (99.10)	Default: 0.00 kW or hp Range: -10000.00 to +10000.00 kW or -13404.83 to +13404.83 hp
		Defines the nominal motor power. The setting must match the value on the rating plate of the motor. The unit is selected by parameter 96.16 Unit selection. **Note:** This parameter cannot be changed while the drive is running.

Table 12-4 Level 1 Parameter Block Definitions Continued

Block Title	Parameter (Number) Selection (Value)	Descriptions
MOTOR DATA (Continued)	**ID RUN REQUESTED** (99.13)	Default: 0 (None) Range: 0 - 6
	0 (None)	See Firmware Manual.
	1 (Normal)	See Firmware Manual.
	2 (Reduced)	See Firmware Manual.
	3 (Standstill)	Preferred ID run mode for cooling tower applications -- Standstill ID run. The motor is injected with DC current. With an AC induction (asynchronous) motor, the motor shaft is not rotated. With a permanent magnet motor, the shaft can rotate up to half a revolution.
	4 (Autophasing)	See Firmware Manual.
	5 (Current Measurement Calibration)	See Firmware Manual.
	6 (Advanced)	See Firmware Manual.
	LAST ID RUN PERFORMED (99.14)	Default: 0 (None) Range: 0 - 6
		Shows the type of ID run that was performed last. • See parameter 99.13.
	MOTOR POLEPAIRS CALCULATED (99.15)	Default: **Read Only** Range: 0 - 1000
		Calculated number of pole pairs in the motor.
	MOTOR PHASE ORDER (99.16)	Default: 0 (U V W) Range: 0, 1
	0 (U V W)	Normal
	1 (U W V)	Reversed Rotation Direction
		Switches the rotation direction of motor. This parameter can be used if the motor turns in the wrong direction (i.e. because of the wrong phase order in the motor cable), and correcting the cabling is considered impractical. **Note:** Changing this parameter does not affect speed reference polarities, so positive speed reference will rotate the motor forward. The phase order selection ensures that “forward” is the correct direction.

Chapter 13
Troubleshooting

The ACS880+N5350 will annunciate events that are abnormal during operation as a warnings or fault. The codes and names of active warnings/faults are displayed on the control panel of the drive. Only the codes of warnings/faults are available over fieldbus.

The chapter lists the warning and fault messages including possible causes and corrective actions. The causes of most warnings and faults can be identified and corrected using the information in this chapter.

13.1 Warnings and Faults

Warnings do not need to be reset; they stop showing when the cause of the warning ceases. Warnings do not latch and the drive will continue to operate the motor.

Faults do latch inside the drive and cause the drive to trip, and the motor stops. After the cause of a fault has been removed, the fault can be reset from a selectable 386 Fault tracing source (see parameter 31.11 Fault reset selection) such as the control panel, Drive composer PC tool, the digital inputs of the drive, or fieldbus. After the fault is reset, the drive can be restarted.

13.1.1 Pure Events
In addition to warnings and faults, there are pure events that are only recorded in the event log of the drive. The codes of these events are included in the Warning messages table.

13.1.2 Editable Messages
For some warnings and faults, the message text can be edited and instructions and contact information added. To edit these messages, choose Menu - Settings - Edit texts on the control panel.

13.2 Warning/Fault History

13.2.1 Event Log
All indications are stored in the event log with a time stamp and other information. The event log can be accessed from the main Menu on the control panel. It can also be accessed (and reset) using the Drive composer PC tool. In Drive composer, some faults are presented with additional data recorded prior to the fault; refer to Drive composer Start-up and maintenance PC tool User's manual (3AUA0000094606.

13.2.2 Auxiliary Codes
Some events generate an auxiliary code that often helps in pinpointing the problem. On the control panel, the auxiliary code is stored as part of the details of the event; in the Drive composer PC tool, the auxiliary code is shown in the event listing.

13.2.3 Parameters that Contain Warning/Fault Information
The drive is able to store a list of the active faults actually causing the drive to trip at the present time. The faults are displayed in parameter group 04 Warnings and faults. The parameter group also displays a list of faults and warnings that have previously occurred.

13.3 Warning Messages

NOTE: This list contains events that only appear in the Event Log.

Table 13-1 Warning Messages (Alphabetical by Keypad Text)

Warning	Fault #	Cause	What to do
Current Calibration	A2A1	Current offset and gain measurement calibration will occur at next start.	Informative warning. (See parameter 99.13 ID run requested.)
Overcurrent	A2B1	Output current has exceeded internal fault limit.	Check motor load. Check acceleration times in parameter group 23 Speed reference ramp (speed control), 26 Torque reference chain (torque control) or 28 Frequency reference chain (frequency control). Also check parameters 46.01 Speed scaling, 46.02 Frequency scaling and 46.03 Torque scaling. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing).
Earth leakage	A2B3	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter 99.04 Motor control mode.) If no earth fault can be detected, contact your local ABB representative.
Short circuit	A2B4	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable.
IGBT overload	A2BA	Excessive IGBT junction to case temperature. This warning protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
DC link overvoltage	A3A1	Intermediate circuit DC voltage too high (when the drive is stopped).	Check the supply voltage setting (parameter 95.01 Supply voltage). Note that the wrong setting of the parameter may cause the motor to rush uncontrollably, or may overload the brake chopper or resistor. Check the supply voltage. If the problem persists, contact your local ABB representative.
DC link undervoltage	A3A2	Intermediate circuit DC voltage too low (when the drive is stopped).	
DC not charged	A3AA	The voltage of the intermediate DC circuit has not yet risen to operating level.	
DC voltage difference	A3C1	Difference in DC voltages between parallel-connected inverter modules.	Contact your local ABB representative.
Motor cable overload	A480	Calculated motor cable temperature has exceeded warning limit.	Check the settings of parameters 35.61 and 35.62. Check the dimensioning of the motor cable in regard to required load.

Table 13-1 Warning Messages (Alphabetical by Keypad Text) Continued

Warning	Fault #	Cause	What to do
Incorrect temperature sensor setup	A490	Sensor type mismatch	Check the settings of temperature source parameters 35.11 and 35.21 against 91.21 and 91.24.
		Faulty wiring between an encoder interface module and the temperature sensor.	Check the wiring of the sensor. The auxiliary code (see the event log) identifies the interface module. (0 = Module 1, 1 = Module 2).
External temperature 1 (Editable message text)	A491	Measured temperature 1 has exceeded warning limit.	Check the value of parameter 35.02 Measured temperature 1. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of 35.13 Temperature 1 warning limit.
External temperature 2 (Editable message text)	A492	Measured temperature 2 has exceeded warning limit.	Check the value of parameter 35.03 Measured temperature 2. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of 35.23 Temperature 2 warning limit.
IGBT overtemperature	A4A1	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
Cooling	A4A9	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40°C (104°F), ensure that load current does not exceed derated load capacity of drive. See appropriate Hardware Manual. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
Excess temperature	A4B0	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
Excess temperature difference	A4B1	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).
IGBT temperature	A4F6	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
PU communication	A580	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit.
Safe torque off Programmable warning: 31.22 STO indication run/stop	A5A0	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is lost.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter 31.22 STO indication run/stop.
Measurement circuit temperature	A5EA	Problem with internal temperature measurement of the drive.	Contact your local ABB representative.
PU board powerfail	A5EB	Power unit power supply failure.	Contact your local ABB representative.
PU communication internal	A5EC	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit.
Measurement circuit ADC	A5ED	Measurement circuit fault.	Contact your local ABB representative.

Table 13-1 Warning Messages (Alphabetical by Keypad Text) Continued

Warning	Fault #	Cause	What to do
Measurement circuit DFF	A5EE	Measurement circuit fault.	Contact your local ABB representative.
PU state feedback	A5EF	State feedback from output phases does not match control signals.	Contact your local ABB representative.
Charging feedback	A5F0	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
Motor nominal value	A6A4	The motor parameters are set incorrectly.	Check the settings of the motor configuration parameters in group 99.
		The drive is not dimensioned correctly.	Check that the drive is sized correctly for the motor.
No motor data	A6A5	Parameters in group 99 have not been set.	Check that all the required parameters in group 99 have been set. **Note:** It is normal for this warning to appear during the start-up and continue until the motor data is entered.
Supply voltage unselected	A6A6	The supply voltage has not been defined.	Set supply voltage in parameter 95.01 Supply voltage.
FBA A parameter conflict	A6D1	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups 50 Fieldbus adapter (FBA) and 51 FBA A settings.
FBA B parameter conflict	A6D2	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups 50 Fieldbus adapter (FBA) and 54 FBA B settings.
AI parametrization	A6E5	The current/voltage hardware setting of an analog input does not correspond to parameter settings.	Check the event log for an auxiliary code. The code identifies the analog input whose settings are in conflict. Adjust either the hardware setting (on the drive control unit) or parameter 12.15/12.25. **Note:** Control board reboot (either by cycling the power or through parameter 96.08 Control board boot) is required to validate any changes in the hardware settings.
Motor stall Programmable warning: 31.24 Stall function	A780	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
Motor fan Programmable warning: 35.106 DOL starter event type	A781	No feedback received from external fan.	Check external fan (or other equipment controlled) by the logic. Check settings of parameters 35.100…35.106.
FEN temperature	A782	Error in temperature measurement when temperature sensor (KTY or PTC) connected to encoder interface FEN-xx is used.	Check that parameter 35.11 Temperature 1 source / 35.21 Temperature 2 source setting corresponds to actual encoder interface installation.
		Error in temperature measurement when KTY sensor connected to encoder interface FEN-01 is used.	FEN-01 does not support temperature measurement with KTY sensor. Use PTC sensor or other encoder interface module.
Brake resistor	A791	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor.

Table 13-1 Warning Messages (Alphabetical by Keypad Text) Continued

Warning	Fault #	Cause	What to do
BR excess temperature	A793	Brake resistor temperature has exceeded warning limit defined by parameter 43.12 Brake resistor warning limit.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group 43 Brake chopper). Check warning limit setting, parameter 43.12 Brake resistor warning limit. Check that the resistor has been dimensioned correctly. Check that braking cycle meets allowed limits.
BR data	A794	Brake resistor data has not been given.	Check the resistor data settings (parameters 43.08…43.10).
Speed feedback configuration	A797	Speed feedback configuration has changed.	Check the event log for an auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the encoder interface module (01: 91.11/91.12, 02: 91.13/91.14), “YY” specifies the encoder (01: 92 Encoder 1 configuration, 02: 93 Encoder 2 configuration). “ZZZZ” indicates the problem (see actions for each code below).
	0001	Adapter not found in specified slot.	Check module location (91.12 or 91.14).
	0002	Detected type of interface module does not match parameter setting.	Check the module type (91.11 or 91.13) against status (91.02 or 91.03).
	0003	Logic version too old.	Contact your local ABB representative.
	0004	Software version too old.	Contact your local ABB representative.
	0006	Encoder type incompatible with interface module type.	Check module type (91.11 or 91.13) against encoder type (92.01 or 93.01).
	0007	Adapter not configured.	Check module location (91.12 or 91.14).
	0008	Speed feedback configuration has changed.	Use parameter 91.10 Encoder parameter refresh) to validate any changes in the settings.
BC short circuit	A79B	Short circuit in brake chopper IGBT	Replace brake chopper if external. Drives with internal choppers will need to be returned to ABB. Ensure brake resistor is connected and not damaged.
BC IGBT excess temperature	A79C	Brake chopper IGBT temperature has exceeded internal warning limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameters 43.06…43.10). Check minimum allowed resistor value for the chopper being used. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
Mechanical brake closing failed Programmable warning: 44.17 Brake fault function	A7A1	Status of mechanical brake acknowledgement is not as expected during brake close.	Check mechanical brake connection. Check mechanical brake settings in parameter group 44 Mechanical brake control. Check that acknowledgement signal matches actual status of brake.
Mechanical brake opening failed Programmable warning: 44.17 Brake fault function	A7A2	Status of mechanical brake acknowledgement is not as expected during brake open.	Check mechanical brake connection. Check mechanical brake settings in parameter group 44 Mechanical brake control. Check that acknowledgement signal matches actual status of brake.

Table 13-1 Warning Messages (Alphabetical by Keypad Text) Continued

Warning	Fault #	Cause	What to do
Mechanical brake opening not allowed Programmable warning: 44.17 Brake fault function	A7A5	Open conditions of mechanical brake cannot be fulfilled (for example, brake has been prevented from opening by parameter 44.11 Keep brake closed).	Check mechanical brake settings in parameter group 44 Mechanical brake control (especially 44.11 Keep brake closed). Check that acknowledgement signal (if used) matches actual status of brake.
FIO-11 AI parametrization	A7AA	The hardware current/ voltage setting of an analog input (on an I/O extension module) does not correspond to parameter settings.	Check the event log for an auxiliary code (format 0000 XXYY). “XX” specifies the number of the I/O extension module (01: parameter group 14 I/O extension module 1, 02: 15 I/O extension module 2, 03: 16 I/O extension module 3). “YY” specifies the analog input on the module. For example, in case of I/O extension module 1, analog input AI1 (auxiliary code 0000 0101), the hardware current/voltage setting on the module is shown by parameter 14.29. The corresponding parameter setting is 14.30. Adjust either the hardware setting on the module or the parameter to solve the mismatch. **Note:** Control board reboot (either by cycling the power or through parameter 96.08 Control board boot) is required to validate any changes in the hardware settings.
Extension I/O configuration failure	A7AB	The I/O extension module types and locations specified by parameters do not match the detected configuration.	Check the event log for an auxiliary code. The code indicates which I/O extension module is affected. Check the type and location settings of the modules (parameters 14.01, 14.02, 15.01, 15.02, 16.01 and 16.02). Check that the modules are properly installed.
Motor speed feedback Programmable warning: 90.45 Motor feedback fault	A7B0	No motor speed feedback is received.	Check the event log for an auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the encoder interface module (01: 91.11/91.12, 02: 91.13/91.14), “YY” specifies the encoder (01: 92 Encoder 1 configuration, 02: 93 Encoder 2 configuration). “ZZZZ” indicates the problem (see actions for each code below).
	0001	Motor gear definition invalid or outside limits.	Check motor gear settings (90.43 and 90.44).
	0002	Encoder not configured.	Check encoder settings (92 Encoder 1 configuration or 93 Encoder 2 configuration). Use parameter 91.10 Encoder parameter refresh) to validate any changes in the settings.
	0003	Encoder stopped working.	Check encoder status.
	0004	Encoder drift detected.	Check for slippage between encoder and motor.
FBA A communication Programmable warning: 50.02 FBA A comm loss func	A7C1	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups 50 Fieldbus adapter (FBA), 51 FBA A settings, 52 FBA A data in and 53 FBA A data out. Check cable connections. Check if communication master is able to communicate.
FBA B communication Programmable warning: 50.32 FBA B comm loss func	A7C2	Cyclical communication between drive and fieldbus adapter module B or between PLC and fieldbus adapter module B is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter group 50 Fieldbus adapter (FBA). Check cable connections. Check if communication master is able to communicate.
DDCS controller comm loss Programmable warning: 60.59 DDCS controller comm loss function	A7CA	DDCS (fiber optic) communication between drive and external controller is lost.	Check status of controller. See user documentation of controller. Check settings of parameter group 60 DDCS communication. Check cable connections. If necessary, replace cables.

