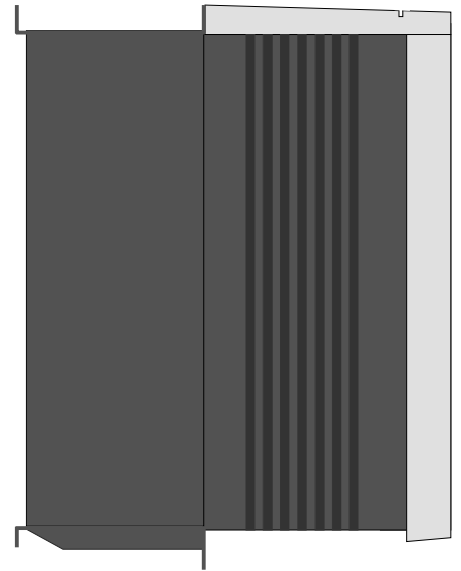
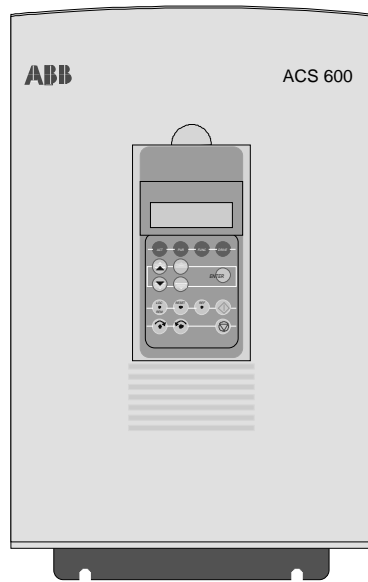


This manual includes

- Safety
- Installation
- Maintenance
- Product Information

ACS/ACC/ACP 601 Frequency Converters 2.2 to 110 kW (3 to 150 HP)



ACS 600 SingleDrive Manuals

GENERAL MANUALS (appropriate hardware manuals 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/ACP 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 Hardware Manual EN 61201394

55 to 630 kW

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

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

630 to 3000 kW

- Safety instructions
- Cable selection
- Mechanical and electrical installation
- Drive section commissioning
- Maintenance
- Technical data
- 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 UNIT USER'S MANUALS (with 630 to 3000 kW units depending on the supply type one of these manuals is included in the delivery)

Diode Supply Unit (DSU) EN 61451544

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

Thyristor Supply Unit (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

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 601 Frequency Converters
2.2 to 110 kW
(3 to 150 HP)

Hardware Manual

This manual concerns the ACS 601, ACC 601 and ACP 601 frequency converters. In the text, they are collectively referred to as ACx 601.

3AFY 61201360 R0425 REV B
EN
EFFECTIVE: 6.9.1999
SUPERSEDES: 5.10.1998

Safety Instructions

Overview

This chapter states the safety instructions that must be followed when installing, operating and servicing the ACS/ACC/ACP 601. 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 601. 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 M Ω) 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.

Supply Connections

For ACx 601 a supply disconnecting device must be installed in the supply, by which the electric parts of the unit can be separated from the mains 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 isolator must be of a load switch type according to EN 60947-3 Class B or of a type that switches off the loaded circuit by means of an auxiliary contact opening the main contacts of a switch.

If an ACx 601 with the integrated EMC filter (code 0 in the type code for EMC Filters) is installed 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 capacitors of the ACx 601. This may cause danger or damage the unit. Disconnect the EMC filter capacitors before connecting the ACx 601 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 I/O 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 mains power) is five in ten minutes.



WARNING! Never connect the mains (line power) to the ACx 600 output. If frequent bypassing is required, mechanically connected switches or contactors should be employed. 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 of the ACS/ACP 600 can be disabled by Parameter 30.17 (ACC: 30.11).

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) and may cause some fault current circuit breakers to function.

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.

Motor Connections



WARNING! Operation is not allowed if the motor nominal voltage is less than one half 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.

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 to the motor insulation. The motor manufacturer should be consulted regarding the construction of the motor insulation. Failure of the motor to fulfil the following requirements may shorten its life.

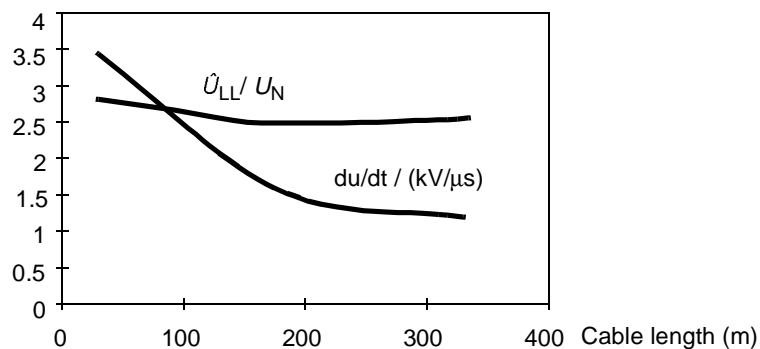
Motor Insulation Requirement

The requirement of motor insulation level in ACx 600 frequency converter drive is given below.

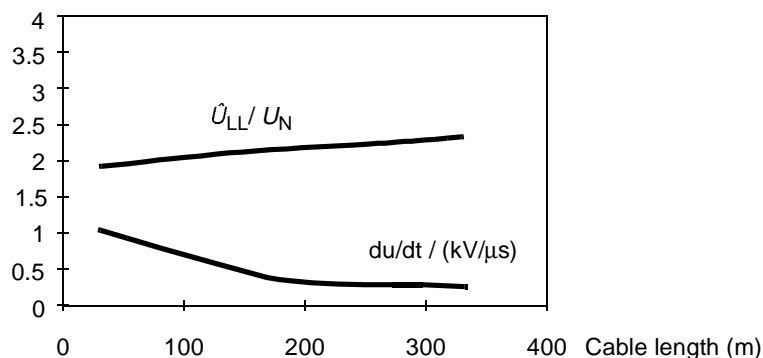
Motor Type	Nominal Mains Voltage	Motor Insulation Requirement
ABB M2_ Motors with IEC Frame	$U_N \leq 500 \text{ V}$	Standard insulation system
	$500 \text{ V} < U_N \leq 600 \text{ V}$	Standard insulation and du/dt filter or reinforced insulation system
	$600 \text{ V} < U_N \leq 690 \text{ V}$	Reinforced insulation system and du/dt filter
ABB M2_ Motors with NEMA Frame	$460 \text{ V} \leq U_N \leq 600 \text{ V}$	Reinforced insulation system
Random-wound Motors	$U_N \leq 420 \text{ V}$	Motor insulation system must withstand $\dot{U}_{LL} = 1300 \text{ V}$.
	$420 \text{ V} < U_N \leq 500 \text{ V}$	If motor insulation system withstands $\dot{U}_{LL} = 1600 \text{ V}$ and $0.2 \mu\text{s}$ rise time, a du/dt filter is not needed. With a du/dt filter at the output of the ACx 600, motor insulation system must withstand $\dot{U}_{LL} = 1300 \text{ V}$.
	$500 \text{ V} < U_N \leq 600 \text{ V}$	Motor insulation system must withstand $\dot{U}_{LL} = 1600 \text{ V}$. A du/dt filter must be used at the output of the ACx 600.
	$600 \text{ V} < U_N \leq 690 \text{ V}$	Motor insulation system must withstand $\dot{U}_{LL} = 1800 \text{ V}$. A du/dt filter must be used at the output of the ACx 600.
Form-wound Motors	$U_N \leq 690 \text{ V}$	If motor insulation system withstands $\dot{U}_{LL} = 2000 \text{ V}$ and rise time $0.3 \mu\text{s}$, no du/dt filter is needed.

Symbol	Definition
U_N	nominal mains voltage
\hat{U}_{LL}	peak line to line voltage at motor terminals
Rise time: $\Delta t = 0.8 \cdot \hat{U}_{LL} / (du/dt)$	Rise time is line to line voltage change rate at motor terminals (the interval during which the voltage changes from 10 % to 90 % of the whole voltage range) \hat{U}_{LL} and Δt depend on cable length. Read the values of \hat{U}_{LL} and du/dt from the diagrams below.

Without Filtering Below is a diagram of \hat{U}_{LL} and du/dt as a function of cable length when no du/dt filter is used.



With du/dt Filter Below is a diagram of \hat{U}_{LL} and du/dt as a function of cable length with du/dt filter at the output of the ACx 600.





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: ACS 600 units via parameter 21.3 (ACP: 10.4), choose COAST. If RAMP is selected, the output of the ACS/ACP 600 must be reduced to zero using Parameter 16.1 by giving zero V DC to the selected digital input. Otherwise the contactor will be damaged. 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

Installing control instruments (contactors or relays) or control cables other than those of the ACx 600 inside the frequency converter (drive enclosure) is not acceptable.

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.

Mechanical Installation

CAUTION! The ACx 601 weighs a considerable amount, and should not be handled by the front cover. The unit should only be placed on its back. Exercise appropriate care when manoeuvring the unit to avoid damage and injury. Lifting the ACx 601 is much easier and safer with two 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! Do not fasten the ACx 600 by riveting or welding.

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 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.

For start-up, refer to *Start-up Guide* (ACS 600 Standard Application Program) or *Firmware Manual* (ACS 600 Crane Drive and Motion Control Application Programs).

For optional equipments, refer to their manuals.

For programming the unit, refer to the appropriate *Firmware Manual*.

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 6x1 Type Code

The meaning of main selections of ACx 6x1 type code characters is given in the table below. Not all selections are available for all types. More information on selections is in *ACS 600 SingleDrive Ordering Information* guide (code: 58977985, available on request).

Character no.	Meaning	Refer to
Example: ACS60100053000B1200001		
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, 1 = Regenerative braking, 2 = 12-pulse rectifier, 7 = Regenerative 4Q thyristor bridge	
6	Construction 1 = Wall mounted, 4 = Module, 7 = Drives-MNS 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	
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 internal EMC Filters (not for 690V or 12-pulse rectifier) 9 = without internal EMC Filters	<i>Appendix A: CE marking</i>
21	Braking Chopper and Cabling Direction	
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 – Technical Data* for allowed operation conditions of the ACx 601.

The ACx 601 should be installed in an upright position with the cooling section facing a wall. The wall should be as close to vertical as possible, of non-flammable material and strong enough to carry the weight of the unit. The floor/material below the installation should be non-flammable.

Sufficient room around the ACx 601 is required to enable cooling air flow, service and maintenance.

Installation Procedure

1. Check the intended installation site for sufficient room and that there is nothing on the wall to inhibit installation. See *Appendix B – Dimensional Drawings* for frame details and screw sizes.
2. Mark the locations for the four holes.
3. Fix the screws to the marked locations.
4. Position the ACx 601 onto the screws on the wall. **Note:** lift ACx 601 by its chassis and not by its cover. (Frame R7 is fitted with lifting lugs to allow the use of a proper lifting device.)
5. Tighten the screws in the wall securely.

