

This manual includes

- Safety
- Installation
- Maintenance
- Technical Data

ACS/ACC/ACP 604/607/627 Frequency Converters 55 to 630 kW (75 to 700 HP)



ACS 600 SingleDrive Manuals (English Originals)

GENERAL MANUALS (appropriate hardware manual is included in the delivery)

ACS/ACC/ACP 601 Hardware Manual EN 61201360

2.2 to 110 kW

- Safety instructions
- Cable selection
- Mechanical and electrical installation
- Maintenance
- Technical data
- Dimensional drawings

ACS/ACC 611 Supplement EN 61504443

(included in ACx 611 deliveries only)

- Safety instructions
- Installation
- Maintenance
- Fault tracing
- Parameters
- Technical data
- Dimensional drawings

ACS/ACC/ACP 604/607/627 Hardware Manual EN 61201394,

55 to 630 kW

- Safety instructions
- Cable selection
- Mechanical and electrical installation
- Maintenance
- Technical data

ACS/ACC/ACP 607/627 Dimensional Drawings 64484311, 55 to 630 kW

- Dimensional drawings
- Cable routing

ACS/ACC 607/617/627/677 Hardware Manual EN 61329005

75 to 3000 kW

- Safety instructions
- Cable selection
- Mechanical and electrical installation
- Drive section commissioning
- Maintenance
- Technical data

ACS/ACC 607/617/627/677 Dimensional Drawings EN 64488422,

75 to 3000 kW

- Dimensional drawings

Converter Module Installation in User-defined Cabinet EN 61264922

(included in modules deliveries only)

- Safety instructions
- Cabinet design
- Wiring
- Installation checks
- Dimensional drawings

ACS/ACC 624 Drive Modules Supplement EN 64186477 (included in ACx 624 module deliveries only)

- Safety instructions
- Technical data
- Dimensional drawings

SUPPLY SECTION MANUALS (with 630 to 3000 kW units depending on the supply type one of these manuals is included in the delivery)

Diode Supply Sections User's Manual (DSU)

EN 61451544

- DSU specific safety instructions
- DSU hardware and software descriptions
- DSU commissioning
- Earth fault protection options

Thyristor Supply Sections User's Manual (TSU)

EN 64170597

- TSU operation basics
- TSU firmware description
- TSU program parameters
- TSU commissioning

FIRMWARE MANUALS FOR DRIVE APPLICATION PROGRAMS

(appropriate manual is included in the delivery)

Standard EN 61201441

- Control Panel use
- Standard application macros with external control connection diagrams
- Parameters of the Standard Application Program
- Fault tracing
- Fieldbus control

Note: a separate Start-up Guide is attached

Motion Control EN 61320130

- Control Panel use
- Start-up
- Operation
- Parameters
- Fault tracing
- Fieldbus control

Crane Drive EN 3BSE 011179

- Commissioning of the Crane Drive Application Program
- Control Panel use
- Crane program description
- Parameters of the Crane Drive Application Program
- Fault tracing

Pump and Fan Control (PFC) EN 61279008

- Control Panel use
- Application macros
- Parameters
- Fault tracing
- Fieldbus control
- PFC application example

System EN 63700177

- Commissioning of the System Application Program
- Control Panel use
- Software description
- Parameters of the System Application Program
- Fault tracing
- Terms

Application Program Template EN 63700185

- Commissioning of the Drive Section
- Control Panel use
- Software description
- Parameters
- Fault tracing
- Terms

OPTION MANUALS (delivered with optional equipment)

Fieldbus Adapters, I/O Extension Modules, Braking Choppers etc.

- Installation
- Programming
- Fault tracing
- Technical data

ACS/ACC/ACP 604/607/627 Frequency Converters 55 to 630 kW (75 to 700 HP)

Hardware Manual

This manual concerns the ACS 607, ACS 627, ACC 607, ACC 627, ACP 607 and ACP 627 frequency converters and the ACS 604, ACC 604 and ACP 604 frequency converter modules. In the text, they are collectively referred to as ACx 604/6x7 or ACx 600.

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Safety Instructions

Overview

This chapter states the safety instructions that must be followed when installing, operating and servicing the ACS/ACC/ACP 604/607/627. If neglected, physical injury and death may follow, or damage may occur to the frequency converter, the motor and driven equipment. The material in this chapter must be studied before attempting any work on, or with, the unit.

The following notation is used throughout the manual:



Dangerous Voltage WARNING! warns of situations in which a high voltage can cause physical injury and/or damage equipment. The text next to this symbol describes ways to avoid the danger.



General WARNING! warns of situations which can cause physical injury and/or damage equipment by means other than electrical. The text next to this symbol describes ways to avoid the danger.



Electrostatic Discharge WARNING! warns of situations in which an electrostatic discharge can damage equipment. The text next to this symbol describes ways to avoid the danger.

CAUTION! Aims to draw special attention to a particular issue.

Note: Gives additional information or points out more information available on the subject.

**Installation and
Maintenance Safety**



These safety instructions are intended for all work on the ACx 604/607/627. Neglecting these instructions can cause physical injury and death.

WARNING! All electrical installation and maintenance work on the ACx 600 should be carried out by qualified electricians.

Do not attempt any work on a powered ACx 600. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before working on the frequency converter, the motor or the motor cable. The voltage between each input terminal (U1, V1, W1) and earth must be measured with a multimeter (impedance at least 1 MΩ) to ensure that the frequency converter is discharged before beginning work.

All insulation tests must be carried out with the ACx 600 disconnected from the cabling.

The ACx 600 motor cable terminals are at a dangerously high voltage when input power is applied, regardless of motor operation. No work on the motor cable should be attempted with mains power applied.

The brake control terminals (UDC+, UDC-, R+ and R- terminals) carry a dangerous DC voltage (over 500 V).

There can be dangerous voltages inside the ACx 600 from external control circuits when the ACx 600 input power is shut off. No work on the control cables should be attempted when power is applied to the frequency converter or to the external control circuits. Exercise appropriate care when working with the unit.

Permanent Magnet Motor



WARNING!

Installation and maintenance work

When a permanent magnet motor is connected to the drive, ensure that the driven machine cannot rotate the motor during installation and maintenance work. When rotating, the permanent magnet motor feeds power to the intermediate circuit of the drive and also the supply connections become live (even when the inverter is stopped!). Disconnect the motor from the drive with a safety switch, or lock the motor shaft and earth the motor connection terminals temporarily by connecting them together as well as to the PE.

Normal use

Ensure that the permanent magnet motor cannot rotate at too high a speed. Overspeed leads to overvoltage which may explode the capacitors in the intermediate circuit of the drive.

Permanent magnet motor may be used with *ACS 600 Permanent Magnet Synchronous Motor (PMSM) System Application Program*, or with other application programs in scalar control mode only.



Supply Connections

ACx 6x7 units include an on-load isolating switch fuse with handle in the front door. This switch fuse does not switch off the power from the EMC Line Filter of ACS/ACC 6x7-0400-3, -0490-3/5/6, -0610-3/5/6 and -0760-5/6 units. For ACS/ACC 6x7-0400-3, -0490-3/5/6, -0610-3/5/6 and -0760-5/6 units with EMC Line Filter and for the ACx 604 module, a supply disconnecting device must be installed in the supply, by which the electric parts of the unit can be separated from the mains (power) network during installation and maintenance work. The supply disconnecting device must be locked to the open position during installation and maintenance work.

To meet the European Union Directives, the disconnecting device shall fulfil the requirements of EN 60204-1 chapter 5.3.3. and shall be one of the following types:

- a switch-disconnector, in accordance with IEC 60947-3, utilization category AC-23B or DC-23B
- a disconnector in accordance with IEC 60947-3, that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector.

It is not allowed to install an ACx 604/6x7 with the EMC Filter options (code 0 or 3 in the type code for EMC Filters) to unearthed mains (an ungrounded power system or a high resistance grounded power system (over 30 ohms)). The mains will be connected to earth potential through the EMC filter of the ACx 600 which may cause danger or damage the unit. Disconnect the EMC filter capacitors before connecting the ACx 600 to unearthed mains. For detailed instructions on how to do this, please contact your local ABB distributor.

The motor must not be controlled with the supply disconnecting device; instead, the  and  keys of the Control Panel or commands via the digital inputs (NIOC board) or serial communication (NAMC board) of the ACx 600 should be used. The maximum number of charging cycles of the d.c. capacitors of ACx 600 (i.e. power-ups by applying the input power) is five in ten minutes.



WARNING! Never connect the mains (line power) to the ACx 600 output. If frequent bypassing is required, employ mechanically connected switches or contactors that prevent simultaneous connection of the motor to the supply network and to the output of the ACx 600. Mains (line) voltage applied to the output can result in permanent damage to the unit.

Operation outside the nominal voltage range should not be attempted, as overvoltages can result in permanent damage to the ACx 600.

Earth (Ground) Fault Protective Function

The ACx 600 is equipped with an internal earth fault protective function to protect the unit against earth faults in the inverter, the motor and the motor cable. This is not a personal safety or a fire protection feature. The earth fault protective function can be disabled by Parameter 30.17 EARTH FAULT (Standard Application Program) and Parameter 30.11 (Crane Application Program). The internal earth fault protective function is not in use in the 12-pulse supplied units. For ACS 62x units, refer to subsection *Special for ACx 6x7 Units from 315 to 630 kW*.


The EMC filter of the ACx 600 includes capacitors connected between the main circuit and the frame. These capacitors increase the earth (ground) leakage current through the PE connector to the mains (line) which may cause some fault current circuit breakers to function.

Power Loss Ride-through Function



WARNING! When equipped with a main contactor option, the drive also includes a Power Loss Ride-through function which keeps the drive control live during a short main supply break. **If this function is not safe for your process, inactivate it** according to the instructions given in *ACS/ACC/ACP 607 Contactor Option Information on the Power Loss Ride-through Function* (EN code 64354949).

Emergency Stop Devices

Emergency stop devices must be installed at each operator control station and at other operating stations where emergency stop may be required. Pressing the  key on the Control Panel of ACx 600 does not generate an emergency stop of the motor or separate the drive from dangerous potential. Line Contactor and Emergency Stop Switch are factory installed as option for ACx 6x7.

Motor Connections



WARNING! Operation is not allowed if the motor nominal voltage is less than 1/2 of (ACP: 0.4 times) the ACx 600 nominal input voltage, or the motor nominal current is less than 1/6 of the ACx 600 nominal output current I_{2hd} .

Pulses in the Drive Output

As with all frequency converters employing the most modern IGBT inverter technology, the ACx 600 output comprises – regardless of output frequency – pulses of approximately 1.35 times the mains network voltage with a very short rise time.

The voltage of the pulses can be almost double at the motor terminals, depending on the motor cable properties. This in turn can cause additional stress on the motor insulation.

Modern variable speed drives with their fast rising voltage pulses and high switching frequencies can cause current pulses through the motor bearings which can gradually erode the bearing races.

Protecting the Motor Winding

The stress on motor insulation can be avoided by using optional ABB du/dt filters. du/dt filters also reduce bearing currents.

Protecting the Motor Bearings

To avoid damage to motor bearings, insulated N-end (non-driven end) bearings and output filters from ABB must be used according to the following table. In addition, the cables must be selected and installed according to the instructions given in this manual. Three types of filters are used individually or in combinations:

1. optional ACS 600 du/dt filter (protects motor insulation system and reduces bearing currents)
2. ACS 600 common mode filter (mainly reduces bearing currents)
3. ACS 600 light common mode filter (mainly reduces bearing currents).

The common mode filter is composed of toroidal cores installed onto the motor cable.

Requirements Table

The following table shows how to select the motor insulation system and when optional ACS 600 du/dt filters, insulated N-end (non-driven end) motor bearings and ACS 600 common mode filters are required. The motor manufacturer should be consulted regarding the construction of the motor insulation and additional requirements for explosion-safe motors. Failure of the motor to fulfil the following requirements or improper installation may shorten motor life or damage the motor bearings.

Manufacturer	Motor Type	Nominal Mains Voltage	Requirement for			
			Motor Insulation System	ACS 600 du/dt Filter, Insulated N-end bearing and ACS 600 Common Mode Filter		
				$P_N < 100 \text{ kW}$ and Frame Size < IEC 315	$100 \text{ kW} \leq P_N < 350 \text{ kW}$ or Frame Size \geq IEC 315	$P_N \geq 350 \text{ kW}$
A B B	Random-wound M2_ and M3_	$U_N \leq 500 \text{ V}$	Standard	-	+ N	+ N + CMF
		$500 \text{ V} < U_N \leq 600 \text{ V}$	Standard	+ du/dt	+ du/dt	+ du/dt + N + LCMF
			or	Reinforced	-	+ N
		$600 \text{ V} < U_N \leq 690 \text{ V}$	Reinforced	+ du/dt	+ du/dt	+ du/dt + N + LCMF
	Form-wound HXR and AM_	$380 \text{ V} < U_N \leq 690 \text{ V}$	Standard	n.a.	+ N + CMF	+ N + CMF
	Old* form-wound HX_ and modular	$380 \text{ V} < U_N \leq 690 \text{ V}$	Check with the motor manufacturer.	+ du/dt filter with voltages over 500 V + N + CMF		
Random-wound HXR	$380 \text{ V} < U_N \leq 690 \text{ V}$	Check with the motor manufacturer.	+ du/dt filter with voltages over 500 V + N + CMF			
N O N - A B B	Random-wound and form-wound	$U_N \leq 420 \text{ V}$	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	-	+ N or CMF	+ N + CMF
		$420 \text{ V} < U_N \leq 500 \text{ V}$	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
			or	+ du/dt + CMF		
			or	Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$, 0.2 microsecond rise time	-	+ N or CMF
		$500 \text{ V} < U_N \leq 600 \text{ V}$	Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$	+ du/dt	+ du/dt	+ du/dt + N + LCMF
			or	Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$	-	+ N or CMF
	$600 \text{ V} < U_N \leq 690 \text{ V}$	Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$	+ du/dt	+ du/dt	+ du/dt + N + LCMF	
	Form-wound	$600 \text{ V} < U_N \leq 690 \text{ V}$	Reinforced: $\hat{U}_{LL} = 2000 \text{ V}$, 0.3 microsecond rise time	n.a.	+ N + CMF	+ N + CMF

* manufactured before 1992

Note 1: The abbreviations used in the table are defined below.

Abbreviation	Definition
U_N	nominal mains voltage
\hat{U}_{LL}	peak line-to-line voltage at motor terminals which the motor insulation must withstand
P_N	motor nominal power
du/dt	du/dt filter
CMF	common mode filter: 3 toroidal cores per each motor cable
LCMF	light common mode filter: 1 toroidal core per each motor cable
N	N-end bearing: insulated motor non-driven end bearing
n.a.	Motors of this power range are not available as standard units. Consult the motor manufacturer.

Note 2: *ACA 635 IGBT Supply Sections and the ACS/ACC 611*

If voltage is raised by the ACA 635 or the ACS/ACC 611, select the motor insulation system according to the increased intermediate circuit d.c. voltage level, especially in the 500 V (+10%) supply voltage range.

Note 3: *HXR and AMA Motors*

All AMA machines (manufactured in Helsinki) to be supplied by a frequency converter have form-wound windings. All HXR machines manufactured in Helsinki since 1997 have form-wound windings.

Note 4: *Chopper Resistor Braking*

When the drive is in braking mode for a large part of its operation time, the intermediate circuit DC voltage of the drive increases, the effect being similar to increasing the supply voltage by up to 20 percent. This should be taken into consideration when determining the motor insulation requirement.

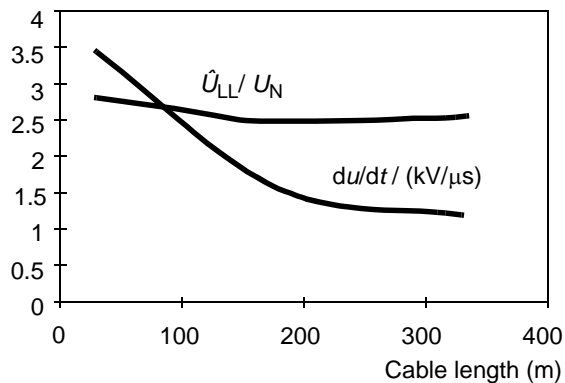
Example: Motor insulation requirement for a 400 V application must be selected as if the drive were supplied with 480 V.

Note 5: This table applies to NEMA motors with the following heading.

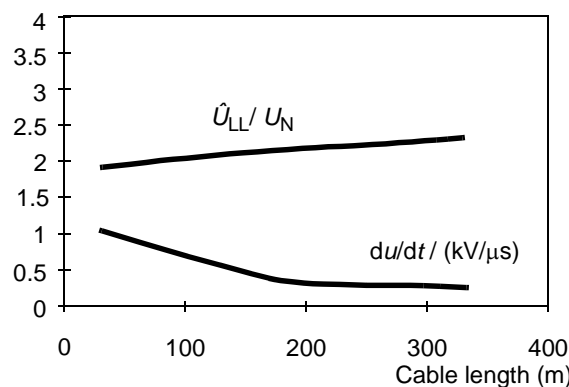
$P_N < 134$ HP and Frame Size < NEMA 500	$134 \text{ HP} \leq P_N < 469$ HP or Frame Size \geq NEMA 500	$P_N \geq 469$ HP
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Note 6: Calculating the Rise Time and the Peak Line-to-line Voltage

The peak line-to-line voltage at the motor terminals generated by the ACS 600 as well as the voltage rise time depend on the cable length. The requirements for the motor insulation system given in the table are “worst case” requirements covering the ACS 600 installations with 30 metre and longer cables. The rise time can be calculated as follows: $\Delta t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$. Read \hat{U}_{LL} and du/dt from the diagrams below.



Without du/dt Filter



With du/dt Filter



WARNING! The ACx 600 introduces electric motors, drive train mechanisms and driven machines to an extended operating range. It should be determined from the outset that all equipment is up to these conditions.



WARNING! There are several automatic reset functions in the ACS 600 (with Standard Application Program). If selected, they reset the unit and resume operation after a fault. These functions should not be selected if other equipment is not compatible with this kind of operation, or dangerous situations can be caused by such action.



WARNING! If an external source for start command is selected and it is ON, the ACS 600 (with Standard Application Program) will start immediately after fault reset.

**Power Factor
Compensation
Capacitors**

Power factor compensation capacitors and surge absorbers must not be connected to the motor cables. These devices are not designed to be used with frequency converters, and will degrade motor control accuracy. They can cause permanent damage to the ACx 600 or themselves due to the rapid changes in the ACx 600 output voltage.

If there are power factor compensation capacitors in parallel with the ACx 600 make sure that the capacitors and the ACx 600 are not charged simultaneously to avoid voltage surges which might damage the unit.

Output Contactors

If a contactor is used between the output of the ACx 600 and the motor with DTC control mode selected, the output voltage of the ACx 600 must be controlled to zero before the contactor is opened. Otherwise the contactor will be damaged. With Standard Application Program, check the settings of Parameters 21.03 STOP FUNCTION and 16.01 RUN ENABLE. For program version 6.x, check also Parameter 21.07 RUN ENABLE FUNC. (For further information, see the *Firmware Manual*.) In scalar control the contactor can be opened with ACS/ACC 600 running.

Varistors or RC networks (AC) or diodes (DC) should be used to protect against voltage transients generated by contactor coils. The protective components should be mounted as close as possible to the contactor coils. Protective components should not be installed at the NIOC board terminal block.

Relay Contacts

When used with inductive loads (relays, contactors, motors), the relay contacts of ACx 600 must be protected with varistors or RC networks (AC) or diodes (DC) against voltage transients. The protective components should not be installed at the NIOC board terminal block.

**Earth (Ground)
Connections**

The ACx 600 and adjoining equipment must be properly earthed.

The ACx 600 and the motor must be earthed at the installation site to ensure personnel safety in all circumstances and in addition to reduce electromagnetic emission and pick-up. Make sure that earthing (grounding) conductors are adequately sized as required by safety regulations.

In CE compliant installations and in other installations where EMC emissions must be minimized, 360° high frequency earthing (grounding) of cable entries is done in order to suppress electromagnetic disturbances. In addition, cable screens have to be connected to protective earth (PE) in order to meet safety regulations. Power cable screens are suitable for use as equipment earthing (grounding) conductors only when the screen conductors are adequately sized as required by safety regulations.

The ACx 600 earth (ground) terminals should not be connected in series in case of a multiple installation. Incorrect earthing can cause physical injury, death or equipment malfunction and increase electromagnetic interference.

Components Connected to Digital/ Analogue Inputs



WARNING! IEC 664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

To fulfil this requirement, the connection of a thermistor (and other similar components) to the digital inputs of ACx 600 can be implemented in three alternate ways:

1. There is double or reinforced insulation between the thermistor and live parts of the motor.
 2. Circuits connected to all digital and analogue inputs of the ACx 600
 - are protected against contact, and
 - insulated with basic insulation (the same voltage level as the converter main circuit) from other low voltage circuits.
 3. An external thermistor relay is used. The insulation of the relay must be rated for the same voltage level as the converter main circuit.
-

EMC

Note: If safety switches, contactors, connection boxes or similar equipment are used in the motor cable, they should be installed in a metal enclosure with 360 degrees earthing for the screens of both the incoming cable and the outgoing cable, or the screens of the cables should otherwise be connected together.



WARNING! The printed circuit boards contain integrated circuits that are extremely sensitive to electrostatic discharge. Exercise appropriate care when working on the unit to avoid permanent damage to the circuits. Do not touch the boards unnecessarily.

Cooling



WARNING! The cooling air flows and space requirements must be fulfilled. Special attention must be paid to cooling if units are installed in confined spaces and user defined cabinets. Air flow from below, e.g. a cable conduit, into the cabinet must be prevented. This is essential for fire safety reasons, and to retain the original degree of protection. For best results, use the lead-through plates delivered with the unit.

Mechanical Installation

CAUTION! The ACx 6x7 should only be transported on the original pallet, or with a proper lifting device using the lifting lugs on top of the cabinet. The frequency converter is not intended to be lifted by running lines under the unit. The ACx 6x7 centre of gravity is quite high, and there is the risk of overturning. The ACx 6x7 can be laid on its back to fit through confined spaces. Exercise appropriate care when manoeuvring the unit to avoid damage and injury. This work should only be attempted with two or more people working together.

CAUTION! Make sure that dust from drilling does not enter the ACx 600 when installing. Electrically conductive dust inside the unit may cause damage or lead to malfunction.

CAUTION! The ACx 6x7 should not be fastened by any other point than the holes at its base or the fastening hooks. Do not fasten the ACx 600 by riveting or welding.

**Special for ACx 6x7
Units from 315 to
630 kW**



For types ACx 6x7-0400-3 and -0490-5/6 and up note the following issues.

WARNING! Make sure that the ACx 6x7 is disconnected from the mains network during installation. The switch fuse (with handle in the front door) of the ACx 6x7 does not switch off power from the EMC Line Filter. Disconnect the ACx 6x7 with EMC Line Filter from the mains network at the distribution board. Wait for 5 minutes before working on the frequency converter, the motor or the motor cable.

Note: On units not equipped with main contactors, additional wiring by the commissioner is required for activation of the mains fuse supervision of the ACx 6x7 and the earth fault detection functions of the ACx 627. It is recommended that these functions be wired to switch off the mains supply should a fuse failure or an earth fault occur. Refer to the circuit diagrams (Sheet 50) supplied with the unit and *Chapter 3 – Electrical Installation (Types ACx 6x7-0400-3, -0490-5/6 and up)*, or contact your ABB representative for information.

Safety Instructions

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Chapter 1 – Introduction

General

The ACS 600 product family of three phase frequency converters and converter modules for speed control of squirrel cage electric motors includes

- the ACS 600 (for most applications)
- the ACP 600 (for positioning, synchronising and other high-precision control applications)
- the ACC 600 (for crane drive applications)
- the ACS 600 MultiDrive (for multidrive applications)

The application programs are introduced in *Appendix – A*.

Study this manual carefully before storing, installing, commissioning, operating or servicing the frequency converter. We expect that you have a basic knowledge of physical and electrical fundamentals, electrical wiring practices, electrical components and electrical schematic symbols.

Other Manuals

Items concerning the ACx 6x4/6x7 in other manuals are listed below. For EN codes of the manuals refer to inside of the front cover of this manual.

For	See
dimensional drawings, cable routing inside the cabinet	<i>ACS/ACC/ACP 607/627 Dimensional Drawings</i>
start-up	<i>Start-up Guide</i> for ACS 600 Standard Application Program. If the ACx 600 is equipped with another application program, see the appropriate <i>Firmware Manual</i> .
ACx 604 modules and 624 modules from 315 to 700 kW	<i>Converter Module Installation in User-defined Cabinet</i>
ACx 624 modules from 75 to 315 kW	<i>ACS/ACC 624 Drive Modules Supplement</i>
optional equipment	their manuals
programming the unit	the appropriate <i>Firmware Manual</i>

Delivery Check

Check that there are no signs of damage. Before attempting installation and operation, check the information on the frequency converter nameplate to verify that the unit is of the correct model.