Table 13-1 Warning Messages (Alphabetical by Keypad Text) Continued

Warning	Fault #	Cause	What to do
MF comm loss Programmable warning: 60.09 M/F comm loss function	A7CB	Master/follower communication is lost.	Check status of other drives on the master/follower link. Check settings of parameter group 60 DDCS communication. Check cable connections. If necessary, replace cables.
Encoder 1	A7E1	Encoder error.	Check the event log for an auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (01: 91.11/91.12, 02: 91.13/91.14), "YY" specifies the encoder (01: 92 Encoder 1 configuration, 02: 93 Encoder 2 configuration). "ZZZZ" indicates the problem (see actions for each code below).
	0001	Cable fault	Check the conductor order at both ends of the encoder cable. Check the groundings of the encoder cable. If the encoder was working previously, check the encoder, encoder cable and encoder interface module for damage. See also parameter 92.21 Encoder cable fault mode.
	0002	No encoder signal	Check the condition of the encoder.
	0003	Overspeed	Contact your local ABB representative.
	0004	Overfrequency	Contact your local ABB representative.
	0005	Resolver ID run failed	Contact your local ABB representative.
	0006	Resolver overcurrent fault	Contact your local ABB representative.
	0007	Speed scaling error	Contact your local ABB representative.
Panel loss Programmable warning: 49.05 Communication loss action	A7EE	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Check mounting platform if being used. Disconnect and reconnect the control panel.
Motor bearing Programmable warnings: 33.14 On-time 1 warn message 33.24 On-time 2 warn message 33.55 Value counter 1 warn message 33.65 Value counter 2 warn message	A880	Warning generated by an ontime timer or a value counter.	Check the event log for an auxiliary code. Check the source of the warning corresponding to the code: 0: 33.13 On-time 1 source 1: 33.23 On-time 2 source 4: 33.53 Value counter 1 source 5: 33.63 Value counter 2 source.
Output relay	A881	Warning generated by an edge counter. Programmable warnings: 33.35 Edge counter 1 warn message 33.45 Edge counter 2 warn message	Check the event log for an auxiliary code. Check the source of the warning corresponding to the code: 2: 33.33 Edge counter 1 source 3: 33.43 Edge counter 2 source.
Motor starts	A882		
Power ups	A883		
Main contactor	A884		
DC charge	A885		
On-time 1 (Editable message text) Programmable warning: 33.14 On-time 1 warn message	A886	Warning generated by on-time timer 1.	Check the source of the warning (parameter 33.13 On-time 1 source).
On-time 2 (Editable message text) Programmable warning: 33.24 On-time 2 warn message	A887	Warning generated by on-time timer 2.	Check the source of the warning (parameter 33.23 On-time 2 source).
Edge counter 1 (Editable message text) Programmable warning: 33.35 Edge counter 1 warn message	A888	Warning generated by edge counter 1.	Check the source of the warning (parameter 33.33 Edge counter 1 source).

Table 13-1 Warning Messages (Alphabetical by Keypad Text) Continued

Warning	Fault #	Cause	What to do
Edge counter 2 (Editable message text) Programmable warning: 33.45 Edge counter 2 warn message	A889	Warning generated by edge counter 2.	Check the source of the warning (parameter 33.43 Edge counter 2 source).
Value counter 1 (Editable message text) Programmable warning: 33.55 Value counter 1 warn message	A88A	Warning generated by value counter 1.	Check the source of the warning (parameter 33.53 Value counter 1 source).
Value counter 2 (Editable message text) Programmable warning: 33.65 Value counter 2 warn message	A88B	Warning generated by value counter 2.	Check the source of the warning (parameter 33.63 Value counter 2 source).
Device clean	A88C	Warning generated by an ontime timer. Programmable warnings: 33.14 On-time 1 warn message 33.24 On-time 2 warn message	Check the event log for an auxiliary code. Check the source of the warning corresponding to the code: 0: 33.13 On-time 1 source 1: 33.23 On-time 2 source 10: 05.04 Fan on-time counter.
DC capacitor	A88D		
Cabinet fan	A88E		
Cooling fan	A88F		
Additional cooling	A890		
AI supervision Programmable warning: 12.03 AI supervision function	A8A0	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group 12 Standard AI.
Signal supervision (Editable message text) Programmable warning: 32.06 Supervision 1 action 32.16 Supervision 2 action 32.26 Supervision 3 action	A8B0	Warning generated by a signal supervision function.	Check the source of the warning (parameter 32.07, 32.17 or 32.28).
External warning 1 (Editable message text) Programmable warning: 31.01 External event 1 source 31.02 External event 1 type	A981	Fault in external device 1.	Check the external device. Check setting of parameter 31.01 External event 1 source.
External warning 2 (Editable message text) Programmable warning: 31.03 External event 2 source 31.04 External event 2 type	A982	Fault in external device 2.	Check the external device. Check setting of parameter 31.03 External event 2 source.
External warning 3 (Editable message text) Programmable warning: 31.05 External event 3 source 31.06 External event 3 type	A983	Fault in external device 3.	Check the external device. Check setting of parameter 31.05 External event 3 source.
External warning 4 (Editable message text) Programmable warning: 31.07 External event 4 source 31.08 External event 4 type	A984	Fault in external device 4.	Check the external device. Check setting of parameter 31.07 External event 4 source.
External warning 5 (Editable message text) Programmable warning: 31.09 External event 5 source 31.10 External event 5 type	A985	Fault in external device 5.	Check the external device. Check setting of parameter 31.09 External event 5 source.
FA2FA DDCS com loss Programmable warning: 60.79 INU-LSU com loss ctrl	AF80	DDCS (fiber optic) communication between converters (for example, the inverter unit and the supply unit) is lost.	Check status of other converter (parameters 06.36 and 06.39). Check settings of parameter group 60 DDCS communication. Check the corresponding settings in the control program of the other converter. Check cable connections. If necessary, replace cables.

Table 13-1 Warning Messages (Alphabetical by Keypad Text) Continued

Warning	Fault #	Cause	What to do
Line side unit warning	AF85	The supply unit has generated a warning.	If using a control panel or the Drive composer tool, connect to the supply unit to read the warning code. Refer to the firmware manual of the supply unit for instructions related to the code.
Process PID sleep mode	AF8C	The drive is entering sleep mode.	Informative warning. See section Sleep function for process PID control, and parameters 40.41…40.48.
Autoreset	AFAA	A fault is about to be autoreset.	Informative warning. See the settings in parameter group 31 Fault functions.
Emergency stop (off2)	AFE1	Drive has received an emergency stop (mode selection off2) command.	Check that it is safe to continue operation. Then return emergency stop push button to normal position. Restart drive. If the emergency stop was unintentional, check the source selected by parameter 21.05 Emergency stop source.
Emergency stop (off1 or off3)	AFE2	Drive has received an emergency stop (mode selection off1 or off3) command.	
Enable start signal missing (Editable message text)	AFEA	No enable start signal received.	Check the setting of (and the source selected by) parameter 20.19 Enable start command.
Run enable missing	AFEB	No run enable signal is received.	Check setting of parameter 20.12 Run enable 1 source. Switch signal on (e.g. in the fieldbus Control Word) or check wiring of selected source.
External power signal missing	AFEC	95.04 Control board supply is set to External 24V but no voltage is connected to the XPOW connector of the control unit.	Check the external 24 V DC power supply to the control unit, or change the setting of parameter 95.04.
Identification run	AFF6	Motor ID run will occur at next start.	Informative warning.
Autophasing	AFF7	Autophasing will occur at next start.	Informative warning.
STO event Programmable event: 31.22 STO indication run/stop	B5A0	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is lost.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter 31.22 STO indication run/stop.

13.4 Fault Messages

Table 13-2 Fault Messages (Alphabetical by Keypad Text)

Fault	Fault #	Cause	What to do
Calibration	2281	Measured offset of output phase current measurement or difference between output phase U2 and W2 current measurement is too great (the values are updated during current calibration).	Try performing the current calibration again (select Current measurement calibration at parameter 99.13). If the fault persists, contact your local ABB representative.
Overcurrent	2310	Output current has exceeded internal fault limit.	Check motor load. Check acceleration times in parameter group 23 Speed reference ramp (speed control), 26 Torque reference chain (torque control) or 28 Frequency reference chain (frequency control). Also check parameters 46.01 Speed scaling, 46.02 Frequency scaling and 46.03 Torque scaling. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing).
Earth leakage Programmable fault: 31.20 Earth fault	2330	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter 99.04 Motor control mode.) If no earth fault can be detected, contact your local ABB representative.
Short circuit	2340	Short-circuit in motor cable(s) or motor	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable. After correcting the cause of the fault, reboot the control unit (using parameter 96.08 Control board boot) or by cycling power.
IGBT overload	2381	Excessive IGBT junction to case temperature. This fault protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
Input phase loss Programmable fault: 31.21 Supply phase loss	3130	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance.
Charge relay lost	3180	No acknowledgement received from charge relay.	Contact your local ABB representative.
Cross connection Programmable fault: 31.23 Cross connection	3181	Incorrect input power and motor cable connection (i.e. input power cable is connected to drive motor connection).	Check input power connections.

Table 13-2 Fault Messages (Alphabetical by Keypad Text) Continued

Fault	Fault #	Cause	What to do
DC link overvoltage	3210	Excessive intermediate circuit DC voltage.	Check that overvoltage control is on (parameter 30.30 Overvoltage control). Check that the supply voltage matches the nominal input voltage of the drive. Check the supply line for static or transient overvoltage. Check brake chopper and resistor (if present). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit drive with brake chopper and brake resistor.
DC link undervoltage	3220	Intermediate circuit DC voltage is not sufficient because of a missing supply phase, blown fuse or fault in the rectifier bridge.	Check supply cabling, fuses and switchgear.
Standby timeout	3280	Automatic restart failed (see section Automatic restart.	Check the condition of the supply (voltage, cabling, fuses, switchgear).
DC voltage difference	3291	Difference in DC voltages between parallel-connected inverter modules.	Contact your local ABB representative.
Output phase loss Programmable fault: 31.19 Motor phase loss	3381	Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.
Autophasing	3385	Autophasing routine (see section Autophasing has failed.	Try other autophasing modes (see parameter 21.13 Autophasing mode) if possible. Check that the motor ID run has been successfully completed. Clear parameter 98.15 Position offset user. Check that the encoder is not slipping on the motor shaft. Check that the motor is not already turning when the autophasing routine starts. Check the setting of parameter 99.03 Motor type.
Motor cable overload	4000	Calculated motor cable temperature has exceeded warning limit.	Check the settings of parameters 35.61 and 35.62. Check the dimensioning of the motor cable in regard to required load.
IGBT overtemperature	4210	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
Cooling	4290	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40°C (104°F), ensure that load current does not exceed derated load capacity of drive. See appropriate Hardware Manual. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
IGBT temperature	42F1	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
Excess temperature	4310	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
Excess temperature difference	4380	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).

Table 13-2 Fault Messages (Alphabetical by Keypad Text) Continued

Fault	Fault #	Cause	What to do
External temperature 1 (Editable message text)	4981	Measured temperature 1 has exceeded fault limit.	Check the value of parameter 35.02 Measured temperature 1. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of parameter 35.12 Temperature 1 fault limit.
External temperature 2 (Editable message text)	4982	Measured temperature 2 has exceeded fault limit.	Check the value of parameter 35.03 Measured temperature 2. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of parameter 35.22 Temperature 2 fault limit.
Fan	5080	Cooling fan stuck or disconnected.	Check fan operation and connection. Replace fan if faulty.
Auxiliary fan broken	5081	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	Check auxiliary fan(s) and connection(s). Replace fan if faulty. Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power.
STO hardware failure	5090	Safe torque off hardware failure.	Contact your local ABB representative.
Safe torque off Programmable fault: 31.22 STO indication run/stop	5091	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is broken during start or run.	Check safe torque off circuit connections. For more information, see appropriate drive hardware manual and description of parameter 31.22 STO indication run/stop.
PU logic error	5092	Power unit memory has cleared.	Cycle the power to the drive. If the control unit is externally powered, also reboot the control unit (using parameter 96.08 Control board boot) or by cycling its power. If the problem persists, contact your local ABB representative.
Rating ID mismatch	5093	The hardware of the drive does not match the information stored in the memory unit. This may occur eg. after a firmware update or memory unit replacement.	Cycle the power to the drive.
PU communication	5681	The way the control unit is powered does not correspond to parameter setting.	Check setting of 95.04 Control board supply.
		Communication errors detected between the drive control unit and the power unit.	Check the connection between the control unit and the power unit.
Power unit lost	5682	Connection between the drive control unit and the power unit is lost.	Check the connection between the control unit and the power unit.
PU communication internal	5690	Internal communication error.	Contact your local ABB representative.
Measurement circuit ADC	5691	Measurement circuit fault.	Contact your local ABB representative.
PU board powerfail	5692	Power unit power supply failure.	Contact your local ABB representative.
Measurement circuit DFF	5693	Measurement circuit fault.	Contact your local ABB representative.

Table 13-2 Fault Messages (Alphabetical by Keypad Text) Continued

Fault	Fault #	Cause	What to do
PU communication configuration	5694	Version check cannot find a matching power unit FPGA logic.	Contact your local ABB representative.
Reduced run	5695	Number of inverter modules detected does not match the value of parameter 95.13 Reduced run mode.	Check that the value of 95.13 Reduced run mode corresponds to the number of inverter modules present. Check that the modules present are powered from the DC bus and connected by fiber optic cables to the BCU control unit. If all modules of the inverter unit are in fact available (eg. maintenance work has been completed), check that parameter 95.13 is set to 0 (reduced run function disabled).
PU state feedback	5696	State feedback from output phases does not match control signals.	Contact your local ABB representative.
Charging feedback	5697	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
Unknown power unit fault	5698	Unidentified power unit logic fault.	Check power unit logic and firmware compatibility. Contact your local ABB representative.
Internal SW error	6180	Internal error.	Contact your local ABB representative. Quote the auxiliary code (check the event details in the event log).
FPGA version incompatible	6181	Firmware and FPGA file version in the power unit are incompatible.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
FBA A mapping file	6306	Fieldbus adapter A mapping file read error.	Contact your local ABB representative.
FBA B mapping file	6307	Fieldbus adapter B mapping file read error.	Contact your local ABB representative.
Task overload	6481	Internal fault.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
Stack overflow	6487	Internal fault.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
Internal file load	64A1	File read error.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
Internal record load	64A2	Internal record load error.	Contact your local ABB representative.
Application loading	64A3	Application file incompatible or corrupted.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
Memory unit detached	64B0	The memory unit was detached when the control unit was powered.	Switch off the power to the control unit and reinstall the memory unit. In case the memory unit was not actually removed when the fault occurred, check that the memory unit is properly inserted into its connector and its mounting screw is tight. Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
Internal SSW fault	64B1	Internal fault.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.

Table 13-2 Fault Messages (Alphabetical by Keypad Text) Continued

Fault	Fault #	Cause	What to do
User set fault	64B2	Loading of user parameter set failed because • requested set does not exist • set is not compatible with control program • drive was switched off during loading.	Ensure that a valid user parameter set exists. Reload if uncertain.
Kernel overload	64E1	Operating system error.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
Parameter system	6581	Parameter load or save failed.	Try forcing a save using parameter 96.07 Parameter save manually. Retry.
FBA A parameter conflict	65A1	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups 50 Fieldbus adapter (FBA) and 51 FBA A settings.
FBA B parameter conflict	65A2	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups 50 Fieldbus adapter (FBA) and 54 FBA B settings.
Text data overflow	6881	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
Text 32-bit table overflow	6882	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
Text 64-bit table overflow	6883	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
Text file overflow	6885	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
Option module comm loss	7080	Communication between drive and an option module is lost.	Check that all option modules are properly seated in their slots. Check that all option modules or slot connectors are not damaged. To pinpoint the problem, try installing the modules into different slots one at a time.
Panel port communication Programmable fault: 49.05 Communication loss action	7081	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Disconnect and reconnect the control panel.
Ext I/O comm loss	7082	The I/O extension module types specified by parameters do not match the detected configuration.	Check the event log for an auxiliary code (format XXYY YYYY). “XX” specifies the number of the I/O extension module (01: parameter group 14 I/O extension module 1, 02: 15 I/O extension module 2, 03: 16 I/O extension module 3). “YY YYYY” indicates the problem (see actions for each code below).
	00 0001	Communication with module failed.	Check that the module is properly seated in its slot. Check that the module and the slot connector is not damaged. Try installing the module into another slot.
	00 0002	Module not found.	Check the type and location settings of the modules (parameters 14.01/14.02, 15.01/15.02 or 16.01/16.02). Check that the module is properly seated in its slot. Check that the module and the slot connector is not damaged. Try installing the module into another slot.
	00 0003	Configuration of module failed.	
	00 0004	Configuration of module failed.	