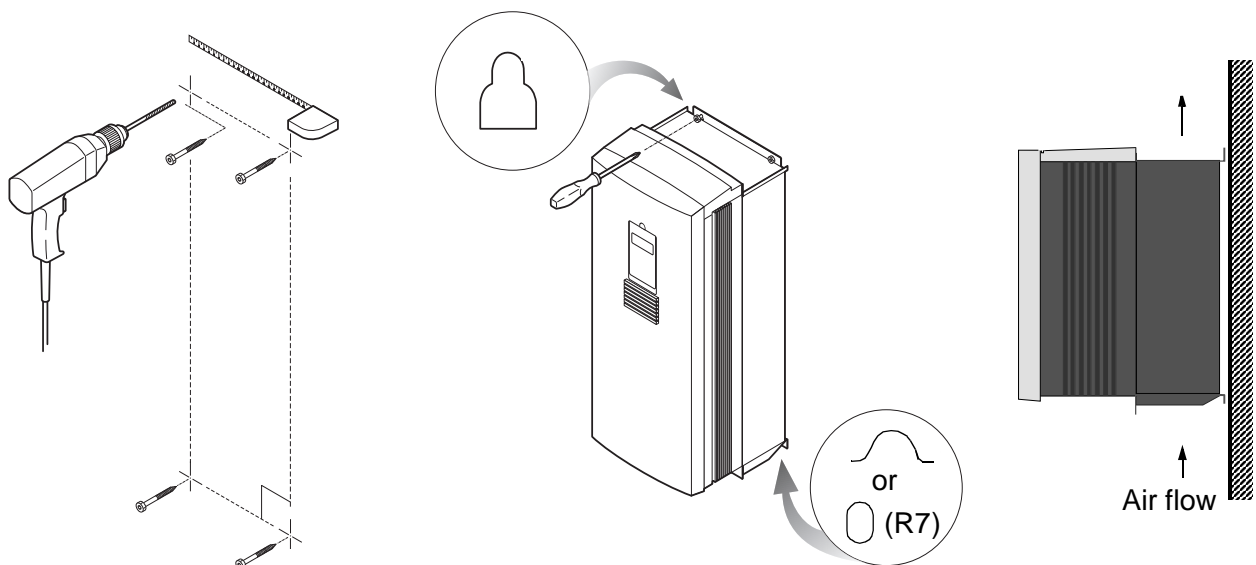


Figure 2-1 Installing the ACx 601 on a wall.

Installation in a Cooling Air Duct

The ACx 601 design allows the unit to be recessed into a wall with the cooling section protruding into a special cooling air duct (frames R2 to R6). The cooling air grates in the bottom and the top of the unit must not be blocked by the wall or any other structure. Steps should be taken to enable service and maintenance for the unit.

The air in the cooling duct must meet the requirements stated for ambient air. If the air in the cooling duct is not clean the enclosure class of the ACx 601 must be IP 54. Note the power ratings of the IP 54 units.

To install the ACx 601 in a cooling air duct, carry out the following steps:

1. See *Appendix B – Dimensional Drawings* for dimensions of the opening in the duct.
2. Make the opening.
3. Mark the locations for the four holes. Drill the holes.
4. Frame R2 and R3: Undo the two screws at the lower front edge of the unit. Lift the front cover somewhat and disconnect the Control Panel cable from the board fitted on the inside of the cover. Remove the front and top covers.
5. Frames R4 to R6: Remove the Control Panel. Remove the telephone connector. Undo the two screws at the lower front edge of the unit. Remove the front and top covers.
6. Follow the installation procedure in Figure 2-2.

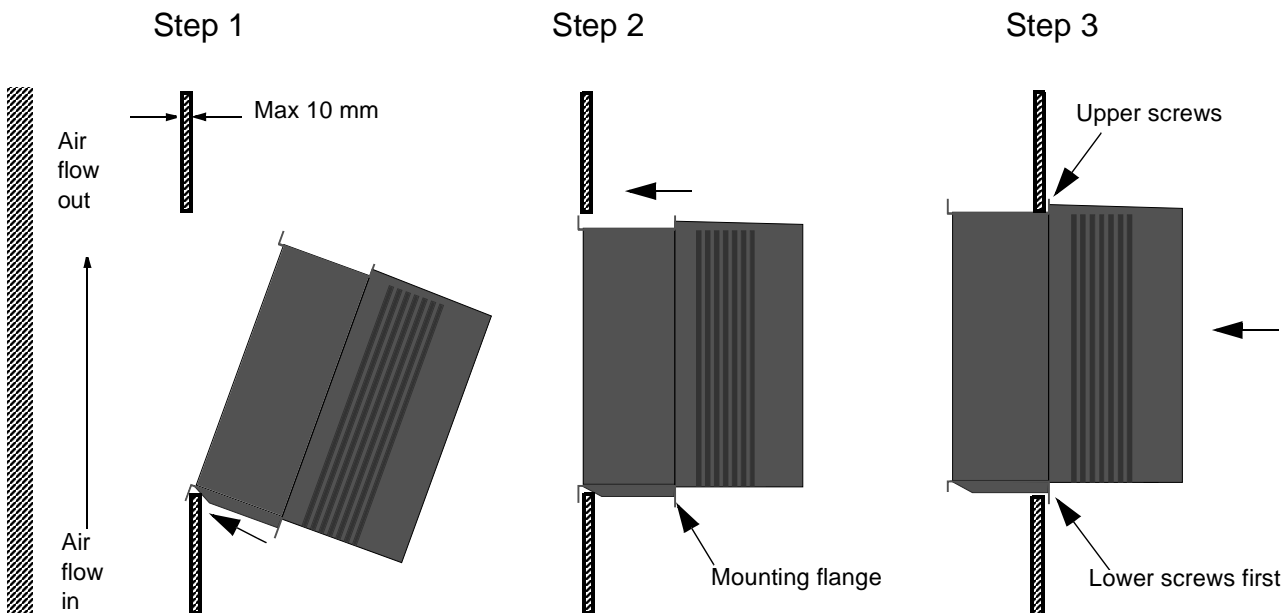


Figure 2-2 Installation procedure of the ACx 601 in a cooling air duct.

Chapter 3 – Electrical Installation



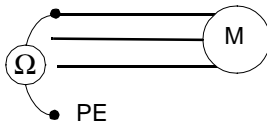
WARNING! The electrical installation described in this chapter should only be carried out by a qualified electrician. The *Safety Instructions* on the first pages of this manual must be followed. Negligence of these instructions can cause injury or death.

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 greater 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 601 is not equipped with input fuses. When installing the ACx 601, it is recommended to connect the supply via ultrarapid fuses introduced in *Appendix A*. For types ACx 601-0030-3 and -0040-5 and larger, ultrarapid fuses must always be used.

If a fuse is blown, it must not be replaced with a normal slow fuse rated according to *Appendix A*. 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 ACx 600. When the ultrarapid fuses of ACx 601 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*).

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.

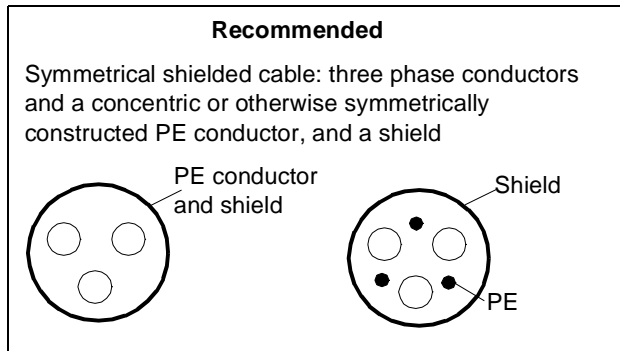
For ACx 601 frame size R5 and larger, or motors larger than 30 kW symmetrical shielded motor cable must be used (figure below). A four-conductor system can be used up to frame size R4 with up to 30 kW motors, but shielded symmetrical motor cable is recommended.

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.

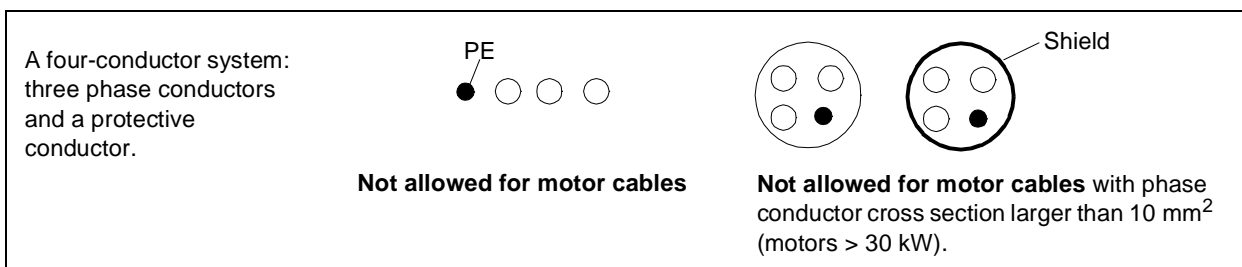
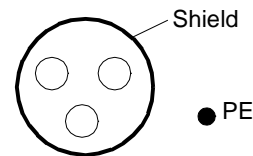
Compared to a four-conductor system, the use of symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as motor bearing currents and wear.

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 ACx 600 are represented below.

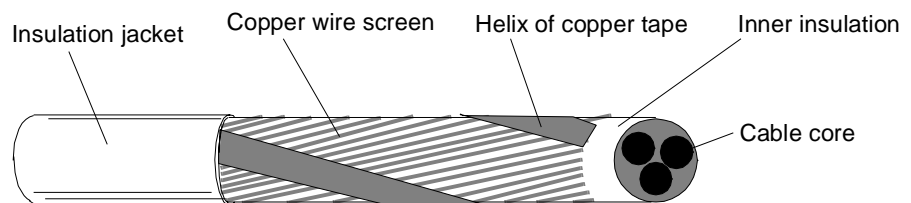


A separate PE conductor is required if the conductivity of the cable shield is < 50 % of the conductivity of the phase conductor.



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 is, the lower is the emission level and the bearing currents.



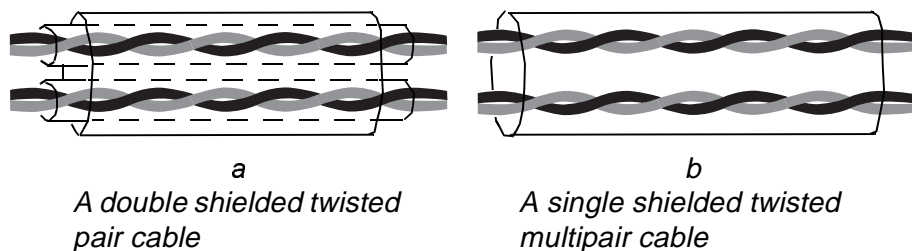
Control Cables

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 and 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 ÖLFLEX (braided metallic screen, 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.

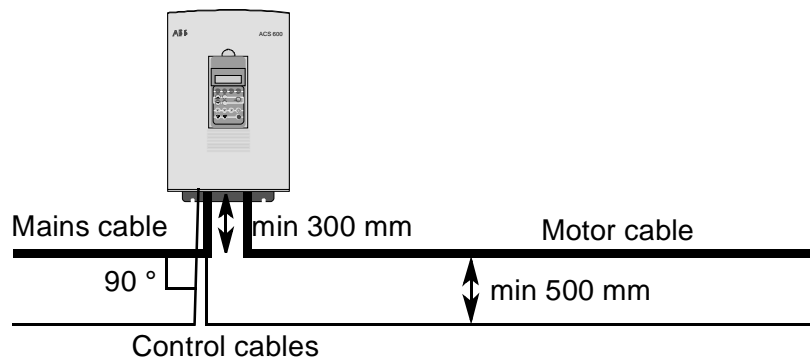
Cable Routing

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 ACS 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