Each ACx 600 is fitted with a nameplate for identification purposes. The nameplate data includes a type code and a serial number, which allow individual recognition of each unit. The type code contains information on the properties and configuration of the unit. 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 serial number.

ACx 6x4/6x7 Type Code

The meaning of the main selections of the ACx 6x4/6x7 type code characters is given in the table below. Not all selections are available for all types. More information on selections is given in *ACS 600 SingleDrive Ordering Information* guide (code: 58977985, available on request).

Character no.	Meaning	Refer to
Example: ACS60701003000B1200901		
1	Product Category A = AC Drive	
2...3	Product Type CS = Standard, CC = Crane Drive, CP = MotionControl	
4	Product Family 6 = ACS 600	
5	Input Bridge 0 = 6-pulse rectifier, 2 = 12-pulse rectifier, 7 = Regenerative 4Q thyristor bridge	
6	Construction 1 = Wall mounted, 4 = Module, 7 = Cabinet	
7..10	Power Rating (kVA)	<i>Appendix A: Ratings</i>
11	Voltage Rating 3 = 380/400/415 V a.c. 4 = 380/400/415/440/460/480/500 V a.c. 5 = 380/400/415/440/460/480/500 V a.c. 6 = 525/550/575/600/660/690 V a.c.	
12...14	Option 1, Option 2, Option 3	
15	Application Software x = Languages and Application Macro Options	<i>Appendix A: Application Programs</i>
16	Control Panel 0 = None, 1 = Control Panel included, 4 = Customer I/O Terminal Block X2, 5 = 1 + 4	

Character no.	Meaning	Refer to
17	Degree of Protection 0 = IP 00 (chassis), A = IP 21, 2 = IP 22, 4 = IP 42, 5 = IP 54, 6 = IP 00 with Coated Boards, 7 = IP 22 with Coated Boards, 8 = IP 42 with Coated Boards 9 = IP 54 with Coated Boards B = IP 21 with Coated Boards	<i>Appendix A: Enclosures</i>
18	Line Input and Protection Options	
19	Starter for Auxiliary Motor Fan	
20	Filters 0 = with EMC Filters (not for 690V or 12-pulse rectifier) 3 = with output du/dt Filters + EMC Filters (not for 690V) 5 = Output du/dt Filters + no EMC Filters 8 = No CE, no EMC filters, US conduit (ACS 607 only, 115 VAC transformer secondary; compliant with NFPA 90) 9 = without EMC Filters A = Common Mode Filter B = Common Mode Filter + EMC Filter (not for 690V) C = du/dt Filter + Light Common Mode filter D = du/dt Filter + Light Common Mode filter + EMC Filter (not for 690V) E = du/dt Filter + Common Mode Filter F = du/dt Filter + Common Mode Filter + EMC Filter (not for 690V) G = Light Common Mode Filter	<i>Appendix A: CE marking</i>
21	ACx 607: Braking Chopper and Cabling Direction ACx 604: R = NDCU control unit outside the module 0 = NIOC and NAMC boards inside the module	
22	Other Options	

Inquiries

Any inquiries about the product should be addressed to the local ABB representative, quoting the type code and the serial number of the unit. If the local ABB representative cannot be contacted, inquiries should be addressed to ABB Industry, Helsinki, Finland.

Chapter 2 – Mechanical Installation

See [Appendix A – ACS/ACC/ACP 604/6x7 Technical Data](#) for allowed operation conditions of the ACx 604/6x7. For installation of ACx 604 module in a cabinet refer to a supplement to this manual: *Converter Module Installation in User-defined Cabinet* (EN code: 61264922).

The ACx 6x7 should be installed in an upright vertical position.

The floor that the unit is installed on should be of non-flammable material, as smooth as possible, and strong enough to support the weight of the unit. The maximum allowed deviation from the surface level must be ≤ 2 mm measured every 1 m. The installation site should be levelled (when needed), as the ACx 6x7 is not equipped with adjustable feet.

The ACx 6x7 can be installed on elevated floor and over a cable duct. The integrity of the supporting structure must be checked before the ACx 6x7 is placed in such a position.

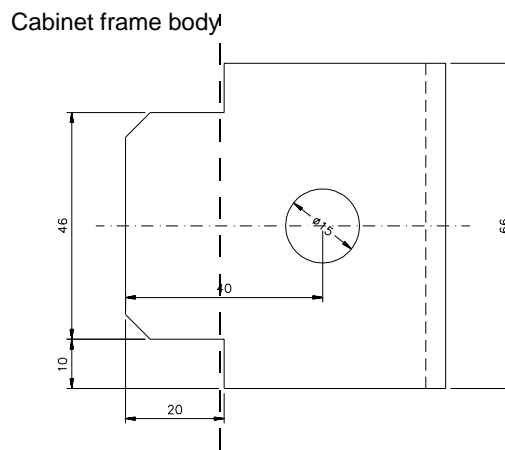
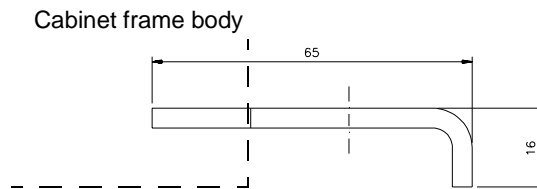
ACx 6x7 can be installed with its back against a wall. Sufficient room around the ACx 6x7 is required to enable cooling air flow, service and maintenance.

The wall behind the unit should be of non-flammable material.

Fastening the Cabinet to the Floor

Fastening the cabinet to the floor is especially important in installations subjected to vibration or other movement. Fasten the cabinet to the floor with bolts through the holes at its base **or** from outside with fastening clamps attached to its bottom front (and back edges if not installed against wall). Check the intended installation site for sufficient room. Check that there is nothing on the floor to inhibit installation. See the dimensional drawings in *ACS/ACC/ACP 607/627 Dimensional Drawings*. Make cable duct opening if cables come from a cable duct. Smooth cable duct edges if required.

Fastening Clamps Insert the clamp into the longitudinal hole in the edge of the cabinet frame body and fasten it with a bolt to the floor. The longitudinal holes for fixing are marked in the dimensional drawings.



Dimensions of the fastening clamp

- Holes inside the Cabinet**
1. See *ACS/ACC/ACP 607/627 Dimensional Drawings* for the fastening hole locations.
 2. Make holes for bolts to the floor. Insert plugs into the fastening holes.
 3. Place the frequency converter carefully onto the holes.
 4. Place bolts in the plugs.
 5. Tighten the bolts.

Chapter 3 – Electrical Installation



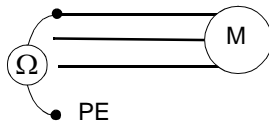
WARNING! The electrical installation described in this chapter should only be carried out by a qualified electrician. The [Safety Instructions](#) on the first pages of this manual must be followed. Negligence of these instructions can cause injury or death.

Insulation Checks

Every ACx 600 unit has been tested for insulation between main circuit and chassis (2500 V rms 50 Hz for 1 second) at the factory. Therefore there is no need to check the insulation on the unit again. When checking the insulation of the assembly, proceed in the following manner:



WARNING! Insulation checks must be performed before connecting the ACx 600 to the mains. Before proceeding with the insulation resistance measurements make sure that the ACx 600 is disconnected from the mains.



1. Check that the motor cable is disconnected from the ACx 600 output terminals U2, V2 and W2.
2. Measure the insulation resistances of motor cable and the motor between each phase and Protective Earth with measuring voltage 1 kV d.c. The insulation resistance must be higher than 1 MΩ.

Mains Fuses

Fuses are needed to protect the input bridge of the ACx 600 in case of an internal short circuit. The ACx 6x7 is equipped with internal input fuses introduced in [Appendix A – ACS/ACC/ACP 604/6x7 Technical Data](#). The ACx 604 is not equipped with input fuses. When installing the ACx 604, you must always connect the supply via ultrarapid fuses given in [Appendix A – ACS/ACC/ACP 604/6x7 Technical Data](#).

If a fuse is blown, it must not be replaced with a normal slow fuse rated according to [Appendix A – ACS/ACC/ACP 604/6x7 Technical Data](#). An ultrarapid fuse must be used.

The ACx 600 protects the input and motor cables from overload when the cables are dimensioned according to the nominal current of the ACx 600. When the ultrarapid fuses of the ACx 604 are placed at the distribution board, they protect the input cable in case of a short circuit.

Input Cable Protection Normal slow fuses can be used to protect the input cable in case of a short circuit. (They do not protect the input bridge of ACx 600 in case of a short circuit.) Slow fuses must be dimensioned according to local safety regulations, appropriate mains voltage and the rated current of the ACx 600 (see [Appendix A – ACS/ACC/ACP 604/6x7 Technical Data](#)).

Cabling Instructions

Power Cables

The mains and motor cables must be dimensioned **according to local regulations**:

1. The cable must be able to carry the ACx 600 load current.
2. The cable terminals of ACx 600 warm up to 60 °C (140 °F) during operation. The cable must be rated for at least 60 °C (140 °F) maximum operating temperature.
3. The cable must fulfil the requirements of the short-circuit protection used.
4. The inductance and impedance of the cable must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise too high when an earth fault occurs).

The voltage rating of the mains cables should be 1 kV for 690 VAC rated equipment. For the North American market, 600 VAC rated cable is accepted for 600 VAC rated equipment. Voltage rating for the motor cables should be minimum 1 kV as a general rule.

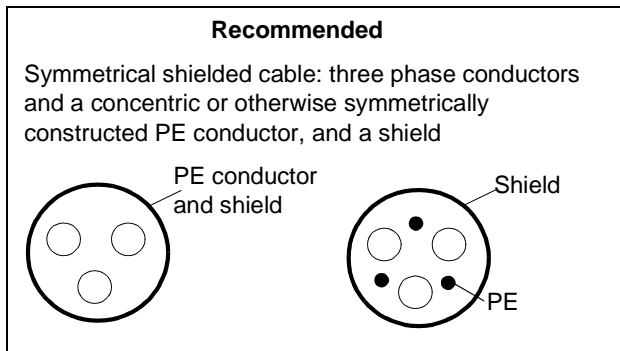
Symmetrical shielded motor cable must be used (figure below).

Four-conductor system is allowed for mains cabling, but shielded symmetrical cable is recommended. To operate as a protective conductor, the shield conductivity must be at least 50 % of the conductivity of the phase lead.

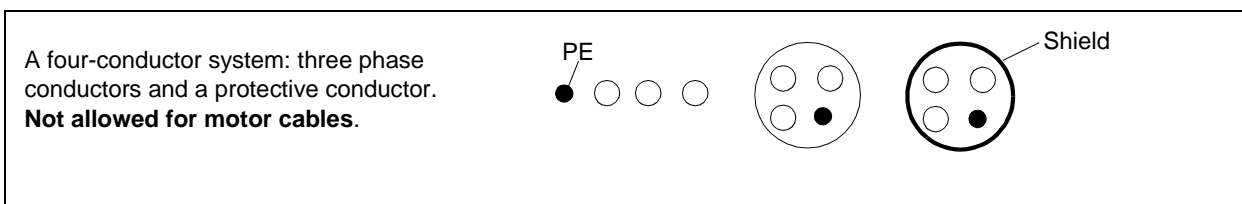
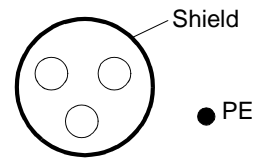
Compared to a four-conductor system, the use of symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as motor bearing currents and wear.

The motor cable and its PE pigtail (twisted screen) should be kept as short as possible in order to reduce electromagnetic emission as well as capacitive current.

Alternative Power Cable Types Power cable types that can be used with the ACx 600 are represented below.

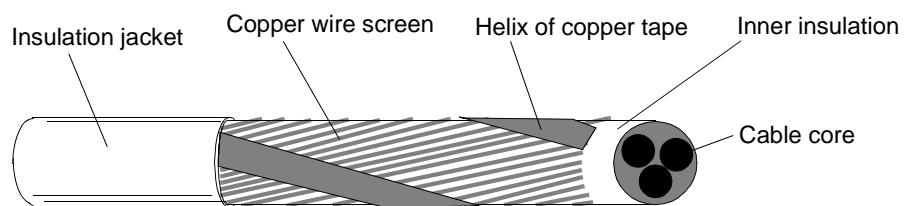


A separate PE conductor is required if the conductivity of the cable shield is < 50 % of the conductivity of the phase conductor.



Motor Cable Shield

To effectively suppress radiated and conducted radio-frequency emissions, the shield conductivity must be at least 1/10 of the phase conductor conductivity. One way of evaluating the effectiveness of the shield is the shield inductance, which must be low and only slightly dependent on the frequency. These requirements are easily met with a copper or aluminium shield/armour. The minimum requirement of the motor cable shield of the ACx 600 is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape. The better and tighter the shield, the lower the emission level and the bearing currents.



**Special for Types
ACx 6x7-0400-3, -0490-5
and -0490-6 and up**

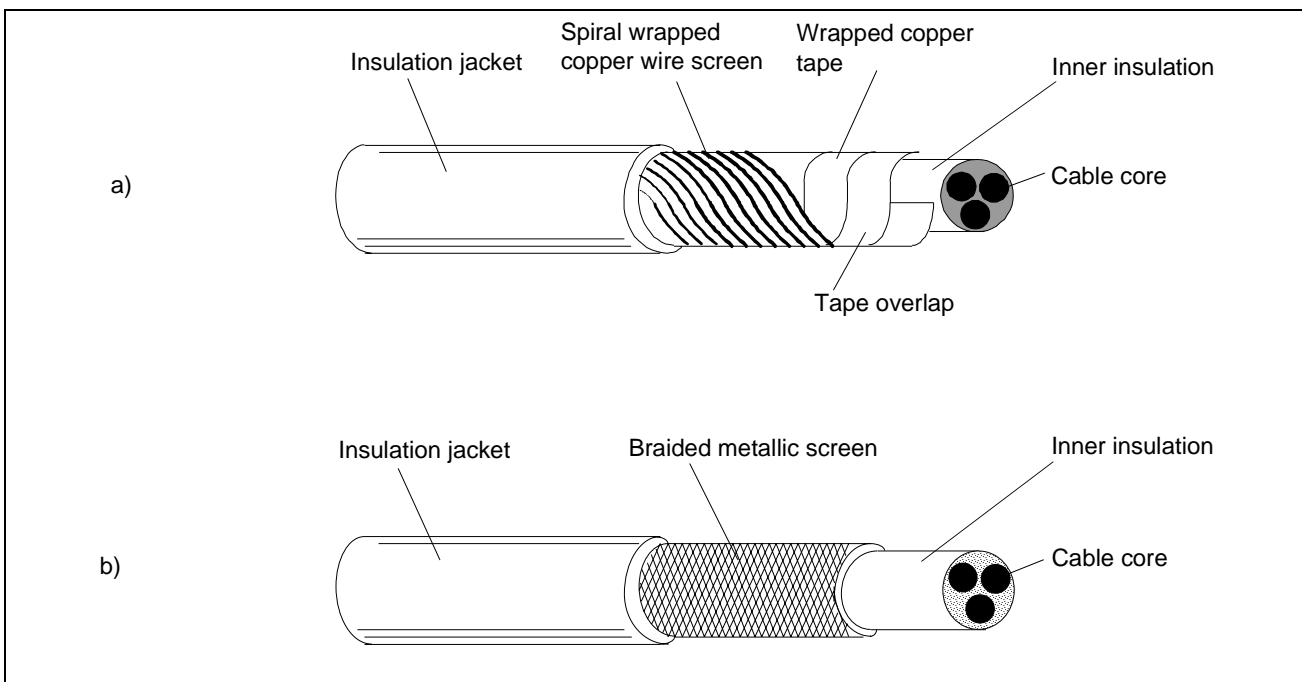
For compliance with the European Union EMC Directive, the ACx 6x7 must be installed with screened power cables specified below. For information on other equivalent cables, please contact your local ABB distributor.

Motor Cable

The motor cable used in the ACx 6x7 frequency converter installation must be a symmetrical three conductor screened cable in order to fulfil the radiated emission requirements stated in the generic emission standard for industrial environment EN 61800-3. The cable types MCCMK and AMCCMK (from NK Cables, Finland) and VUSO and VO-YMvK-as from DRAKA KABEL have been tested and approved by ABB Industry.

Equivalent cables from other manufacturers that fulfil the requirements can be used in the installation of ACx 6x7 as well. The suitability of a cable type can be decided on the grounds of either screen construction or transfer impedance. The general rule for the cable screen effectiveness is: the better and tighter the screen of the cable, the lower the radiated emission level.

There are two kinds of cable screen constructions that fulfil the minimum requirement of screen effectiveness: a screen consisting of a layer of copper tape (overlapping each round) and a concentric layer of copper wires (figure a below), or a screen consisting of a braided galvanised steel wire (item b below).



Mains Cable The mains cable used in the installation must be a three- or four-conductor screened cable. The cable types MCMK and AMCMK from NK Cables have been tested and approved by ABB Industry.

The mains cable screen of an equivalent cable must at least consist of a concentric layer of copper wires with an open helix of copper tape connecting the wires together and reducing the size of the holes in the screen (figure on page 3-3). However, motor cables with better shielding (eg. braided screen) emit considerably less high frequency interference.

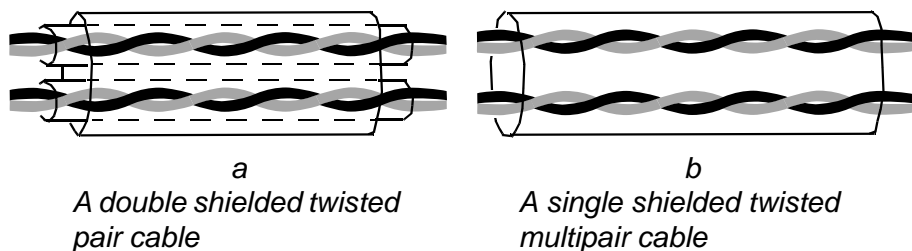
Control Cables

All control cables must be shielded. As a general rule, the control signal cable shield should be earthed directly in the ACx 600. The other end of the shield should be left unconnected or earthed indirectly via some nanofarad high-frequency, high-voltage capacitor (e.g. 3.3 nF / 3000 V). The screen can also be earthed directly at both ends if they are *in the same earth line* with no significant voltage drop between the end points.

Twisting the signal wire with its return wire reduces disturbances caused by inductive coupling. Pairs should be twisted as close to terminals as possible.

A double shielded twisted pair cable (figure a, e.g. JAMAK by NK Cables, Finland) must be used for analogue signals and is recommended for the pulse encoder signals. Employ one individually shielded pair for each signal. Do not use common return for different analogue signals.

A double shielded cable is the best alternative for low voltage digital signals but single shielded twisted multipair cable (figure b) is also usable.



The analogue and digital signals should be run in separate, screened cables.

Relay-controlled signals, providing their voltage does not exceed 48 V, can be run in the same cables as digital input signals. It is recommended that the relay-controlled signals be run as twisted pairs.

Never mix 24 VDC and 115 / 230 VAC signals in the same cable.

Relay Cable

The cable type with braided metallic screen (e.g. ÖLFLEX, LAPPKABEL, Germany) has been tested and approved by ABB Industry.

Encoder Cable (ACP 600)

Min. $4 \cdot 0.25 \text{ mm}^2 + 2 \cdot 0.5 \text{ mm}^2$, min. single shielded twisted multipair cable, optical coverage $\geq 91 \%$. The maximum cable length is 150 m. Suitable cable is available from ABB.

Control Panel Cable In remote use the cable connecting the Control Panel to the ACx 600 must not exceed 3 metres. The cable type tested and approved by ABB Industry is used in Control Panel option kits.

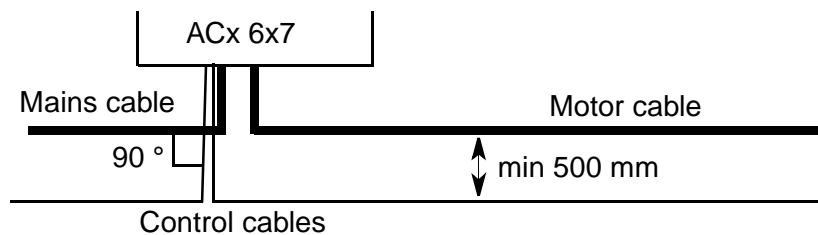
Cable Routing

The motor cable should be installed away from other cable routes. Motor cables of several frequency converters can be run in parallel installed next to each other. It is recommended that the motor cable, mains cable and control cables be installed on separate trays (minimum distance 500 mm). Long parallel runs of motor cable with other cables should be avoided in order to decrease electromagnetic interference caused by the rapid changes in the frequency converter output voltage.

Where control cables must cross power cables make sure they are arranged at an angle as near to 90 degrees as possible. Extra cables should not be run through the ACx 600.

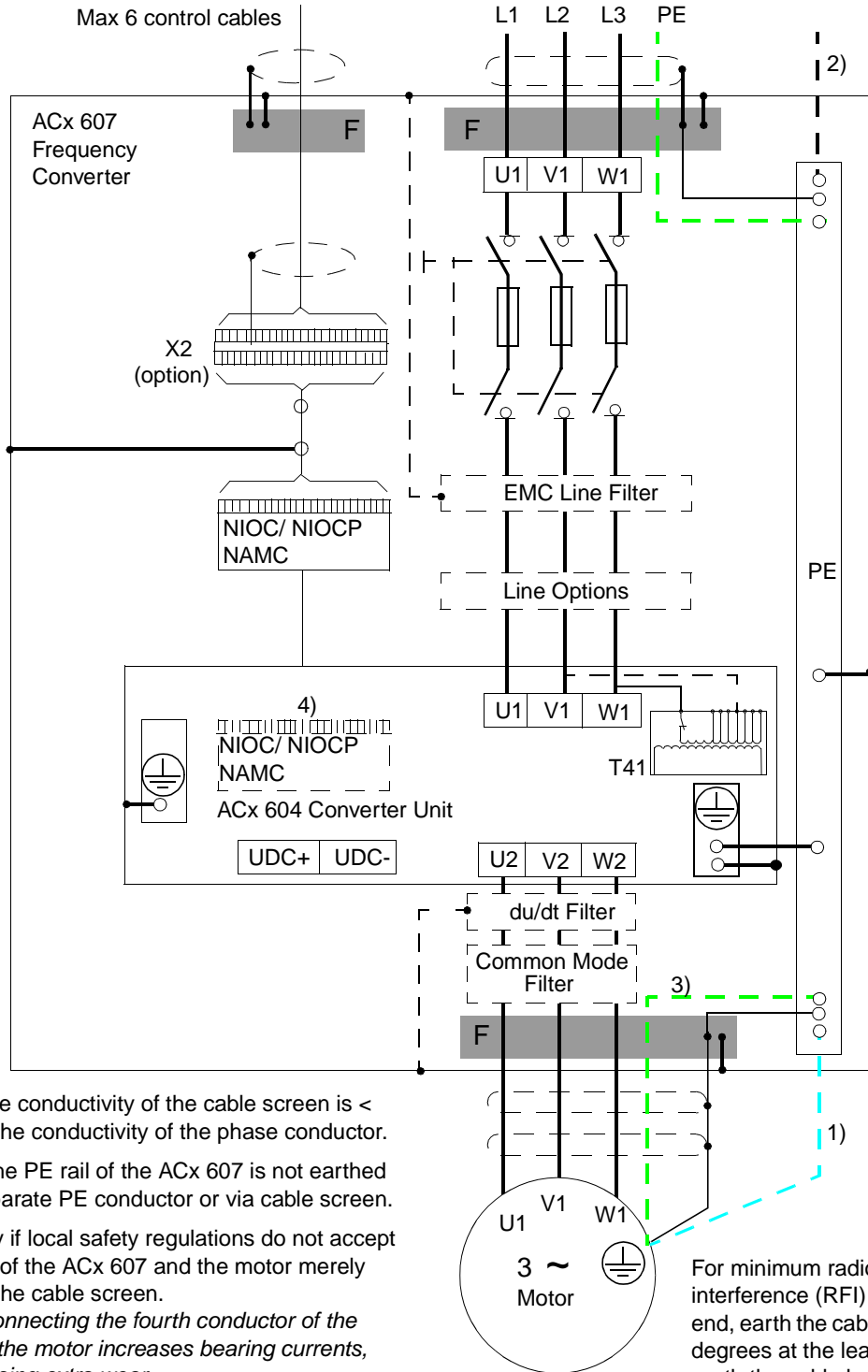
The cable trays shall have good electrical bonding to each other and to the earthing electrodes. Aluminium tray systems can be used to improve local equalizing of potential.