Table 13-2 Fault Messages (Alphabetical by Keypad Text) Continued

Fault	Fault #	Cause	What to do
Motor stall Programmable fault: 31.24 Stall function	7121	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
Brake resistor	7181	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor. Check the dimensioning of the brake resistor.
BR excess temperature	7183	Brake resistor temperature has exceeded fault limit defined by parameter 43.11 Brake resistor fault limit.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group 43 Brake chopper). Check fault limit setting, parameter 43.11 Brake resistor fault limit. Check that braking cycle meets allowed limits.
Brake resistor wiring	7184	Brake resistor short circuit or brake chopper control fault.	Check brake chopper and brake resistor connection. Ensure brake resistor is not damaged. After correcting the cause of the fault, reboot the control unit (using parameter 96.08 Control board boot) or by cycling power.
BC short circuit	7191	Short circuit in brake chopper IGBT.	Ensure brake resistor is connected and not damaged. Check the electrical specifications of the brake resistor against the Hardware manual. Replace brake chopper (if replaceable). After correcting the cause of the fault, reboot the control unit (using parameter 96.08 Control board boot) or by cycling power.
BC IGBT excess temperature	7192	Brake chopper IGBT temperature has exceeded internal fault limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameter group 43 Brake chopper). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
Mechanical brake closing failed Programmable fault: 44.17 Brake fault function	71A2	Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake closing.	Check mechanical brake connection. Check mechanical brake settings in parameter group 44 Mechanical brake control. Check that acknowledgement signal matches actual status of brake.
Mechanical brake opening failed Programmable fault: 44.17 Brake fault function	71A3	Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake opening.	Check mechanical brake connection. Check mechanical brake settings in parameter group 44 Mechanical brake control. Check that acknowledgement signal matches actual status of brake.
Mechanical brake opening not allowed Programmable fault: 44.17 Brake fault function	71A5	Open conditions of mechanical brake cannot be fulfilled (for example, brake has been prevented from opening by parameter 44.11 Keep brake closed).	Check mechanical brake settings in parameter group 44 Mechanical brake control (especially 44.11 Keep brake closed). Check that acknowledgement signal (if used) matches actual status of brake.
Motor fan Programmable fault: 35.106 DOL starter event type	71B1	No feedback received from external fan.	Check external fan (or other equipment controlled) by the logic. Check settings of parameters 35.100…35.106.
Motor speed feedback Programmable fault: 90.45 Motor feedback fault	7301	No motor speed feedback received.	See A7B0 Motor speed feedback.

Table 13-2 Fault Messages (Alphabetical by Keypad Text) Continued

Fault	Fault #	Cause	What to do
Overspeed	7310	Motor is turning faster than highest allowed speed due to incorrectly set minimum/maximum speed, insufficient braking torque or changes in load when using torque reference.	Check minimum/maximum speed settings, parameters 30.11 Minimum speed and 30.12 Maximum speed. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
Line side converter faulted	7358	The supply unit has tripped on a fault.	If using a control panel or the Drive composer tool, connect to the supply unit to read the fault code. Refer to the firmware manual of the supply unit for instructions related to the code.
Encoder internal	7380	Internal fault.	Contact your local ABB representative.
Encoder 1	7381	Encoder feedback fault.	See A7E1 Encoder 1.
Speed feedback configuration	73A0	Speed feedback configuration incorrect.	See A797 Speed feedback configuration.
Load position feedback	73A1	No load feedback received.	Check the event log for an auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the encoder interface module (01: 91.11/91.12, 02: 91.13/91.14), “YY” specifies the encoder (01: 92 Encoder 1 configuration, 02: 93 Encoder 2 configuration). “ZZZZ” indicates the problem (see actions for each code below).
	0001	Load gear definition invalid or outside limits.	Check load gear settings (90.53 and 90.54).
	0002	Feed constant definition invalid or outside limits.	Check feed constant settings (90.63 and 90.64).
	0003	Motor/load gear definition invalid or outside limits.	Check motor/load gear settings (90.61 and 90.62).
	0004	Encoder not configured.	Check encoder settings (92 Encoder 1 configuration or 93 Encoder 2 configuration). Use parameter 91.10 Encoder parameter refresh) to validate any changes in the settings.
	0005	Encoder stopped working.	Check encoder status.
Emergency ramp failed	73B0	Emergency stop did not finish within expected time.	Check the settings of parameters 31.32 Emergency ramp supervision and 31.33 Emergency ramp supervision delay. Check the predefined ramp times (23.11…23.19 for mode Off1, 23.23 for mode Off3).
FBA A communication Programmable fault: 50.02 FBA A comm loss func	7510	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups 50 Fieldbus adapter (FBA), 51 FBA A settings, 52 FBA A data in and 53 FBA A data out. Check cable connections. Check if communication master is able to communicate.
FBA B communication Programmable fault: 50.32 FBA B comm loss func	7520	Cyclical communication between drive and fieldbus adapter module B or between PLC and fieldbus adapter module B is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter group 50 Fieldbus adapter (FBA). Check cable connections. Check if communication master is able to communicate.
FA2FA DDCS com loss Programmable fault: 60.79 INU-LSU com loss ctrl	7580	DDCS (fiber optic) communication between converters (for example, the inverter unit and the supply unit) is lost.	Check status of other converter (parameters 06.36 and 06.39). Check settings of parameter group 60 DDCS communication. Check the corresponding settings in the control program of the other converter. Check cable connections. If necessary, replace cables.

Table 13-2 Fault Messages (Alphabetical by Keypad Text) Continued

Fault	Fault #	Cause	What to do
DDCS controller comm loss Programmable fault: 60.59 DDCS controller comm loss function	7581	DDCS (fiber optic) communication between drive and external controller is lost.	Check status of controller. See user documentation of controller. Check settings of parameter group 60 DDCS communication. Check cable connections. If necessary, replace cables.
MF comm loss Programmable fault: 60.09 M/F comm loss function	7582	Master/follower communication is lost.	Check status of other drives on the master/follower link. Check settings of parameter group 60 DDCS communication. Check cable connections. If necessary, replace cables.
Line side unit faulted	7583	The supply unit (or other converter) connected to the inverter unit has generated a fault.	Check fault status of supply unit (or other converter). Refer to the firmware manual of the supply unit.
AI supervision Programmable fault: 12.03 AI supervision function	80A0	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group 12 Standard AI.
Signal supervision (Editable message text) Programmable fault: 32.06 Supervision 1 action 32.16 Supervision 2 action 32.26 Supervision 3 action	80B0	Fault generated by a signal supervision function.	Check the source of the fault (parameter 32.07, 32.17 or 32.28).
External fault 1 (Editable message text) Programmable fault: 31.01 External event 1 source 31.02 External event 1 type	9081	Fault in external device 1.	Check the external device. Check setting of parameter 31.01 External event 1 source.
External fault 2 (Editable message text) Programmable fault: 31.03 External event 2 source 31.04 External event 2 type	9082	Fault in external device 2.	Check the external device. Check setting of parameter 31.03 External event 2 source.
External fault 3 (Editable message text) Programmable fault: 31.05 External event 3 source 31.06 External event 3 type	9083	Fault in external device 3.	Check the external device. Check setting of parameter 31.05 External event 3 source.
External fault 4 (Editable message text) Programmable fault: 31.07 External event 4 source 31.08 External event 4 type	9084	Fault in external device 4.	Check the external device. Check setting of parameter 31.07 External event 4 source.
External fault 5 (Editable message text) Programmable fault: 31.09 External event 5 source 31.10 External event 5 type	9085	Fault in external device 5.	Check the external device. Check setting of parameter 31.09 External event 5 source.
Safe torque off 1	FA81	Safe torque off function is active, ie. STO circuit 1 is broken.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter 31.22 STO indication run/stop.
Safe torque off 2	FA82	Safe torque off function is active, ie. STO circuit 2 is broken.	

Table 13-2 Fault Messages (Alphabetical by Keypad Text) Continued

Fault	Fault #	Cause	What to do
ID run	FF61	Motor ID run was not completed successfully.	Check the nominal motor values in parameter group 99 Motor data. Check that no external control system is connected to the drive. Cycle the power to the drive (and its control unit, if powered separately). Check that the motor shaft is not locked. Check the event log for an auxiliary code. The second number of the code indicates the problem (see actions for each code below).
	0001	Maximum current limit too low.	Check settings of parameters 99.06 Motor nominal current and 30.17 Maximum current. Make sure that 30.17 > 99.06. Check that the drive is dimensioned correctly according to the motor.
	0002	Maximum speed limit or calculated field weakening point too low.	Check settings of parameters • 30.11 Minimum speed • 30.12 Maximum speed • 99.07 Motor nominal voltage • 99.08 Motor nominal frequency • 99.09 Motor nominal speed. Make sure that • 30.12 > (0.55 × 99.09) > (0.50 × synchronous speed) • 30.11 < 0, and • supply voltage > (0.66 × 99.07).
	0003	Maximum torque limit too low.	Check settings of parameter 99.12 Motor nominal torque, and the torque limits in group 30 Limits. Make sure that the maximum torque limit in force is greater than 100%.
	0004	Current measurement calibration did not finish within reasonable time.	Contact your local ABB representative.
	0005 - 0008	Internal error.	Contact your local ABB representative.
	0009	(Asynchronous motors only) Acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000A	(Asynchronous motors only) Deceleration did not finish within reasonable time.	Contact your local ABB representative.
	000B	(Asynchronous motors only) Speed dropped to zero during ID run.	Contact your local ABB representative.
	000C	(Permanent magnet motors only) First acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000D	(Permanent magnet motors only) Second acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000E - 0010	Internal error.	Contact your local ABB representative.
FB A force trip	FF81	A fault trip command has been received through fieldbus adapter A.	Check the fault information provided by the PLC.
FB B force trip	FF82	A fault trip command has been received through fieldbus adapter B.	Check the fault information provided by the PLC.

Appendix A
Technical Specifications

A.1 ACS880+N5350 Technical Data

Table A-1 ACS880+N5350 Technical Data

Electrical Power Network Specification	
Voltage (U_1)	ACS880-01-xxxx-2 units: 208 … 240V AC 3-phase +10%…-15%
	ACS880-01-xxxx-3 units: 380 … 415V AC 3-phase +10%…-15%
	ACS880-01-xxxx-5 units: 380 … 500V AC 3-phase +10%…-15%
	ACS880-01-xxxx-7 units: 525 … 690V AC 3-phase +10%…-15%
Network Type	TN (grounded) and IT (ungrounded) systems
Rated Conditional Short-Circuit Current (IEC 61439-1)	65 kA when protected by fuses given in the fuse tables
Short-Circuit Current Protection (UL 508C, CSA C22.2 No. 14-05)	US and Canada: The drive is suitable for use on a circuit capable of delivering not more than 100kA symmetrical amperes (rms) at 600V maximum when protected by fuses given in the fuse table
Frequency	47 to 63 Hz, maximum rate of change 17%/s
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Fundamental Power Factor (cos phi$_1$)	0.98 (at nominal load)

Motor Connection Data	
Motor Types	Permanent magnet synchronous cooling tower direct drive motors
Voltage (U_2)	0 to U1, 3-phase symmetrical, U_{max} at the field weakening point
Frequency	0…500 Hz
Current	See Chapter 3 Ratings.
Switching Frequency	2.7 kHz (typically)
Maximum Recommended Motor Cable Length	For ACS880-01-xxxx-2, ACS880-01-xxxx-3 and ACS880-01-xxxx-5 frames R1 to R3 and for types ACS880-01-07A3-7, ACS880-01-09A8-7, ACS880-01-14A2-7 and ACS880-01-018A-7: 150m (492 ft)
	For ACS880-01-xxxx-2, ACS880-01-xxxx-3 and ACS880-01-xxxx-5 frames R4 to R9 and for types from ACS880-01-022A-7 to ACS880-01-271A-7: 300m (984 ft)
	Note: With motor cables longer than 150m (492 ft) the EMC Directive requirements may not be fulfilled.

Control Unit (ZCU-12) Connection Data	
Power Supply (XPOW)	24V (±10%) DC, 2A
	Supplied from the power unit of the drive, or from an external power supply through connector XPOW (pitch 5mm, wire size 2.5mm^2)
Relay Outputs RO1...RO3 (XRO1...XRO3)	Connector pitch 5 mm, wire size 2.5mm^2
	250 VAC / 30 VDC, 2A
	Protected by varistors
+24V Output (XD24:2 and XD24:4)	Connector pitch 5 mm, wire size 2.5mm^2
	Total load capacity of these outputs is 4.8W (200mA / 24V) minus the power taken by DIO1 and DIO2

Table A-1 ACS880+N5350 Technical Data Continued

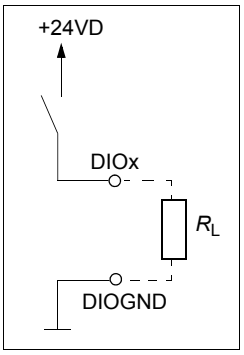
Digital Inputs DI1...DI6 (XDI:1...XDI:6)	Connector pitch 5 mm, wire size 2.5mm^2
	24V logic levels: “0” < 5V, “1” > 15V
	R_{in}: 2.0 kohm
	Input type: NPN/PNP (DI1…DI5), NPN (DI6)
	Hardware filtering: 0.04ms, digital filtering up to 8ms
	DI6 (XDI:6) can alternatively be used as an input for PTC sensors
	“0” > 4kohm, “1” < 1.5kohm
	I_{max}: 15mA (for DI6 5mA)
Start Interlock Input DIIL (XD24:1)	Connector pitch 5mm, wire size 2.5mm^2
	24V logic levels: “0” < 5V, “1” > 15V
	R_{in}: 2.0 kohm
	Input type: NPN/PNP
	Hardware filtering: 0.04ms, digital filtering up to 8ms
Digital Inputs/ Outputs DIO1 and DIO2 (XDIO:1 and XDIO:2) Input/output selection by parameters. DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24V level square wave frequency output. See the firmware manual, parameter group 11.	Connector pitch 5mm, wire size 2.5mm^2
	As inputs: 24V logic levels: “0” < 5V, “1” > 15V
	R_{in}: 2.0 kohm
	Filtering: 0.25ms
	As outputs: Total output current from +24VD is limited to 200mA. **Figure A-1** 
Reference Voltage for Analog Inputs +VREF and -VREF (XAI:4...XAI:2)	Connector pitch 5mm, wire size 2.5mm^2
	10V ±1% and –10V ±1%, R_{load} 1…10kohm
Analog Inputs AI1 and AI2 (XAI:4... XAI:7) Current/voltage input selection by jumpers.	Connector pitch 5mm, wire size 2.5mm^2
	Current input: –20…20mA, R_{in}: 100ohm
	Voltage input: –10…10V, R_{in}: > 200kohm
	Differential inputs, common range ±30V
	Sampling interval per channel: 0.25ms
	Hardware filtering: 0.25ms, adjustable digital filtering up to 8ms
	Resolution: 11 bit + sign bit
	Inaccuracy: 1% of full scale range

Table A-1 ACS880+N5350 Technical Data Continued

Analog Outputs AO1 and AO2 (XAO)	Connector pitch 5mm, wire size 2.5mm^2
	0…20mA, R_{load} < 500ohm
	Frequency range: 0…300Hz
	Resolution: 11 bit + sign bit
	Inaccuracy: 2% of full scale range
Drive to Drive Link (XD2D)	Connector pitch 5mm, wire size 2.5mm^2
	Physical layer: RS-485
	Termination by switch
Safe Torque Off Connection (XSTO)	Connector pitch 5mm, wire size 2.5mm^2
	Current consumption per channel: 55mA (continuous)
	For the drive to start, both connections must be closed (OUT1 to IN1 and IN2).
Control Panel / PC Connection	Connector: RJ-45
	Cable length < 3m

The terminals on the board fulfil the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if a voltage higher than 48V is connected to the relay output.