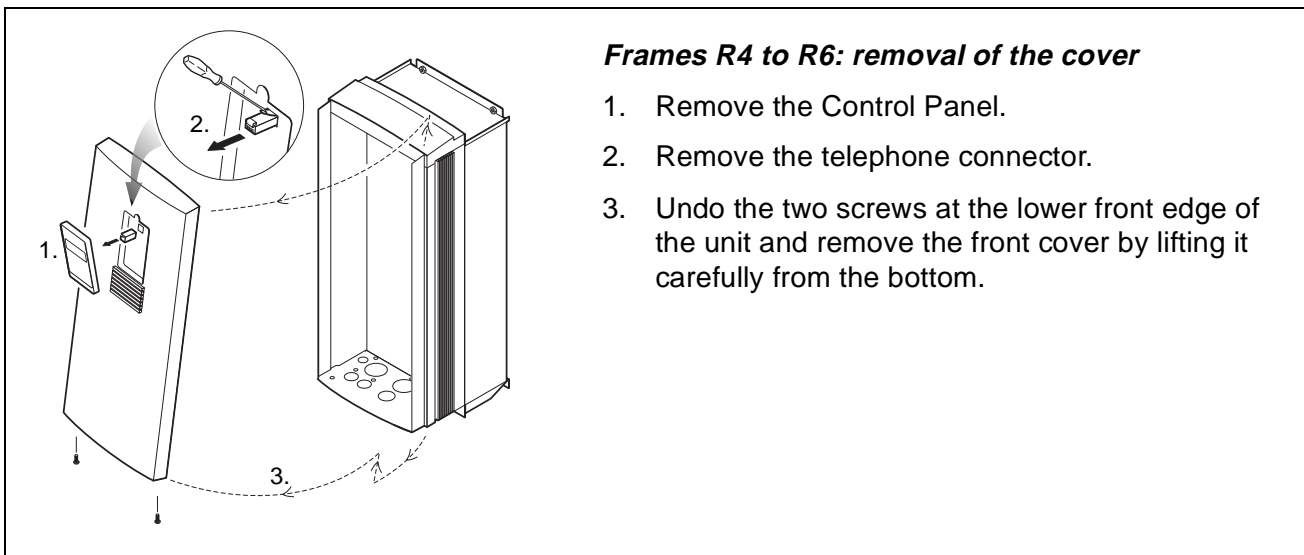


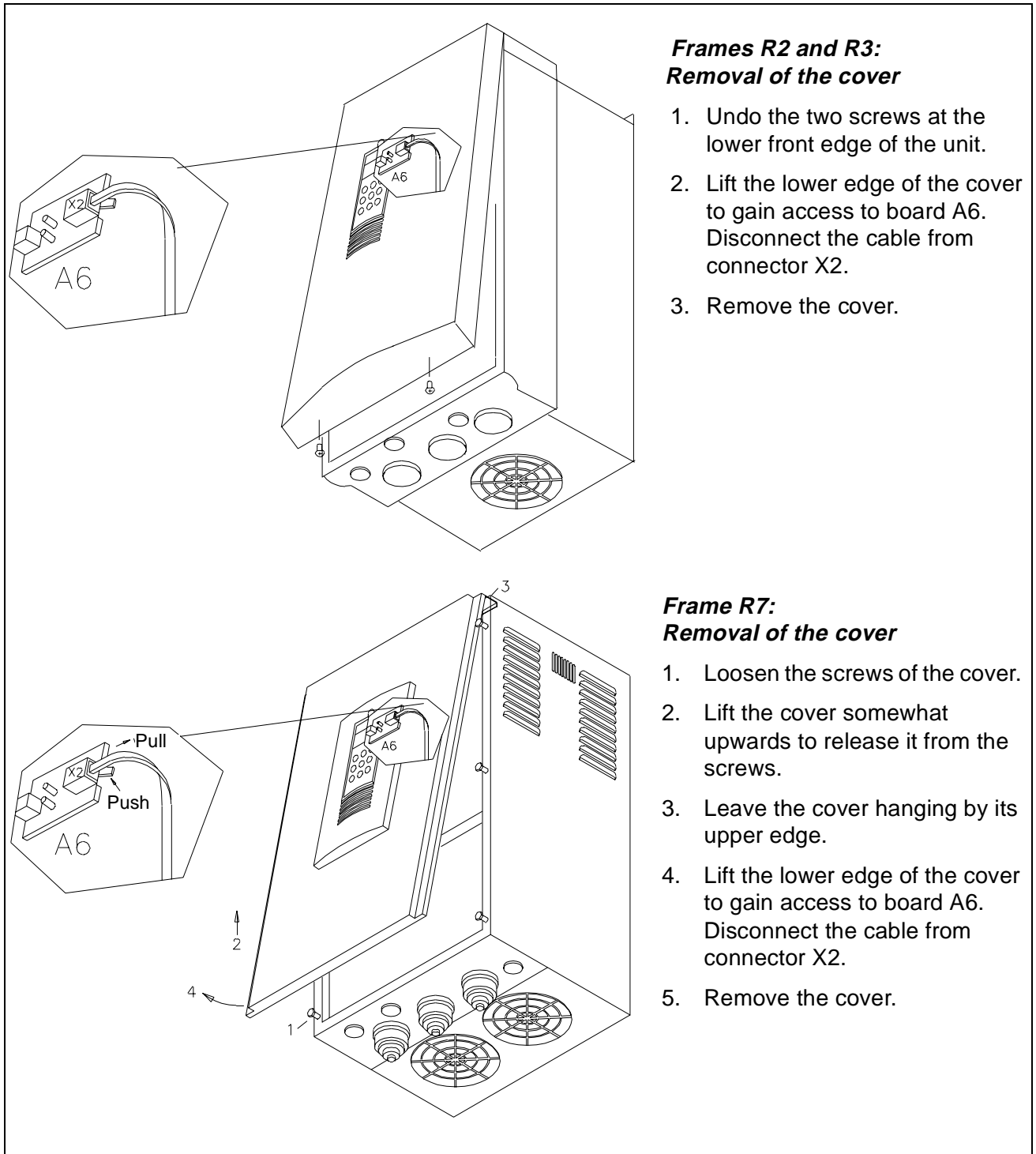
WARNING! This work should only be carried out by a qualified electrician. The *Safety Instructions* on the first pages of this manual must be followed. Negligence of these instructions can cause injury or death.

The mains and motor cables connect to the terminal block of the ACx 601 in the lower part of the frame, the control cables over them to the NIOC/NIOCP board (A2).

To connect the mains, motor and control cables carry out the following procedure.

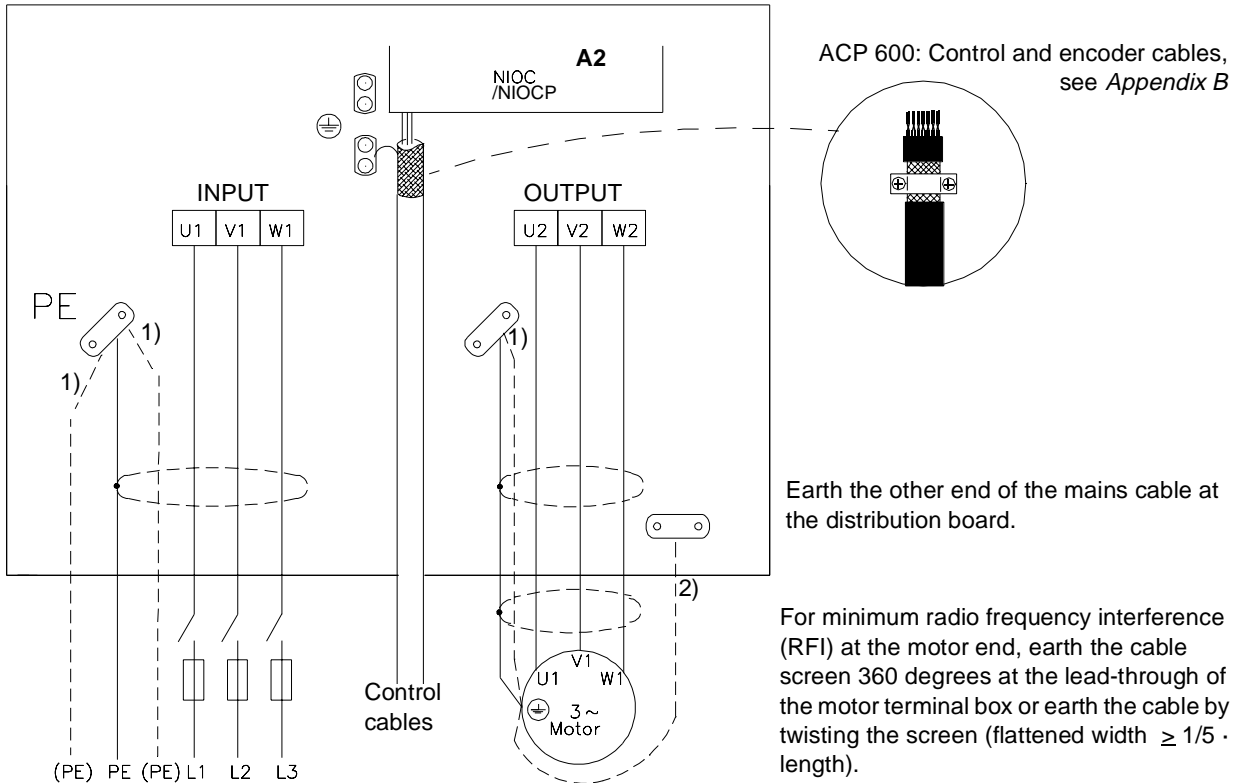
Make sure that the ACx 601 is disconnected from the mains network during installation. If the ACx 601 is already connected to the mains, wait for 5 minutes after disconnecting mains power.



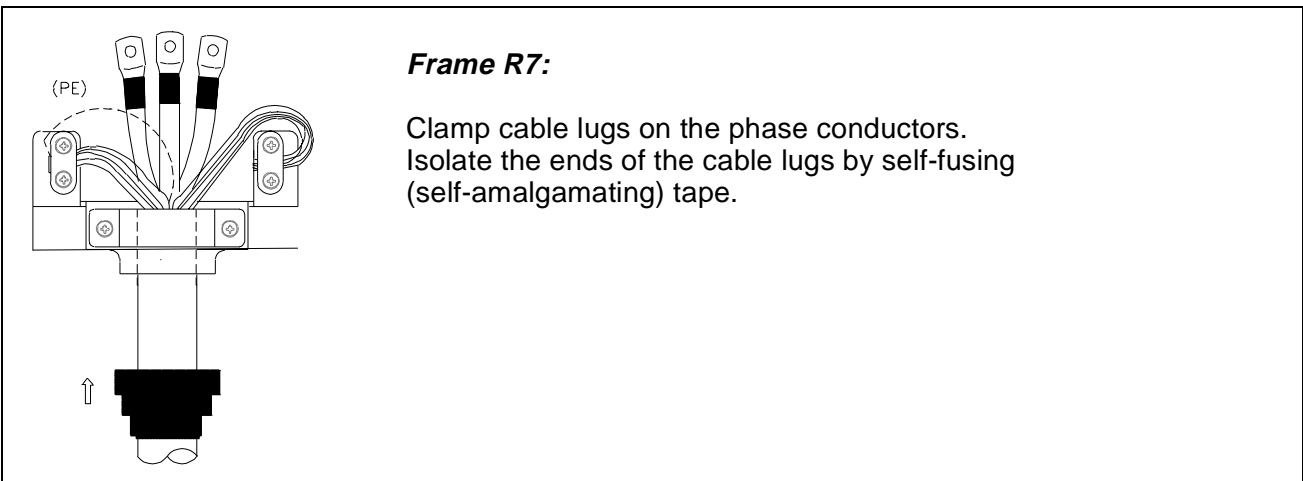


Cable Connections

Recommended earthing, mains and motor cable connections are presented below. See *Appendix B – Dimensional Drawings* to locate the terminals.



- 1) Alternative to earthing of the ACx 601 and the motor through the cable screen.
Note: Connecting the fourth conductor of the motor cable at the motor end increases bearing currents, thus causing extra wear.
- 2) Used if the conductivity of the cable screen is $< 50\%$ of the conductivity of the phase conductor.



Earthing, Mains and Motor Cable Connections

1. Lead the mains cable through the INPUT cable entry, and the motor cable through the OUTPUT entry into the unit.
2. 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.
3. Connect the twisted screen of the mains cable to the earthing terminal. Perform the same with the motor cable screen.

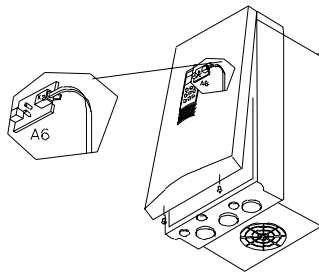
Connect the additional PE conductors (if present) of the mains and motor cables to the earthing terminal. Connect the separate PE conductor (if used) to the earthing terminal.

Control Cable Connections

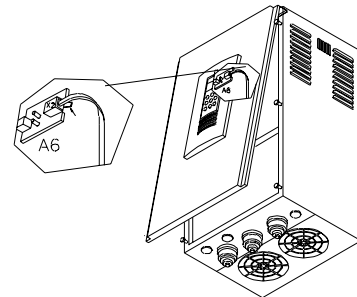
1. Lead the cable inside the unit through the SIGN entry.
2. Connect the conductor in appropriate terminal at the NIOC/NIOCP board (**A2**, refer *Appendix A* and *Firmware Manual*) and tighten screw to secure connection. Connect the twisted screen (earthing wires) as short as possible to the earthing rail (⊕) next to the NIOC board. For ACP 600 see *Appendix B* for control and encoder cable clamping and earthing.