Below is a diagram of cable routing.



Mains, Motor and Control Cable Connection

A view of the recommended earthing, mains and motor cable connections of the ACx 607 (types -0320-3 and -0400-5/6 and smaller) is presented below. F denotes a 360 degrees earthing.



- 1) used if the conductivity of the cable screen is < 50 % of the conductivity of the phase conductor.
- 2) used if the PE rail of the ACx 607 is not earthed via a separate PE conductor or via cable screen.
- 3) used only if local safety regulations do not accept earthing of the ACx 607 and the motor merely through the cable screen.
Note: Connecting the fourth conductor of the cable at the motor increases bearing currents, thus causing extra wear.
- 4) The NIOC/NIOCP board is located inside the module in ACx 604 deliveries.

For minimum radio frequency interference (RFI) at the motor end, earth the cable screen 360 degrees at the lead-through or earth the cable by twisting the screen (flattened width $\geq 1/5$ · length).



WARNING! This work should only be carried out by a qualified electrician. The *Safety Instructions* on the first pages of this manual must be followed. Negligence of these instructions can cause injury or death.

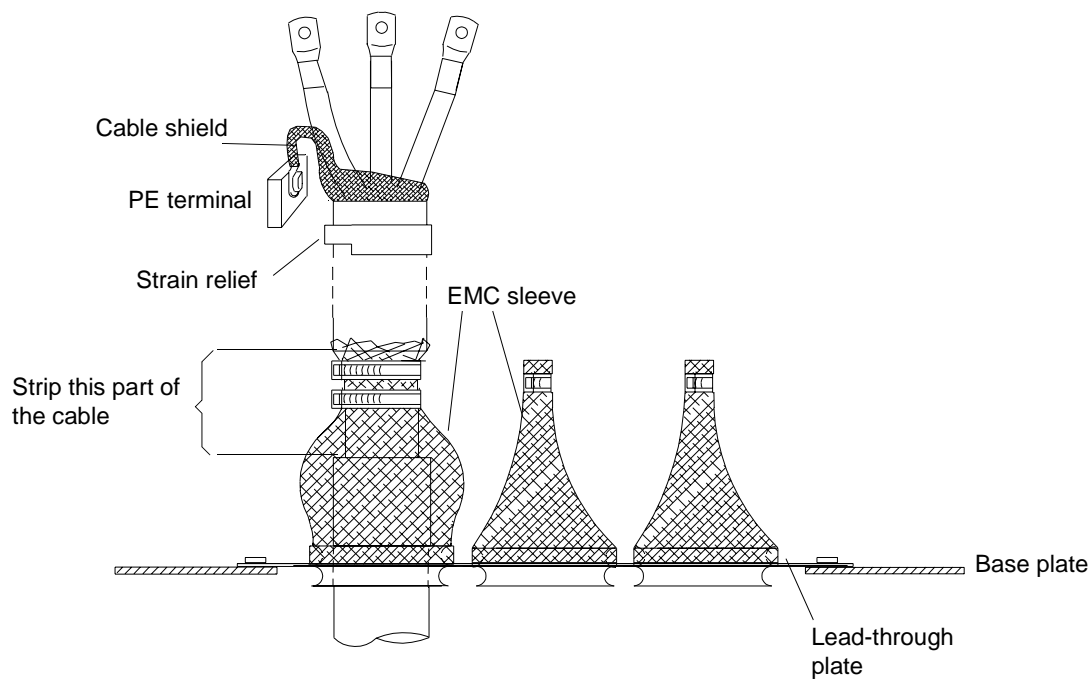
Frame Sizes R7 to R9

The mains and motor cables connect to the ACx 607 in the left part of the cabinet. Mains, motor and control cable lead-through is from below or from above. To locate the terminals see the dimensional drawings (*Appendix B*). To connect the mains and motor cables to the ACx 607, carry out the following procedure.

1. **Make sure that the ACx 607 is disconnected from the mains network during installation. Wait for 5 minutes if the ACx 607 is already connected to the mains after disconnecting mains power.**
2. Open the cabinet door.
3. Open the hinged assembly plate to gain access to the mains and motor cable terminals.
4. **Measure the voltage between each input terminal (U1, V1, W1) and earth with a multimeter (impedance at least 1 M Ω) to ensure that the frequency converter is discharged.**
5. Lead the cables inside the cabinet through the EMC sleeves.
If cable entry is not possible otherwise, remove the lead-through plate and slide it onto the cable. After the earthing connections are done, fasten the lead-through plate. *IP 54 and cable entry from above:* Remove the rubber grommets from the lead-through plates and cut them to adequate diameter for the mains and the motor cable. To ensure proper sealing, cut along the diameter marking that corresponds to the cable diameter. Slide the grommet onto the cable.

Earthing Connections

6. Strip the cable according to the figure below. (For IP 54 units and cable entry from above, add a rubber grommet on the cable under/above the lead-through plate.)
7. Tighten the EMC sleeve on the bare cable screen with cable ties.
8. Twist the screen wires together to a pigtail and connect to the PE terminal of the cabinet.

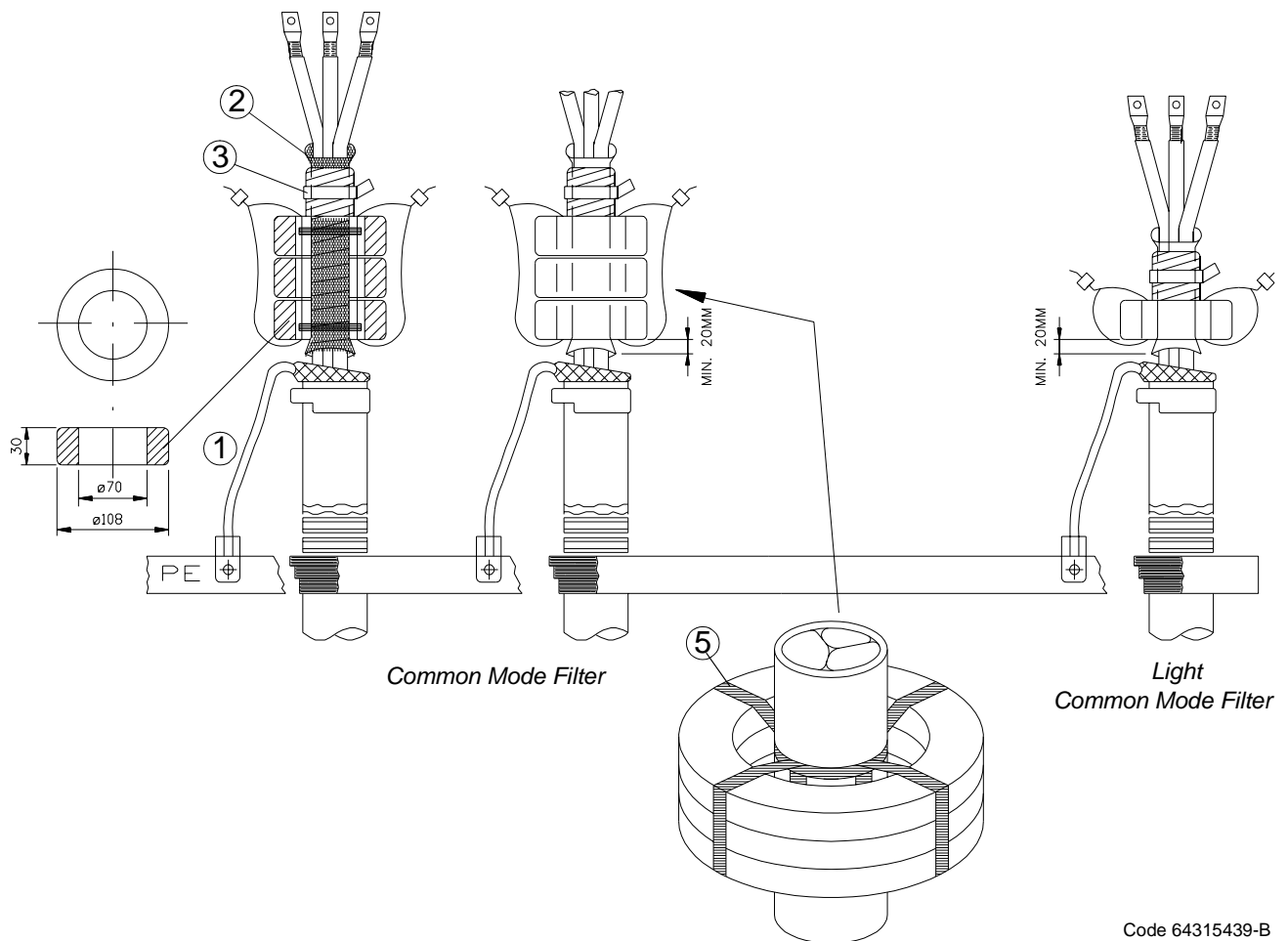


9. Earth the other end of the mains cable screen at the distribution board.
10. Earth the motor cable screen 360 degrees on the motor side.
11. Connect the additional PE conductors (if present) of the mains and motor cables to the PE terminal of the cabinet.
12. Connect the separate PE conductor (if used) to the PE terminal of the cabinet.

Common Mode Filter

If common mode filter or light common mode filter is required (see *Safety Instructions: Motor Connections / Requirements Table*), lead the motor cable phase conductors through the toroidal cores as follows:

1. Connect the twisted cable screen to the PE terminal.
2. Wrap the phase conductors together with the silicon rubber tape delivered with the toroidal cores to provide thermal insulation for the conductor insulator. Cover the part of the cable which will be left inside the core(s) + 20 mm below. Approximately 1.5 metres of tape is needed per cable. Each turn must overlap the previous turn by half the width of the tape.
3. Bind the conductors tightly with non-conductive electrical tape and a non-metallic cable tie in order to prevent conductor insulation damage caused by the core edges.
4. Slide the core(s) onto the taped part of the phase conductors.
5. Bind the cores together and onto the taped part of the phase conductors with heat-resisting non-metallic cable ties.



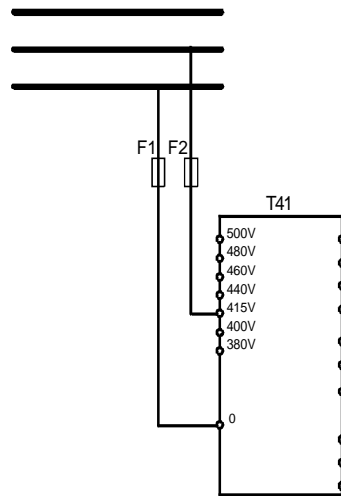
Code 64315439-B

Mains and Motor Cable Connections

1. Connect the phase conductors of the mains cable to the U1, V1 and W1 terminals and the phase conductors of the motor cable to the U2, V2 and W2 terminals.
2. Check that the earthing is still OK.
3. Close the hinged assembly plate.

Transformer Settings

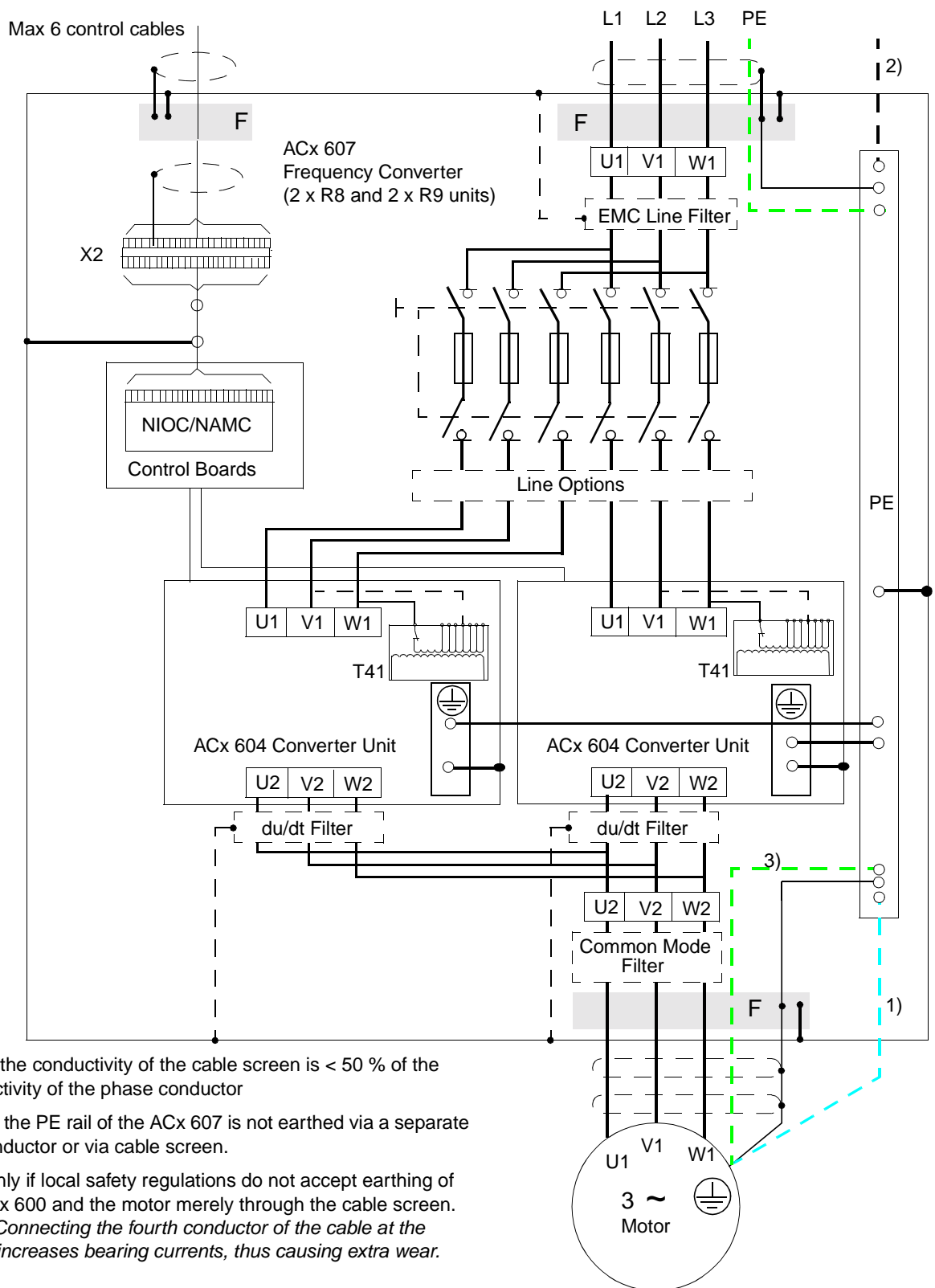
1. ACx 604/607 units (except frame R7 units) include a transformer (T41) which supplies power to the cooling fan at the base of the converter unit. The transformer is set to 415 V, 500 V or 690 V at the factory. Adjust the setting if it does not correspond to the supply voltage. To access the transformer remove the front cover of the converter unit with the ABB logo. After adjusting the voltage put the plate back into its place.



2. Cabinets with the line contactor option include an internal auxiliary voltage transformer. Its input voltage is set to 415 V, 500 V or 690 V at the factory. Adjust the setting if it does not correspond to the supply voltage. The transformer is located in the upper right part of the cabinet, and is visible when the cabinet door is opened.

**Types ACx 6x7-0400-3,
-0490-5/6 and up (2 x R8
and 2 x R9)**

A detailed view of the recommended earthing, mains and motor cable connections of the ACx 6x7 parallel connected units is presented below. F denotes a 360 degrees earthing.



- 1) used if the conductivity of the cable screen is < 50 % of the conductivity of the phase conductor
- 2) used if the PE rail of the ACx 607 is not earthed via a separate PE conductor or via cable screen.
- 3) used only if local safety regulations do not accept earthing of the ACx 600 and the motor merely through the cable screen.
Note: Connecting the fourth conductor of the cable at the motor increases bearing currents, thus causing extra wear.

To connect the mains and motor cables for ACx 6x7 frame sizes 2 x R8 and 2 x R9, carry out the following procedure:

1. **Make sure that the ACx 6x7 is disconnected from the mains network during installation. The switch fuse (with handle in the front door) of the ACx 6x7 does not switch off power from the EMC Line Filter. Disconnect the ACx 6x7 with EMC Line Filter from the mains network at the distribution board. Wait for 5 minutes before working on the frequency converter, the motor or the motor cable.**
2. Open the cabinet door.
3. If EMC Line Filter is used, check that there is no voltage in its output terminals: measure the voltage from one terminal against the two other terminals and from terminal to earth.
4. Remove the emission shields and shrouds.
5. Go to point 5 on page 3-9. Connect the earthing, common mode filter, mains and motor cables.

Transformer Settings

1. Both converter units include a transformer (designation T41) which supplies the cooling fan at the base of the unit (as well as the mains fuse supervision function). On each converter unit, remove the front cover plate and verify that the transformer is set to the correct supply voltage.
2. Both the left-hand and right-hand cabinets include an auxiliary voltage transformer, designated T21 and T10 respectively (pointed out in *Appendix C*). Verify that these transformers are set to the correct supply voltage.

Mains Fuse Supervision

The mains fuse supervision function uses the outputs of transformers T21 (LH cabinet), T10 (RH cabinet), and T41 (inside each converter unit) for detecting mains fuse failure. The fuse condition information is wired to terminal block X3, and further to the main contactors (if present).

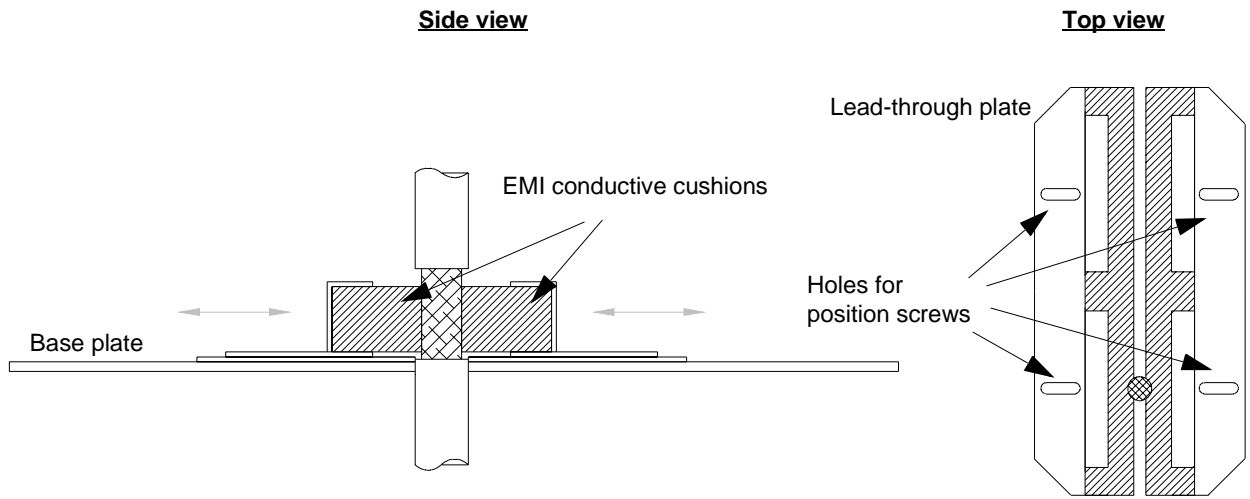
ACx 627 Earth Fault Detection

The internal earth fault protective function is not in use in 12-pulse supplied ACx 627 units. Earth fault detection is implemented by means of a separate unit, wired to terminal block X3, and further to the main contactors (if present).

Note: On units **not** equipped with main contactors, additional wiring by the commissioner is required for activation of the mains fuse supervision and ACx 627 earth fault detection functions. It is recommended that these functions be wired to switch off the mains supply should a fuse failure or an earth fault occur. Refer to the circuit diagrams (Sheet 50) supplied with the unit.

Control Cable Connecting Procedure

To connect the control cables for the ACx 6x7 carry out the following procedure:



Special for Top Entry

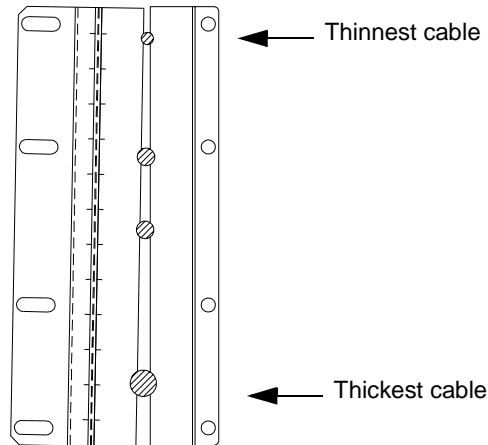
When each cable has its own rubber grommet, sufficient IP and EMC protection can be achieved. However, if very many control cables come to one cabinet, plan the installation beforehand as follows:

1. Make a list of the cables coming to the cabinet.
2. Sort the cables going to the left into one group and the cables going to the right into another group to avoid unnecessary crossing of cables inside the cabinet.
3. Sort the cables in each group according to size.
4. Group the cables for each grommet as follows:

Cable diameter in mm	Max. number of cables per grommet
≤ 13	4
≤ 17	3
< 25	2
≥ 25	1

5. Divide the bunches so that the cables will be arranged according to size between the *EMI conductive cushions*.

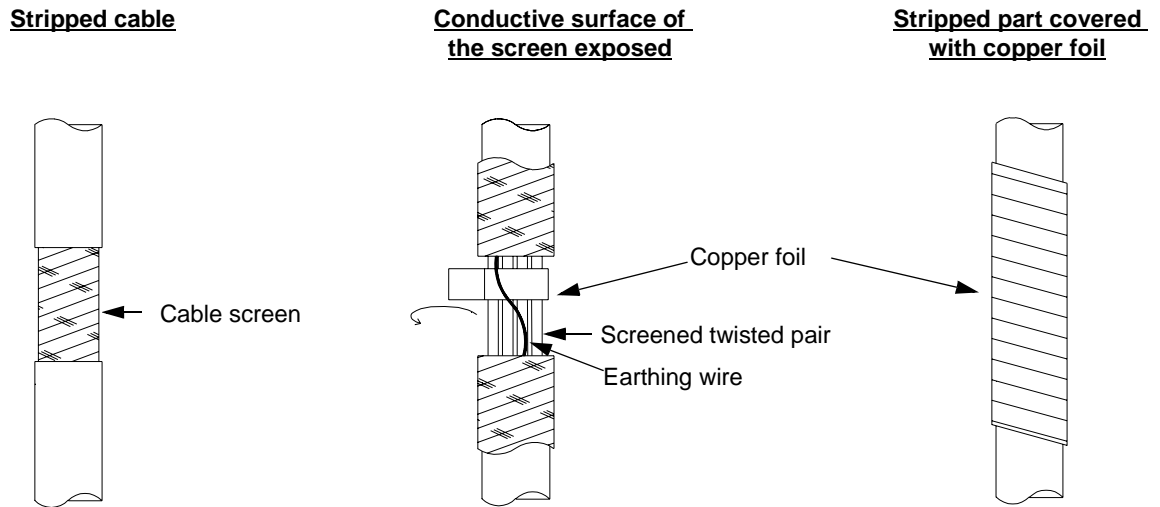
View from below



Bottom and Top Entry Proceed as follows:

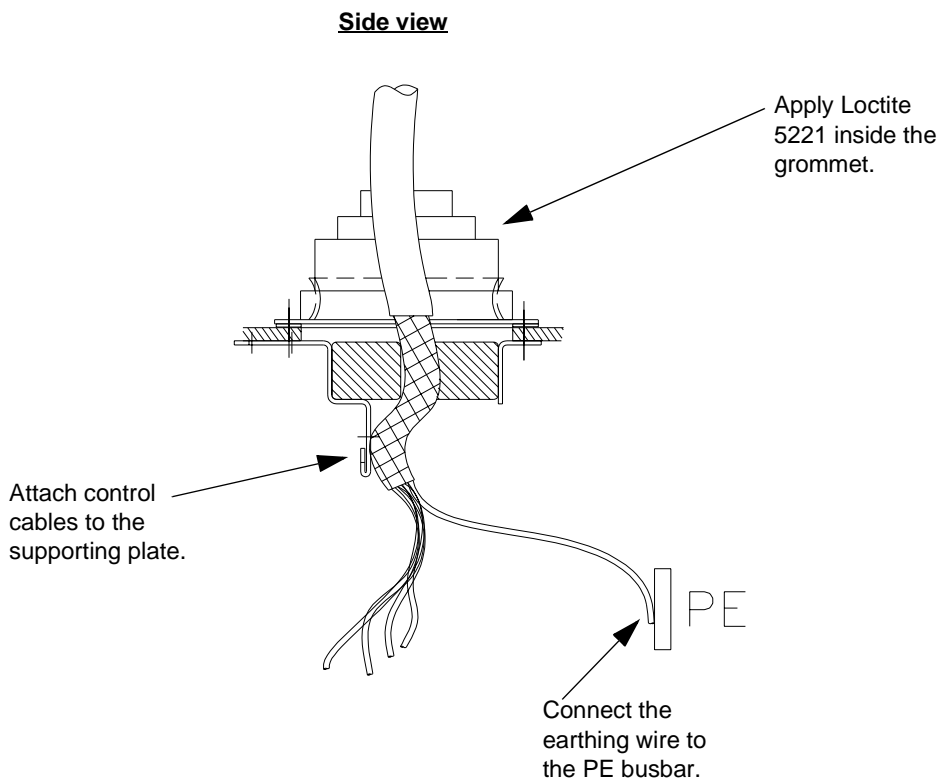
1. Loosen the *lead-through plate position screws*. Pull the two parts apart.
2. **Bottom entry**
Lead the cable inside the cabinet through the *EMI conductive cushions*.
Top entry
Lead the cable inside the cabinet through the grommet and the *EMI conductive cushions*. If you have several cables, bunch them together at the grommet, but ensure that each cable has a proper contact to the cushions on both sides.
3. Strip off the cable plastic sheath above the *base plate* (only a distance wide enough to ensure proper connection of the bare screen and the *EMI conductive cushions*).
4. Earth the screen between the *EMI conductive cushions*:
 - a. If the outer surface of the screen is conductive:
 - Push the two parts of the *lead-through plate* together so that the *EMI conductive cushions* press tightly round the bare screen.