Figure A-2 Ground Isolation Diagram

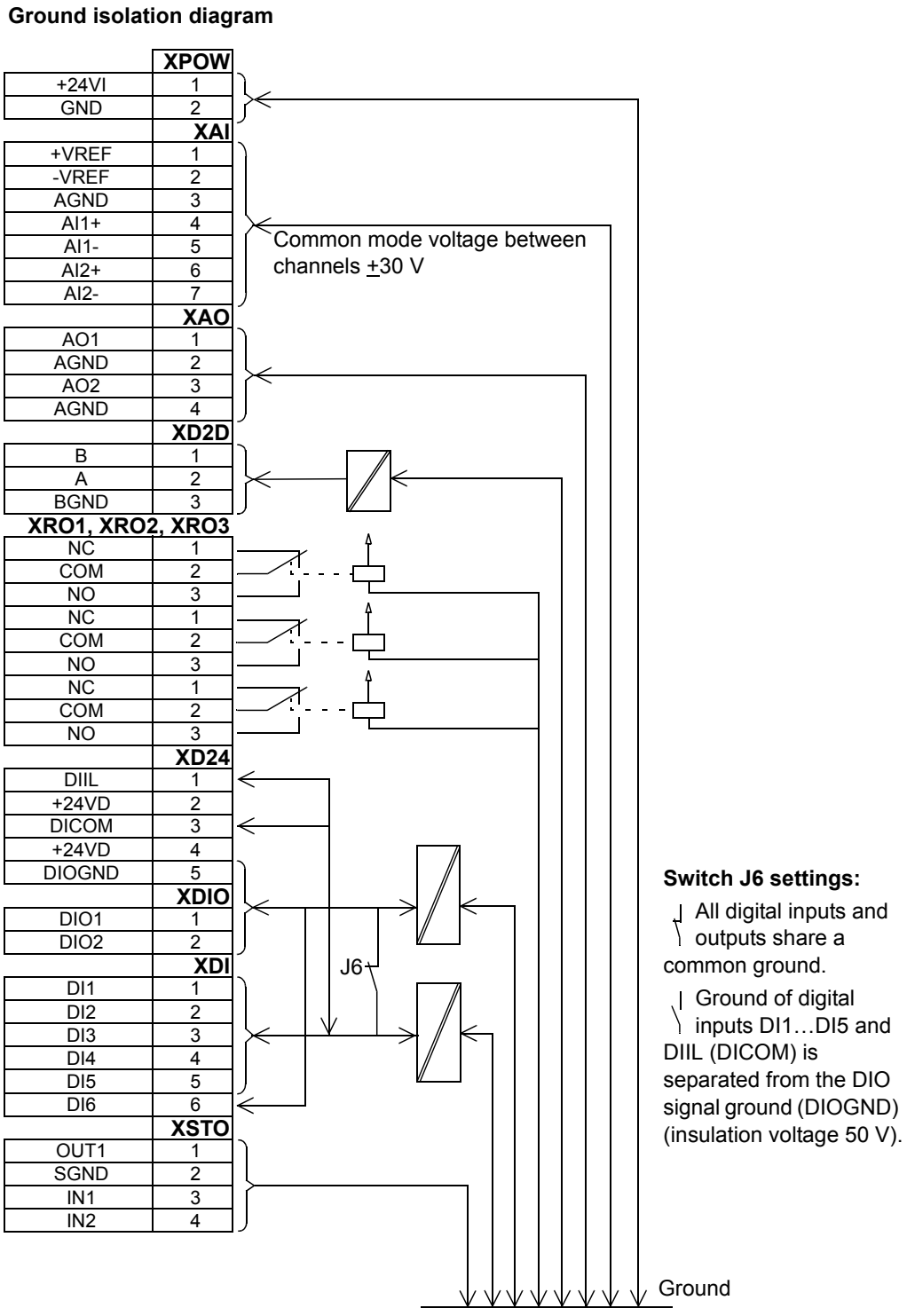


Table A-1 ACS880+N5350 Technical Data Continued

Efficiency	
	Approximately 98% at nominal power level

Protection Classes	
Degree of Protection (IEC/EN 60529)	IP21, IP55
Enclosure Types (UL508C)	UL Type 1, UL Type 12. For indoor use only
Overvoltage Category (IEC 60664-1)	III
Protective Class (IEC/EN 61800-5-1)	I

Ambient Conditions

Environmental limits for the drive are given below. The drive is to be used in a heated, indoor, controlled environment.

	Operation Installed for Stationary Use	**Storage in the Protective Package**	**Transportation in the Protective Package**
Installation Site Altitude	1. 0 to 4000m (13123 ft) above sea level 2. 0 to 2000m (6561 ft) above sea level Above 1000m [3281 ft]	-	-
	1. For neutral-grounded TN and TT systems and non-corner grounded IT systems 2. For corner-grounded TN, TT and IT systems		
Air Temperature	-15 to +55°C (5 to 131°F). No frost allowed. See Chapter 3 Ratings.	-40 to +70°C (-40 to +158°F)	-40 to +70°C (-40 to +158°F)
Relative Humidity	5 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination Levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	Chemical gases: Class 3C2 Solid particles: Class 3S2	Chemical gases: Class 1C2 Solid particles: Class 1S3	Chemical gases: Class 2C2 Solid particles: Class 2S2
Atmospheric Pressure	70 to 106 kPa 0.7 to 1.05 atmospheres	70 to 106 kPa 0.7 to 1.05 atmospheres	60 to 106 kPa 0.6 to 1.05 atmospheres
Vibration (IEC 60068-2)	Max. 1mm (0.04in.) (5 to 13.2 Hz), max. 7m/s^2 (23ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 1mm (0.04in.) (5 to 13.2 Hz), max. 7m/s^2 (23ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 3.5mm (0.14in.) (2 to 9 Hz), max. 15m/s^2 (49ft/s^2) (9 to 200 Hz) sinusoidal
Shock (IEC 60068-2-27)	Not allowed	Max. 100m/s2 (330 ft./s^2), 11ms	Max. 100m/s^2 (330 ft./s2), 11ms
Free Fall	Not allowed	100mm (4 in.) for weight over 100 kg (220 lb)	100mm (4 in.) for weight over 100 kg (220 lb)

Table A-1 ACS880+N5350 Technical Data Continued

Materials	
Drive Enclosure	• PC/ABS 3 mm, color NCS1502-Y (RAL 9002 / PMS 1C Cool Grey) and RAL 9017
	• PC+10%GF 3.0mm, Color RAL 9017 (in frames R1 to R3 only)
	• Hot-dip zinc coated steel sheet 1.5 to 2.5mm, thickness of coating 100 micrometers, color NCS1502-Y
Package	Plywood and cardboard. Foam cushions PP-E, bands PP.
Disposal	The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated.
	Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and DC capacitors (C1-1 to C1-x) need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code.
	Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.

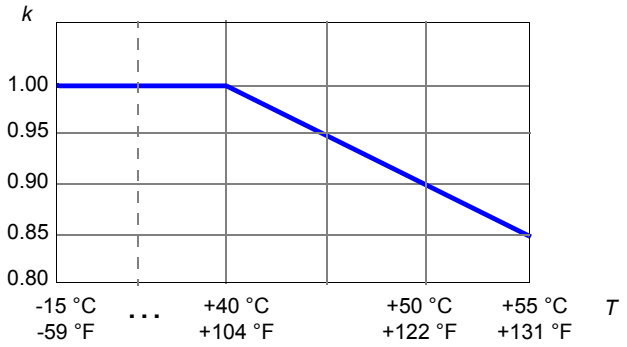
A.2 Derating

A.2.1 Ambient Temperature Derating

IP21 (UL Type 1) drive types and other IP55 (UL Type 12) types than listed in the following subheadings

In the temperature range +40…55°C (+104…131°F), the rated output current is derated by 1% for every added 1°C (1.8°F). The output current can be calculated by multiplying the current given in the rating table by the derating factor (k):

Figure A-3



A.2.2 Altitude Derating

At altitudes from 1000 to 4000m (3300 to 13123 ft) above sea level, the continuous output currents given above must be derated 1% for every 100m (328ft). For a more accurate derating, use the DriveSize PC tool.

A.2.3 Low Noise Control Mode Derating

When low noise drive control mode is used, the motor and braking powers are derated. Contact ABB for more information.

Appendix B
Dimensions

B.1 Dimensions, Weights and Free Space Requirements

Table B-1

Frame	IP21					UL Type 1				
	H1	H2	W	D	Weight	H1	H2	W	D	Weight
	mm	mm	mm	mm	kg	in.	in.	in.	in.	lb
R1	405	370	155	226	6	15.94	14.57	6.10	8.89	13
R2	405	370	155	249	8	15.94	14.57	6.10	9.80	18
R3	471	420	172	261	10	18.54	16.54	6.77	10.28	22
R4	576	490	203	274	18.5	22.70	19.30	7.99	10.80	41
R5	730	596	203	274	23	28.74	23.46	7.99	10.79	51
R6	726	569	251	357	45	28.60	22.40	9.92	14.09	99
R7	880	600	284	365	55	34.70	23.60	11.22	14.37	121
R8	963	681	300	386	70	37.90	26.82	11.81	15.21	154
R9	955	680	380	413	98	37.59	26.77	14.96	16.27	216

H1 Height with cable entry box.
H2 Height without cable entry box.
H3 Height with hood.
W Width with cable entry box.
D Depth with cable entry box.

Note: For more information on dimensions, see Dimension drawings.

200mm (7.87 in.) free space is required at top of the drive.

300mm (11.81 in.) free space (when measured from the drive base without the cable entry box) is required at bottom of the drive.

Figure B-1 Frame R1 (IP21, UL Type 1)

Frame R1 (IP21, UL Type 1)

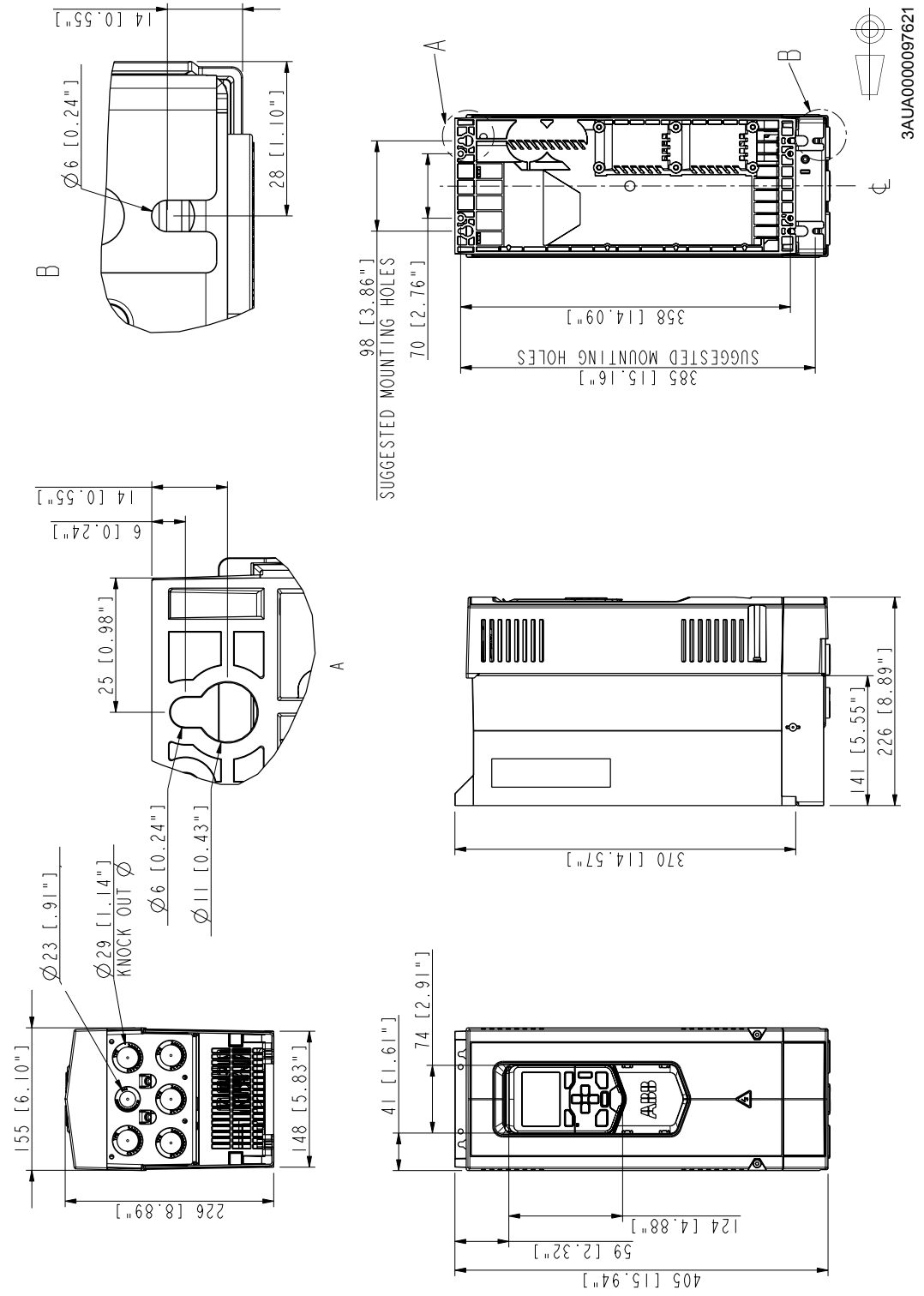


Figure B-2 Frame R2 (IP21, UL Type 1)

Frame R2 (IP21, UL Type 1)

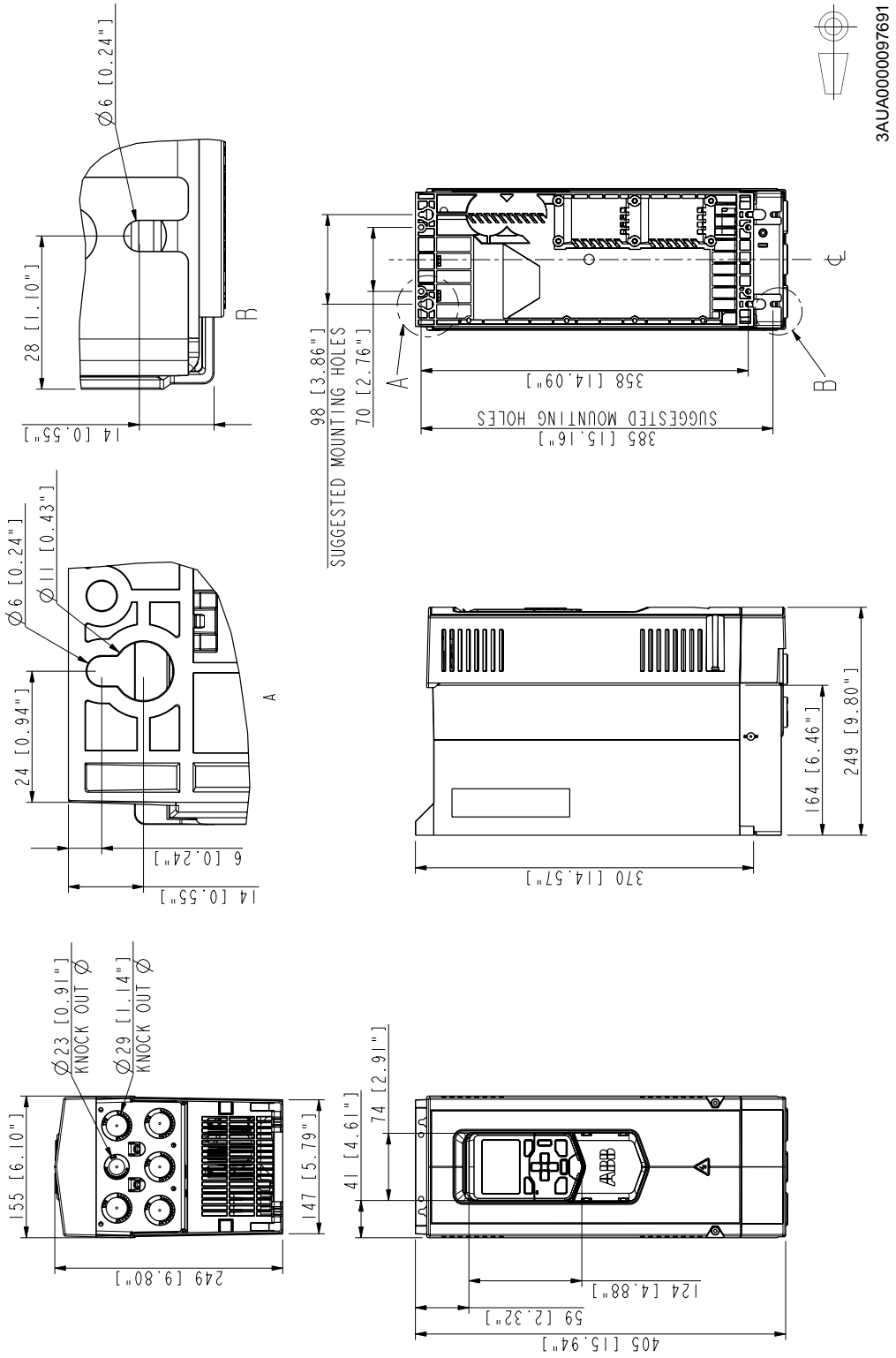


Figure B-3 Frame R3 (IP21, UL Type 1)

Frame R3 (IP21, UL Type 1)