Replacing the front cover

Frames R2 to R3



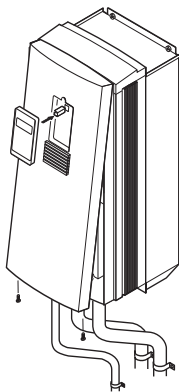
Frame R7



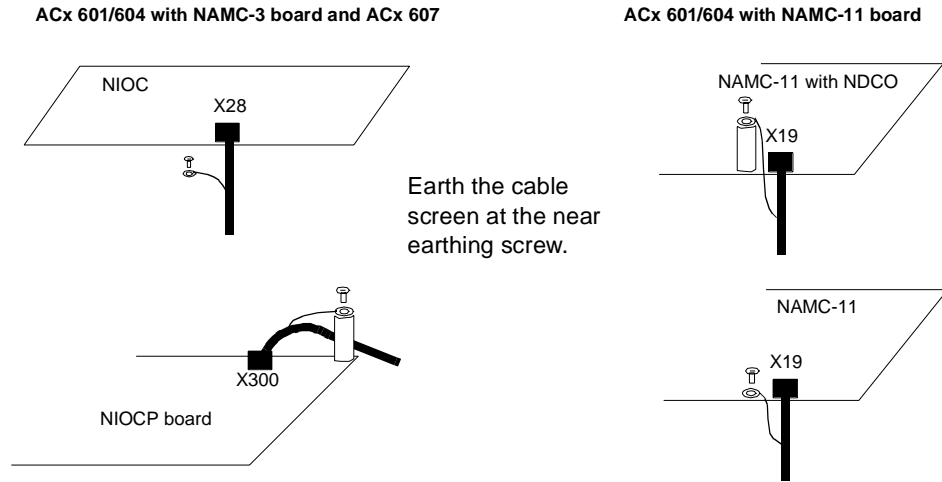
Connect the Control Panel cable to the connector X2, and replace the front cover.

Frames R4 to R6

1. Replace the front cover.
2. Replace the telephone connector.
3. Attach the Control Panel by pushing it softly down onto the connector in the front cover hollow.



Control Panel in Remote Use Connect the Control Panel cable to terminal X19 of the NAMC-11, or with 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 stator or rotor to prevent forming of 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. See *Appendix B* for earthing of the other end of the encoder cable shield.

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 inside the unit on the location shown in the dimensional drawings (*Appendix B*). Option modules for the frame sizes R2 and R3 are installed outside the frequency converter. 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 NAMC-11 board. Channels CH0, CH2 and CH3 are on 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 5.0	V17*, V18*
	CH1 with ACS 600 System, Crane, Master/Follower and Template Application Programs	V15, V16
Double Pulse Encoder Interface Module (for ACP 600 only)	CH2*	V17*, V18*
DriveWindow ¹⁾	CH3*	V19*, V20*

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

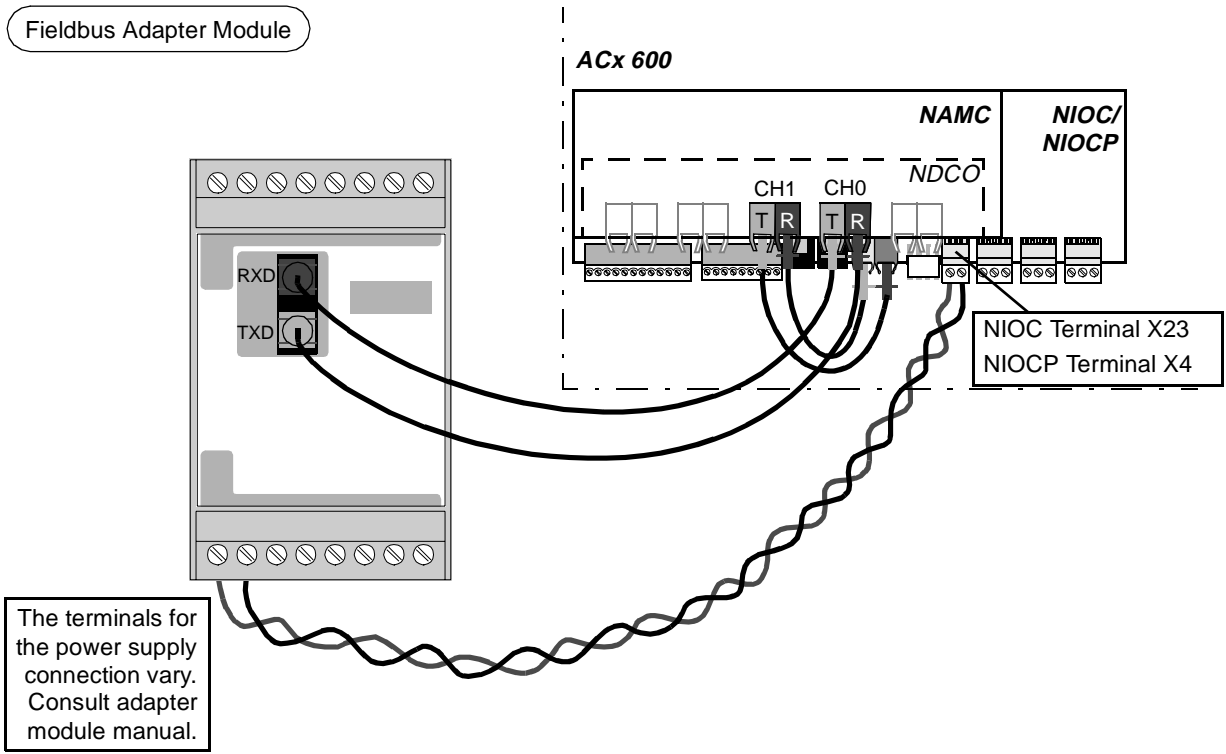
¹⁾ DriveWindow Light is connected via NPCU RS-232/485 converter to the panel connector on the cover (or to telephone connector X19 on NAMC-11 board).

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.

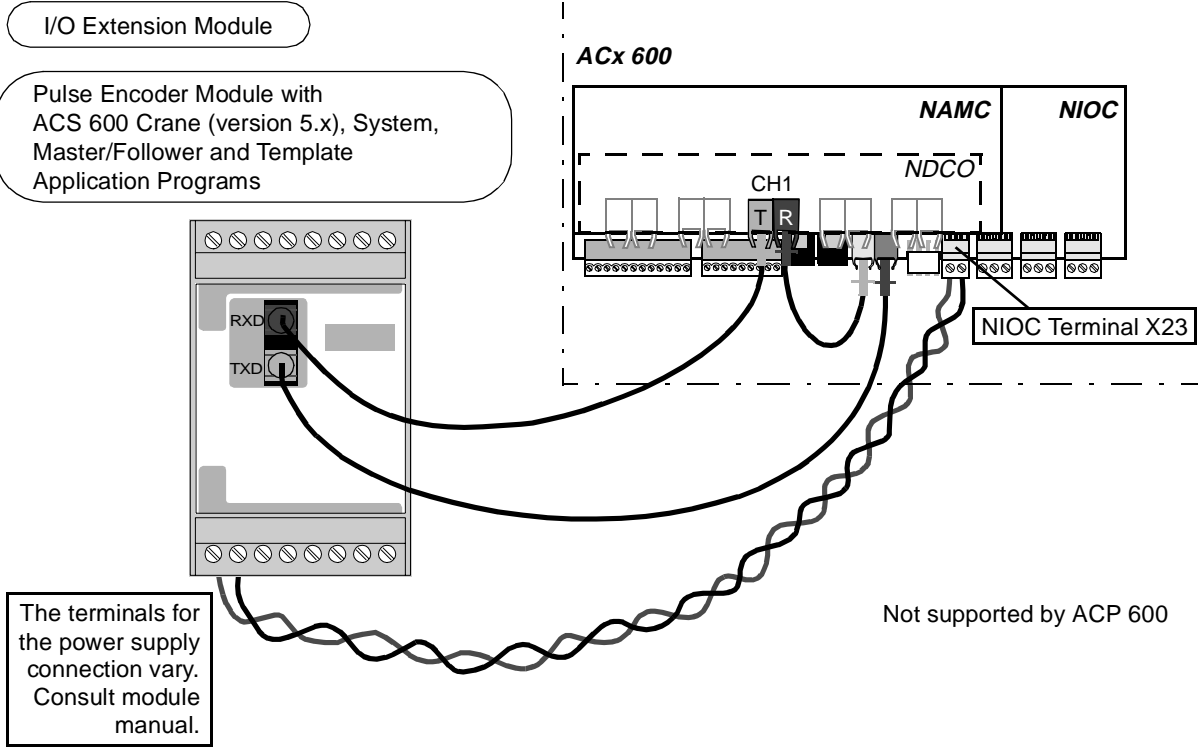
Connection Examples

Fieldbus Adapter Module

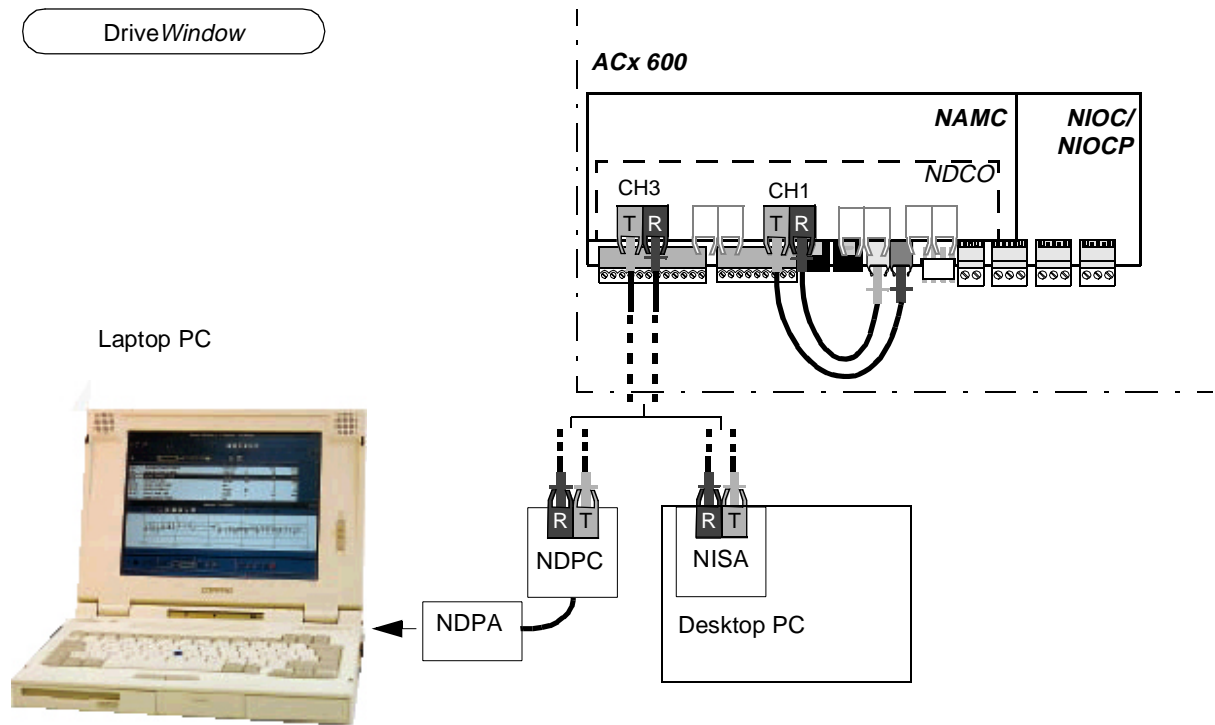
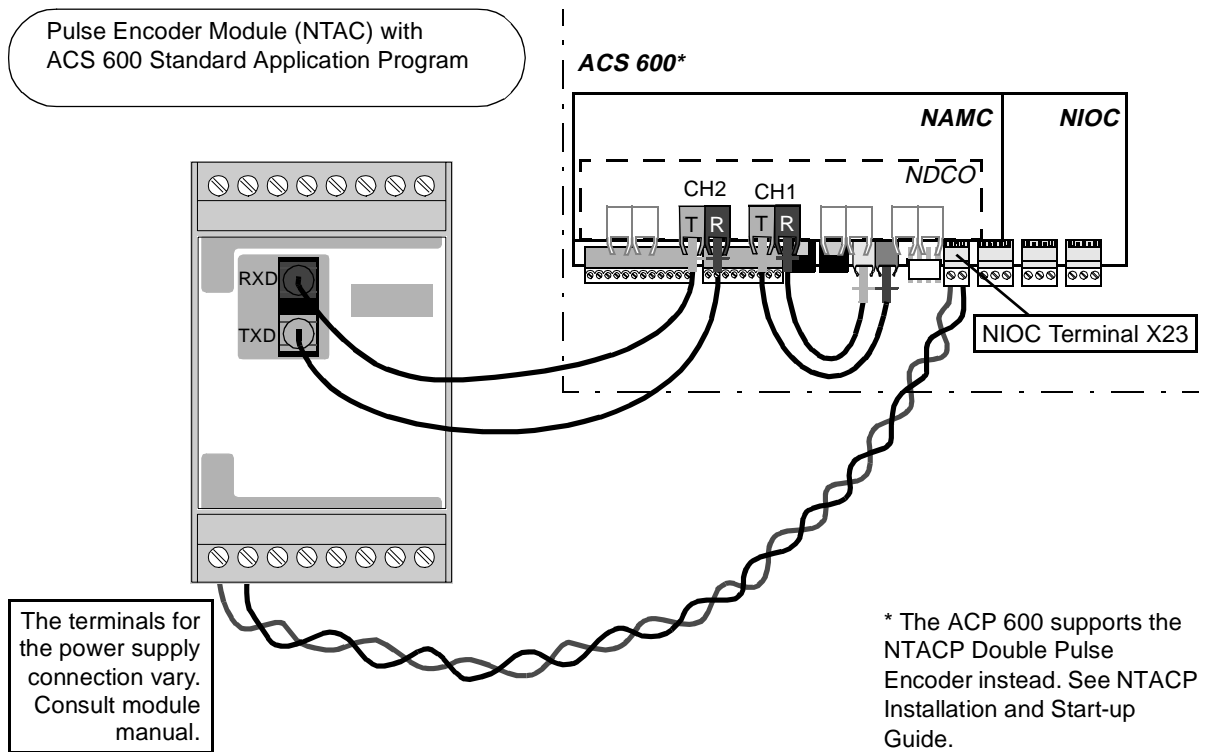