- b. If the outer surface of the screen is covered with non-conductive material:



- Cut the screen at the midpoint of the bare part. Be careful not to cut the conductors.
 - Turn the screen inside out to expose its conductive surface.
 - Cover the turned screen and the stripped cable with copper foil to keep the shielding continuous. **Note:** The earthing wire (if present) must not be cut.
 - Push the two parts of the *lead-through plate* together such that the *EMI conductive cushions* press tightly round the foil-covered screen.
5. Lock the two parts of the *lead-through plate* by tightening the *positioning screws*.

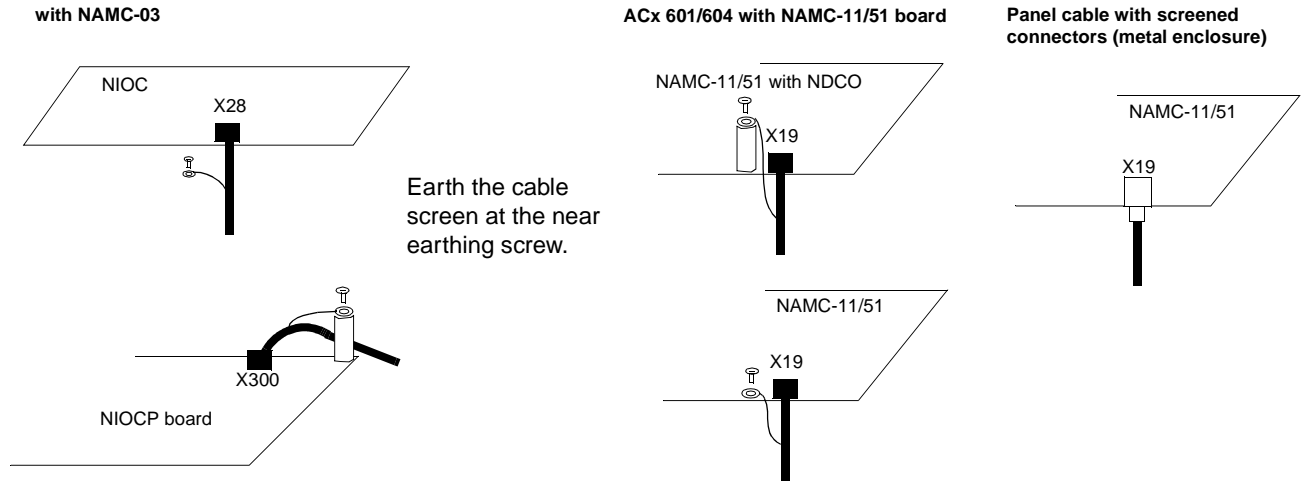
6. Top entry: If more than one cable go through a grommet, the grommet must be sealed by Loctite 5221 (catalogue number 25551).



7. Connect the control cables in appropriate terminal to NIOC/NIOCP board (or optional terminal block X2/2TB, or other options on the DIN rail). Refer to *Appendix A* and *Firmware Manual*. Tighten screw to secure connection. Connect the twisted screen (as short as possible) to the earthing rail \oplus of the terminal.
8. Close the cabinet door if no other cables are to be connected.

Control Panel in Remote Use

Connect the Control Panel cable to terminal X19 of the NAMC-11/51, or with the NAMC-03 board to terminal X28 of the NIOC board (X300 of the NIOCP board).



Pulse Encoder Insulation (ACP 600)

The pulse encoder shall be insulated electrically from the stator or the rotor to prevent forming of a current path through the pulse encoder. The usual coupling-type encoder must have an electrically insulating coupling. When a hollow-shaft type pulse encoder is used, the insulation can be implemented by insulating the ball joints of the engaging arm, or insulating the bar of the engaging arm. Shield of the encoder cable should be insulated from the encoder frame.

Pulse Encoder Phasing (ACP 600, NIOCP Board)

When the encoder is connected correctly, running the drive in the *Forward* (positive) direction should produce positive encoder feedback.

On incremental encoders, the two output channels, usually marked 1 and 2 or A and B, are 90° (electrical) apart from each other. When rotated clockwise, most encoders – but not all – have channel 1 leading channel 2. Determine the leading channel by referring to the encoder documentation, or by measuring with an oscilloscope.

The encoder output channel that leads when the drive runs *Forward* should be connected to NIOCP input A, the output channel that trails to NIOCP input B.

The zero reference output channel is connected to NIOCP input Z.

Installation of Optional Modules and DriveWindow

This section gives general installation instructions for DriveWindow PC tool and ACx 600 optional modules, such as fieldbus adapters, I/O extension modules and the pulse encoder interface. Connection examples are given at the end of the section.

Placement The module should be installed on the DIN mounting rail inside the cabinet. Follow the instructions given in the *Mechanical Installation* chapter of the module manual.

Power Supply for the Module The 24 V d.c. supply for **one** optional module is provided by the NIOC/NIOCP board of the converter (NIOC: terminal X23, NIOCP: terminal X4). The location of the NIOC/NIOCP board is shown in the dimensional drawings (*Appendix B*).

Fibre Optic Link Optional modules are connected via a DDCS fibre optic link to the NAMC board or NDCO board (both mounted on top of the NIOC board). The terminals on the NAMC/NDCO board to which the cables are connected are given in the table below. Channel CH1 is on the NAMC-11/51 board. Channels CH0, CH2 and CH3 are on the NDCO board. NAMC-3 board includes channels CH0 to CH3.

Module Type	Channel	Terminals
Fieldbus Adapter Modules	CH0*	V13*, V14*
I/O Extension Modules	CH1	V15, V16
Pulse Encoder Interface Module	CH2* with ACS 600 Standard Application Program 5.x/6.x	V17*, V18*
	CH1 with ACS 600 System, Crane Master/Follower and Template Application Program	V15, V16
Double Pulse Encoder Interface Module (for ACP 600 only)	CH2*	V17*, V18*
DriveWindow	CH3*	V19*, V20*

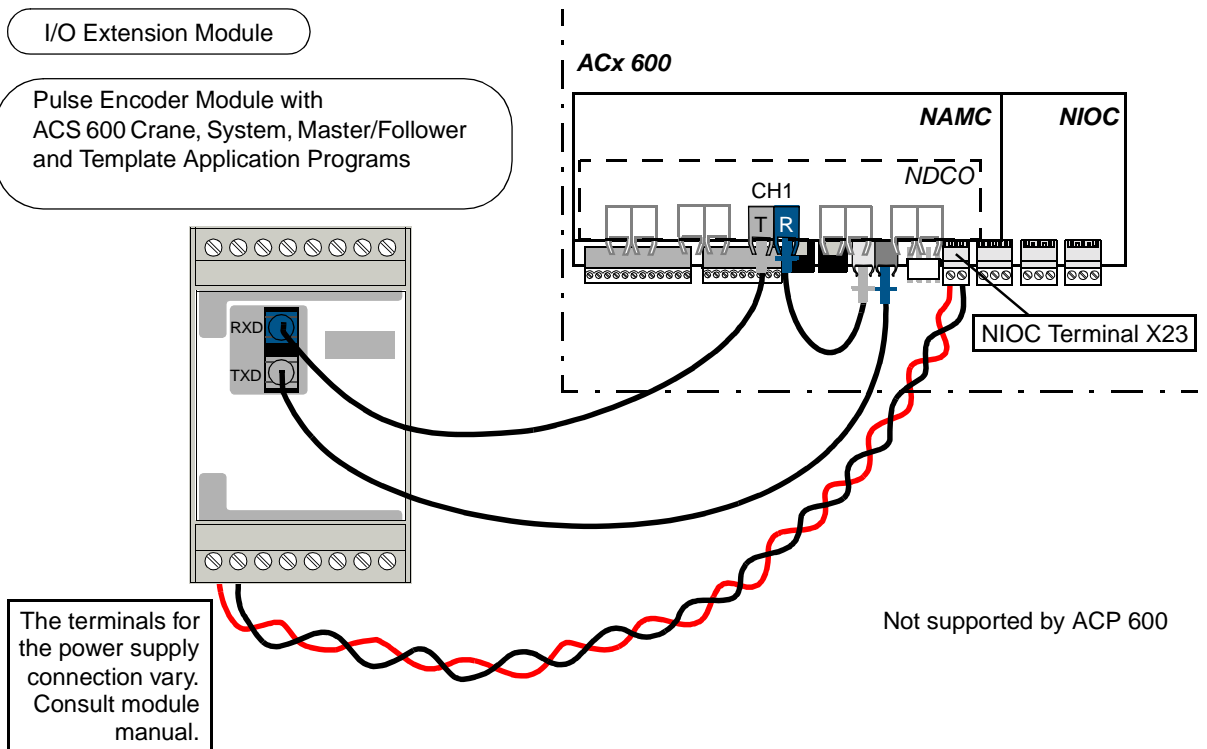
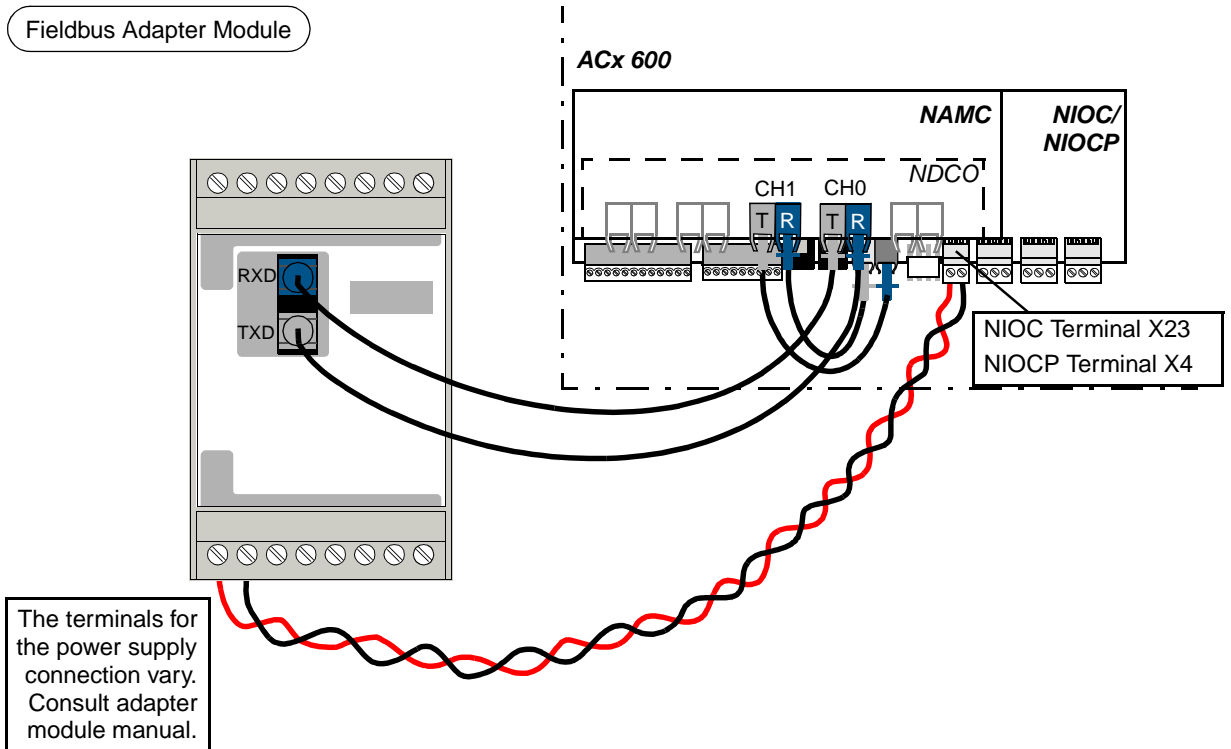
* on NDCO board when NAMC-11/51 board is used.

¹⁾ DriveWindow Light is connected via an NPCU RS-232/485 converter to the panel connector on the cover (or to modular jack X19 on the NAMC-11/51 board).

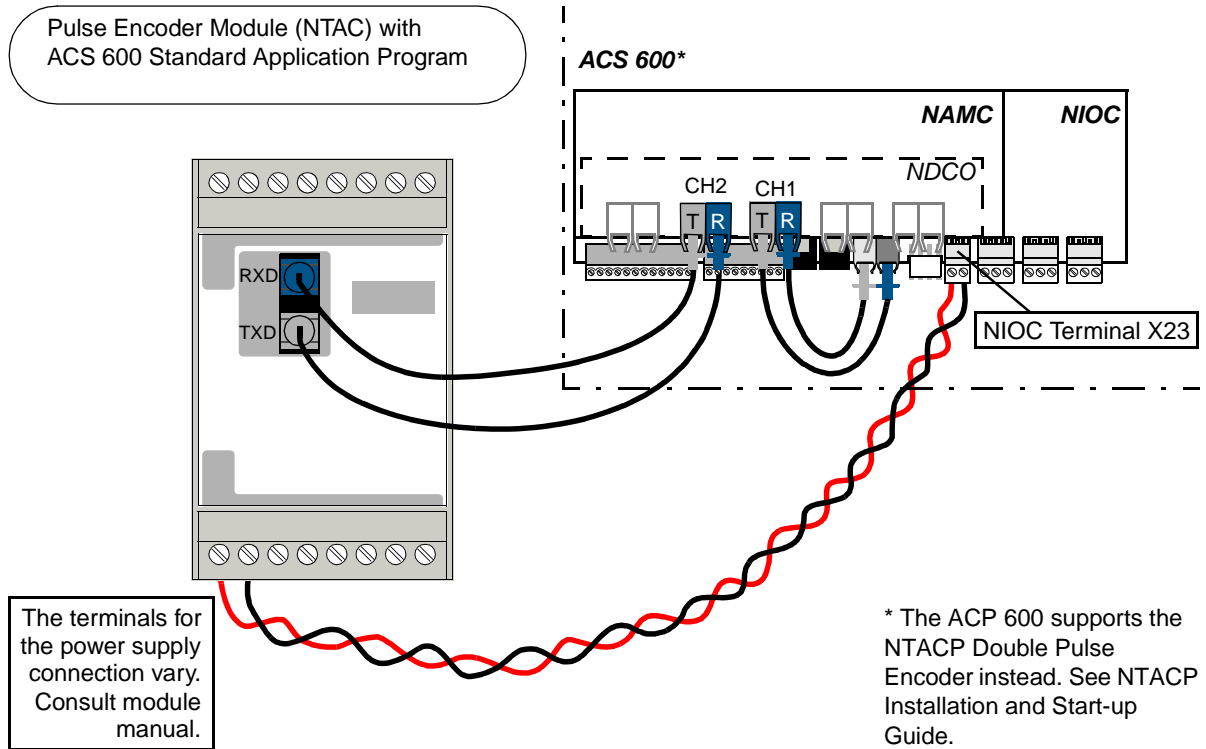
Observe colouring codes when installing fibre optic cables. Blue connectors should go to blue terminals, and grey connectors to grey terminals.

In case multiple modules are installed on the same channel, they must be connected in a ring.

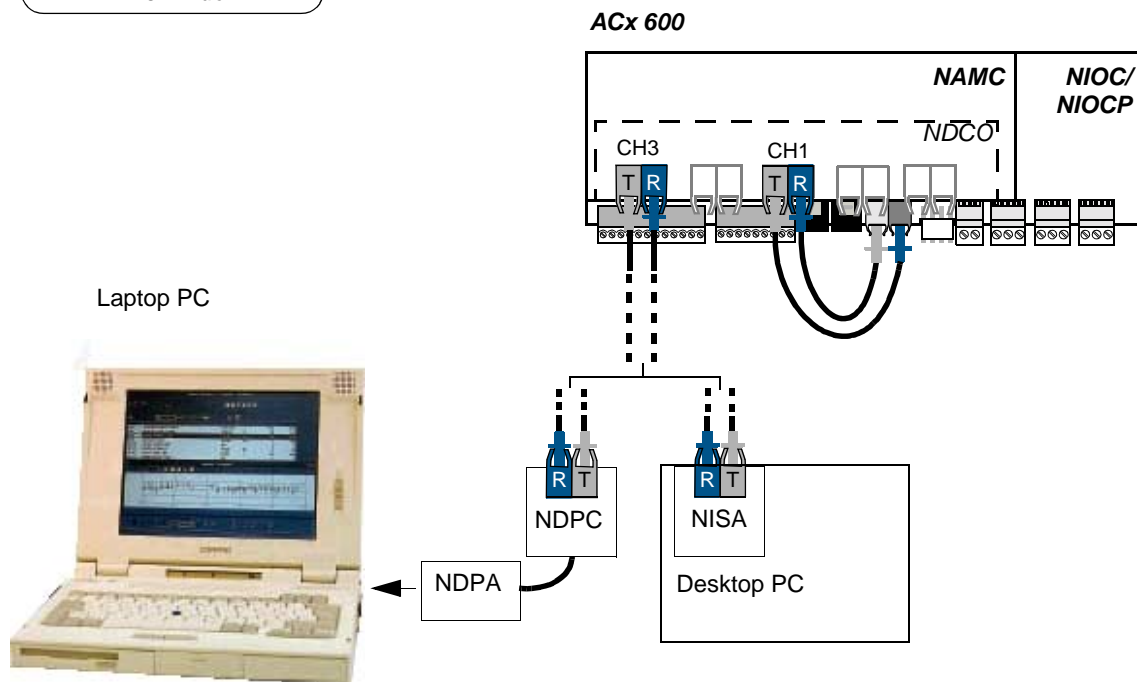
Connection Examples



Connection Examples



DriveWindow



***Installation of Other
Optional Equipment***

Install options such as PTC/PT100 relays, cubicle heater, motor fan starter etc. according to circuit diagrams delivered with the unit.

Chapter 4 – Installation Checklist

Installation Checklist

The ACx 600 mechanical and electrical installation should be checked before start-up. It is advisable to go through the checklist below together with another person. Study carefully the *Safety Instructions* on the first pages of this manual before attempting any work on, or with, the unit.

INSTALLATION CHECKLIST

MECHANICAL INSTALLATION

- Check that the ambient operating conditions are allowable. (See *Appendix A: environmental limits, cooling air flow requirements, free space requirements*)
- Check that the unit is fixed properly. (See *Chapter 2 – Mechanical Installation*)
- Check that cooling air flows freely.
- Check the applicability of the motor and the driven equipment. (See *Appendix A: Motor Connection*)

ELECTRICAL INSTALLATION (see *Chapter 3 – Electrical Installation*)

- If the ACx 600 is connected to unearthed mains, check that the EMC filter capacitors are disconnected.
- Check that the converter unit is earthed properly.
- Check that the mains voltage matches the frequency converter nominal input voltage.
- In the ACx 607 (except frame R7) and the ACx 604, check that the setting of the transformer T41 corresponds to the supply voltage.
- In ACx 6x7 types -0400-3 and -0490-5/6 and up, check that the settings of the transformers T21 and T10 correspond to the supply voltage.
- With line contactor option, check that the setting of the internal transformer corresponds to the supply voltage.
- Check that mains connections at U1, V1 and W1 are OK.
- Check that appropriate mains fuses are installed.
- Check that toroidal cores are properly installed on the motor cable when common mode filter is required.

INSTALLATION CHECKLIST

- Check that motor connections at U2, V2 and W2 are OK.
- Check motor cable routing.
- Check that there are no power factor compensation capacitors in the motor cable.
- Check that control connections inside the frame are OK.
- Check that options such as PTC/PT100 relays, cubicle heater, motor fan starter etc. are wired inside the cabinet. See the circuit diagrams delivered with the unit.
- In ACx 627 types -0400-3 and -0490-5/6 and up not equipped with main contactors, check the wiring for switching off the mains supply in case of a fuse failure and an earth fault. See *Safety Instructions*.
- Check that there are no tools or other foreign objects inside the cabinet.
- With bypass connection, check that mains voltage cannot be applied to the output of the ACx 600.

Chapter 5 – Maintenance



WARNING! All maintenance work described in this chapter must be undertaken by a qualified electrician only. The [Safety Instructions](#) on the first pages of this manual must be followed.

Heatsink

The ACx 600 can run into overtemperature Faults if the heatsink is not clean. In normal environment, the heatsink should be checked and cleaned annually.

Use compressed air to remove dust from the heatsink. (The airflow direction must be from bottom to top.) Also, use a vacuum cleaner at the air outlet to trap the dust. Fan rotation must be prevented in order to prevent bearing wear.

Fan

The cooling fan lifespan is about 60 000 hours (R7) or 30 000 hours (R8 and R9). The actual lifespan depends on the frequency converter usage and ambient temperature.

Fan failure is often preceded by increasing noise from fan bearings and gradual rise of the heatsink temperature (in spite of heatsink cleaning). If the frequency converter is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing.

Capacitors

The ACx 600 intermediate circuit employs several electrolytic capacitors. Their lifespan is about 100 000 hours. It depends on the frequency converter loading and the ambient temperature.

Capacitor life can be prolonged by lowering the ambient temperature. It is not possible to predict capacitor failure.

Capacitor failure is usually followed by a mains fuse failure or a Fault trip. Contact ABB if capacitor failure is suspected. Replacements are available from ABB. Do not attempt operation with other than ABB specified spare parts.

Reforming

Converter DC link capacitors need to be reformed (re-aged) if the converter has been non-operational for more than one year. Without reforming capacitors may be damaged when the converter starts to operate. The reforming methods introduced here require that the converter has been stocked clean and dry. It is recommended to reform the capacitors once a year.

How to check the converter age

Converter serial number defines the week, when the converter has been built:

- 8 digit: e.g. 18250125, 1 denotes manufacturing country (1 = Finland), 8 manufacturing year (1998), 25 manufacturing week and 0125 running manufacturing number.
- 10 digit: e.g. 1983200725, 1 denotes manufacturing country, 98 manufacturing year, 32 manufacturing week and 00725 running manufacturing number.

Reforming time

The intermediate circuit of the converter is kept in its nominal voltage for the reforming time to “wake up” the capacitors. The reforming time required depends on how long the converter has been stocked (non-operational).

Reforming time (hours)

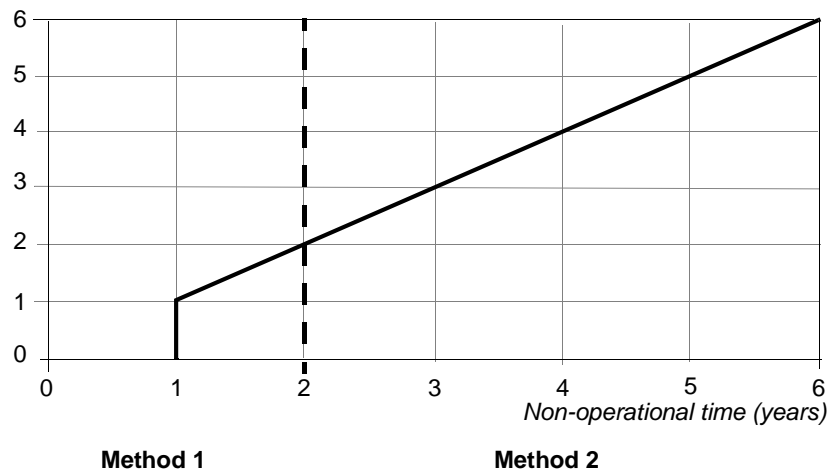


Figure 5-1. Capacitor reforming time for Method 1 and Method 2.