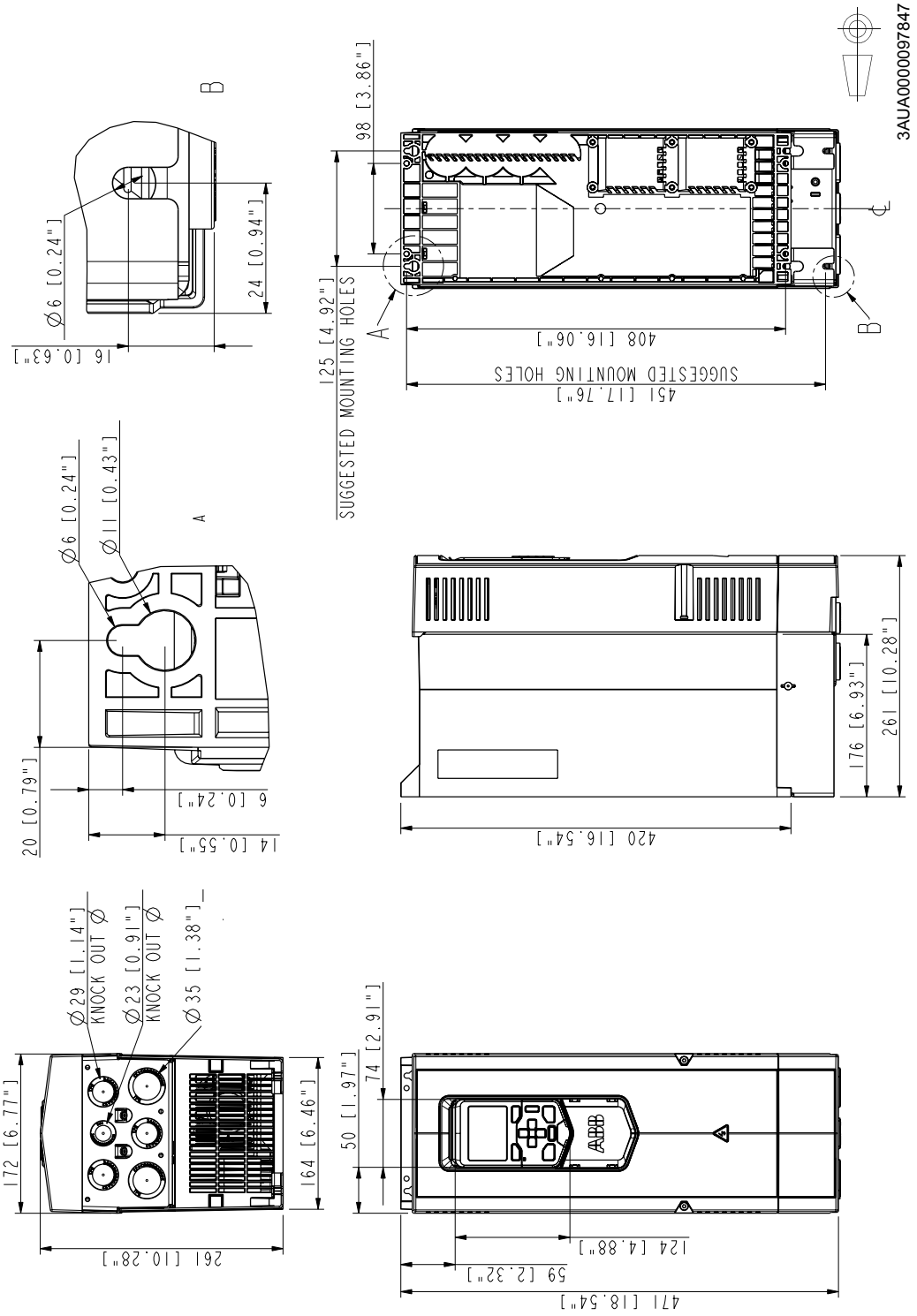


Figure B-4 Frame R4 (IP21, UL Type 1)

Frame R4 (IP21, UL Type 1)

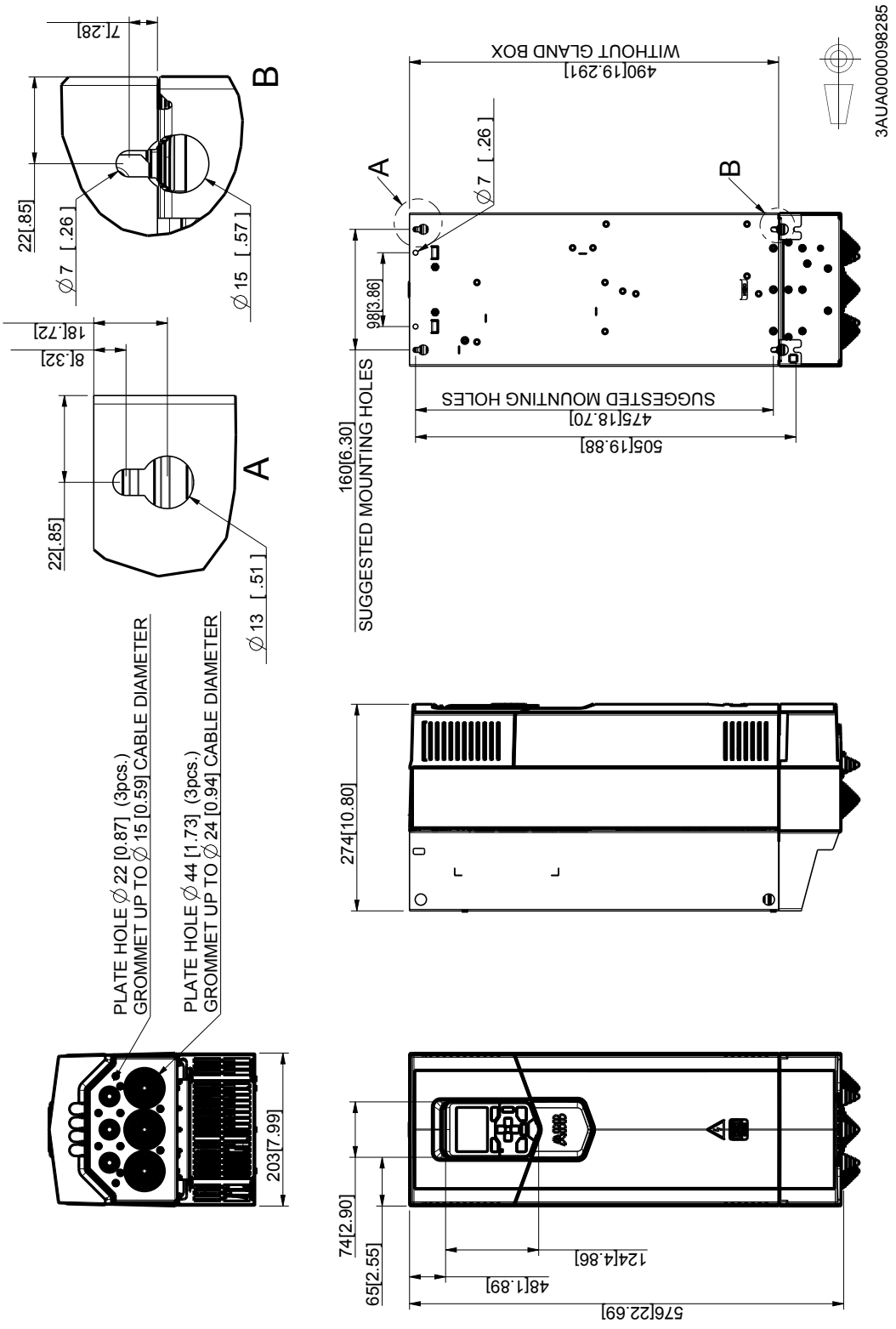


Figure B-5 Frame R5 (IP21, UL Type 1)

Frame R5 (IP21, UL Type 1)

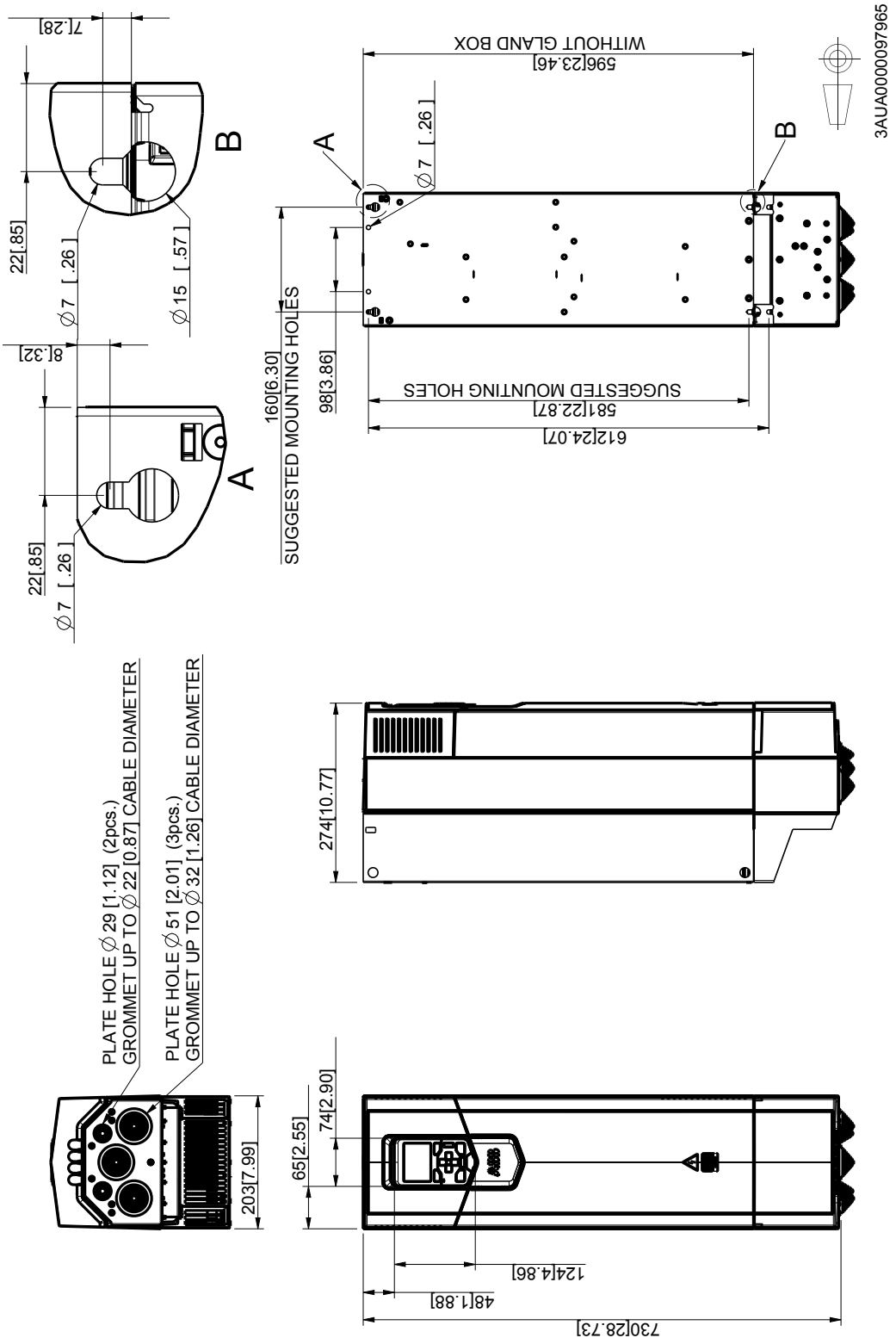


Figure B-6 R6 (IP21, UL Type 1)

Frame R6 (IP21, UL Type 1)

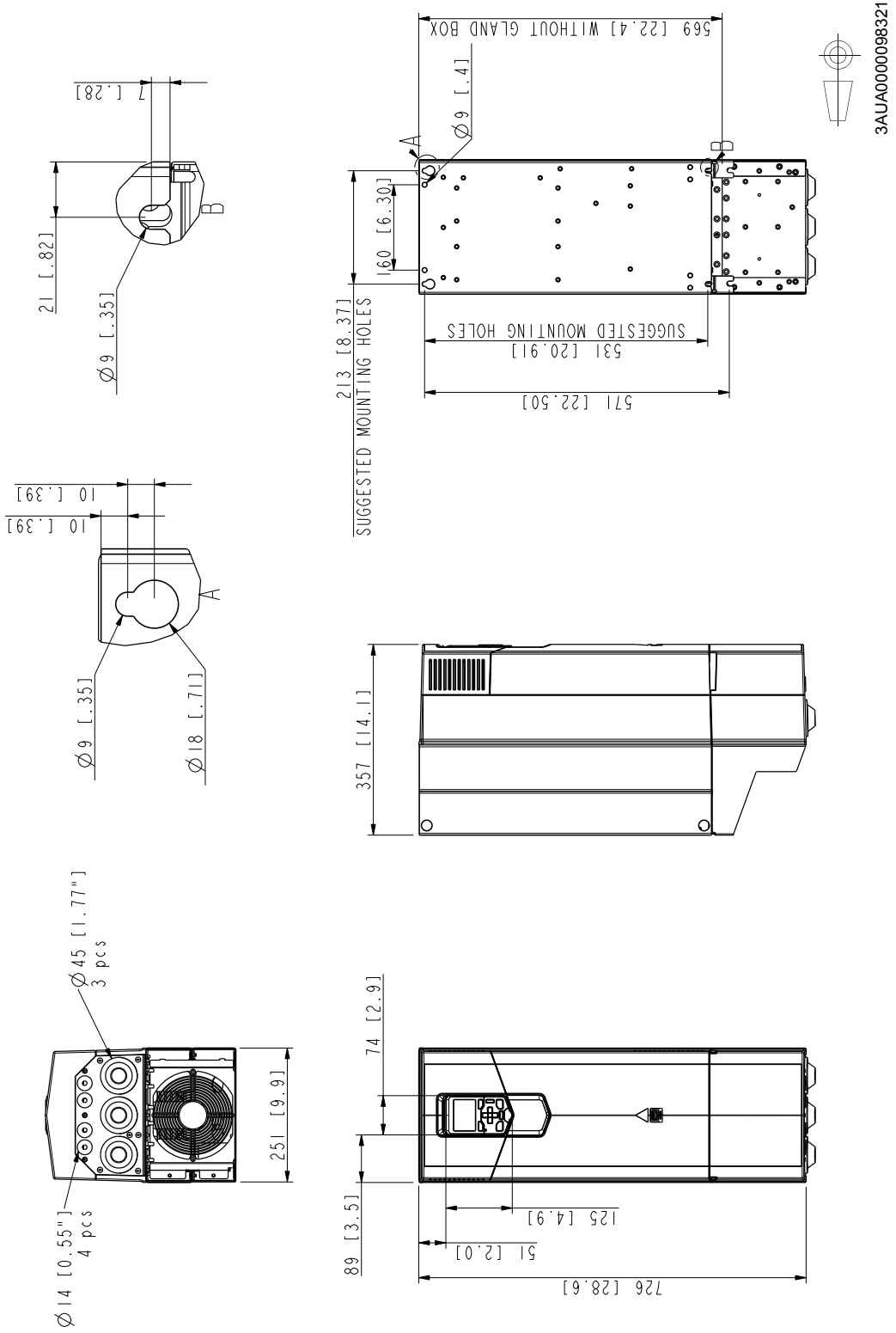


Figure B-7 Frame R7 (IP21, UL Type 1)

Frame R7 (IP21, UL Type 1)