I/O Extension Module

Pulse Encoder Module with ACS 600 Crane (version 5.x), System, Master/Follower and Template Application Programs



Connection Examples



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.

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 on a vertical non-flammable wall (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.
- Check that mains connections at U1, V1 and W1 are OK.
- Check that appropriate mains fuses are installed.
- 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 there are no tools or other foreign objects inside the frame.
- With bypass connection, check that mains voltage cannot be applied to the output of the ACx 600.

Chapter 5 – Maintenance

The ACx 600 requires minimum maintenance.



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

Heatsink

The heatsink fins pick up dust from the cooling air. The ACx 600 can run into overtemperature Warnings and Faults if the heatsink is not cleaned regularly. In normal environment, the heatsink should be checked and cleaned annually.

The dust should be removed gently with a soft brush if the cleaning is carried out in the same room where the unit is normally operated. Compressed air should not be used for cleaning unless the installation can be taken apart and the cleaning is carried out in another room (or outdoors). Fan rotation should be prevented (in order to prevent bearing wear) when using compressed air for heatsink cleaning.

Fan

The cooling fan lifespan of ACx 601 units is about 60 000 hours. The actual lifespan depends on the frequency converter usage and ambient temperature.

Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in 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. The fan can be withdrawn by removing the bottom of the frame.

Replacement fans are available from ABB. Do not attempt operation with other than ABB specified spare parts.

Capacitors

The ACx 600 intermediate circuit employs several electrolytic capacitors. Their lifespan is approximately 100 000 hours, but dependent on the frequency converter loading and the ambient temperature.

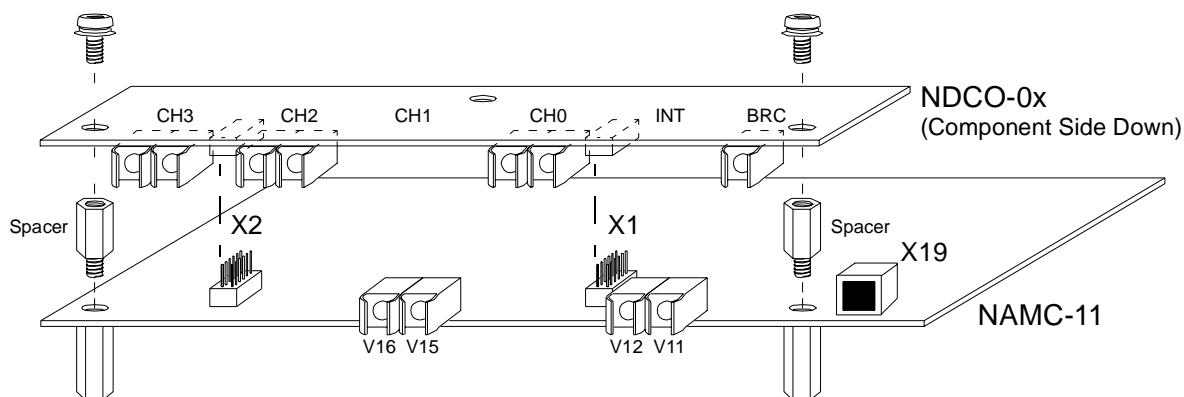
Capacitor life can be prolonged by lowering the ambient temperature. It is not possible to predict capacitor failure.

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 Reform (re-age) spare part capacitors once a year according to *ACS 600 Capacitor Reforming Guide* (code: 64059629).

Control Panel Connection

The Control Panel is connected to telephone connector X19 on NAMC-11 board. The telephone connectors on NIOC board are **not** intended for Panel use (they are used by Standard Modbus Link).



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 601 Technical Data

IEC Ratings

The IEC ratings for ACS/ACC/ACP 601 with 50 Hz and 60 Hz supplies are below. ACx = ACS/ACC/ACP. The 690 V series is not available for ACP 600. Symbols are described below the table.

ACx 601 Type	Normal Use					Heavy-duty Use							Frame Type
	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 601-0005-3	7.6	8.4	5	3	3	6.2	9.3	6.2	12.4	4	2.2	3	R2
ACx 601-0006-3	11	12	6	4	5	7.6	11	7.6	15.2	5	3	3	
ACx 601-0009-3	15	17	9	5.5	7.5	11	17	11	22	6	4	5	
ACx 601-0011-3	18	20	11	7.5	10	15	23	15	30	9	5.5	7.5	R3
ACx 601-0016-3	24	26	16	11	15	18	27	18	36	11	7.5	10	
ACx 601-0020-3	32	35	20	15	20	24	36	24	48	16	11	15	R4
ACx 601-0025-3	41	45	25	18.5	25	32	48	32	64	20	15	20	
ACx 601-0030-3	47	52	30	22	30	41	62	41	82	25	18.5	25	R5
ACx 601-0040-3	62	68	40	30	40	47	71	47	94	30	22	30	
ACx 601-0050-3	76	84	50	37	50	62	93	62	124	40	30	40	
ACx 601-0060-3	89	98	60	45	60	76	114	76	152	50	37	50	R6
ACx 601-0070-3	112	123	70	55	75	89	134	89	178	60	45	60	
ACx 601-0100-3	147	162	100	75	100	112	168	112	224	70	55	75	R7
ACx 601-0120-3	178	196	120	90	125	147	221	147	294	100	75	100	
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or 500 V													
ACx 601-0006-5	7.6	8.4	6	4	5	6.2	9.3	6.2	12.4	5	3	3	R2
ACx 601-0009-5	11	12	9	5.5	7.5	7.6	11	7.6	15.2	6	4	5	
ACx 601-0011-5	15	17	11	7.5	10	11	17	11	22	9	5.5	7.5	
ACx 601-0016-5	18	20	16	11	10	15	23	15	30	11	7.5	10	R3
ACx 601-0020-5	24	26	20	15	15	18	27	18	36	16	11	10	
ACx 601-0025-5	31	34	25	18.5	20	24	36	24	48	20	15	15	R4
ACx 601-0030-5	41	45	30	22	30	31	47	31	62	25	18.5	20	
ACx 601-0040-5	47	52	40	30	30	41	62	41	82	30	22	30	
ACx 601-0050-5	58	64	50	37	40	47	71	47	94	40	30	30	R5
ACx 601-0060-5	65	72	60	45	50	58	87	58	116	50	37	40	
ACx 601-0070-5	84	92	70	55	60	65	98	65	130	60	45	50	
ACx 601-0100-5	112	123	100	75	75	84	126	84	168	70	55	60	R6
ACx 601-0120-5	135	149	120	90	100	112	168	112	224	100	75	75	
ACx 601-0140-5	164	180	140	110	125	135	203	135	270	120	90	100	R7
Three-phase supply voltage 525 V, 550 V, 575 V, 600 V, 660 V or 690 V													
ACx 601-0009-6	7.6	11	9	5.5	7.5	6.2	9	6.2	9	6	4	5.0	R3
ACx 601-0011-6	11	12	11	7.5	10	7.6	11	7.6	11	9	5.5	7.5	
ACx 601-0016-6	15	17	16	11	15	11	17	11	17	11	7.5	10	
ACx 601-0020-6	20	22	20	15	20	15	23	15	23	16	11	15	R4
ACx 601-0025-6	25	28	25	18.5	25	20	30	20	30	20	15	20	
ACx 601-0030-6	28	31	30	22	30	25	38	25	38	25	18.5	25	R5
ACx 601-0040-6	36	40	40	30	40	28	42	28	42	30	22	30	
ACx 601-0050-6	44	48	50	37	50	36	54	36	54	40	30	40	
ACx 601-0060-6	52	57	60	45	60	44	66	44	66	50	37	50	R6
ACx 601-0070-6	65	72	70	55	75	52	78	52	78	60	45	60	
ACx 601-0100-6	88	97	100	75	100	65	98	65	98	70	55	75	R7
ACx 601-0120-6	105	116	120	90	125	88	132	88	132	100	75	100	

The table continues on the next page.

The table continues from previous page.

ACS 601 Type	Pump and Fan Use (Squared Load)		Frame Type
	I_{2Nsq} [A]	P_N [kW]	
Three-phase supply voltage 380 V, 400 V or 415 V			
ACS 601-0020-3	41	18.5	R4
ACS 601-0025-3	47	22	
ACS 601-0030-3	62	30	R5
ACS 601-0040-3	76	37	
ACS 601-0050-3	89	45	
ACS 601-0060-3	112	55	R6
ACS 601-0070-3	124	75 (60)	
ACS 601-0100-3	178	90	R7
ACS 601-0120-3	200	110 (100)	
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or 500 V			
ACS 601-0025-5	41	22	R4
ACS 601-0030-5	47	30	
ACS 601-0040-5	58	37	R5
ACS 601-0050-5	65	45	
ACS 601-0060-5	84	55	
ACS 601-0070-5	112	75	R6
ACS 601-0100-5	124	90 (83)	
ACS 601-0120-5	164	110	R7
ACS 601-0140-5	193	132	

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 is 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 ACS 601-0120-03 and ACS 601-0140-05 units in Pump and Fan Use). This applies to units with degree of protection IP 21/22. See Output Current Temperature Derating on page A-4.

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 motorpower with I_{2Nsq}

Note 1: The I_{2Nsq} currents do not apply to IP 54 units.