Converters Stocked (Non-operational) for Less Than 2 years

Switch the power on to the converter for a time given in Figure 5-1 (Method 1). The converter “wakes up” its capacitors by itself. Power the converters up once a year to keep the capacitors in operational condition.

Converters Stocked (Non-operational) for 2 Years and Over

Use Method 2 A or Method 2 B (both explained below) for capacitor reforming if the converter has been stocked or non-operational for two or more years.

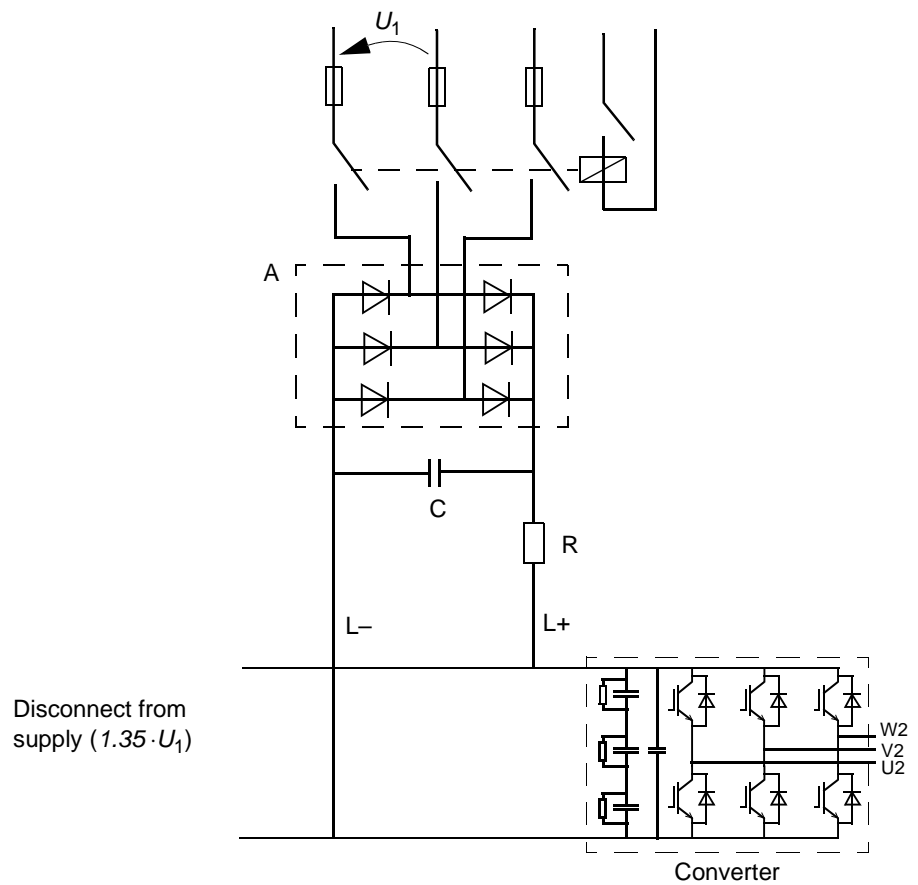


WARNING! The ACx 6x7 inverters must be reformed outside the cabinet.

Method 2 A Capacitor reforming is realised by connecting a rectifier and a resistor circuit to the converter DC link. The reforming circuit and component values for different voltages are given below. See the reforming time from Figure 5-1.



WARNING! The converter supply must be disconnected while the reforming circuit is connected.

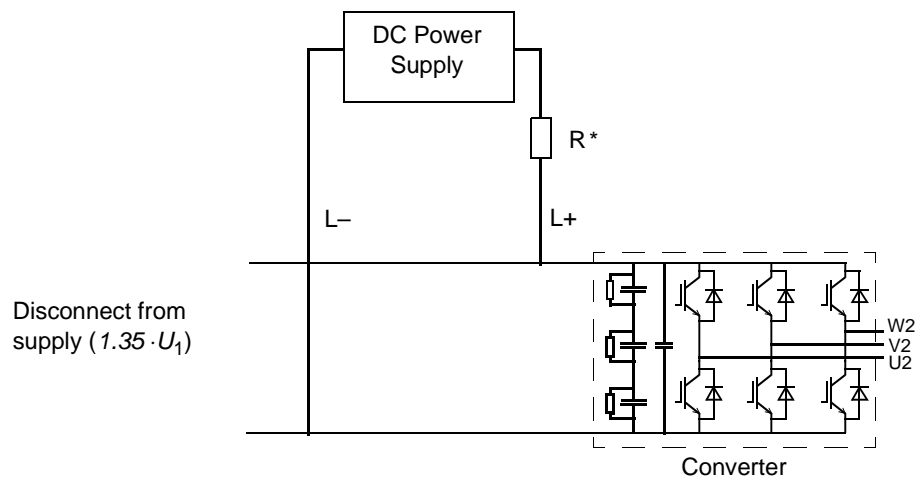


Supply Voltage	Recommended Components		
	A	R	C
$380\text{ V} < U_1 < 415\text{ V}$	SKD 82/16	220 Ohm / 700 W	22 nF / 2000 V
$380\text{ V} < U_1 < 500\text{ V}$	SKD 82/16	470 Ohm / 1200 W	22 nF / 2000 V
$525\text{ V} < U_1 < 690\text{ V}$	SKD 82/16	680 Ohm / 1700 W	22 nF / 2000 V

Method 2 B Capacitor reforming is based on a DC power supply connected to converter DC link. Power supply current charges converter capacitors. If power supply cannot limit the current, voltage is increased gradually (with e.g. 100 V steps). Maximum recommended reforming current is 500 mA. An appropriate reforming voltage is $(1.35 \dots \sqrt{2}) \cdot U_1$. The reforming circuit is shown below. See reforming time from Figure 5-1.



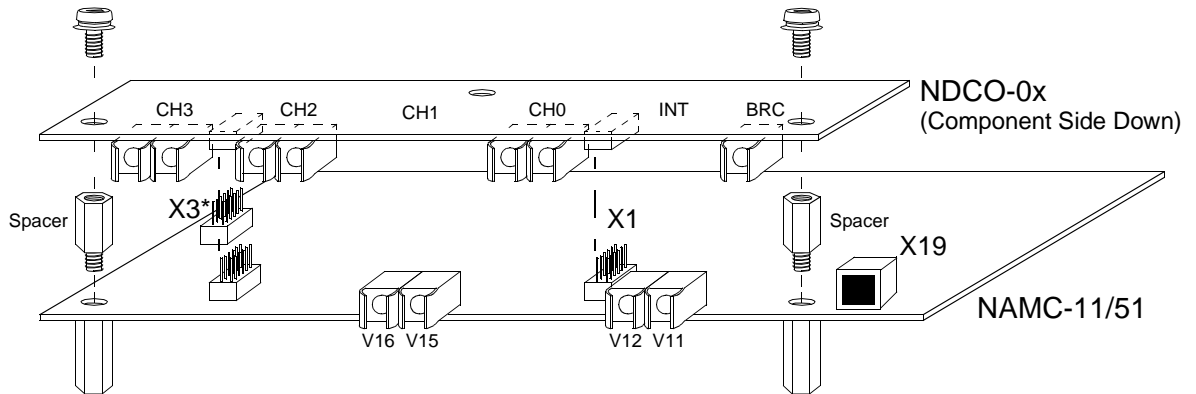
WARNING! The converter supply must be disconnected while the reforming circuit is connected.



* R = 100 Ohm / 500 W

Control Panel Connection

The Control Panel is connected to modular jack X19 on NAMC-11/51 board. The modular jacks on the NIOC board are **not** intended for Panel use (they are used by Standard Modbus Link).



* on NAMC-51 for optional Memory Backup board (NMBO)

LEDs

The table below shows the indications of the LEDs on the control boards.

Control Board	LED	When the LED is lit
NAMC	Green V4	The power supply of the board is OK.
	Red V18	Fault
	Red V5 (not in use)	–
NINT	Green V14	The board is powered.
NIOC	Green V5	The power supply of the board is OK.
	Red V6	Fault
NPOW	Green V4	The board is powered.

Appendix A – ACS/ACC/ACP 604/6x7 Technical Data

IEC Ratings

The IEC ratings for ACx 604 and ACx 6x7 with 50 Hz and 60 Hz supplies are below. ACx = ACS/ACC/ACP. The 690 V series and 2 x R8 and 2 x R9 frame sizes are not available for ACP 600. See the next page for symbols.

Frequency Converter Type	Normal Use					Heavy-duty Use							Frame Size
	Duty Cycle 1/5 min		S _N [kVA]	P _N [kW]	P _N [HP]	Duty Cycle 1/5 min		Duty Cycle ¹⁾ 2/15 s		S _{hd} [kVA]	P _{hd} [kW]	P _{hd} [HP]	
	I _{2N} 4/5min [A]	I _{2Nmax} 1/5min [A]				I _{2hd} 4/5min [A]	I _{2hdmax} 1/5min [A]	I _{2hd} 13/15s [A]	I _{2hdmax} 2/15s [A]				
Three-phase supply voltage 380 V, 400 V or 415 V													
ACx 604/607-0100-3	147	162	100	75	100	112	168	112	224	70	55	75	R7
ACx 604/607-0120-3	178	196	120	90	125	147	221	147	294	100	75	100	R8
ACx 604/607-0140-3	216	238	140	110	150	178	267	178	356	120	90	125	
ACx 604/607-0170-3	260	286	170	132	200	216	324	216	432	140	110	150	
ACx 604/607-0210-3	316	348	210	160	250	260	390	260	520	170	132	200	R9
ACx 604/607-0260-3	395	435	260	200	300	316	474	316	632	210	160	250	
ACx 604/607-0320-3	480	528	320	250	350	395	593	395	790	260	200	300	
ACx 604/6x7-0400-3	600	661	400	315	400	494	741	494	988	320	250	350	2xR8
ACx 604/6x7-0490-3	751	827	490	400	500	600	901	600	1200	400	315	400	2xR9
ACx 604/6x7-0610-3	912	1003	610	500	600	751	1127	751	1502	490	400	500	
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or 500 V													
ACx 604/607-0120-5	135	149	120	90	100	112	168	112	224	100	75	75	R7
ACx 604/607-0140-5	164	180	140	110	125	135	203	135	270	120	90	100	R8
ACx 604/607-0170-5	200	220	170	132	150	164	246	164	328	140	110	125	
ACx 604/607-0210-5	240	264	210	160	200	200	300	200	400	170	132	150	
ACx 604/607-0260-5	300	330	260	200	250	240	360	240	480	210	160	200	R9
ACx 604/607-0320-5	365	402	320	250	300	300	450	300	600	260	200	250	
ACx 604/607-0400-5	460	506	400	315	350	365	548	365	730	320	250	300	
ACx 604/6x7-0490-5	570	627	490	400	500	456	684	456	912	400	315	400	2xR8
ACx 604/6x7-0610-5	694	764	610	500	600	570	855	570	1140	490	400	500	2xR9
ACx 604/6x7-0760-5	874	961	760	630	700	694	1041	694	1388	610	500	600	
Three-phase supply voltage 525 V, 550 V, 575 V, 600 V, 660 V or 690 V													
ACx 604/607-0100-6	88	97	100	75	100	65	98	65	98	70	55	75	R7
ACx 604/607-0120-6	105	116	120	90	125	88	132	88	132	100	75	100	R8
ACx 604/607-0140-6	127	140	140	110	150	105	158	105	158	120	90	125	
ACx 604/607-0170-6	150	165	170	132	150	127	191	127	191	140	110	150	
ACx 604/607-0210-6	179	197	210	160	200	150	225	150	225	170	132	150	R9
ACx 604/607-0260-6	225	248	260	200	250	179	269	179	269	210	160	200	
ACx 604/607-0320-6	265	292	320	250	300	225	338	225	338	260	200	250	
ACx 604/607-0400-6	351	386	400	315	350	265	398	265	398	320	250	300	
ACx 604/6x7-0490-6	428	470	490	400	450	340	511	340	510	400	315	350	2 x R8
ACx 604/6x7-0610-6	504	555	610	500	500	428	642	428	642	490	400	450	2 x R9
ACx 604/6x7-0760-6	667	734	760	630	700	504	756	504	756	610	500	500	

ACS 604/607 Type	Pump and Fan Use (Squared Load)		Frame Size
	I_{2Nsq} [A]	P_N [kW]	
Three-phase supply voltage 380 V, 400 V or 415 V			
ACS 604/607-0100-3	178	90	R7
ACS 604/607-0120-3	200	110 (100)	R8
ACS 604/607-0140-3	260	132	
ACS 604/607-0170-3	300	160	
ACS 604/607-0210-3	375	200	R9
ACS 604/607-0260-3	480	250	
ACS 604/607-0320-3	510	315 (265)	
ACS 6x4/6x7-0400-3	712	400	2xR8
ACS 6x4/6x7-0490-3	912	500	2xR9
ACS 6x4/6x7-0610-3	969	560	
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or 500 V			
ACS 604/607-0120-5	164	110	R7
ACS 604/607-0140-5	193	132	R8
ACS 604/607-0170-5	240	160	
ACS 604/607-0210-5	285	200	
ACS 604/607-0260-5	345	250	R9
ACS 604/607-0320-5	460	315	
ACS 604/607-0400-5	490	400 (335)	
ACS 6x4/6x7-0490-5	656	450	2xR8
ACS 6x4/6x7-0610-5	874	630	2xR9
ACS 6x4/6x7-0760-5	990	710	

The current ratings are the same regardless of the supply voltage within one voltage range. The rated current of the ACx 60x must be higher than or equal to the rated motor current to achieve the rated motor power given in the table.

Note 1: The maximum allowed motor shaft power is limited to $1.5 \cdot P_{hd}$. If the limit are exceeded, the motor torque and the I_{2hdmax} 2/15 s current is automatically restricted. The function protects the input bridge of the ACS 600 against overload.

Note 2: The load capacity (current and power) decreases if the installation site altitude exceeds 1000 metres, or if the ambient temperature exceeds 40 °C (or 35 °C with ACx 60x-0120-03 and ACx 60x-0140-05 units in Pump and Fan Use). See Output Current Temperature Derating on page A-3.

Note 3: The Pump and Fan rating is not to be used with du/dt filters. du/dt filters are usually needed at the output of 525 V to 690 V units with random-wound motors. No du/dt filters are usually required with form-wound motors.

Notes concerning Pump and Fan Use only

Pump and Fan rating is available for ACS 600 with Standard and Pump and Fan Control Application Programs.

() typically achieved motor power with I_{2Nsq}

Normal use (10 % overload capacity):

I_{2N} rated rms output current
 I_{2Nmax} rms overload current (allowed for one minute every 5 minutes):
 $I_{2Nmax} (1/5 \text{ min}) = 1.1 \cdot I_{2N}$

S_N rated apparent output power
 P_N typical motor power. The power ratings in kW apply to most IEC 34 motors. The power ratings in HP apply to most four pole NEMA rated motors.

Heavy-duty use (50 % or 100 % overload capacity):

I_{2hd} rated rms output current
 I_{2hdmax} rms overload current (allowed for one minute every 5 minutes or 2 seconds every 15 seconds). Maximum current depends on parameter setting, refer to *Firmware Manual*.
 $I_{2hdmax} (1/5 \text{ min}) = 1.5 \cdot I_{2hd}$
 $I_{2hdmax} (2/15 \text{ s}) = 2.0 \cdot I_{2hd}$ (400 and 500 VAC units) or $1.5 \cdot I_{2hd}$ (690 VAC units)

S_{hd} rated apparent output power
 P_{hd} typical motor power. The power ratings in kW apply to most IEC 34 motors. The power ratings in HP apply to most four pole NEMA rated motors.

Pump and Fan Use (Squared Load): no overload capacity

I_{2Nsq} rated rms output current

NEMA Ratings

The NEMA ratings for ACS 604 and ACS 607 with 60 Hz supply are below. Symbols are described on the previous page.

ACS 604/607 Type	Normal Use			Heavy-duty Use					Frame Size
	Duty Cycle 1/5 min		P_N [HP]	Duty Cycle 1/5 min		Duty Cycle ¹⁾ 2/15 s		P_{hd} [HP]	
	I_{2N} 4/5min [A]	I_{2Nmax} 1/5min [A]		I_{2hd} 4/5min [A]	I_{2hdmax} 1/5min [A]	I_{2hd} 13/15s [A]	I_{2hdmax} 2/15s [A]		
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or 500 V									
ACS 604/607-0120-4	156	172	125	113	168	113	224	75	R7
ACS 604/607-0140-4	180	198	150	141	203	141	270	100	R8
ACS 604/607-0170-4	216	238	150	172	246	172	328	125	
ACS 604/607-0210-4	260	286	200	200	300	200	400	150	
ACS 604/607-0260-4	316	348	250	240	360	240	480	200	R9
ACS 604/607-0320-4	414	455	300/350	300	450	300	600	250	
ACS 604/607-0400-4	480	528	400	365	548	365	730	300	

Note: The US manufactured units are labelled to -4 types. The information in this manual concerning the corresponding -5 type applies to them.

**Output Current
Temperature Derating**

The output current is calculated by multiplying the current given in the rating table by the derating factor.

Temperature derating factor for ACx 6x7:

- **General rule:** Above +40 °C / +104 °F (+35 °C / +95 °F for types ACS 60x-0120-03 and ACS 60x-0140-5 with I_{2Nsq} rating), the rated output current is decreased by 1.5 % for every additional 1 °C / 1.8 °F (up to +50 °C / +122 °F). This applies to I_{2N} and I_{2Nsq} (for I_{2hd} no derating is needed).
- **Example 1.** If the ambient temperature is 50 °C / +122 °F the derating factor is

$$100 \% - 1.5 \frac{\%}{^{\circ}\text{C}} \cdot 10 ^{\circ}\text{C} = 85 \% \text{ or } 0.85.$$

The output current is then $0.85 \cdot I_{2N}$ or $0.85 \cdot I_{2Nsq}$ or $1 \cdot I_{2hd}$.

Input Power Connection

Voltage (U_1):

380/400/415 VAC 3-phase $\pm 10\%$ for 400 VAC units
 380/400/415/440/460/480/500 VAC 3-phase $\pm 10\%$ for 500 VAC units
 525/550/575/600/660/690 VAC 3-phase $\pm 10\%$ for 690 VAC units

Short Circuit Capability: The rated short-time withstand current of the ACx 600 is 50 kA 1 s.

Measured according to US standards up to 400 kVA: Suitable for use in a circuit capable of delivering not more than 65 kA rms symmetrical amperes at 480 V maximum (500 V units), and at 600 V maximum (690 V units).

Frequency: 48 to 63 Hz, maximum rate of change 17 %/s

Imbalance: Max. $\pm 3\%$ of nominal phase to phase input voltage

Fundamental Power Factor ($\cos \phi_1$): 0.97 (at nominal load)

Motor Connection

Voltage (U_2): 0 to U_1 , 3-phase symmetrical

Frequency: DTC mode: 0 to $3.2 \cdot f_{FWP}$. Maximum frequency 300 Hz.

$$f_{FWP} = \frac{U_{Nmains}}{U_{Nmotor}} \cdot f_{Nmotor}$$

f_{FWP} : Frequency at field weakening point; U_{Nmains} : Mains (input power) voltage;
 U_{Nmotor} : Rated motor voltage; f_{Nmotor} : Rated motor frequency

Scalar Control mode (not for ACP 600): 0 to 300 Hz

With du/dt Filter (DTC and Scalar Control modes): 0 to 120 Hz

Frequency Resolution: 0.01 Hz

Current: see rating tables

Power Limit: $1.5 \cdot P_{hd}$

Overcurrent Trip: $3.5 \cdot I_{2hd}$

Field Weakening Point: 8 to 300 Hz

Switching Frequency: 3 kHz (average). In 690 V units 2 kHz (average).

Maximum Recommended Motor Cable Length: 300 m (980 ft). This is the cumulative length in case of parallel connected motors. For ACx 601-0005-3 to ACx 601-0016-3, ACx 601-0006-5 to ACx 601-0020-5 and ACx 601-0009-6 to ACx 601-0020-6, if the motor cable length exceeds 70 metres (230 ft), an ABB representative should be consulted.

Bearings of over 90 kW (125 HP) Motors: Insulated bearing at non-driven end is recommended.

Efficiency and Cooling

Efficiency: Approximately 98 % at nominal power level

Cooling Method: Internal fan, flow direction from the bottom to the top

Ambient Conditions

Environmental limits of the ACS/ACC/ACP 600 frequency converters are given below. The frequency converters are to be used in a heated, indoor, controlled environment.

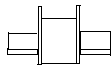
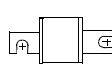
ACS/ACC/ACP 600	Operation installed for stationary use	Storage in the protective package	Transportation in the protective package
Installation Site Altitude	Nominal output power at 0 to 1000 m (3300 ft) above sea level ¹⁾	-	-
Air Temperature	0 to +40 °C (32 to 104°F) ²⁾ (IP 21/22 and ACx 607, IP 54) 0 to +25 °C (32 to 77°F) ²⁾ (ACx 601, IP 54)	-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 721-3-3)	No conductive dust allowed.		
	Boards without coating: Chemical gases: Class 3C1 Solid particles: Class 3S2 Boards with coating: Chemical gases: Class 3C2 Solid particles: Class 3S2	Boards without coating: Chemical gases: Class 1C2 Solid particles: Class 1S3 Boards with coating: Chemical gases: Class 1C2 Solid particles: Class 1S3	Boards without coating: Chemical gases: Class 2C2 Solid particles: Class 2S2 Boards with coating: 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 68-2-6)	Max. 0.3 mm (0.01 in.) (2 to 9 Hz), max. 1 m/s ² (3.3 ft./s ²) (9 to 200 Hz) sinusoidal	Max. 1.5 mm (0.06 in.) (2 to 9 Hz), max. 5 m/s ² (16.4 ft./s ²) (9 to 200 Hz) sinusoidal	Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s ² (49 ft./s ²) (9 to 200 Hz) sinusoidal
Shock (IEC 68-2-29)	Not allowed	Max. 100 m/s ² (330 ft./s ²), 11 ms	Max. 100 m/s ² (330 ft./s ²), 11 ms
Free Fall	Not allowed	250 mm (10 in.) for weight under 100 kg (220 lbs.) 100 mm (4 in.) for weight over 100 kg (220 lbs.)	250 mm (10 in.) for weight under 100 kg (220 lbs.) 100 mm (4 in.) for weight over 100 kg (220 lbs.)

¹⁾ At sites over 1000 m (3300 ft.) above sea level, the maximum output current is derated 1% for every additional 100 m (330 ft.). If the installation site is higher than 2000 m (6600 ft.) above sea level, please contact your local ABB distributor or office for further information.

²⁾ See subsection *Output Current Temperature Derating*.

Fuses

The input fuse ratings of the ACS/ACC/ACP 6x7 and recommended input fuse ratings of the ACS/ACC/ACP 604 are presented below. A minimum rated current in amperes, A²s maximum I²t value, V rated voltage in volts. Only ultra rapid fuses guarantee proper protection for the rectifier semiconductors.

ACx 604/6x7 Types	Fuses							
	A	A ² s	V	Manufacturer	Type DIN 43620 	Size	Type DIN 43653 	Size
ACx 60x-0100-3 ACx 60x-0120-5 ACx 60x-0120-3 ACx 60x-0140-5 ACx 60x-0140-3 ACx 60x-0170-5	400	105000	660	Bussmann	170M3819	1*	170M3019	1*
ACx 60x-0170-3 ACx 60x-0210-5	550	190000	690	Bussmann	170M5811	2	170M5011	2
ACx 60x-0210-3 ACx 60x-0260-5 ACx 6xx-0400-3 ACx 6xx-0490-5 ACx 60x-0260-3 ACx 60x-0320-5 ACx 6xx-0490-3 ACx 6xx-0610-5	700	405000	660	Bussmann	170M5813	2	170M5013	2
ACx 60x-0320-3 ACx 60x-0400-5 ACx 6xx-0610-3 ACx 6xx-0760-5	800	465000	660	Bussmann	170M6812	3	170M6012	3
ACx 60x-0100-6	125	8500	660	Bussmann	170M1568	000	170M1368	000
ACx 60x-0120-6 ¹⁾	200	15000/ 28000	660	Bussmann	170M3815/ 170M1570	1*/ 000	170M1370 170M1370	000 000
ACx 60x-0140-6 ACx 60x-0170-6	250	28500	690	Bussmann	170M3816	1*	170M3016	1*
ACx 60x-0210-6	315	46500	660	Bussmann	170M3817	1*	170M3017	1*
ACx 60x-0260-6	400	105000	660	Bussmann	170M3819	1*	170M3019	1*
ACx 60x-0320-6 ACx 60x-0400-6	550	190000	690	Bussmann	170M5811	2	170M5011	2
ACx 6xx-0490-6	400	105000	660	Bussmann	170M3819	1*	170M3019	1*
ACx 6xx-0610-6 ACx 6xx-0760-6	550	190000	690	Bussmann	170M5811	2	170M5011	2

Note: Fuses from other manufacturers can be used if they meet the ratings given in the table. Only ultra rapid fuses guarantee proper protection for the rectifier semiconductors. The fuses recommended in the table are UL R/C (JFRHRZ) fuses.