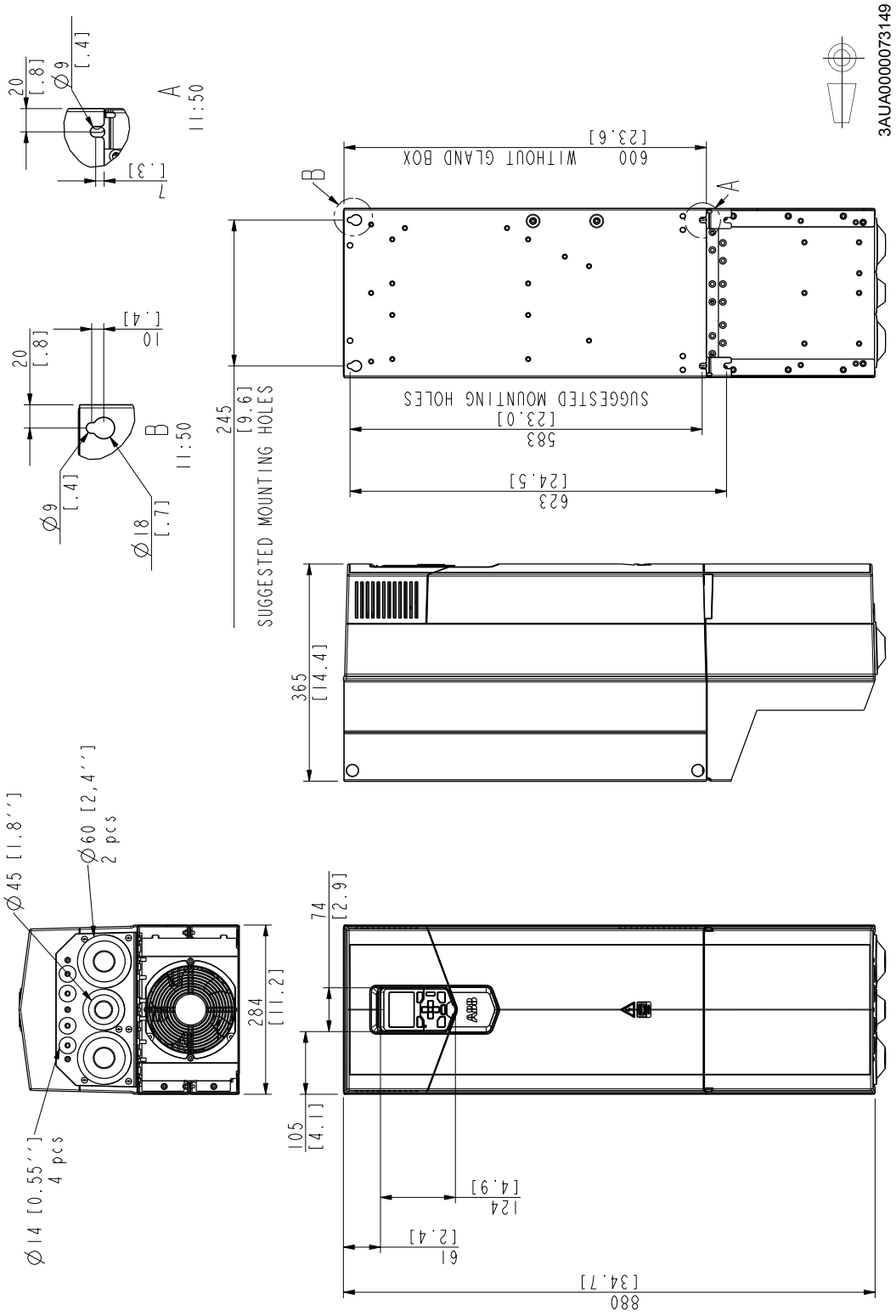


Figure B-8 Frame R8 (IP21, UL Type 1)

Frame R8 (IP21, UL Type 1)

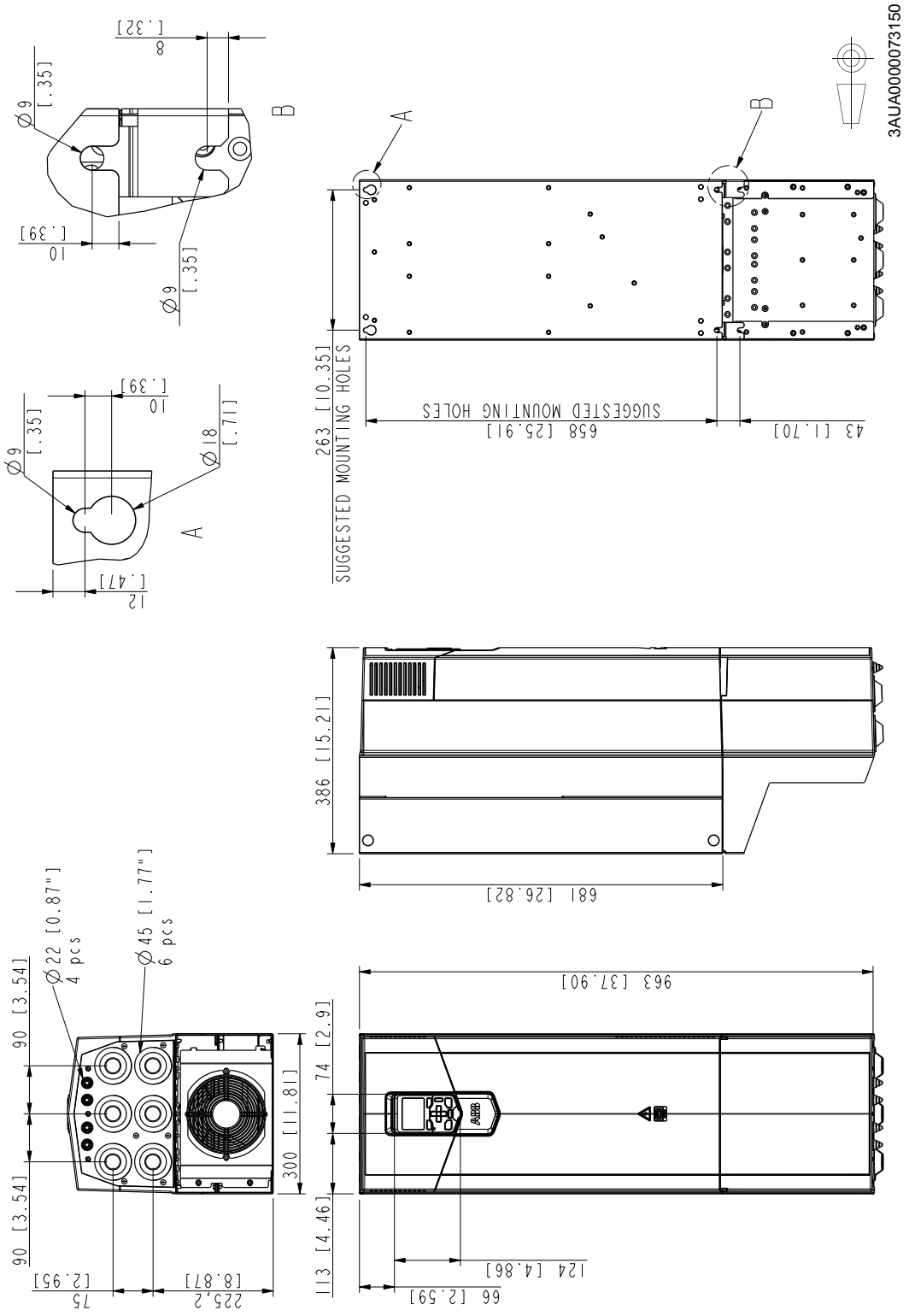
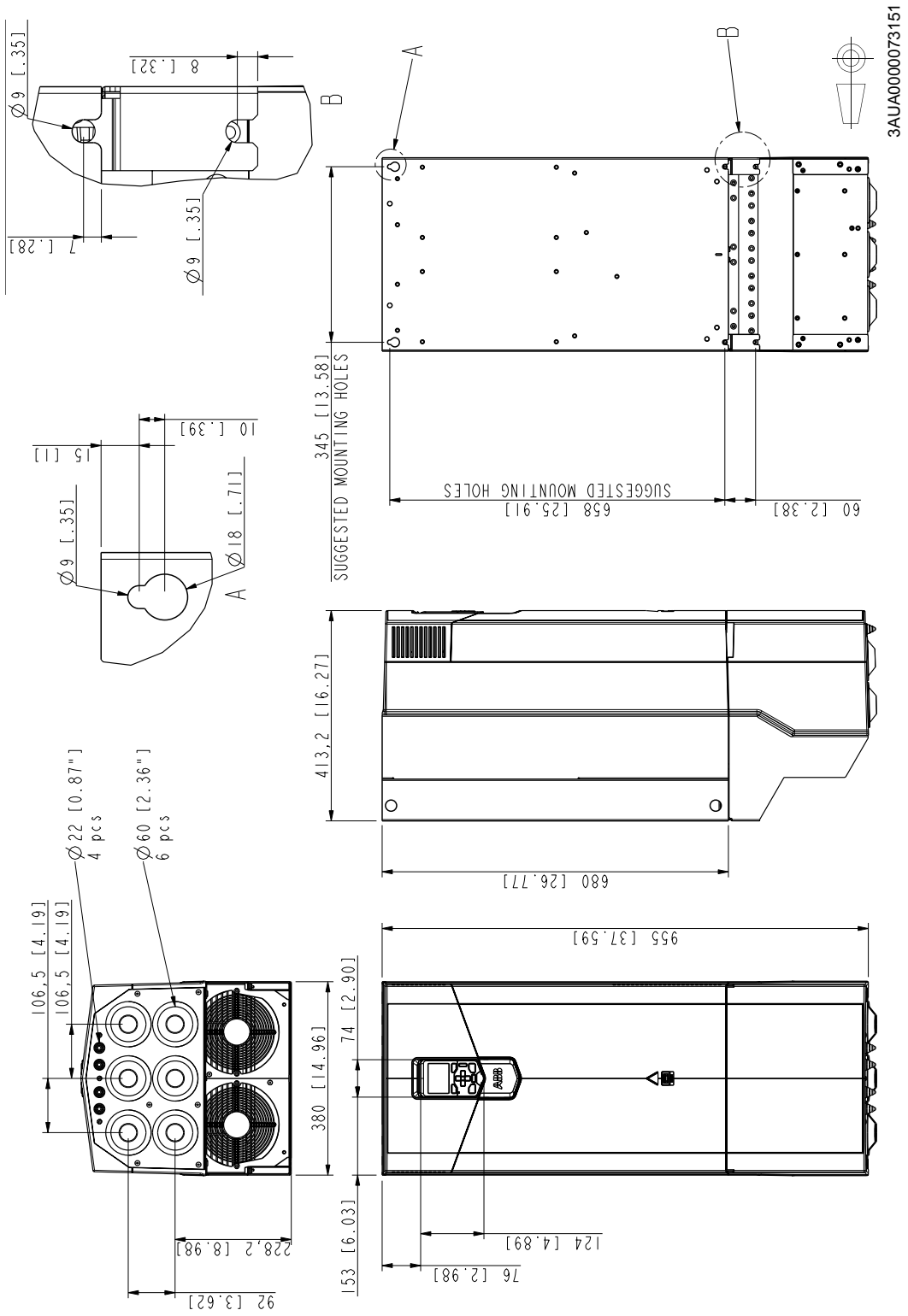


Figure B-9 Frame R9 (IP21, UL Type 1)

Frame R9 (IP21, UL Type 1)



Appendix C
CE Guidelines

This section provides general information regarding recommended methods of installation for CE compliance. It is not intended as an exhaustive guide to good practice and wiring techniques. It is assumed that the installer of the ACS880+N5350 is sufficiently qualified to perform the task, and is aware of local regulations and requirements. ABB products that meet the EMC directive requirements are indicated with a “CE” mark. A duly signed CE declaration of conformity is available from ABB.

C.1 Applicable Standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standard EN61800-5-1.

Table C-1

EN 60204-1:2006 + A1 2009	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. Provisions for compliance: The final assembler of the machine is responsible for installing - emergency-stop device - supply disconnecting device.
IEC/EN 60529:1991 + A1 2000	Degrees of protection provided by enclosures (IP code)
IEC 60664-1:2007	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.
EN 61800-3:2004	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
EN 61800-5-1:2007	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy
EN 61800-5-2:2007	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional
UL 508C:2002	UL Standard for Safety, Power Conversion Equipment, third edition
NEMA 250:2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
CSA C22.2 No. 14-10	Industrial control equipment
GOST R 51321-1:2007	Low-voltage switchgear and control gear assemblies. Part 1 - Requirements for type-tested and partially type-tested assemblies - General technical requirements and methods of tests

C.2 CE Marking

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage, EMC and RoHS Directives. The CE marking also verifies that the drive, in regard to its safety functions (such as Safe torque off), conforms with the Machinery Directive as a safety component.

C.2.1 Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standards EN 60204-1 and EN61800-5-1.

C.2.2 Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN61800-3:2004) covers requirements stated for drives. See section Compliance with the EN61800-3:2004 below.

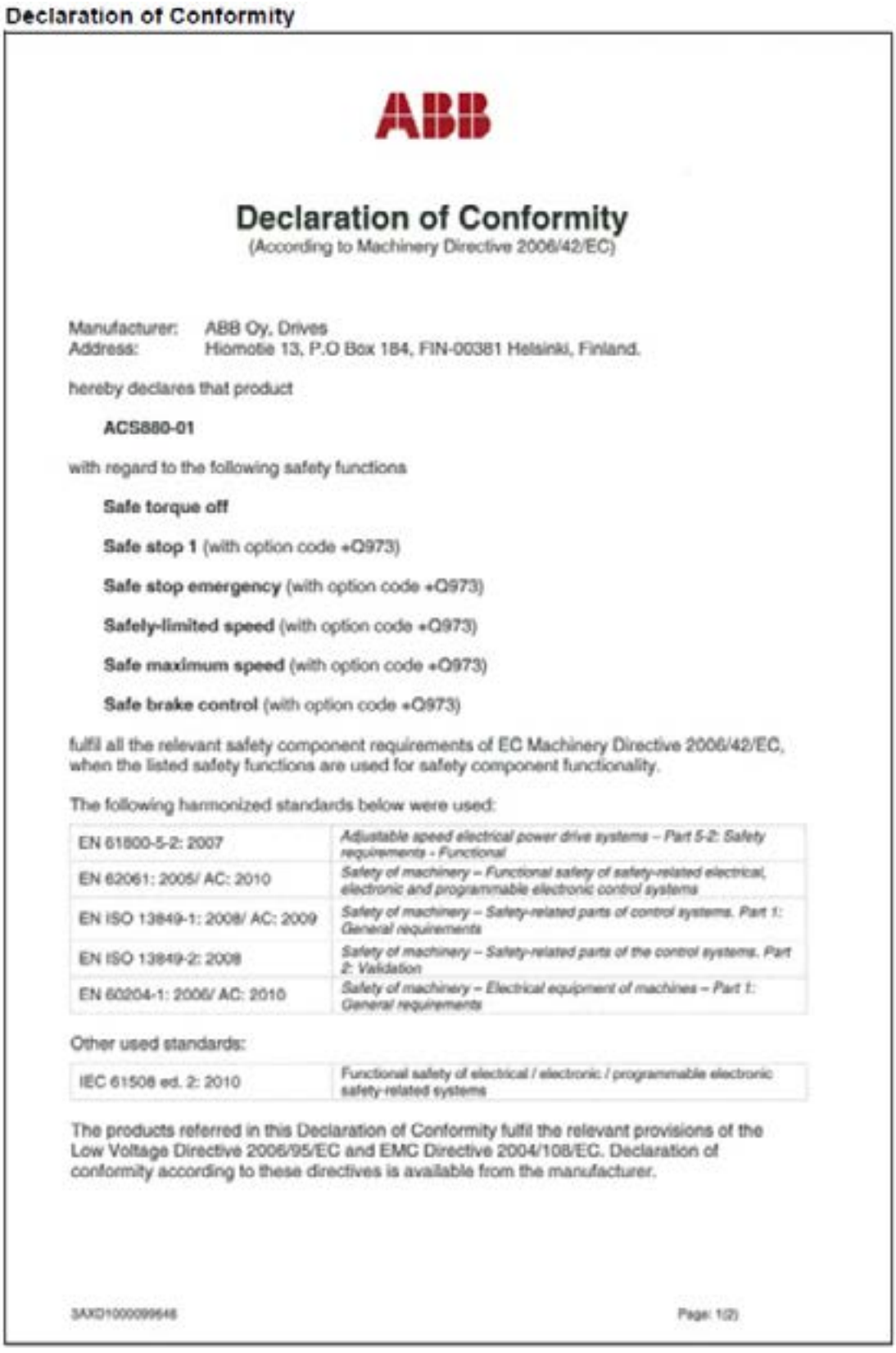
C.2.3 Compliance with the European RoHS Directive

The RoHS Directive defines the restriction of the use of certain hazardous substances in electrical and electronic equipment.

C.2.4 Compliance with the European Machinery Directive

The drive is an electronic product which is covered by the European Low Voltage Directive. However, the drive includes the Safe torque off function and can be equipped with other safety functions for machinery which, as safety components, are in the scope of the Machinery Directive. These functions of the drive comply with European harmonized standards such as EN 61800-5-2. The declaration of conformity is shown below.

Figure C-1 Declaration of Conformity



Declaration of Conformity

ABB

Declaration of Conformity

(According to Machinery Directive 2006/42/EC)

Manufacturer: ABB Oy, Drives
Address: Hiomotie 13, P.O Box 184, FIN-00381 Helsinki, Finland.

hereby declares that product

ACS880-01

with regard to the following safety functions

Safe torque off

Safe stop 1 (with option code +Q973)

Safe stop emergency (with option code +Q973)

Safely-limited speed (with option code +Q973)

Safe maximum speed (with option code +Q973)

Safe brake control (with option code +Q973)

fulfil all the relevant safety component requirements of EC Machinery Directive 2006/42/EC, when the listed safety functions are used for safety component functionality.