Normal use (10 % overload capacity):

- I_{2N} rated rms output current
- I_{2Nmax} rms overload current (allowed for one minute every 5 minutes):
 $I_{2Nmax} (1/5 \text{ min}) = 1.1 \cdot I_{2N}$
 $I_{2Nmax} (2/15 \text{ s}) = 1.5 \cdot I_{2N}$ (400 and 500 VAC units)
- 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 601 with 60 Hz supply are below. Symbols are described on previous page.

ACS 601 Type	Normal Use			Heavy-duty Use				Frame Type	
	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 601-0006-4	7.6	8.4	5	6.2	9.3	6.2	12.4	3	R2
ACS 601-0009-4	11	12	7.5	7.6	11	7.6	15.2	5	
ACS 601-0011-4	15	17	10	11	17	11	22	7.5	
ACS 601-0016-4	21	23	15	15	23	15	30	10	R3
ACS 601-0020-4	27	30	20	19	27	19	36	10	
ACS 601-0025-4	34	37	25	24	36	24	48	15	R4
ACS 601-0030-4	41	45	30	31	47	31	62	20	
ACS 601-0040-4	52	57	40	41	62	41	82	30	R5
ACS 601-0050-4	65	72	50	47	71	47	94	30	
ACS 601-0060-4	77	85	60	58	87	58	116	40	
ACS 601-0070-4	96	106	75	68	98	68	130	50	R6
ACS 601-0100-4	124	136	100	86	126	86	168	60	
ACS 601-0120-4	156	172	125	113	168	113	224	75	R7
ACS 601-0140-4	180	198	150	141	203	141	270	100	

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 degree of protection IP 21/22:

- **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 3.5 % for every additional 1 °C / 1.8 °F (up to +50 °C / +122 °F).
- **Example 1.** If the ambient temperature is 50 °C / +122 °F the derating factor is

$$100 \% - 3.5 \frac{\%}{^{\circ}\text{C}} \cdot 10 \text{ }^{\circ}\text{C} = 65 \% \text{ or } 0.65.$$

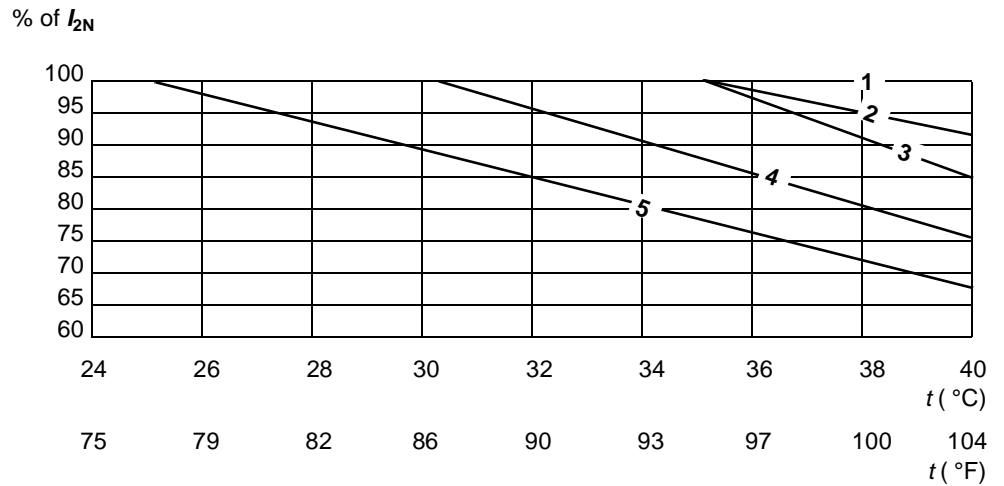
The output current is then $0.65 \cdot I_{2N}$, $0.65 \cdot I_{2hd}$ or $0.65 \cdot I_{2Nsq}$.

Derating factor for ACx 601 with degree of protection IP 54:

- From +25 °C to +40 °C, the output current is calculated using the table below.
- Above +40 °C, the output current is decreased 3.5 % for every additional 1 °C (up to +50 °C).
- **Example 1.** If the ambient temperature is 38 °C, the derating factor for ACx 601-0006-3 is 95 % or 0.95 (Curve 2). The output current is then $0.95 \cdot I_{2N}$.
- **Example 2.** If the ambient temperature is 50 °C, the output current for ACx 601-0006-3 is first calculated at 40 °C (I_{2N} : derating factor 92 % or 0.92 from Curve 2) and the result is multiplied by factor 0.65 (See *Example 1* (IP 22)). The output current is then $0.92 \cdot 0.65 \cdot I_{2N}$. For I_{2hd} the output current must be smaller or equal than $0.92 \cdot 0.65 \cdot I_{2N}$.

Diagram Output current for ACS/ACC/ACP 601 with degree of protection IP 54 and with ambient temperature from 25 °C (77 °F) to 40 °C (104 °F) is presented in the diagram below. I_{2N} total rms output current for normal use.

Note: The output current in heavy-duty use (I_{2hd}) must be smaller or equal than the derated I_{2N} .



Curve 1 (100 % no derating)	Curve 2	Curve 3	Curve 4	Curve 5
ACx 601-0005-3	ACx 601-0006-3	ACx 601-0011-3	ACx 601-0009-3	ACx 601-0016-3
ACx 601-0006-5	ACx 601-0009-5	ACx 601-0020-3	ACx 601-0070-3	ACx 601-0020-5
ACx 601-0009-6	ACx 601-0016-6	ACx 601-0025-3	ACx 601-0011-5	ACx 601-0070-6
ACx 601-0025-5		ACx 601-0030-3	ACx 601-0100-5	
ACx 601-0030-5		ACx 601-0040-3	ACx 601-0040-6	
ACx 601-0040-5		ACx 601-0050-3	ACx 601-0050-6	
ACx 601-0070-5		ACx 601-0060-3		
ACx 601-0011-6		ACx 601-0016-5		
		ACx 601-0050-5		
		ACx 601-0060-5		
		ACx 601-0020-6		
		ACx 601-0025-6		
		ACx 601-0030-6		
		ACx 601-0060-6		

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
 (690 VAC 3-phase -10...+5 % for ACx 607 units)

Short Circuit Capability: The rated short time withstand current of 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.

$$f_{FWP} = \frac{U_{N\text{mains}}}{U_{N\text{motor}}} \cdot f_{N\text{motor}}$$

f_{FWP} : Frequency at field weakening point; $U_{N\text{mains}}$: Mains (input power) voltage;
 $U_{N\text{motor}}$: Rated motor voltage; $f_{N\text{motor}}$: 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.

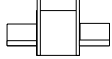
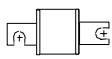
ACS/ACC/ACP 600	Operation installed for stationary use	Storage in the protective package	Transportation in the protective package
Installation Site Altitude	Nominal output power at 0 to 1000 m (3300 ft) above sea level ¹⁾	-	-
Air Temperature	0 to +40 °C (32 to 104°F) ²⁾ (IP 21/22 and ACx 607, IP 54) 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* on page A-4.

Fuses

Recommended input fuse ratings of the ACS/ACC/ACP 601 are 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 601 Type	Fuses							
	A	A ² s	V	Manufacturer	Type DIN 43620 	Size	Type DIN 43653 	Size
ACx 601-0005-3 ACx 601-0006-5	16	48	660	Bussmann	170M1559	000	170M1359	000/80
ACx 601-0006-3 ACx 601-0009-5	16	48	660	Bussmann	170M1559	000	170M1359	000/80
ACx 601-0009-3 ACx 601-0011-5	25	130	660	Bussmann	170M1561	000	170M1361	000/80
ACx 601-0011-3 ACx 601-0016-5	32	270	660	Bussmann	170M1562	000	170M1362	000/80
ACx 601-0016-3 ACx 601-0020-5	40	460	660	Bussmann	170M1563	000	170M1363	000/80
ACx 601-0020-3 ACx 601-0025-5 ACx 601-0025-3 ACx 601-0030-5	63	1450	660	Bussmann	170M1565	000	170M1365	000/80
ACx 601-0030-3 ACx 601-0040-5 ACx 601-0040-3 ACx 601-0050-5	80	1250	660	Bussmann	170M3811	1*	170M3011	1*/80
ACx 601-0050-3 ACx 601-0060-5	125	3700	660	Bussmann	170M3813	1*	170M3013	1*/80
ACx 601-0060-3 ACx 601-0070-5	160	7500	660	Bussmann	170M3814	1*	170M3014	1*/80
ACx 601-0070-3 ¹⁾ ACx 601-0100-5 ¹⁾	200/ 250	28000/ 28500	660	Bussmann	170M1570/ 170M3816	000/ 1*	170M1370/ 170M3016	000/80 / 1*
ACx 601-0100-3 ACx 601-0120-5 ACx 601-0120-3 ACx 601-0140-5	400	105000	660	Bussmann	170M3819	1*	170M3019	1*/80
ACx 601-0009-6	32	270	660	Bussmann	170M1562	000	170M1362	000/80
ACx 601-0011-6	32	270	660	Bussmann	170M1562	000	170M1362	000/80
ACx 601-0016-6	32	270	660	Bussmann	170M1562	000	170M1362	000/80
ACx 601-0020-6	32	270	660	Bussmann	170M1562	000	170M1362	000/80
ACx 601-0025-6	40	460	660	Bussmann	170M1563	000	170M1363	000/80
ACx 601-0030-6	50	770	660	Bussmann	170M1564	000	170M1364	000/80
ACx 601-0040-6	50	770	660	Bussmann	170M1564	000	170M1364	000/80
ACx 601-0050-6	63	1450	660	Bussmann	170M1565	000	170M1365	000/80
ACx 601-0060-6	100	4650	660	Bussmann	170M1567	000	170M1367	000/80
ACx 601-0070-6	100	4650	660	Bussmann	170M1567	000	170M1367	000/80
ACx 601-0100-6	125	8500	660	Bussmann	170M1568	000	170M1368	000/80
ACx 601-0120-6	200	28000	660	Bussmann	170M1570	000	170M1370	000/80

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

¹⁾ 200 A and 250 A Bussmann fuses can be used with ACx 601-0070-3 and ACx 601-0100-5 units.

Example For ACS 601-0120-3, the recommended fuses for the input bridge protection are 400 A ultrarapid fuses.

The values I_{2N} , I_{2hd} and I_{2Nsq} for ACS 601-0120-3 are 178 A, 147 A and 200 A respectively. $1.1 \cdot 178 \text{ A} = 195.8 \text{ A}$ and $1.5 \cdot 147 \text{ A} = 220.5 \text{ A}$ and $1.0 \cdot 200 \text{ A} = 200 \text{ A}$. Normal fuses with nominal currents higher than 195.8 A or 220.5 A or 200 A can be used to protect the input cable; thus, 200 A or 250 A fuses are selected depending on the use (normal, heavy-duty or pump and fan, respectively).

Cable Entries

Mains and motor cable terminal sizes (per phase) and tightening torques for the ACS/ACC/ACP 601 with cable diameters accepted by the rubber glands are given below.

ACx 600 Type	U1,V1,W1 / U2,V2,W2						Earthing PE				Braking
	Terminal		Cable Ø		Tightening Torque		Terminal		Cable Ø		UDC+, UDC-
	mm ²	AWG	mm	in	Nm	Ft/lbs	mm ²	AWG	mm	in	mm ²
ACx 601-0005-3 ACx 601-0006-5 ACx 601-0006-3 ACx 601-0009-5 ACx 601-0009-3 ACx 601-0011-5	6	8	14...20	0.55...0.79	1.5...1.8	1.1...1.3	6	8	10...14	0.39...0.55	6
ACx 601-0009-6 ACx 601-0011-6 ACx 601-0011-3 ACx 601-0016-5 ACx 601-0016-6 ACx 601-0016-3 ACx 601-0020-5 ACx 601-0020-6	10	6	14...20	0.55...0.79	1.5...1.8	1.1...1.3	10	6	10...14	0.39...0.55	10
ACx 601-0020-3 ACx 601-0025-5 ACx 601-0025-6 ACx 601-0025-3 ACx 601-0030-5 ACx 601-0030-6	16	4	14...20	0.55...0.79	1.5...1.8	1.1...1.3	16	4	10...14	0.39...0.55	16
ACx 601-0030-3 ACx 601-0040-5 ACx 601-0040-6 ACx 601-0040-3 ACx 601-0050-5 ACx 601-0050-6 ACx 601-0050-3 ACx 601-0060-5	Cu 35 *) Al 50	Cu 2 *)	20...26	0.79...1.0	8	6	35	2	10...14	0.39...0.55	M6
ACx 601-0060-3 ACx 601-0070-5 ACx 601-0060-6 ACx 601-0070-3 ACx 601-0100-5 ACx 601-0070-6	70	2/0	26...35	0.79...1.4	8	6	35	2	10...14	0.39...0.55	M6
ACx 601-0100-3 ACx 601-0120-5 ACx 601-0100-6 ACx 601-0120-3 ACx 601-0140-5 ACx 601-0120-6	M10 ¹⁾	0375			30	22	70	2/0			M8

*) 35 mm² copper cable and 50 mm² aluminium fits in.