¹⁾ 15000 A²s and 28000 A²s Bussmann fuses can be used with the ACx 60x-0120-6.

Example For ACS 604-0260-3, the recommended fuses for the input bridge protection are 700 A ultrarapid fuses.

The values I_{2N} , I_{2hd} and I_{2Nsq} for ACS 604-0260-3 are 395 A, 316 A and 480 A respectively. $1.1 \cdot 395 \text{ A} = 434.5 \text{ A}$ and $1.5 \cdot 316 \text{ A} = 474 \text{ A}$ and $1.0 \cdot 480 \text{ A} = 480 \text{ A}$. Normal fuses with nominal currents higher than 434.5 A, 474 A or 480 A can be used to protect the input cable; thus, 450 A or 500 A fuses are selected depending on the use (normal, heavy-duty or pump and fan, respectively).

Cable Entries

Input power and motor cable terminal wire size capabilities and tightening torques for the ACS/ACC/ACP 604/6x7 are in the table below. The capability is specified based on wire lug that the terminal accepts (according to DIN 46234 for copper cables and DIN 46329 for aluminium cables), cable cross section that will fit through the European lead-through plate hole, and maximum electrically needed European cable cross section. NEMA two hole lugs (1/2 inch in diameter and 1.75 inches on center) can be used in frame sizes R8 and R9 and R7 output.

Terms used

- Terminal kit (crush-down) connection. This kit is used in frame size R7 frequency converters (input cable terminal) and includes screws. The conductor is plugged into the kit without a cable lug.

1X120 —————> Maximum cable cross section in mm²
 L—————> Maximum number of cable connections

- Bus bar connection with hole requiring bolt, washer, nut, and wire lug to be supplied by others. The other style connection using the same reference is an insulated stud connection, washer and nut. The wire lug is provided by others.

1X(10-120) —————> Maximum cable cross section in mm²
 L—————> Diameter of maximum bolt that will fit through the hole in the bus bar, or stud connection in mm
 L—————> Maximum number of cable connections

- If an M is added before the number in the table (e.g. M10) we have a designator for a standard metric screw.

Substitution Metric to US Standard

M8 - 5/16 inch diameter bolt

M10 - 3/8 inch diameter bolt

M12 - 1/2 inch diameter bolt

- T = Tightening torque.

Terminal Sizes and Tightening Torques

Input power and motor cable terminal wire size capabilities (per phase) and tightening torques for the ACS/ACC/ACP 604/6x7 are below. For terms used see above.

ACx 600 Type	Mains Terminals			Motor Terminals			Earthing Terminals		Frame Size
	U1,V1,W1		T	U2,V2,W2		T	Earthing PE	T	
	Cu	Al	Nm	Cu	Al			Nm	
ACx 607-0100-3/0120-5	1x185 ³⁾	1x185 ³⁾	22	1x(12-185)	1x(12-185)	30	M12	30	(R7)
ACx 607-0100-6	1x120 ³⁾	1x120 ³⁾	30	1x(12-185)	1x(12-185)	30	M12	30	
ACx 607-0120-3/0140-5/0120-6	1x185 ³⁾	1x185 ³⁾	22	1x(12-185)	1x(12-185)	30	M12	30	
ACx 607-0140-3/0170-5/0140-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	(R8)
ACx 607-0170-3/0210-5/0170-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	
ACx 607-0210-3/0260-5/0210-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	
ACx 607-00260-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	
ACx 607-0260-3/0320-5/0320-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	(R9)
ACx 607-0320-3/0400-5/0400-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	
ACx 6x7-0400-3/0490-5/0490-6	4x(12-185)	4x(12-240)	55	4x(12-185)	4x(12-240)	55	M10 (2x2 pcs)	35	(2xR8)
ACx 6x7-0490-3/0610-5/0610-6	4x(12-185)	4x(12-240)	55	4x(12-185)	4x(12-240)	55	M10 (2x2 pcs)	35	(2xR9)
ACx 6x7-0610-3/0760-5/0760-6	4x(12-185)	4x(12-240)	55	4x(12-185)	4x(12-240)	55	M10 (2x2 pcs)	35	
ACx 604-0100-3/0120-5/0100-6	1x(10-120) ⁴⁾	1) ¹⁾	30	1x(10-120)	1) ¹⁾	30	41 mm ² 2) ³⁾	30	(R7)
ACx 604-0120-3/0140-5/0120-6	1x(10-120) ⁴⁾	1) ¹⁾	30	1x(10-120)	1) ¹⁾	30	41 mm ² 2) ³⁾	30	
ACx 604-0140-3/0170-5/0140-6	1x(10-240) ⁴⁾	1x(10-240) ⁴⁾	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs) ²⁾	30	(R8)
ACx 604-0170-3/0210-5/0170-6	1x(10-240) ⁴⁾	1x(10-240) ⁴⁾	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs) ²⁾	30	
ACx 604-0210-3/0260-5/0210-6	1x(10-240) ⁴⁾	1x(10-240) ⁴⁾	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs) ²⁾	30	
ACx 604-0260-6	1x(10-240) ⁴⁾	1x(10-240) ⁴⁾	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs) ²⁾	30	
ACx 604-0260-3/0320-5/0320-6	1x(10-240) ⁴⁾	1x(10-240) ⁴⁾	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs) ²⁾	30	(R9)
ACx 604-0320-3/0400-5/0400-6	1x(10-240) ⁴⁾	1x(10-240) ⁴⁾	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs) ²⁾	30	

- 1) The maximum acceptable size of the cable is 3x120+70 (3x(AWG 0000) + AWG 00); cross-sectional areas of copper conductors in mm², 3 x phase conductor + PE conductor). Aluminium cable cannot be connected due to cable lug size.
- 2) This is the earthing terminal for the PE bus and the frame of the ACx 604 module. The terminal is to be connected to the PE bus of the cabinet the module is installed in.
- 3) Cable size: 6 AWG...300 MCM
- 4) Isolated Stud terminal

External Control Connection Diagrams

External control connections of ACS 600 equipped with Standard Application Program (Factory Macro) are shown below. External control connections are different with other application macros and programs (see *Firmware Manual*).

External control wiring is connected either directly to terminals on the NIOC board or through an optional terminal block. If an optional I/O terminal block is furnished, the control panel code (16th digit) of the ACS 600 type code is 4 or 5. Refer to [Chapter 1 – Introduction](#) for the ACS 600 type code description.

An optional terminal block can be designated X2 (IEC standard designation) or 2TB (ANSI standard designation, for US manufactured units only). The 2TB arrangement is supplied in drives with 8 as the 20th digit of the ACS 600 type code.

When making the external control connections compare carefully the terminal configuration found in the drive with diagrams below to ensure that the correct diagram is used.

External control wiring of ACP 600 is connected either to terminals on the NIOC board or the NIOCP board. External control connections to NIOCP board are shown below.

NIOC Board External control connections of NIOC board for ACS 600 with Standard Application Software (Factory Macro) are shown below. (For the connections of other application macros and programs see *Firmware Manual*).

Terminal Block Size

X21, X22: cables 0.5 to 1.5 mm² (#20 to #16 AWG)
 X23, X25, X26, X27: cables 0.5 to 2.5 mm² (#20 to #14 AWG)

Control Cable Lead-through Size:

Ø: 2 x 3x2...11 mm

Factory settings of application software selection B (type code):

DI1: Start, DI2: Stop, DI3: Reverse, DI4: Acc/Dec 2, DI5,6: Constant speed 1 to 3 select.

1) If Par. 10.3 is REQUEST.

2) Operation: 0 = Open, 1 = Closed

DI 5	DI 6	Output
0	0	Set speed through AI1
1	0	Constant Speed 1
0	1	Constant Speed 2
1	1	Constant Speed 3

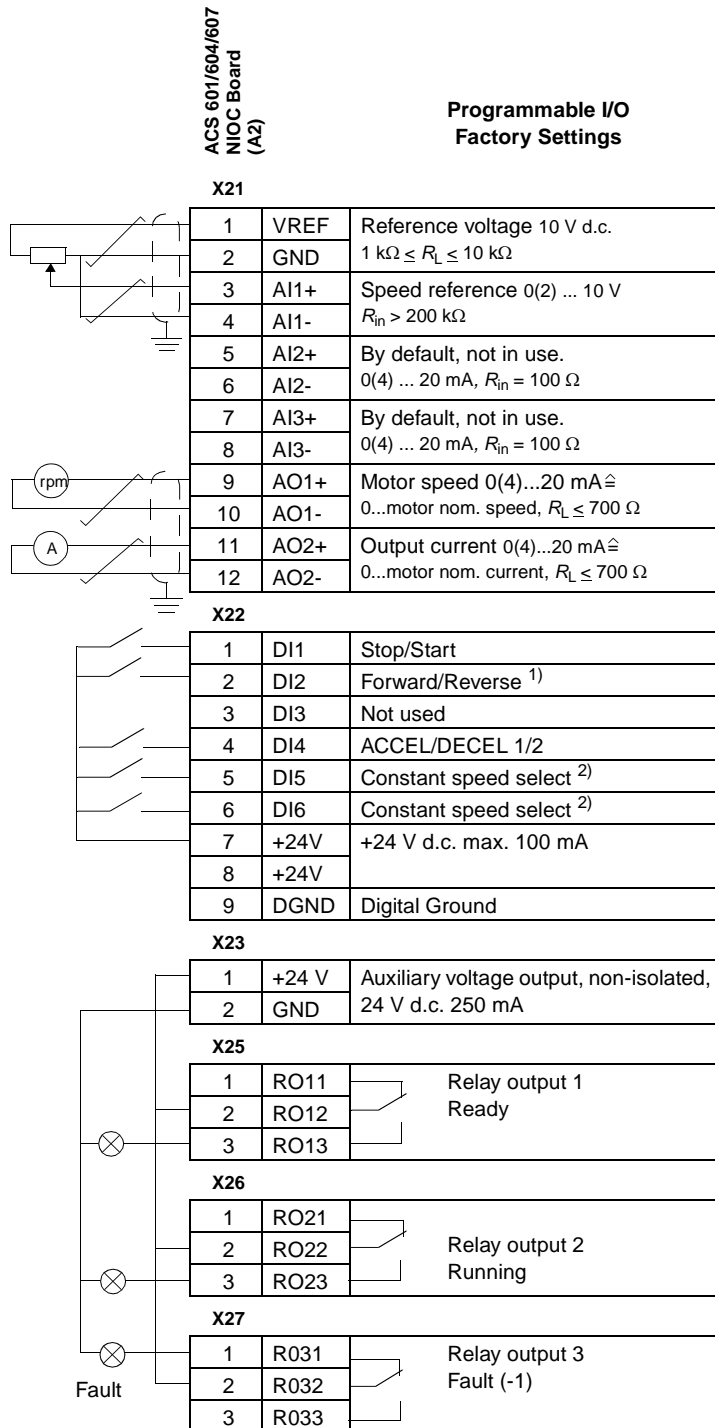
Connector X28 for RS 485 connection*

1	TRANS	Standard Modbus Link
2	GND	
3	B-	
4	A+	
5	GND	
6	+24 V	

Connector X29 for RS 485 connection*

1	TRANS	Standard Modbus Link
2	FAULT	
3	B-	
4	A+	
5	GND	
6	+24 V	

* Connector shield is connected via RC filter to frame.



Optional Terminal Block X2

External connections to optional terminal block X2 for ACS 600 Standard Application Program (Factory Macro) are shown below. (For the connections of other application macros and programs see *Firmware Manual*).

Terminal Block Size

X21, X22: cables 0.5 to 1.5 mm² (#20 to #16 AWG)
 X2, X23, X25, X26, X27: cables 0.5 to 2.5 mm² (#20 to #14 AWG)

Control Cable Lead-through Size:

Ø: 2 x 3x2...11 mm (0.08 to 0.43")

Factory settings of application software selection B (type code):

DI1: Start, DI2: Stop, DI3: Reverse, DI4: Acc/Dec 2, DI5,6: Constant speed 1 to 3 select.

1) Parameter 10.3 must be set to REQUEST.

2) Operation: 0 = Open, 1 = Closed

DI 5	DI 6	Output
0	0	Set speed through AI 1
1	0	Constant Speed 1
0	1	Constant Speed 2
1	1	Constant Speed 3

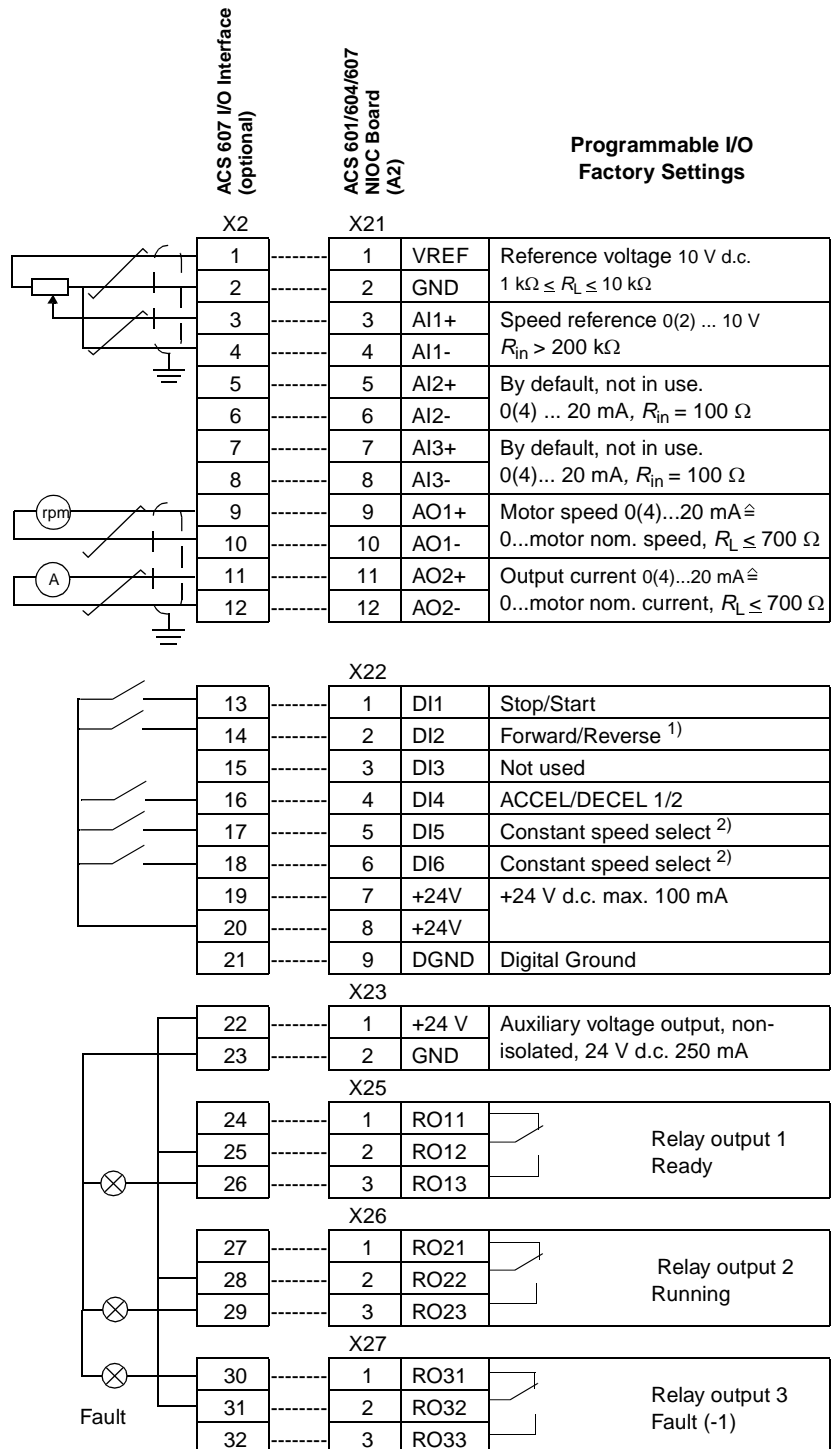
Connector X28 for RS 485 connection*

1	TRANS	Standard Modbus Link
2	GND	
3	B-	
4	A+	
5	GND	
6	+24V	

Connector X29 for RS 485 connection*

1	TRANS	Standard Modbus Link
2	FAULT	
3	B-	
4	A+	
5	GND	
6	+24V	

* Connector shield is connected via RC filter to frame.



**Optional Terminal Block
2TB (US Version)**

External connections to optional terminal block 2TB. This option is available only with ACS 600 Standard Application Program US version. External control connections with Factory Macro are shown below. (For the connections of other application macros and programs see *Firmware Manual*).

Terminal Block Size

X21, X22: cables 0.5 to 1.5 mm² (#20 to #16 AWG)
2TB, X23, X25, X26, X27: cables 0.5 to 2.5 mm² (#20 to #14 AWG)

Control Cable Lead-through Size:

Ø: 2 x 3x2...11 mm (0.08 to 0.43")

Factory settings of application software selection B (type code):

DI1: Start, DI2: Stop, DI3: Reverse,
DI4: Acc/Dec 2,
DI5,6: Constant speed 1 to 3 select.

1) Parameter 10.3 must be set to REQUEST.

2) Operation: 0 = Open, 1 = Closed

DI 5	DI 6	Output
0	0	Set speed through AI 1
1	0	Constant Speed 1
0	1	Constant Speed 2
1	1	Constant Speed 3

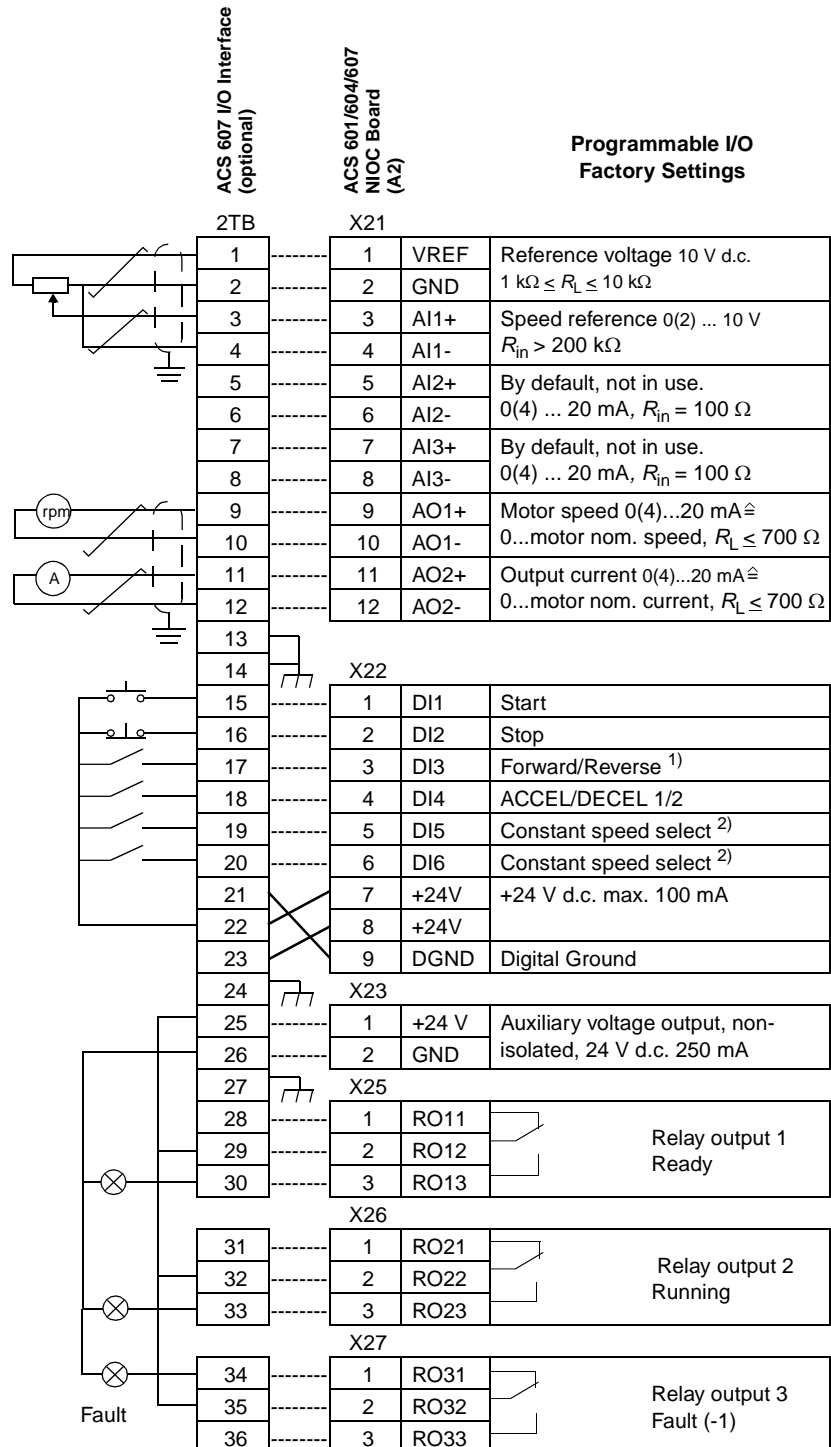
Connector X28 for RS 485 connection*

1	TRANS	Standard Modbus Link
2	GND	
3	B-	
4	A+	
5	GND	
6	+24V	

Connector X29 for RS 485 connection*

1	TRANS	Standard Modbus Link
2	FAULT	
3	B-	
4	A+	
5	GND	
6	+24V	

* Connector shield is connected via RC filter to frame.



NIOCP Board External control connections of ACP 600 with NIOCP board (and Speed Control Application Macro) are shown below. (For the connections of other application macros and programs see *Firmware Manual*).