The following harmonized standards below were used:

EN 61800-5-2: 2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional*
EN 62061: 2005/ AC: 2010	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1: 2008/ AC: 2009	*Safety of machinery – Safety-related parts of control systems. Part 1: General requirements*
EN ISO 13849-2: 2008	*Safety of machinery – Safety-related parts of the control systems. Part 2: Validation*
EN 60204-1: 2006/ AC: 2010	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

Other used standards:

IEC 61508 ed. 2: 2010	*Functional safety of electrical / electronic / programmable electronic safety-related systems*

The products referred in this Declaration of Conformity fulfil the relevant provisions of the Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC. Declaration of conformity according to these directives is available from the manufacturer.

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Declaration of Conformity

(According to Machinery Directive 2006/42/EC)

Person authorized to compile the technical file:

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Helsinki, 29 Nov 2012

Mika Kulju

Vice President
ABB Oy

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C.3 Compliance with the EN 61800-3:2004

C.3.1 Definitions

EMC stands for Electromagnetic Compatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not supplying domestic premises.

Drive of category C2: drive of rated voltage less than 1000V and intended to be installed and started up only by a professional when used in the first environment.
Note: A professional is a person or organization having necessary skills in installing and/or starting up power drive systems, including their EMC aspects.

Drive of category C3: drive of rated voltage less than 1000V and intended for use in the second environment and not intended for use in the first environment.

Drive of category C4: drive of rated voltage equal to or above 1000V, or rated current equal to or above 400A, or intended for use in complex systems in the second environment.

C.3.2 Category C2

The drive complies with the standard with the following provisions:
1. The drive is equipped with EMC filter +E202.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 150 meters.

WARNING! **The drive may cause radio interference if used in residential or domestic environment. The user is required to take measures to prevent interference, in association to the requirements for the CE compliance listed above, if necessary.**

Note: Do not install a drive equipped with EMC filter +E202 on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage to the unit.

C.3.3 Category C3

The drive complies with the standard with the following provisions:
1. The drive is equipped with EMC filter +E200 or +E201.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 150 meters.

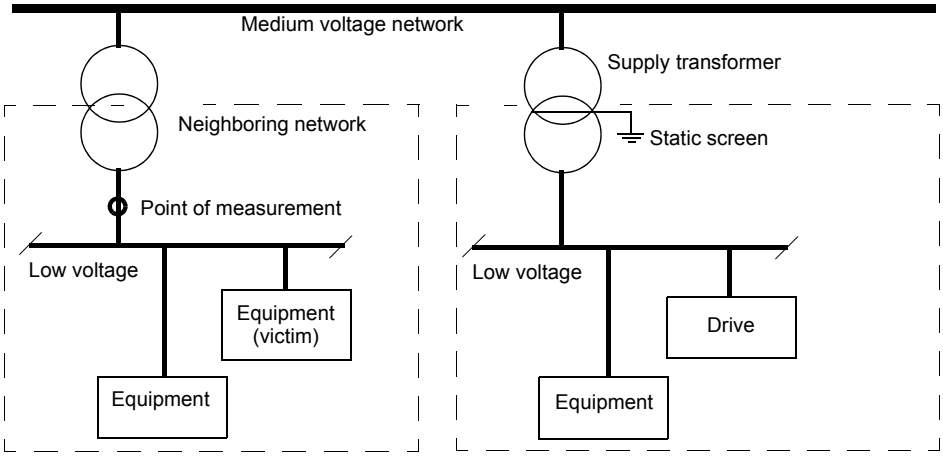
WARNING! **A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.**

C.3.4 Category C4

If the provisions under Category C3 cannot be met, the requirements of the standard can be met as follows:

1. It is ensured that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the inherent suppression in transformers and cables is sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.

Figure C-2



2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available from the local ABB representative.
3. The motor and control cables are selected as specified in the hardware manual.
4. The drive is installed according to the instructions given in the hardware manual.

WARNING! **A drive of category C4 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.**

C.4 UL Marking

cULus Listed UL Type 1 (IP21) drives:
- frames R1 to R3 of voltage range 208…240V
- frames R1 to R9 of voltage ranges 380…415V and 380…500V
- frames R5 to R9 of voltage range 525…600V

cULus Listed UL Type 12 (IP55) drives:
- frames R1 to R3 of voltage range 208…240V
- frames R1 to R5 of voltage ranges 380…415V and 380…500V
- frames R5 of voltage range 525…600V

The listing is pending for the other types. The approval is valid with rated voltages.

C.4.1 UL Checklist

- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.
- The maximum ambient air temperature is 40°C (104°F) at rated current. The current is derated for 40 to 55°C (104 to 131°F).
- The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 V maximum. The ampere rating is based on tests done according to UL508C.
- The cables located within the motor circuit must be rated for at least 75°C (167°F) in UL-compliant installations.
- The input cable must be protected with fuses. Circuit breakers must not be used without fuses in the USA. See hardware manual for suitable IEC (class aR) fuses and UL (class T) fuses. For suitable circuit breakers, contact your local ABB representative.
- For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, use the UL classified fuses.
- For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfill this requirement, use the UL classified fuses.
- The drive provides overload protection in accordance with the National Electrical Code (NEC).

C.4.2 CSA Marking

The drives of frame sizes R1 to R3 are CSA marked. The CSA marking is pending for the other frames. The approval is valid with rated voltages.

C.4.3 “C-tick” Marking

“C-tick” marking is required in Australia and New Zealand. A “C-tick” mark is attached to the 380…500V drives to verify compliance with the relevant standard (IEC 61800-3:2004), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme. C-tick marking is pending for drives of voltage ranges 204…240V and 525…690V.

For fulfilling the requirements of the standard, see section Compliance with the EN61800-3:2004 in hardware manual.

C.5 GOST R Certificate of Conformity

The drive has been given a GOST R certificate of conformity.

C.6 Disclaimer

The manufacturer shall have no obligation hereunder with respect to any product which (i) has been improperly repaired or altered; (ii) has been subjected to misuse, negligence or accident; (iii) has been used in a manner contrary to the Manufacturer’s instructions; or (iv) has failed as a result of ordinary wear and tear.

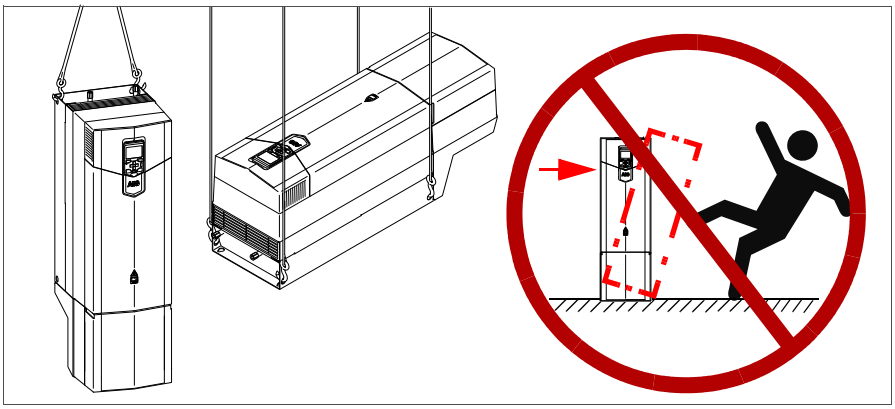
Appendix D
Mechanical Installation

This chapter gives a description of the mechanical installation of the drive.

D.1 Safety

WARNING: For frame sizes R6 to R9: Use the lifting eyes of the drive when you lift the drive. Do not tilt the drive. The drive is heavy and its center of gravity is high. An overturning drive can cause physical injury.

Figure D-1

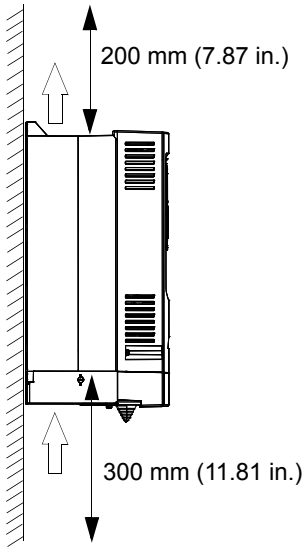


D.2 Examining the Installation Site

The drive must be installed in an upright position with the cooling section against a wall. All IP21 (UL Type 1) and IP55 drives and UL Type 12 drives of frames R1 to R3 can be installed tightly side by side. For UL Type 12 drives of frames R4 to R9, leave 100mm (4 in) between the hoods.

Make sure that the installation site agrees with these requirements:
- The installation site has sufficient ventilation to prevent overheating of the drive. See section Losses, cooling data and noise.
- The operation conditions of the drive agree with the specifications in section Ambient conditions.
- The wall is vertical, not flammable and strong enough to hold the weight of the drive.
- The material below the installation is not flammable.
- There is enough free space above and below the drive for cooling air flow, service and maintenance. There is enough free space in front of the drive for operation, service and maintenance.

Figure D-2



D.3 Necessary Tools

- Drill and drill bits
- Screwdriver and/or wrench with bits. The drive cover has Torx screws.

D.4 Moving the Drive

Move the transport package by pallet truck to the installation site.

D.5 Unpacking and Examining the Delivery (Frames R1 to R5)

This illustration shows the layout of the transport package. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type.

Figure D-3

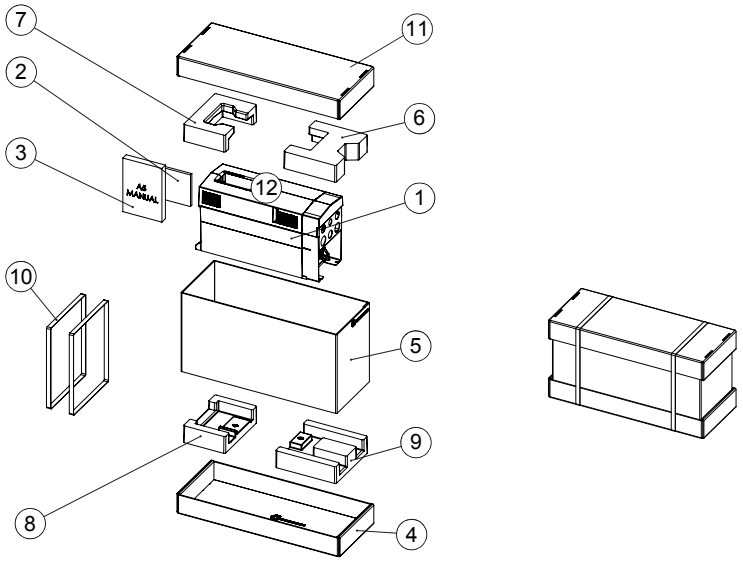


Table D-1

Item	Description	Item	Description
1	Drive with factory installed options. Control cable grounding shelf. Romex connectors in IP21 frames R1 to R3 in a plastic bag inside the cable entry box.	5	Cardboard sleeve
2	Manuals CD	6 - 9	Cushions
3	Printed quick guides and manuals, multilingual residual voltage warning sticker	10	PET straps
4	Cardboard tray	11	Top cardboard cover
-	-	12	Hood included with option +B056

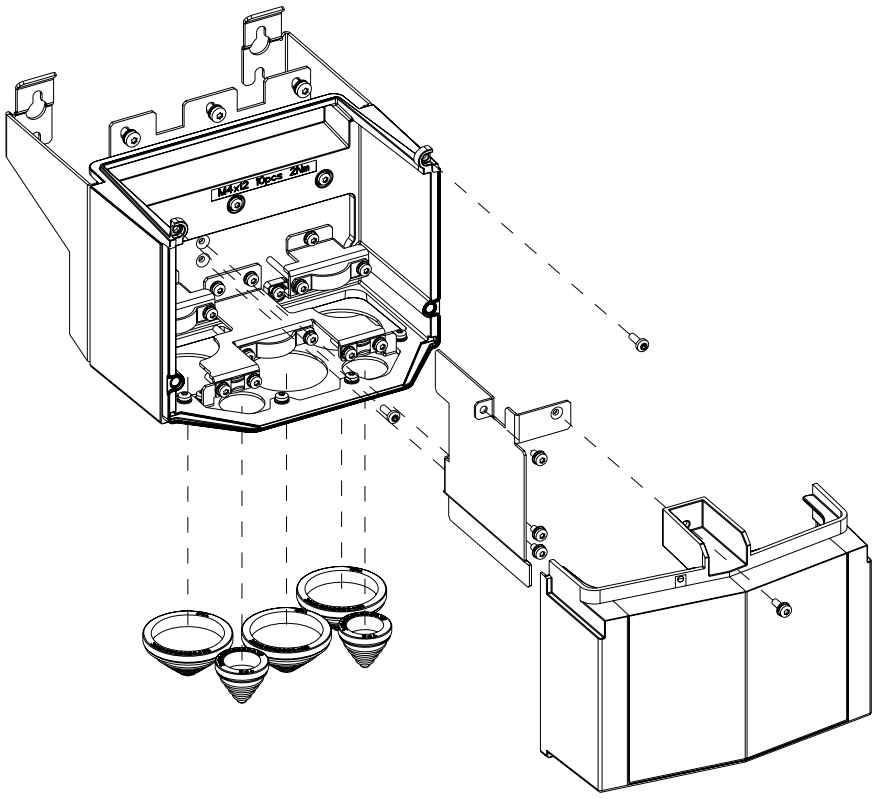
To unpack:

- Cut the straps (10).
- Remove the top cardboard cover (11) and cushions (6 - 9).
- Lift the cardboard sleeve (5).
- Lift the drive.

D.5.1 Frame R5 Cable Entry Box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive module frame.

Figure D-4



D.6 Unpacking and Examining the Delivery (Frames R6 to R9)

This illustration shows the layout of the transport package. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type.

Figure D-5

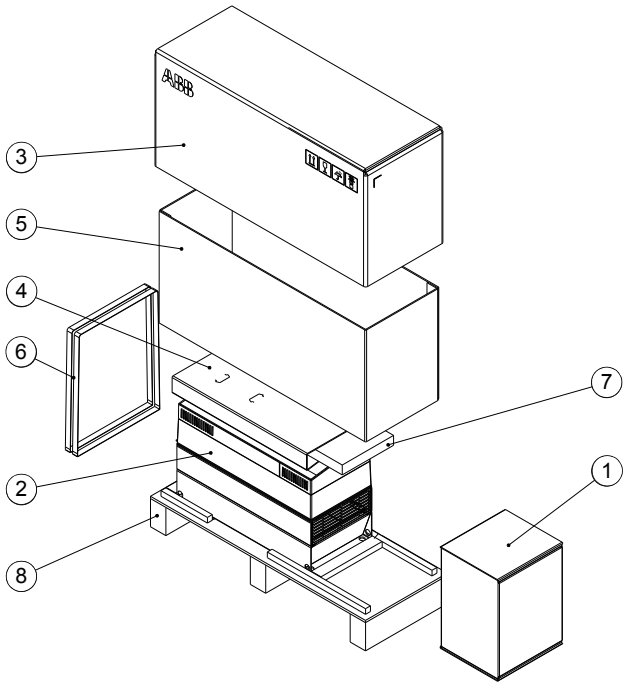


Table D-2

Item	Description	Item	Description
1	Cable entry box. Power and control cable grounding shelves in a plastic bag, assembly drawing. **Note:** The cable entry box is mounted to a IP55 drive module frame at the factory.	5	Cardboard sleeve
2	Drive with factory installed options	6	Straps
3	Top cardboard cover	7	Printed quick guides and manuals CD and multilingual residual valtage warning sticker
4	Cushion	8	Pallet tray

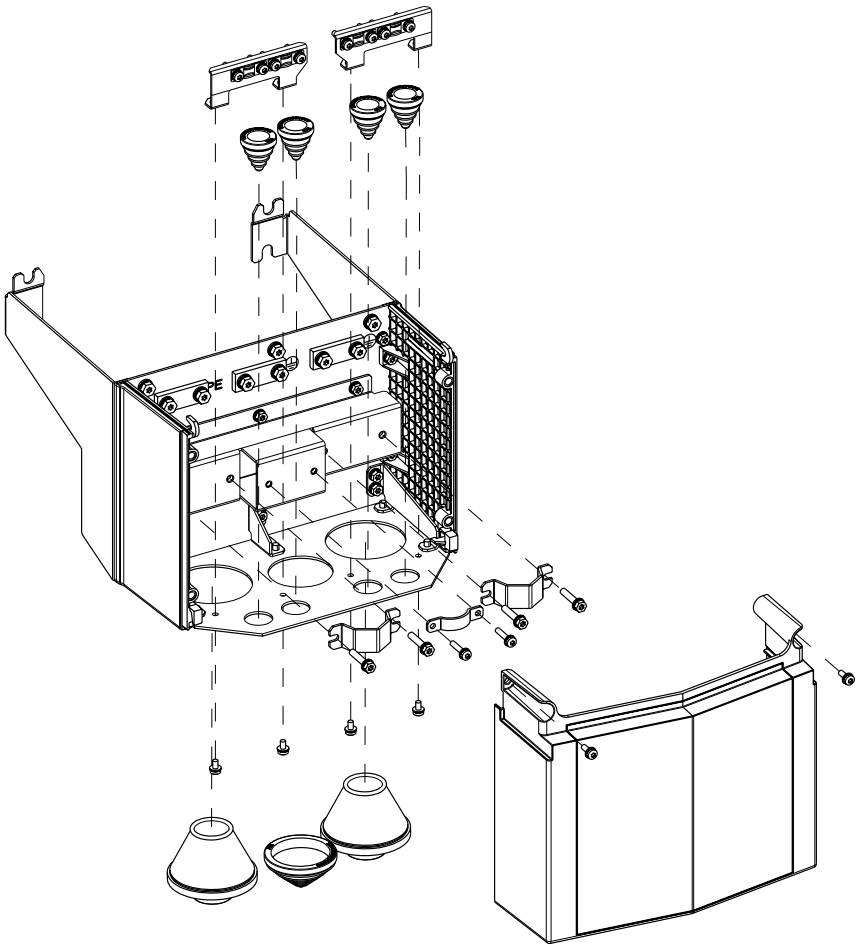
To unpack:

- Cut the straps (6).
- Remove the top cardboard cover (3) and cushion (4).
- Lift the cardboard sleeve (5).
- Attach lifting hooks to the lifting eyes of the drive. Lift the drive with a hoist.