1) The maximum acceptable size of the mains and motor 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.

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 directly to terminals on the NIOC board.

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

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

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

ACS 601/604/607
NIOC Board
(A2)

**Programmable I/O
Factory Settings**

Terminal Block Size

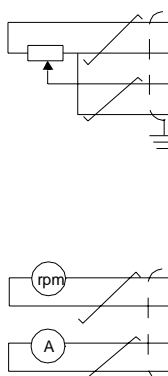
X21, X22, X23, X25, X26, X27: cables 0.5 to 1.5 mm²

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.



X21		
1	VREF	Reference voltage 10 V d.c.
2	GND	$1\text{ k}\Omega \leq R_L \leq 10\text{ k}\Omega$
3	AI1+	Speed reference 0(2) ... 10 V $R_{in} > 200\text{ k}\Omega$
4	AI1-	
5	AI2+	By default, not in use.
6	AI2-	0(4) ... 20 mA, $R_{in} = 100\ \Omega$
7	AI3+	By default, not in use.
8	AI3-	0(4) ... 20 mA, $R_{in} = 100\ \Omega$
9	AO1+	Motor speed 0(4)...20 mA $\hat{=}$ 0...motor nom. speed, $R_L \leq 700\ \Omega$
10	AO1-	
11	AO2+	Output current 0(4)...20 mA $\hat{=}$ 0...motor nom. current, $R_L \leq 700\ \Omega$
12	AO2-	

X22		
1	DI1	Stop/Start
2	DI2	Forward/Reverse ¹⁾
3	DI3	Not used
4	DI4	ACCEL/DECEL 1/2
5	DI5	Constant speed select ²⁾
6	DI6	Constant speed select ²⁾
7	+24V	+24 V d.c. max. 100 mA
8	+24V	
9	DGND	Digital Ground

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

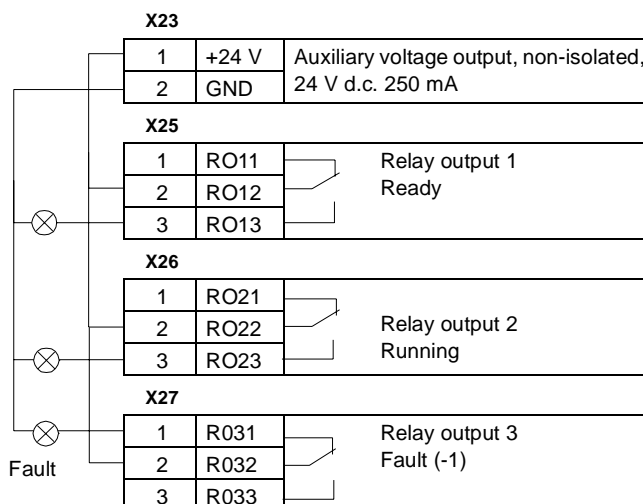
Connector X28 for RS 485 connection

1	TRANS	Standard Modbus Link
2	GND	
3	B-	
4	A+	
5	GND	
6	+24 V	
SH*	SHIELD	Cable shield is connected via RC filter to frame

Connector X29 for RS 485 connection

1	TRANS	Standard Modbus Link
2	FAULT	
3	B-	
4	A+	
5	GND	
6	+24 V	
SH*	SHIELD	Cable shield is connected via RC filter to frame

* from October 1999



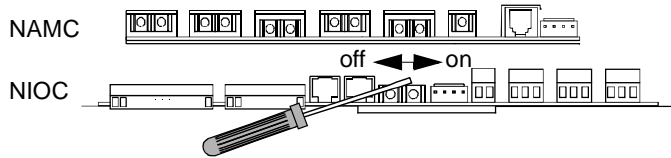
X23		
1	+24 V	Auxiliary voltage output, non-isolated, 24 V d.c. 250 mA
2	GND	


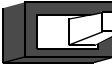
X25		
1	RO11	Relay output 1 Ready
2	RO12	
3	RO13	

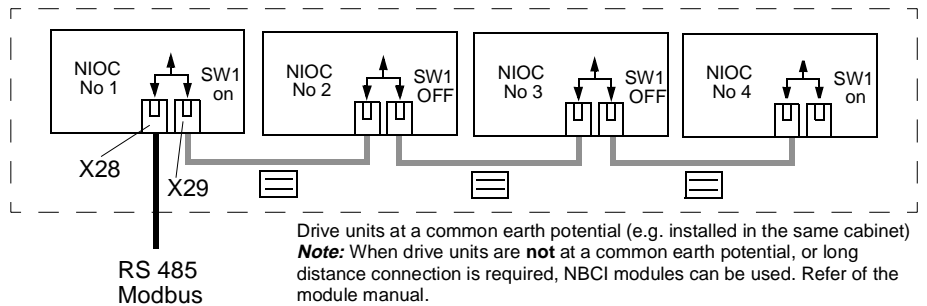
X26		
1	RO21	Relay output 2 Running
2	RO22	
3	RO23	


X27		
1	R031	Relay output 3 Fault (-1)
2	R032	
3	R033	

Bus Termination Switch When several NIOC boards are daisy-chained for common control from external Modbus device, switch SW1 must be set to the OFF position on the intermediate boards. See figure below. (SW1 is on the NIOC board from October 1999.)



Settings of Switch SW1	Function
OFF 	Bus is not terminated
OFF 	Bus is terminated (default)



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

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

Terminal Block Size

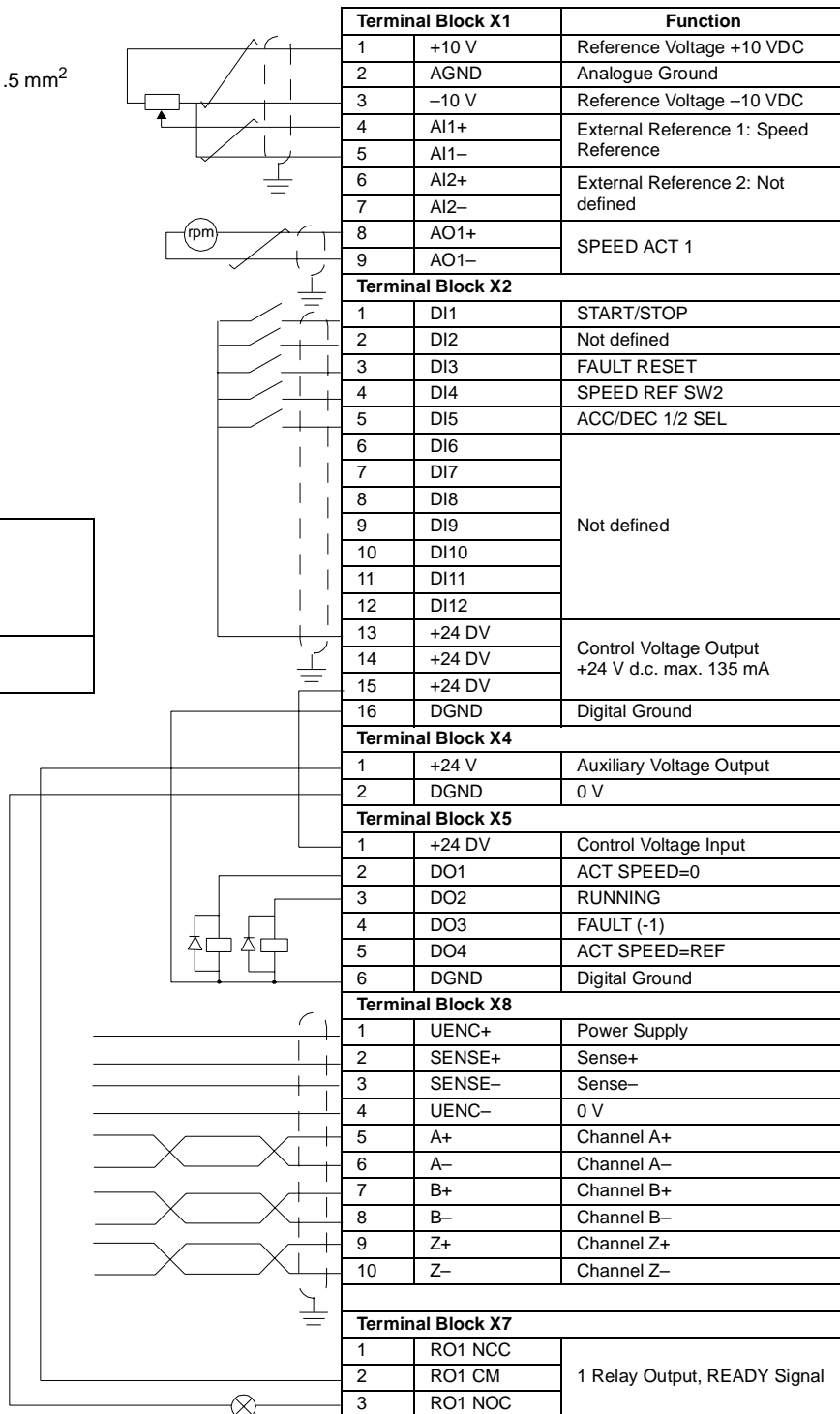
X21, X22, X23, X25, X26, X27: cables 0.5 to 1.5 mm²

Control Cable Lead-through Size:

Ø: 2 x 3x2...11 mm

Connector X300 for RS 485 connection

1	TRANS	Panel Link Connections
2	GND	
3	B-	
4	A+	
5	GND	Power to Remote Panel
6	+24 V	



NIOC and NIOCP Board Specifications

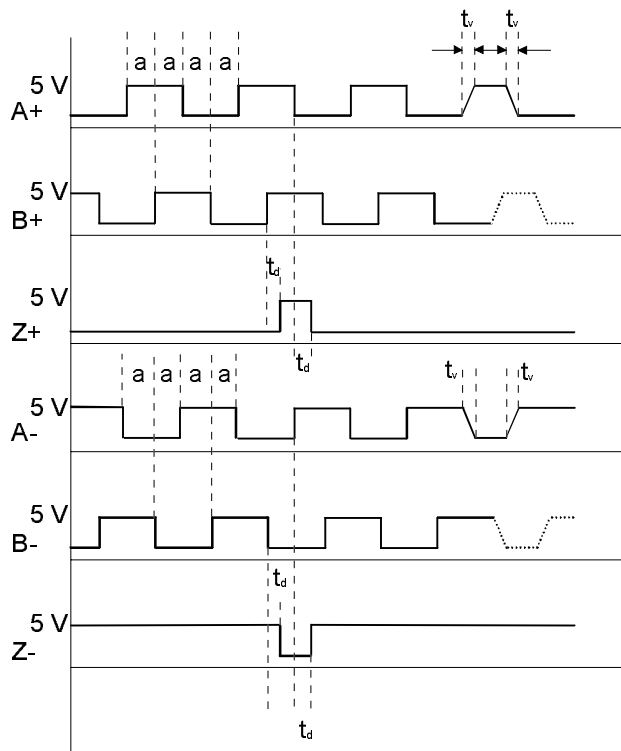
Data of the external control connection boards of the ACS 600 product family are given below.