Terminal Block Size

X1, X2, X4, X5, X8: cables 0.5 to 1.5 mm²
 X7: cables 0.5 to 2.5 mm²

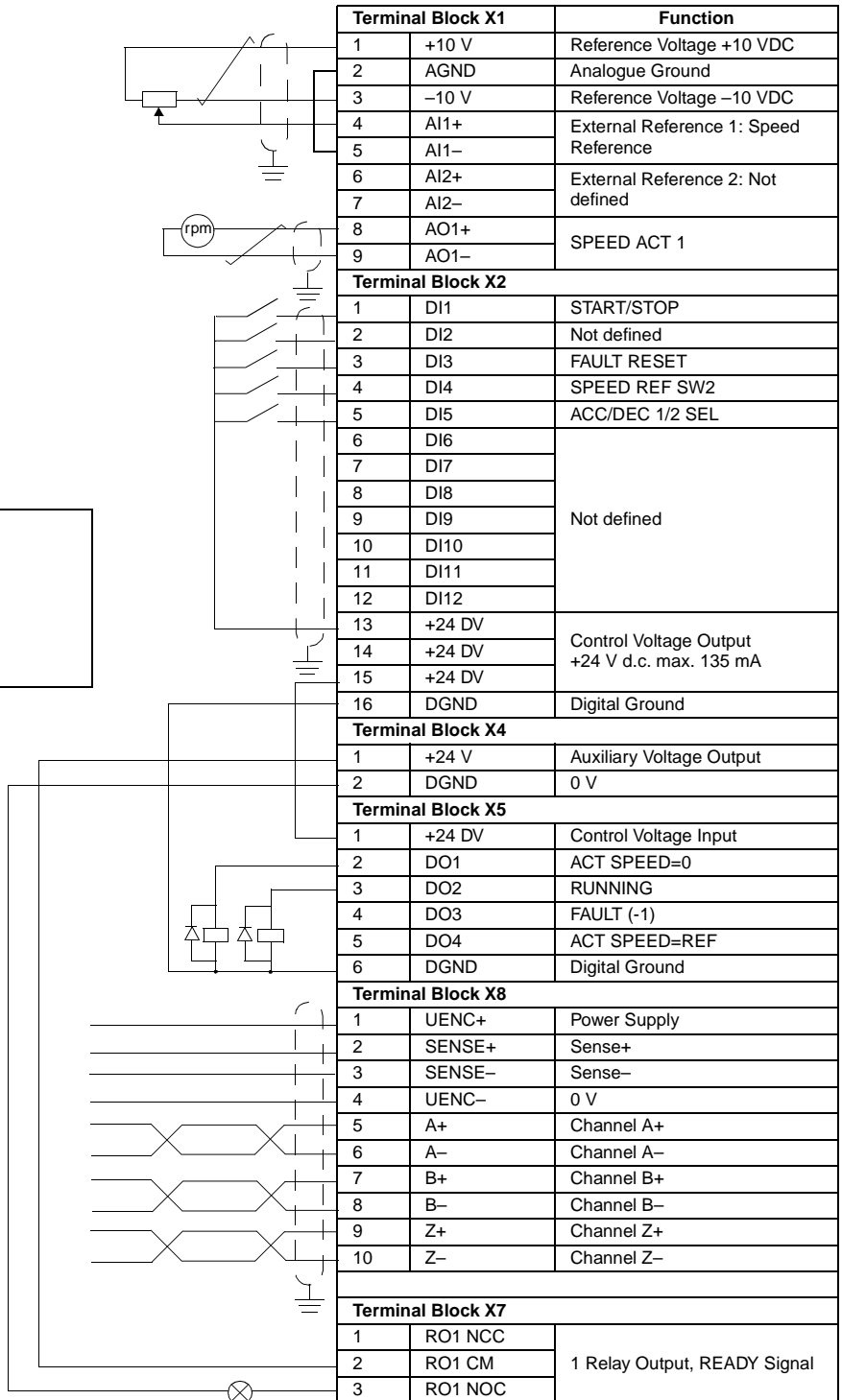
Control Cable Lead-through Size:

Ø: 2 x 3x2...11 mm

Connector X300 for RS 485 connection*

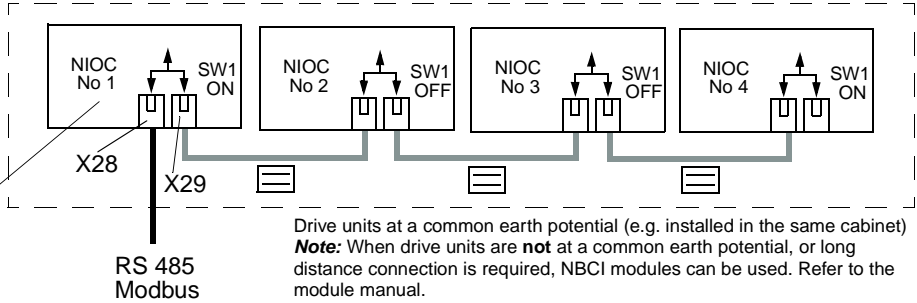
1	TRANS	Standard Modbus Link
2	GND	
3	B-	
4	A+	
5	GND	
6	+24 V	

* Connector shield is connected via RC filter to frame.



NIOC Board Chaining

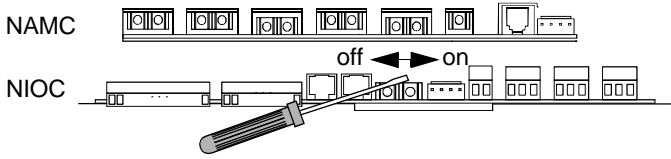
When several NIOC boards are daisy-chained for common control from an external Modbus device the bus termination switch (SW1) must be set on the participating boards as shown below.



This board should have SW1 in the OFF position if the external Modbus device has a bus termination circuit. If in doubt, set SW1 to ON here.

Drive units at a common earth potential (e.g. installed in the same cabinet)
Note: When drive units are **not** at a common earth potential, or long distance connection is required, NBC1 modules can be used. Refer to the module manual.

Straight-through cable (Ident.: Grey) (pin 1 to pin 1, pin 2 to pin 2, etc.)



Settings of Switch SW1	Function
OFF	Termination OFF
OFF ON	Termination ON (default)

**NIOC and NIOCP
Board Specifications**

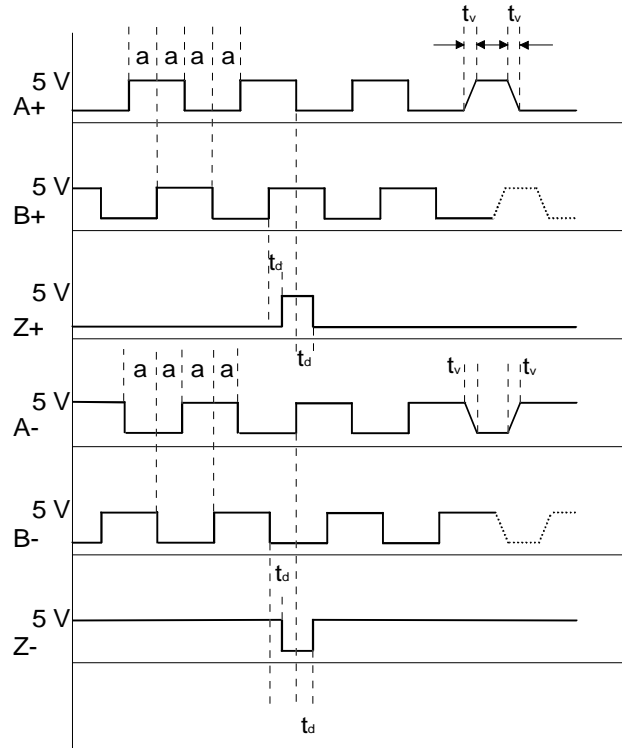
Data of the external control connection boards of the ACS 600 product family are given below.

	ACS/ACC/ACP 600 NIOC-01 Board	ACP 600 NIOCP-01 Board										
<p>Analogue Inputs</p> <p>The advantage of the differential analogue input is that the earth potential of the device or transmitter sending an analogue signal can differ up to ± 15 V from the earth potential of the ACx 600 chassis without disturbing the signal. Differential input also efficiently attenuates common mode disturbances coupled to control cables.</p>	<p>ACS 600: Two Programmable Differential Current Inputs: 0 (4) to 20 mA, $R_{in} = 100 \Omega$</p> <p>ACC 600: Two Differential Current Inputs: 0 to 20 mA, $R_{in} = 100 \Omega$</p> <p>ACP 600: One Programmable Differential Current Input: 0 to 20 mA, $R_{in} = 100 \Omega$</p> <p>ACS/ACP 600: One Programmable Differential Voltage Input: ACS 600: 0 (2) to 10 V, $R_{in} > 200 \text{ k}\Omega$; ACP 600: 0 to 10 V, $R_{in} > 200 \text{ k}\Omega$</p> <p>ACC 600: One Differential Voltage Input: 0 to 10 V, $R_{in} > 200 \text{ k}\Omega$</p> <p>Common Mode Voltage: ± 15 VDC, max.</p> <p>Common Mode Rejection Ratio: ≥ 60 dB at 50 Hz</p> <p>Resolution: 0.1 % (10 bit)</p> <p>Inaccuracy: ± 0.5 % (Full Scale Range) at 25 °C. Temperature Coefficient: $\pm 100 \text{ ppm}/^\circ\text{C}$, max.</p> <p>Input Updating Time:</p> <table border="1"> <thead> <tr> <th>Application Program</th> <th>Updating Time</th> </tr> </thead> <tbody> <tr> <td>Standard 5.x</td> <td>12 ms</td> </tr> <tr> <td>Standard 6.x</td> <td>AI1: 12 ms, AI2 and AI3: 6 ms *</td> </tr> <tr> <td>Crane</td> <td>44 ms</td> </tr> <tr> <td>Motion Control</td> <td>1 ms</td> </tr> </tbody> </table> <p>* 12 ms with NAI0 extension module</p>	Application Program	Updating Time	Standard 5.x	12 ms	Standard 6.x	AI1: 12 ms, AI2 and AI3: 6 ms *	Crane	44 ms	Motion Control	1 ms	<p>Two Bipolar Differential Voltage Inputs: ± 10 V, $R_{in} = 30 \text{ k}\Omega$</p> <p>Common Mode Voltage: ± 20 VDC, max.</p> <p>Common Mode Rejection Ratio: ≥ 60 dB at 50 Hz</p> <p>Resolution: 0.02 % (12 bit)</p> <p>Accuracy: 11 bit</p> <p>Inaccuracy: ± 0.1 % (Full Scale Range) at 25 °C. Temperature Coefficient: $\pm 100 \text{ ppm}/^\circ\text{C}$, max.</p> <p>Input Updating Time: 1 ms</p>
Application Program	Updating Time											
Standard 5.x	12 ms											
Standard 6.x	AI1: 12 ms, AI2 and AI3: 6 ms *											
Crane	44 ms											
Motion Control	1 ms											
<p>Constant Voltage Output</p>	<p>Voltage: 10 VDC ± 0.5 % (Full Scale Range) at 25 °C. Temperature Coefficient: $\pm 100 \text{ ppm}/^\circ\text{C}$, max.</p> <p>Maximum Load: 10 mA</p> <p>Applicable Potentiometer: 1 kΩ to 10 kΩ</p>	<p>Voltage: ± 10 VDC ± 0.5 % (Full Scale Range) at 25 °C. Temperature Coefficient: $\pm 100 \text{ ppm}/^\circ\text{C}$, max.</p> <p>Maximum Load: 10 mA</p> <p>Applicable Potentiometer: $\geq 1 \text{ k}\Omega$</p>										
<p>Auxiliary Power Output</p>	<p>Voltage: 24 VDC ± 10 %, Short circuit proof</p> <p>Maximum Current: 250 mA (130 mA with NLMD-01 option)</p>	<p>Voltage: 24 VDC ± 10 %, Short circuit proof</p> <p>Maximum Current: 300 mA</p>										

	ACS/ACC/ACP 600 NIOC-01 Board	ACP 600 NIOCP-01 Board										
Analogue Outputs	<p>ACS/ACC 600: Two Programmable Current Outputs: 0 (4) to 20 mA, $R_L \leq 700 \Omega$</p> <p>ACP 600: One Programmable Current Output: 0 to 20 mA, $R_L \leq 700 \Omega$</p> <p>Resolution: 0.1 % (10 bit)</p> <p>Inaccuracy: $\pm 1 \%$ (Full Scale Range) at 25 °C. Temperature Coefficient: $\pm 200 \text{ ppm}/^\circ\text{C}$, max.</p> <p>Output Updating Time:</p> <table border="1" style="width: 100%;"> <thead> <tr> <th>Application Program</th> <th>Updating Time</th> </tr> </thead> <tbody> <tr> <td>Standard 5.x</td> <td>24 or 100 ms</td> </tr> <tr> <td>Standard 6.x</td> <td>24 ms</td> </tr> <tr> <td>Crane</td> <td>44 ms</td> </tr> <tr> <td>Motion Control</td> <td>8 ms</td> </tr> </tbody> </table>	Application Program	Updating Time	Standard 5.x	24 or 100 ms	Standard 6.x	24 ms	Crane	44 ms	Motion Control	8 ms	<p>One Bipolar Programmable Voltage Output: $\pm 10 \text{ V}$, $R_L \geq 2 \text{ k}\Omega$</p> <p>Resolution: 0.02 % (12 bit)</p> <p>Accuracy: 10 bit</p> <p>Inaccuracy: $\pm 0.1 \%$ (Full Scale Range) at 25 °C. Temperature Coefficient: $\pm 200 \text{ ppm}/^\circ\text{C}$, max.</p> <p>Output Updating Time: 2 ms</p> <p>Output Rising Time: 3 ms</p>
Application Program	Updating Time											
Standard 5.x	24 or 100 ms											
Standard 6.x	24 ms											
Crane	44 ms											
Motion Control	8 ms											
Digital Inputs	<p>ACS/ACP 600: Six Programmable Digital Inputs (Common Ground): 24 VDC, -15 % to +20 %</p> <p>ACC 600: Six Digital Inputs (Common Ground): 24 VDC, -15 % to +20 %</p> <p>Logical Thresholds: $< 8 \text{ VDC} \hat{=} "0"$, $> 12 \text{ VDC} \hat{=} "1"$</p> <p>Input Current: DI1 to DI 5: 10 mA, DI6: 5 mA</p> <p>Filtering Time Constant: 1 ms</p> <p>Thermistor Input: 5 mA, $< 1.5 \text{ k}\Omega \hat{=} "1"$ (normal temperature), $> 4 \text{ k}\Omega \hat{=} "0"$ (high temperature), Open Circuit $\hat{=} "0"$ (high temperature)</p> <p>Internal Supply For Digital Inputs (+24 VDC): Short circuit proof, group isolated</p> <p>Isolation Test Voltage: 500 VAC, 1 minute</p> <p>Input Updating Time:</p> <table border="1" style="width: 100%;"> <thead> <tr> <th>Application Program</th> <th>Updating Time</th> </tr> </thead> <tbody> <tr> <td>Standard 5.x</td> <td>12 ms</td> </tr> <tr> <td>Standard 6.x</td> <td>6 ms</td> </tr> <tr> <td>Crane</td> <td>44 ms</td> </tr> <tr> <td>Motion Control</td> <td>4 ms</td> </tr> </tbody> </table> <p>An external 24 VDC supply can be used instead of the internal supply.</p>	Application Program	Updating Time	Standard 5.x	12 ms	Standard 6.x	6 ms	Crane	44 ms	Motion Control	4 ms	<p>12 Programmable Digital Inputs (Common Ground): 24 VDC, -15 % to +20 %</p> <p>Logical Thresholds: $< 8 \text{ VDC} \hat{=} "0"$, $> 12 \text{ VDC} \hat{=} "1"$</p> <p>Filtering Time Constant: $\leq 50 \mu\text{s}$</p> <p>DI 11 and DI 12 can be used for time measurement between two external events (PROBE1 and PROBE2).</p> <p>Internal Supply For Digital Inputs (+24 VDC): Short circuit proof, group isolated</p> <p>Isolation Test Voltage: 500 VAC, 1 minute</p> <p>Input Updating Time: 1 ms</p> <p>An external 24 VDC supply can be used instead of the internal supply.</p> <p>Filtering Time Constant: $\leq 100 \mu\text{s}$</p>
Application Program	Updating Time											
Standard 5.x	12 ms											
Standard 6.x	6 ms											
Crane	44 ms											
Motion Control	4 ms											
Digital Outputs	-	<p>Four Programmable Digital Outputs: Short circuit proof, Overload protection</p> <p>Maximum Load: 10 mA with internal 24 V supply, 100 mA with external supply</p> <p>Output Updating Time: 2 ms</p>										

	ACS/ACC/ACP 600 NIOC-01 Board	ACP 600 NIOCP-01 Board
Relay Outputs	<p>Three Programmable Relay Outputs</p> <p>Switching Capacity: 8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC</p> <p>Minimum Continuous Current: 5 mA rms at 24 VDC</p> <p>Maximum Continuous Current: 2 A rms</p> <p>Contact Material: Silver Cadmium Oxide (AgCdO)</p> <p>Isolation Test Voltage: 4 kVAC, 1 minute</p> <p>Output Updating Time: 100 ms (ACS 600), 44 ms (ACC 600), 8 ms (ACP 600)</p>	<p>One Relay Output</p> <p>Switching Capacity: 8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC</p> <p>Minimum Continuous Current: 5 mA rms at 24 VDC</p> <p>Max Continuous Current: 2 A rms</p> <p>Contact Material: Silver Cadmium Oxide (AgCdO)</p> <p>Isolation Test Voltage: 4 kVAC, 1 minute</p> <p>Output Updating Time: 2 ms</p>
DDCS Fibre Optic Link	Protocol: DDCS (ABB Distributed Drives Communication System)	
Modbus Communication Link	<p>RS 485</p> <p>Transmission Rate: Max. 9600 bit/s</p> <p>Parity: Selectable</p> <p>Connectors: Shielded modular telecommunication socket</p>	
Encoder Input		<p>One Encoder Input: 3 channel differential, frequency ≤ 200 kHz, supply cable resistance compensation. COMBICON connector, 10 pins. Meets the EIA standard RS 422. Encoder supply: +5 VDC ... +10 VDC, short circuit proof, max. 150 mA.</p> <p>Required Encoder Type: the type listed here or equivalent:</p> <ul style="list-style-type: none"> • GI 356 (IRION & VOSSELER) • ROD 426A (Heidenhain) <p>Encoder Signals: Signal level/Load capacity: 5 V rectangular-pulse signals; Time between edges: $a > 0,8 \mu\text{s}$ at f_{max} ; Edge steepness: $t_v \leq 120$ ns; Delay of reference signal Z (zero pulse): $t_d \leq 60$ ns; Sampling frequency: $f_{\text{max}} = 200$ kHz.</p>

Encoder Signals A characteristic of encoder signals in applications using the incremental encoder for forward direction is presented below.



Enclosures, Space Requirements

The cabinets, degrees of protection and free space requirements of ACx 600 types are given below.

ACx 600 Type	Enclosure	Degree of Protection ⁵⁾	Space above		Space below		Space on left/right		Space in front/back	
			mm	in	mm	in	mm	in	mm	in
601	wall-mounted metal frame	IP 22/IP 54 ¹⁾	300	12	300	12	50/50	2/2	20/0	0.8/0
604 ²⁾	frame R7	IP 22	300	12	300	12	50/50	2/2	20/0	0.8/0
604 ³⁾	frames R8 and R9	IP 00	400	16	0	0	50 ⁴⁾ /50	2/2	100/0	4/0
6x7	Common cabinet	IP 21 ⁵⁾ /22 IP 42/54	200	8	0	0	0	0	200/0	8/0

¹⁾ not for R7 frame size (ACx 601-0100-3, -0120-3, -0120-5, -0140-5, -0100-6, -0120-6), not for ACP 601 units

²⁾ ACx 604-0100-3, -0120-3, -0120-5, -0140-5, -0100-6, -0120-6

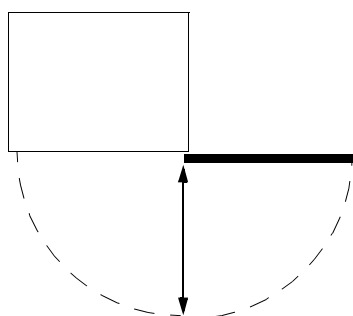
³⁾ ACx 604-0140-3 to -0320-3 & -0170-5 to -0400-5, -0140-6 to -0400-6

⁴⁾ 50 mm is needed for air-cooling. In addition, free space is needed for terminal connections.

⁵⁾ louvred gratings which are visible on the dimensional drawings are not included

⁶⁾ The degrees of protection is specified by listing the IEC standard IP (Ingress Protection) number. The first digit of the IP number specifies the protection against solid objects and dirt. The second digit specifies the protection against liquids. IP 00 is an open chassis. NEMA 1 enclosures are comparable to approximately IP 20 to IP 33. NEMA 3R enclosures are comparable to IP 32. NEMA 12 and NEMA 13 enclosures are comparable to IP 54 to IP 65. NEMA 4 enclosures are comparable to IP 65 or IP 66.

	First digit of IP number (protection against solid objects)	Second digit of IP number (protection against liquids)
0	Not protected	Not protected
1	Protected against solid objects larger than 50 mm (2 in.) dia.	Protected against dripping water
2	Protected against solid objects larger than 12 mm (1/2 in.) dia.	Protected against downward sprays of water up to 15 degrees from vertical.
3	Protected against solid objects larger than 2.5 mm (0.1 in.) dia.	Protected against downward sprays of water up to 60 degrees from vertical.
4	Protected against solid objects larger than 1.0 mm (0.04 in.) dia.	Protected against light sprays or splashing water from all directions - water shall not enter the enclosure in harmful quantities.
5	Dust protected - dust shall not enter the enclosure in sufficient quantity to interfere with satisfactory operation of equipment.	Protected against low pressure sprays of water from all directions - water shall not enter the enclosure in harmful quantities.
6	Dust tight	Protected against heavy seas on shipdecks or strong sprays of water from all directions - water shall not enter the enclosure in harmful quantities.



Space requirement for the door opening
 700 mm (27.6 in.) (2 x R8 and 2 x R9)
 800 mm (31.5 in.) (R7, R8 and R9)

Cooling Air Flow Requirements

Cooling air flow requirements are given below.

ACx 60x 60x = 604/6x7	Flow m³/h
ACx 60x-0100-3/0120-5/0100-6	660
ACx 60x-0120-3/0140-5/0120-6	660
ACx 60x-0140-3/0170-5/0140-6/0170-6	1640
ACx 60x-0170-3/0210-5/0210-6	1640
ACx 60x-0210-3/0260-5/0260-6	1640
ACx 60x-0260-3/0320-5/0320-6	1840
ACx 60x-0320-3/0400-5/0400-6	1840
ACx 6x7-0400-3/0490-5/0490-6	3580
ACx 6x7-0490-3/0610-5/0610-6	3980
ACx 6x7-0610-3/0760-5/0760-6	3980

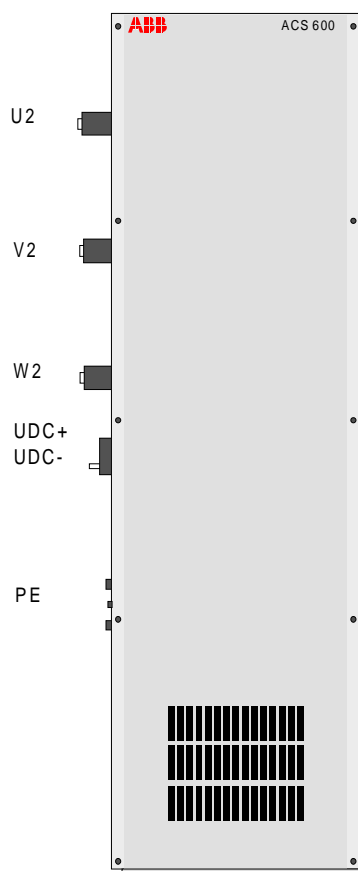
Heat Losses and Noise Levels

Heat losses and noise levels are given below.

Frequency Converter Type	Heat Loss kW	Noise dB (A)
ACx 604/607-0100-3	1.9	65.8
ACx 604/607-0120-3	2.3	65.8
ACx 604/607-0140-3	2.8	61.8
ACx 604/607-0170-3	3.3	61.8
ACx 604/607-0210-3	4.0	61.8
ACx 604/607-0260-3	5.0	67.6
ACx 604/607-0320-3	6.3	67.6
ACx 6x4/6x7-0400-3	7.9	65
ACx 6x4/6x7-0490-3	10.0	71
ACx 6x4/6x7-0610-3	12.5	71
ACx 604/607-0120-5	2.3	65.8
ACx 604/607-0140-5	2.8	65.8
ACx 604/607-0170-5	3.3	61.8
ACx 604/607-0210-5	4.0	61.8
ACx 604/607-0260-5	5.0	61.8
ACx 604/607-0320-5	6.3	67.6
ACx 604/607-0400-5	7.9	67.6
ACx 6x4/6x7-0490-5	10.0	65
ACx 6x4/6x7-0610-5	12.5	71
ACx 6x4/6x7-0760-5	15.8	71
ACx 604/607-0100-6	1.9	65.8
ACx 604/607-0120-6	2.3	65.8
ACx 604/607-0140-6	2.8	61.8
ACx 604/607-0170-6	3.3	61.8
ACx 604/607-0210-6	4.0	61.8
ACx 604/607-0260-6	5.0	61.8
ACx 604/607-0320-6	6.3	67.6
ACx 604/607-0400-6	7.9	67.6
ACx 6x4/6x7-0490-6	10.0	65.0
ACx 6x4/6x7-0610-6	12.5	71.0
ACx 6x4/6x7-0760-6	15.8	71.0

Dimensions and Weights (ACx 604)

Dimensions and weights of the ACx 604s are given below.



ACS 604 Type			Height mm (in)	Width mm (in)	Depth mm (in)	Weight kg (lbs)
0100-3	0120-5	0100-6	860 (33.86)	480 (18.89)	428 (16.85)	88 (194)
0120-3	0140-5	0120-6	860 (33.86)	480 (18.89)	428 (16.85)	88 (194)
0140-3	0170-5	0140-6/ 0170-6	1250 (49.2)	462*/524 (18.19/20.63)	407 (16)	135 (297)
0170-3	0210-5	0210-6	1250 (49.2)	462*/524 (18.19/20.63)	407 (16)	140 (308)
0210-3	0260-5	0260-6	1250 (49.2)	462*/524 (18.19/20.63)	407 (16)	140 (308)
0260-3			1600 (63)	462*/524 (18.19/20.63)	407 (16)	166 (365)
0320-3			1600 (63)	462*/524 (18.19/20.63)	407 (16)	166 (365)
	0320-5	0320-6	1600 (63)	462*/524 (18.19/20.63)	407 (16)	171 (376)
	0400-5	0400-6	1600 (63)	462*/524 (18.19/20.63)	407 (16)	171 (376)
0400-3	0490-5	0490-6	2 x Dimensions of ACx 604-0210-3			
0490-3	0610-5	0610-6	2 x Dimensions of ACx 604-0260-3			
0610-3	0760-5	0760-6	2 x Dimensions of ACx 604-0320-3			

Width marked with * does not include motor cable terminals, PE terminal or DC bus terminals.