D.6.1 Frame R6 Cable Entry Box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive module frame.

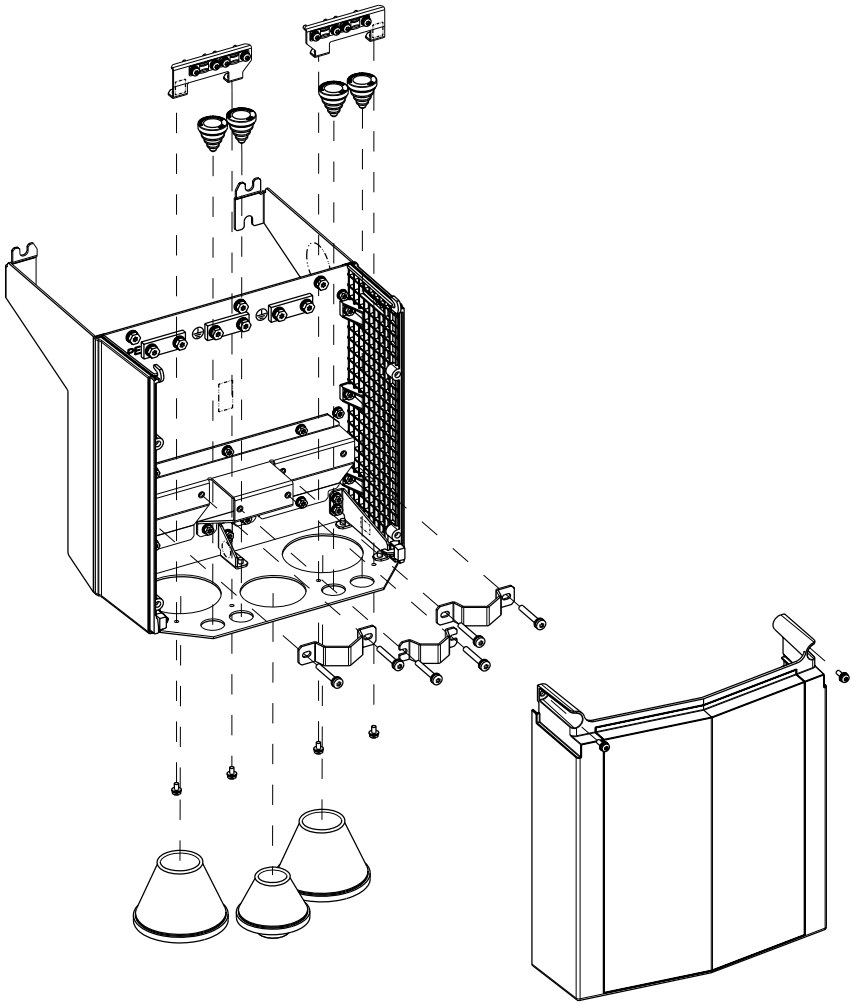
Figure D-6



D.6.2 Frame R7 Cable Entry Box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive module frame.

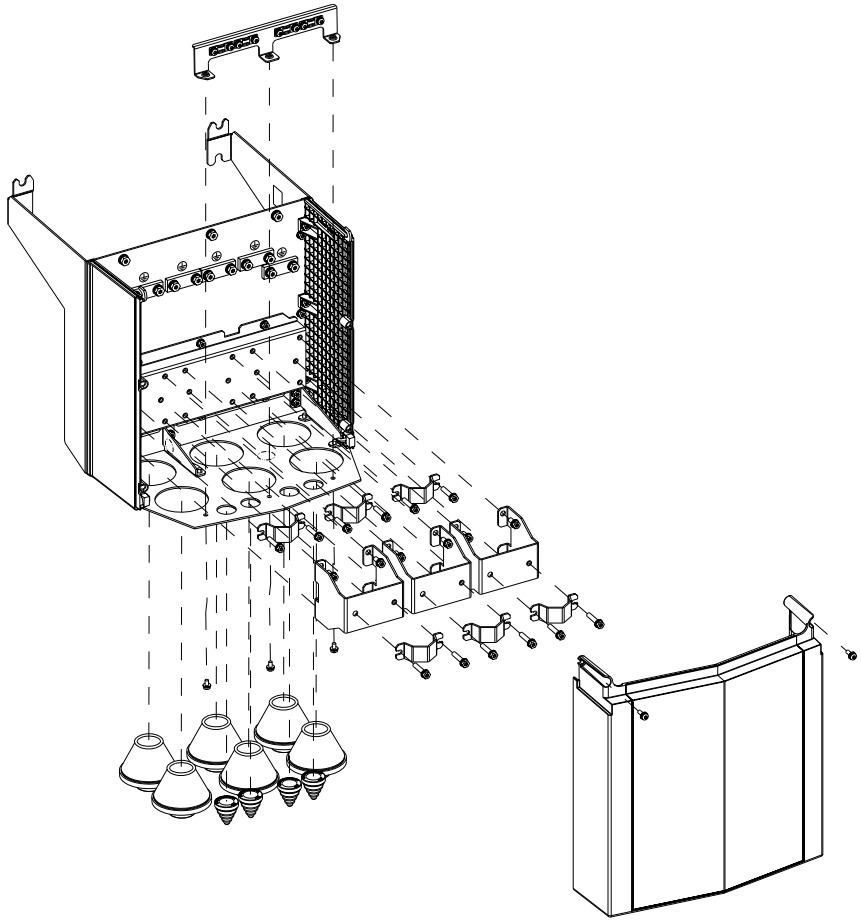
Figure D-7



D.6.3 Frame R8 Cable Entry Box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. There is also an assembly drawing which shows how to install the cable entry box to the drive module frame.

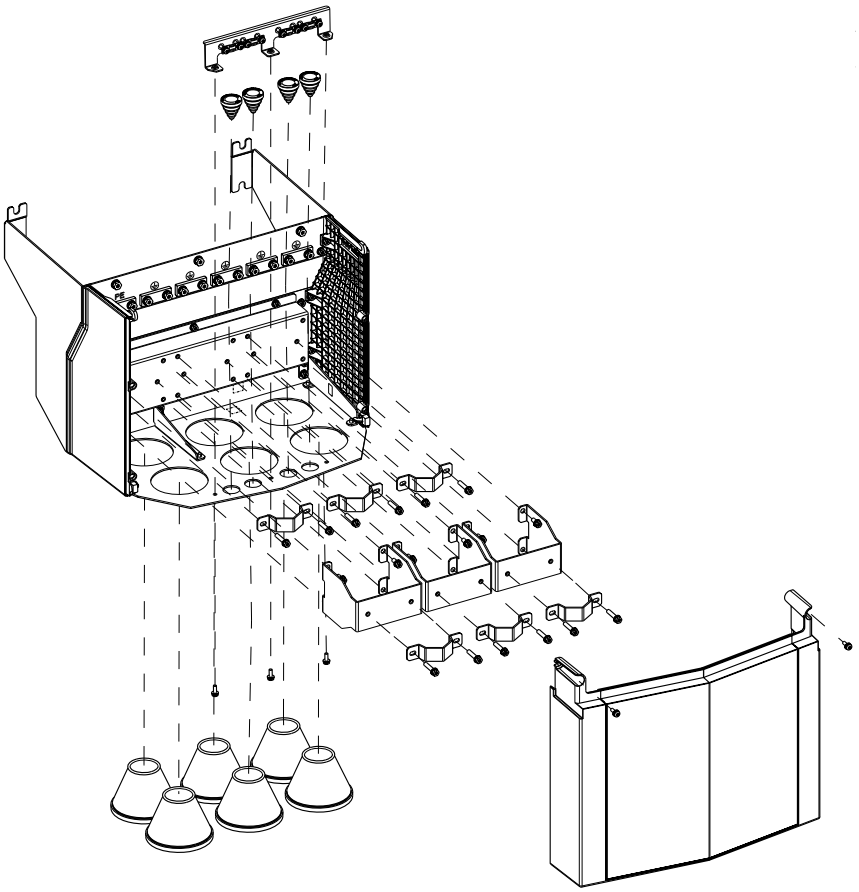
Figure D-8



D.6.4 Frame R9 Cable Entry Box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive module frame.

Figure D-9



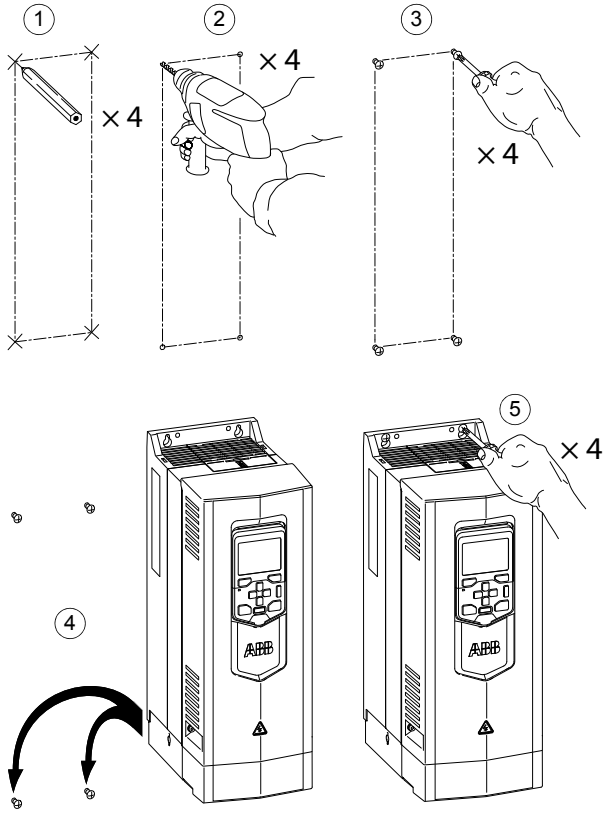
D.7 Installing the Drive

These instructions are for drives without vibration dampers. For drives with vibration dampers (option +C131), see the additional instructions (included with the dampers and on the manuals CD).

D.7.1 Frames R1 to R4

1. See the dimensions in chapter Dimension drawings. Mark the locations for the four mounting holes.
2. Drill the mounting holes.
3. Start the screws or bolts into the mounting holes.
4. Position the drive onto the screws on the wall.
5. Tighten the screws in the wall securely.

Figure D-10



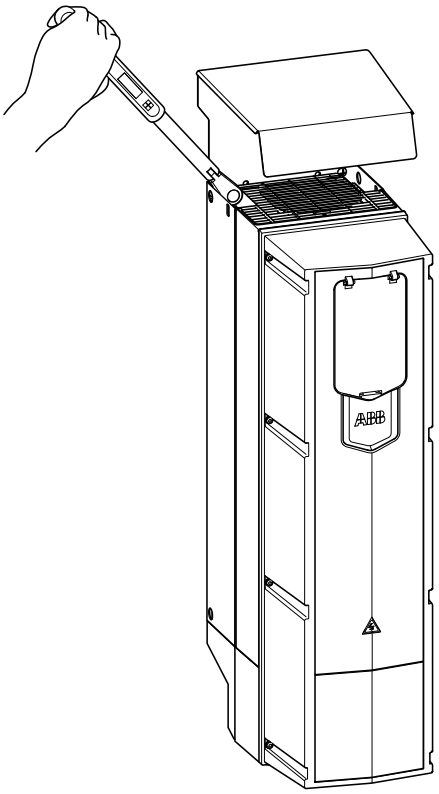
	Screw size
R1	M5
R2	M5
R3	M5
R4	M5

D.7.2 Frames R4 and R7 (UL Type 12)

1. Position the drive onto the screws on the wall as shown in section Frames R5 to R9 without vibration dampers on page 50.
2. Put the hood onto the upper screws.
3. Tighten the upper screws in the wall securely.
4. Tighten the lower screws in the wall securely.

Note: Do not open or remove the cable entry box for easier installation. The gaskets do not fulfill the degree of protection if the box is opened.

Figure D-11

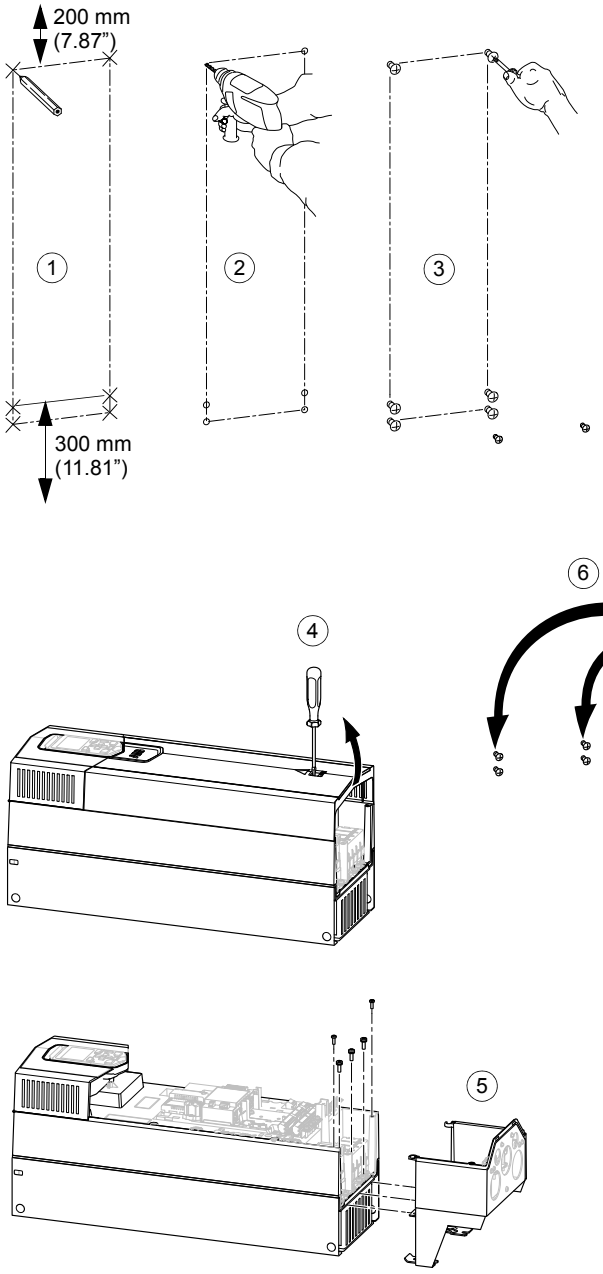


D.7.3 Frames R5 and R9 without Vibration Dampers

1. See the dimensions in chapter Dimension drawings. Mark the locations for the four or six mounting holes.
2. Drill the mounting holes.
3. Start the screws or bolts into the mounting holes.
4. Remove the front cover.
5. For IP21 units: Attach the cable entry box to the drive frame. For instructions, see the assembly drawing in the cable entry box. A view of frame R5 is shown below.
6. Position the drive onto the screws on the wall.
7. Tighten the accessible screws in the wall securely.

Note: If you use the lower mounting screws, you can replace the drive module without unfastening the cable entry box.

Figure D-12



	Screw size
R5	M5
R6	M8
R7	M8
R8	M8
R9	M8

D.8 Cabinet Installation

See ACS880-01 cabinet installation supplement (3AUA0000145446 [English]).

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