Dimensions and Weights (ACx 6x7)

Dimensions and weights of the ACx 6x7s are given below.



ACx 6x7 Type			Height ¹⁾ mm (in)	Width mm (in)	Depth mm (in)	Weight ⁴⁾ kg (lbs)
0100-3	0120-5	0100-6	2078 ¹⁾ /2316 ²⁾ (81.8)/(91.2)	830 (32.7)	644 (25.35)	275/300 ⁵⁾ (605)/(660)
0120-3	0140-5	0120-6	2078 ¹⁾ /2316 ²⁾ (81.8)/(91.2)	830 (32.7)	644 (25.35)	275/300 ⁵⁾ (605)/(660)
0140-3	0170-5	0140-6/0170-6	2078 ¹⁾ /2316 ²⁾ (81.8)/(91.2)	830/1230 ³⁾ (32.7)/(48.4)	644 (25.35)	340/390 ⁵⁾ (748)/(858)
0170-3	0210-5	0210-6	2078 ¹⁾ /2316 ²⁾ (81.8)/(91.2)	830/1230 ³⁾ (32.7)/(48.4)	644 (25.35)	345/390 ⁵⁾ (749)/(858)
0210-3	0260-5	0260-6	2078 ¹⁾ /2316 ²⁾ (81.8)/(91.2)	830/1230 ³⁾ (32.7)/(48.4)	644 (25.35)	345/390 ⁵⁾ (749)/(858)
0260-3			2078 ¹⁾ /2316 ²⁾ (81.8)/(91.2)	830/1230 ³⁾ (32.7)/(48.4)	644 (25.35)	370 (814)
0320-3			2078 ¹⁾ /2316 ²⁾ (81.8)/(91.2)	830/1230 ³⁾ (32.7)/(48.4)	644 (25.35)	370 (814)
	0320-5	0320-6	2078 ¹⁾ /2316 ²⁾ (81.8)/(91.2)	830/1230 ³⁾ (32.7)/(48.4)	644 (25.35)	375/435 ⁵⁾ (825)/(957)
	0400-5	0400-6	2078 ¹⁾ /2316 ²⁾ (81.8)/(91.2)	830/1230 ³⁾ (32.7)/(48.4)	644 (25.35)	375/435 ⁵⁾ (825)/(957)
0400-3	0490-5	0490-6	2078 ¹⁾ /2215 ²⁾ (87.3)/(87.2)	2130 ⁶⁾ (83.9)	644 (25.35)	710 (1562)
0490-3	0610-5	0610-6	2078 ¹⁾ /2215 ²⁾ (87.3)/(87.2)	2130 ⁶⁾ (83.9)	644 (25.35)	870 (1914)
0610-3	0760-5	0760-6	2078 ¹⁾ /2215 ²⁾ (87.3)/(87.2)	2130 ⁶⁾ (83.9)	644 (25.35)	870 (1914)

- 1) Height of bottom entry/exit, degree of protection IP 21 / IP 22 / IP 42. Heights include the lifting lugs. Height of top entry/exit is 2132 (83.9 in).
- 2) Degree of protection IP 54
- 3) EMC Line Filter version

- 4) Weight of the IP 21 / IP 22 / IP 42 version
- 5) Weight of the 690 V unit with du/dt filter
- 6) With cable top exit an additional 400 mm wide section

Braking Chopper Dimensions

The widths of units with braking chopper are below.

ACx 6x7 Type	Width with Braking Chopper mm (in)	Width with Braking Chopper and Resistor(s) mm (in)	ACx 6x7 Type	Width with Braking Chopper mm (in)	Width with Braking Chopper and Resistor(s) mm (in)	ACx 6x7 Type	Width with Braking Chopper mm (in)	Width with Braking Chopper and Resistor(s) mm (in)
0100-3	830 (32.7)	1230 (48.4)	0120-5	830 (32.7)	1230 (48.4)	0100-6	830 (32.7)	1230 (48.4)
0120-3	830 (32.7)	1230 (48.4)	0140-5	830 (32.7)	1230 (48.4)	0120-6	830 (32.7)	1230 (48.4)
0140-3	1230 (48.4)	1230 (48.4)	0170-5	1230 (48.4)	1230 (48.4)	0140-6	1230 (48.4)	1230 (48.4)
0170-3	1230 (48.4)	1530 (60.2)	0210-5	1230 (48.4)	1230 (48.4)	0170-6	1230 (48.4)	1230 (48.4)
0210-3	1230 (48.4)	1530 (60.2)	0260-5	1230 (48.4)	1530 (60.2)	0210-6	1230 (48.4)	1230 (48.4)
0260-3	1230 (48.4)	1530 (60.2)	0320-5	1230 (48.4)	1530 (60.2)	0260-6	1230 (48.4)	1530 (60.2)
0320-3	1230 (48.4)	1530 (60.2)	0400-5	1230 (48.4)	1530 (60.2)	0320-6	1230 (48.4)	1530 (60.2)
0400-3	2930 (115.4)	3530 (139)	0490-5	2930 (115.4)	3530 (139)	0400-6	1230 (48.4)	1530 (60.2)
0490-3	2930 (115.4)	3530 (139)	0610-5	2930 (115.4)	3530 (139)	0490-6	2930 (115.4)	3530 (139)
0610-3	2930 (115.4)	3530 (139)	0760-5	2930 (115.4)	3530 (139)	0610-6	2930 (115.4)	3530 (139)
						0760-6	2930 (115.4)	3530 (139)

Application Programs Various application programs are available for the ACS 600 frequency converters. Not all selections are available for all types. One application program at a time can be loaded in the memory of the frequency converter.

ACS 600 Application Programs	
Standard	Decanter Centrifuge
Pump and Fan Control (PFC)	Extruder
Master/Follower (M/F)	Centrifuge
Spinning Control	
Motion Control	
Crane	
System	

Application Macros The macros of the application programs are introduced below.

Application Program	Macros	For...
Standard	Factory	basic industrial applications
	Hand/Auto	applications that require frequent switching between two external control locations
	PID Control	closed loop processes
	Torque Control	processes that require torque control
	Sequential Control	operation at preset constant speeds
	User macro 1 & 2	user's own customised parameter settings
Pump and Fan Control	Pump and Fan Control	pump or fan station control
	Hand/Auto	applications that require frequent switching between two external control locations and/or speed control of a pump or a fan
Master/Follower	Master/Follower + macros included in Standard Application program	drives which are coupled to each other
Spinning Control	Spinning control	running motor rotating bobbins in ring-frame machines
Motion Control	Torque Control	processes that require torque control
	Speed Control	closed loop speed control
	Positioning	point-to-point positioning
	Synchronising	positioning to moving target
	User macro 1 & 2	user's own customised parameter settings
Crane	Crane	normal crane drive
	Master/Follower Control	two crane drive applications with Master/Follower operation
	User macro 1 & 2	user's own customised parameter settings
Decanter Centrifuge	Decanter	separating solid particles from liquids
Extruder	Extruder, Hand/Auto, PID Control, Torque Control, Sequential Control, User macro 1 & 2	extruder drives
Centrifuge	Centrifuge	centrifuge drives
Traverse Control	Traverse	textile machines

**Macro/Language
Combinations**

Languages and application macros included in each ACx 600 application program are shown below. Not all selections are available for all types.

Application Program	Type code character no. 15	Application Macros	Languages
Standard	B*, **	Factory, Hand/Auto, PID Control, Torque Control, Sequential Control	English (UK & Am), French, Spanish, Portuguese
	C**	Factory, Hand/Auto, PID Control, Torque Control, Sequential Control	English (UK & Am), German, Italian, Dutch
	D	Factory, Hand/Auto, PID Control, Torque Control, Sequential Control	English (UK & Am), Danish, Swedish, Finnish
	E	Factory, Hand/Auto, PID Control, Torque Control, Sequential Control	English (UK & Am), French, Spanish, Portuguese
Pump and Fan Control	F**	PFC (Pump and Fan Control)	English (UK & Am), German, Italian, Dutch
	G	Pump and Fan Control, Hand/Auto	English (UK & Am), Danish, Swedish, Finnish
	H	Pump and Fan Control, Hand/Auto	English (UK & Am), French, Spanish, Portuguese
Master/Follower	J**	Master/Follower + Macros included in selection C	English (UK & Am), German, Italian, Dutch
	K	Master/Follower + Macros included in selection D	English (UK & Am), Danish, Swedish, Finnish
	L	Master/Follower + Macros included in selection E	English (UK & Am), French, Spanish, Portuguese
	M*, **	Master/Follower + Macros included in selection B	English (UK & Am), French, Spanish, Portuguese
System	N	System application (ACS 600 MultiDrive)	English, German
Motion Control	P	ACP 600: Torque Control, Speed Control, Positioning, Synchronising	English, German
	Q	ACP 600: Torque Control, Speed Control	English, German
Crane	S	Crane, Master/Follower Control	English
Spinning Control	V	Spinning control	English
Custom	T	Application program template (FCB Programmable)	English
	Y	Special application program	Custom specified
Decanter Centrifuge	P	Decanter	English, German
Extruder	Q	Extruder, Hand/Auto, PID Control, Torque Control, Sequential Control, User macro 1 & 2	English, German
Centrifuge	2	Centrifuge	English
Traverse Control	1	Traverse	English

* This selection is for the North American market. The default parameter settings in the standard application macros include minor changes to fulfil the local regulations, such as 3-wire start/stop.

**Standard Application Program version 6.x includes MASTER/FOLLOWER Parameter Group and the following languages: Czech, Danish, Dutch, English (UK & Am), Finnish, French, German, Italian, Polish, Spanish, Swedish, Portuguese.

**PFC Application Program version 6.x includes the following languages: Czech, Danish, Dutch, English (UK & Am), Finnish, French, German, Italian, Polish, Spanish, Swedish, Portuguese.

Protection Features Application program dependent features of the ACx 600 are listed below. ● available as standard, ○ optional. Not all selections are available for all types. For more information refer to the appropriate application program *Firmware Manual*.

Preprogrammed Faults	Standard PFC, M/F				Programmable Fault Functions	Standard PFC, M/F				Programm. Supervision Functions	Standard PFC, M/F			
	Crane	Motion Control	System			Crane	Motion Control	System			Crane	Motion Control	System	
ACx 600 temperature	●	●	●	●	Analogue input below minimum value	●				Speed	2		2	2
Overcurrent	●	●	●	●	Loss of Control Panel	●	●		●	Motor current	●			●
Short circuit	●	●	●	●	External fault	●	●	●	●	Motor torque	2		●	2
DC overvoltage	●	●	●	●	Motor overtemperature	●	●	●	●	Motor speed	●			●
Supply phase	●	●	●	●	Thermistor/Pt 100	●	●	●	●	Reference 1	●			
DC undervoltage	●	●	●	●	Motor stalled	●		●	●	Reference 2	●			
Overfrequency	●	●		●	Motor underload	●		●	●	Actual value 1	●			
Loss of Control Panel			●		Loss of motor phase	●	●	●	●	Position error			●	
Internal fault	●	●	●	●	Earth fault	●	●	●	●	Synchron error			●	
Internal fault on the I/O control board	●	●	●	●	Speed measurement			●		Position threshold			4	
Ambient temperature	●	●	●	●	Motor overspeed		●			Joystick		●		
User Macro	●	●	●	●	Torque		●			Brake long falling time		●		
Braking chopper (in fieldbus mode)		●			Torque proving		●							
Inverter overload		●			Master/Follower communication	●	●							
No motor data	●	●		●	Brake		●							
ID Run fail	●	●		●	Communication test			●						
Motor fan control and diagnostics				●	Following error			●						
					Position limits	○	○	●	○					
					Communication error									
					Encoder interface module	○	○	●	○					
					Overspeed			●						

Preprogrammed Warnings: ACS 600 temperature, Motor Identification Run, Drive Identification Number change, User Macro, Target position (ACP).

Programmable Automatic Reset Functions (ACS 600 Standard Application Program only): after overcurrent, overvoltage, undervoltage and analogue input below minimum value.

Information Functions: ACx 600 control firmware package version, ACx 600 application program version, ACx 600 test date.

Applicable Standards

The ACS 600 complies with the following standards:

- EN 60204-1: 1992 + Corr. 1993 (IEC 204-1). Safety of machinery. Electrical equipment of machines. Part 1: General requirements. *Provisions for compliance:* The final assembler of the machine is responsible for installing
 - an emergency-stop device
 - a supply disconnecting device (ACx 601 and ACx 604)
 - the ACx 604 (IP 00) into a separate casing.
- EN 60529: 1991 (IEC 529), IEC 664-1: 1992. Degrees of protection provided by enclosures (IP code).
- EN 61800-3 (1996): EMC product standard including specific test methods.
- AS/NZS 2064 (1997): Limits and methods of measurement of electronic disturbance characteristics of industrial, scientific and medical radiofrequency equipment. (ACS 600 complies with the requirements given for class A equipment.) This standard is applied in Australia and New Zealand.

Materials

Enclosure (ACx 601)	Thickness of Coating	Color
PS (polystyrene) 3 mm		NCS 1502-Y (RAL 90021 / PMS 420 C)
hot-dip zinc coated steel sheet 1.5 to 2 mm painted with epoxy polyester powder paint	60 µm	NCS 8502-Y (RAL 9004 / PMS 426 C) semigloss
anodised aluminium profile (R2 to R6)		black ES 900
Enclosure (ACx 604/6x7)		
hot-dip zinc coated steel sheet 1.5 to 2 mm with polyester thermosetting powder coating	60 µm	RAL 7035
Package (ACx 604/6x7)		
wood or plywood (seaworthy package). Plastic covering of the package: PE-LD, bands PP or steel.		

Transportation Position

ACx 604/6x7: Upright. Units without du/dt filters can be transported also on their back in their protective package.

Disposal

ACx 600 contains raw materials that should be recycled, thus preserving energy and natural resources. Package materials of ACx 600 units and options are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. If recycling is not feasible, all parts excluding electrolytic capacitors can be landfilled. The DC capacitors of the unit contain electrolyte which is classified as hazardous waste. (Location of the electrolytic capacitors is shown on a sticker in the back of the front cover, C11 to C13.) The capacitors must be removed and handled according to local regulations.

For further information on environmental aspects, please contact your local ABB distributor.

CE Marking

A CE mark is attached to ACx 601/607/627 frequency converters to verify that the unit follows the provisions of the European Low Voltage and EMC Directives (Directive 73/23/EEC, as amended by 93/68/EEC and Directive 89/336/EEC, as amended by 93/68/EEC).

Compliance with the EMC Directive

EMC stands for **E**lectromagnetic **C**ompatibility. 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.

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used in the European Economic Area. The EMC product standard EN 61800-3 covers the requirements stated for frequency converters.

The ACx 607/627 frequency converters (55 kW to 630 kW) comply with the EMC Directive in industrial low-voltage network, public low-voltage network (restricted distribution) and IT networks (unearthed mains) with the following provisions:

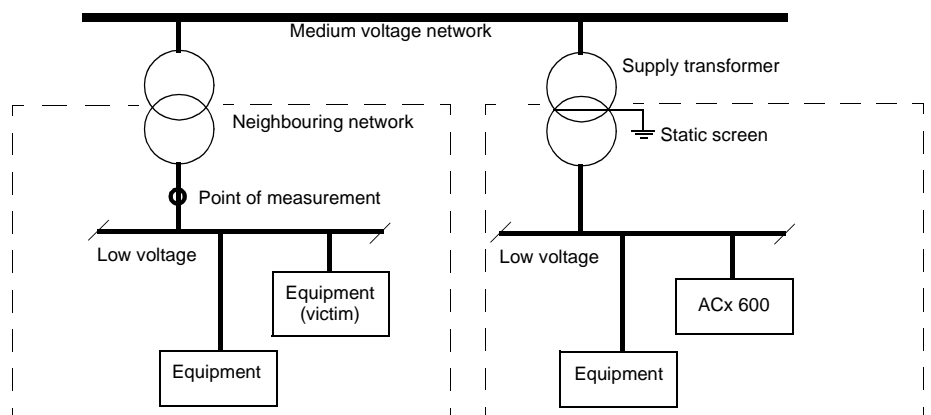
Industrial Low-Voltage Network

1. It is ensured that no excessive emission is propagated to neighbouring low-voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, the ACx 600 can be equipped with EMC filtering (refer to Table A-1) or the supply transformer with static screening between the primary and secondary windings can be used.
2. The ACx 6x7 is installed according to the instructions given in this manual.
3. The motor and control cables are selected as specified in this manual.

Note: It is recommended to equip the ACx 600 with the EMC filtering if there is equipment sensitive to conducted emission connected to the same supply transformer as the ACx 600.

Table A-1 The EMC filtering of the ACx 600 units is marked in the type code as follows. * du/dt Filters + EMC Filters, ** du/dt Filters + No EMC Filters.

ACS 600 Type	Type Code		
	Character no.	EMC Filter Selections	No EMC Filter Selections
ACS/ACC/ACP 604	ACxxxxxxxxxxxxxxxxxxxxx ↑ 20	0	9
ACS/ACC/ACP 6x7 (55 to 630 kW)	ACxxxxxxxxxxxxxxxxxxxxx ↑ 20	0, 3*	5**, 9



Use of the ACx 600 in Second Environment without EMC filtering (EN 61800-3: second environment includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.)

Public Low-Voltage Network

1. The ACx 600 is equipped with EMC filtering (refer to Table A-1).
2. The ACx 6x7 is installed according to the instructions given in this manual.
3. The motor and control cables are selected as specified in this manual.
4. Maximum cable length is 100 metres.

Without considering the EMC requirements, do not use the ACx 600 on a low voltage public network supplying domestic premises. This kind of use might cause radio frequency interference.

Unearthed Mains (IT Network)

1. It is ensured that no excessive emission is propagated to neighbouring low-voltage networks. In some cases, the natural 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.
2. The ACx 6x7 is installed according to the instructions given in this manual.
3. The motor and control cables are selected as specified in this manual.

Note: The ACx 600 must not be equipped with EMC filtering (refer to Table A-1) when installed to IT networks. The mains becomes connected to earth potential through the EMC filter capacitors. In IT networks this may cause danger or damage the unit.

Machinery Directive

ACx 601/604/607/627 frequency converters comply with the European Union Machinery Directive (98/37/EC) requirements for an equipment intended to be incorporated into machinery.

UL/CSA Markings

The UL/CSA markings are often required in North America. The UL/UL_C/CSA markings of the ACS 600 frequency converters are listed below (x).

ACx 600 Type	UL	UL _C	CSA
ACS 601 (IP 22) 480 V, 500 V and 600 ¹⁾ V ranges	x	x	x
ACS 601 (IP 54)	x	x	x
ACS 604 frame sizes R7 to R9 480 V, 500 V and 600 ¹⁾ V ranges	x	x	x
ACS 604 480 V, 500 V and 600 ¹⁾ V parallel connected units	x	pending	pending

¹⁾ the approval is valid up to 600 V

UL

ACS 600 is suitable for use in a circuit capable of delivering not more than 65 kA rms symmetrical amperes at 480 V maximum (500 V units), and at 600 V maximum (690 V units).

ACS 600 provides overload protection in accordance with the National Electrical Code (US). See *ACS 600 Firmware Manual* for setting. Default setting is off, must be activated at start-up.

ACS 600 drives are to be used in a heated indoor controlled environment. See subsection *Ambient Conditions* for specific limits.

ACS 600 braking chopper - ABB has braking chopper modules that, when applied with appropriately sized braking resistors, will allow the drive to dissipate regenerative energy (normally associated with quickly decelerating a motor). Proper application of the braking chopper is defined in the *NBRA-6xx Braking Choppers Installation and Start Up Guide, Appendix A*. These guide lines will allow you to size braking choppers to your specific application needs for standard or extended duty cycles. This can be applied to a single drive or multiple drives with DC Bus connected to allow a sharing of regenerative energy.

“C-tick” Marking 

“C-tick” marking is required in Australia and New Zealand. A “C-tick” mark is attached to ACx 601/607 frequency converters to verify that the unit follows the provisions of

- Radiocommunications (Electromagnetic Compatibility) Standard 1998
- Radiocommunications (Compliance Labelling - Incidental Emissions) Notice 1998
- AS/NZS 2064: 1997. Limits and methods of measurement of electronic disturbance characteristics of industrial, scientific and medical (ISM) radiofrequency equipment.
- Radiocommunication Regulations of New Zealand (1993).

**Compliance with AS/
NZS 2064**

The above rules define the essential requirements for emissions of electrical equipment used in Australia and New Zealand. The standard AS/NZS 2064 (Limits and methods of measurement of electronic disturbance characteristics of industrial, scientific and medical radiofrequency equipment, 1997) covers the detailed requirements for three-phase frequency converters.

The ACx 607 frequency converters comply with AS/NZS 2064 for class A equipment (suitable for use in all establishments other than domestic and those directly connected to a low-voltage network which supplies buildings used for domestic purposes). The compliance is valid with the following provisions:

1. The ACx 600 is equipped with EMC filtering (refer to Table A-1).
2. The ACx 607 is installed according to the instructions given in this manual.
3. The motor and control cables are selected as specified in this manual.
4. Maximum cable length is 100 metres.

Note: The ACx 600 must not be equipped with EMC filtering (refer to Table A-1) when installed to IT networks. The mains becomes connected to earth potential through the EMC filter capacitors. In IT networks this may cause danger or damage the unit.

Equipment Warranty and Liability

General: ABB warrants the Equipment supplied by ABB against defects in material and workmanship for a period of twelve (12) months after installation or twenty four (24) months from date of shipment from factory, whichever first occurs.

Should any failure to conform with the applicable warranties appear during the specified periods under normal and proper use and provided the Equipment has been properly stored, installed, operated and maintained, and if given prompt notice by Purchaser, ABB shall correct such nonconformity, at its option; by (1) repair or replacement of the nonconforming equipment or parts thereof. Repairs or replacements pursuant to warranty shall not renew or extend the applicable original equipment warranty period, provided however, that any such repairs or replacement of equipment or parts thereof shall be warranted for the time remaining of the original warranty period or 30 days, whichever is longer.

ABB shall not be responsible for providing working access to the defect, including disassembly and reassembly of equipment or for providing transportation to and from repair or factory facility, all of which shall be at Purchaser's risk and expense.

These warranties shall not apply to any Equipment or parts thereof which (1) have been improperly repaired or altered; (2) have been subjected to misuse, negligence or accident; (3) have been used in a manner contrary to ABB's instructions; (4) are comprised of materials provided or designed stipulated by Purchaser; or (5) are used equipment.

The foregoing warranties are exclusive and in lieu of all other warranties of quality and performance, written, oral or implied, and all other warranties including any implied warranties of merchantability or fitness for a particular purpose are hereby disclaimed by ABB and all equipment manufacturers.

Correction of nonconformities in the manner and for the period of time provided above shall be the Purchaser's exclusive remedy and shall constitute fulfilment of all liabilities of ABB and any Equipment manufacturer (including any liability for direct, indirect, special, incidental or consequential damages) whether in warranty, contract, negligence, tort, strict liability, or otherwise with respect to any nonconformance of or defect or deficiency in the equipment supplied or services furnished hereunder.

Limitation of Liability

IN NO EVENT SHALL ABB, ITS SUPPLIERS OR SUBCONTRACTORS BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, including, but not limited to loss of profits or revenue, loss of use of the Equipment or any associated equipment, cost of capital, cost of substitute equipment, facilities or services, downtime costs, delays, or claims of customers of the Purchaser or other third parties for such or other damages. ABB's liability on any claim whether in contract, warranty, negligence, tort, strict liability, or otherwise for any loss or damage arising out of, connected with, or resulting from the contract or the performance or breach thereof, or from the design, manufacture, sale, delivery, resale, repair, replacement, installation, technical direction of installation, inspection, operation or use of any equipment covered by or in connection therewith, shall in no case exceed the purchase price of the Equipment or part thereof or services which give rise to the Claim.

All clauses of action against ABB arising out of or relating to the contract or the performance or breach hereof shall expire unless brought within one year of the time of accrual thereof.

In no event, regardless of cause, shall ABB assume responsibility for or be liable for penalties or penalty clauses of any description or for indemnification of customer or others for costs, damages, or expenses each arising out of or related to the goods or services of the order.

Your local distributor or ABB office may hold different guarantee details, which are specified in the sales terms, conditions, or guarantee terms. These terms are available on request.

If you have any questions concerning your ABB frequency converter, please contact the local distributor or ABB office. The technical data, information and specifications are valid at the time of printing. The manufacturer reserves the right to modifications without prior notice.



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