	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: 12 ms (ACS 600), 44 ms (ACC 600), 1 ms (ACP 600)</p>	<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>
<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>
<p>Analogue Outputs</p>	<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: ± 1 % (Full Scale Range) at 25 °C. Temperature Coefficient: $\pm 200 \text{ ppm}/^\circ\text{C}$, max.</p> <p>Output Updating Time: 24 or 100 ms (ACS 600), 44 ms (ACC 600), 8 ms (ACP 600)</p>	<p>One Bipolar Programmable Voltage Output: ± 10 V, $R_L \geq 2 \text{ k}\Omega$</p> <p>Resolution: 0.02 % (12 bit)</p> <p>Accuracy: 10 bit</p> <p>Inaccuracy: ± 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>

	ACS/ACC/ACP 600 NIOC-01 Board	ACP 600 NIOCP-01 Board
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 VDC $\hat{=}$ "0", > 12 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 kΩ $\hat{=}$ "1" (normal temperature), > 4 kΩ $\hat{=}$ "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: 12 ms (ACS 600), 44 ms (ACC 600), 4 ms (ACP 600)</p> <p>An external 24 VDC supply can be used instead of the internal supply.</p>	<p>12 Programmable Digital Inputs (Common Ground): 24 VDC, -15 % to +20 %</p> <p>Logical Thresholds: < 8 VDC $\hat{=}$ "0", > 12 VDC $\hat{=}$ "1"</p> <p>Filtering Time Constant: \leq 50 μs</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 μs</p>
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>
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>	

	ACS/ACC/ACP 600 NIOC-01 Board	ACP 600 NIOCP-01 Board
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 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	0/50	0/2	100/0	4/0
607	Drives-MNS cabinet	IP 21 ⁴⁾ /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⁾ not for frame sizes 2xR8 and 2xR9

⁵⁾ 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.

Cooling Air Flow Requirements

Cooling air flow requirements are given below.

ACx 601	Flow		Heat Dissipation		ACx 601	Flow		Heat Dissipation		ACx 601	Flow		Heat Dissipation	
	m ³ /h	ft ³ /h	W	BTU/Hr		m ³ /h	ft ³ /h	W	BTU/Hr		m ³ /h	ft ³ /h	W	BTU/Hr
-0005-3	40	1413	80	273	-0006-5	40	1413	100	341	-0009-6	60	2119	130	444
-0006-3	40	1413	100	341	-0009-5	40	1413	130	444	-0011-6	60	2119	170	581
-0009-3	40	1413	130	444	-0011-5	40	1413	170	581	-0016-6	60	2119	240	820
-0011-3	60	2119	170	581	-0016-5	60	2119	240	820	-0020-6	60	2119	320	1093
-0016-3	60	2119	240	820	-0020-5	60	2119	320	1093	-0025-6	70	2472	390	1332
-0020-3	70	2472	390	1332	-0025-5	70	2472	460	1571	-0030-6	100	3531	460	1571
-0025-3	100	3531	460	1571	-0030-5	100	3531	620	2117	-0040-6	260	9182	620	2117
-0030-3	260	9182	620	2117	-0040-5	260	9182	760	2596	-0050-6	260	9182	760	2596
-0040-3	260	9182	760	2596	-0050-5	260	9182	920	3142	-0060-6	280	9888	920	3142
-0050-3	260	9182	920	3142	-0060-5	260	9182	1130	3859	-0070-6	280	9888	1130	3859
-0060-3	280	9888	1130	3859	-0070-5	280	9888	1530	5225	-0100-6	660	23308	1530	5225
-0070-3	280	9888	1530 (1230)	5225 (4201)	-0100-5	280	9888	1840 (1700)	6284 (5806)	-0120-6	660	23308	1840	6284
-0100-3	660	23308	1840	6284	-0120-5	660	23308	2250	7684					
-0120-3	660	23308	2250 (2240)	7684 (7650)	-0140-5	660	23308	2700	9221					

() with I_{2Nsq} rating typically

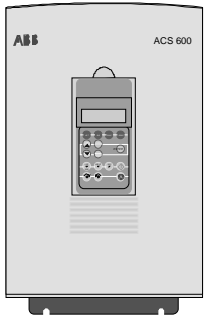
Cooling Air Duct

Heat dissipations and cooling air flows of ACx 601 in a cooling air duct installation are below.

Degree of protection	Heat Dissipation		Degree of protection	Cooling Air Flow Out	
	Heatsink	Front Section		Heatsink	Front Section
IP 22	85 % of ACx 600 losses	15 % of ACx 600 losses	IP 22	80 % of air flow	20 % of air flow
IP 54	90 % of ACx 600 losses	10 % of ACx 600 losses	IP 54	100 % of air flow	0 % of air flow

Dimensions and Weights

Dimensions and weights of the wall-mounted ACS/ACC/ACP 601 units are given below.



ACS 601 Type			Height mm	Width mm	Depth mm	Weight kg
0005-3	0006-5		420	220	292	14
0006-3	0009-5		420	220	292	14
0009-3	0011-5		420	220	292	14
0011-3	0016-5	0009-6/0011-6	420	260	298	17.5
0016-3	0020-5	0016-6/0020-6	420	260	298	17.5
0020-3	0025-5	0025-6	526	306	310	25
0025-3	0030-5	0030-6	526	306	310	25
0030-3	0040-5	0040-6	715	306	360	35
0040-3	0050-5	0050-6	715	306	360	35
0050-3	0060-5		715	306	360	35
0060-3	0070-5	0060-6	715	306	432	50
0070-3	0100-5	0070-6	715	306	432	50
0100-3	0120-5	0100-6	860	480	428	88
0120-3	0140-5	0120-6	860	480	428	88

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
Pump and Fan Control (PFC)
Master/Follower (M/F)
Spinning Control
Motion Control
Crane
System

Application Macros

The macros of the application programs are introduced below.

Applic. Program	Macros	For...
Standard	Factory	basic industrial applications
	Hand/Auto	for local and remote operation
	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 and fan station control
	Hand/Auto	local and remote operation
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

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.

Applic. Program	Type code charcter 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
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 application program	English
Custom	T	Application program template (FCB Programmable)	English
	Y	Special application program	Custom specified

*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.

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	Satndard	Crane	Motion Control	System	Programmable Fault Functions	Satndard	Crane	MotionControl	System	Programm. Supervision Functions	Satndard	Crane	Motion Control	System
	PFC, M/F					PFC, M/F								
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.

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
Package (ACx 601)		
corrugated board (frames R2 to R5 and option modules), plywood (R6). Plastic covering of the package: PE-LD, bands PP or steel.		

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.) They 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 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 European Economic Area. The EMC product standard EN 61800-3 covers the requirements stated for frequency converters.

The ACx 601 frequency converters 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 601 is installed with motor and control cables 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.

Public Low-Voltage Network

1. The ACx 600 is equipped with EMC filtering (refer to Table A-1).
2. The ACx 601 is installed with motor and control cables as specified in this manual.
3. 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 601 is installed with motor and control cables as specified in this manual.

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

Machinery Directive

ACx 601/604/607 frequency converters comply with the European Union Machinery Directive (89/392/EEC) requirements for an equipment intended to be incorporated into machinery.

UL/CSA Markings

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 604 600 V parallel connected units	pending	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 brake chopper - ABB has brake 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 brake chopper is defined in the Brake Chopper Installation Manual (NBRA-6xx; Braking Choppers Installation and Start Up Guide), Appendix A. These guide lines will allow you to size brake 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.

Marking

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 601 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 601 is installed according to the instructions given in this manual.
3. The motor and control cables used 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 floating networks. The mains becomes connected to earth potential through the EMC filter capacitors. In floating 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 fulfillment 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.

Appendix A – ACS/ACC/ACP 601 Technical Data


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.

Appendix B – ACS/ACC/ACP 601 Dimensional Drawings

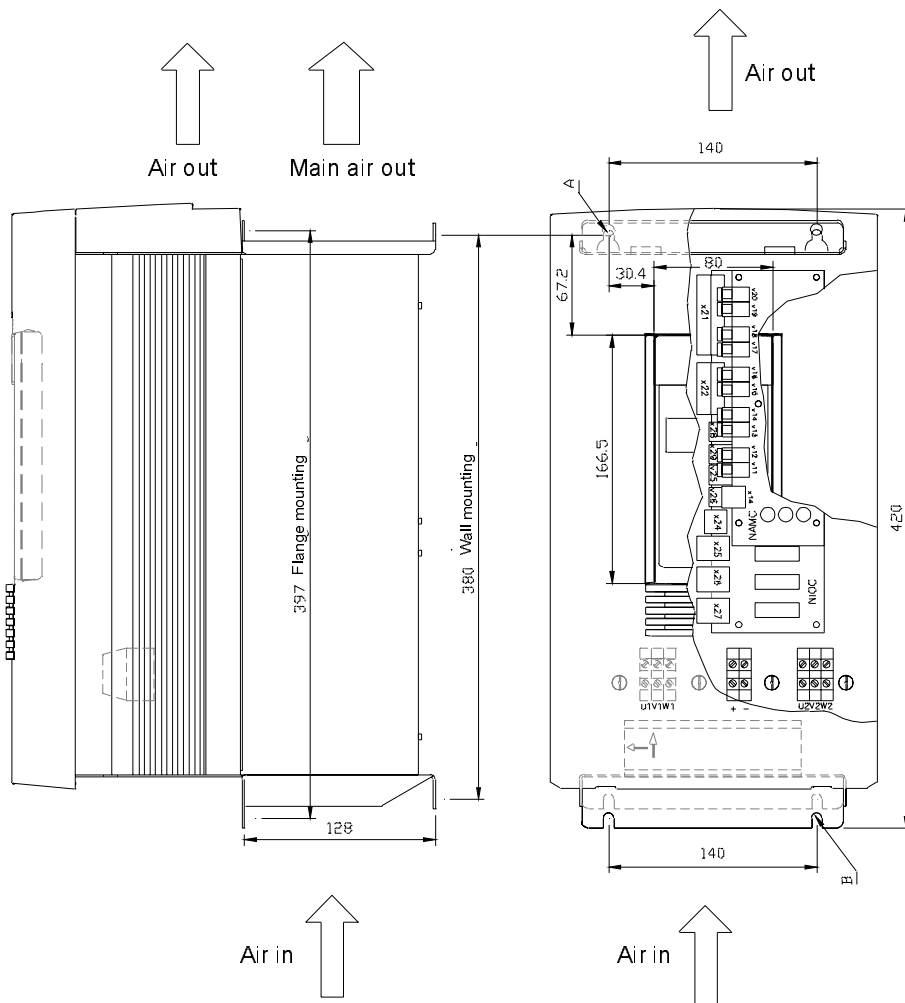
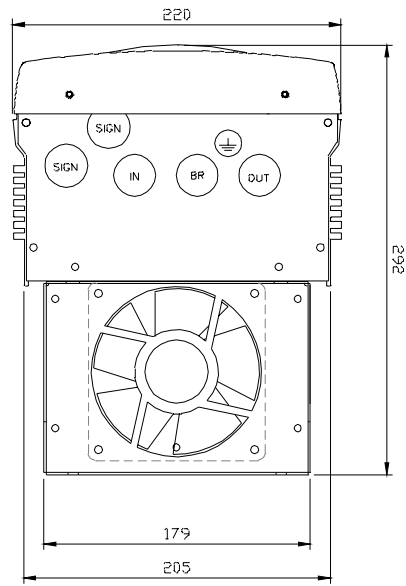
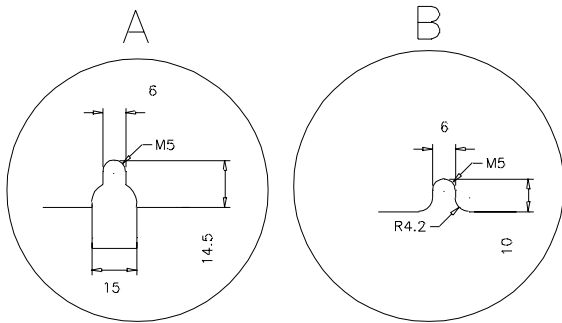
The following drawing package is effective from 6.9.1999.

Gland Plate Holes

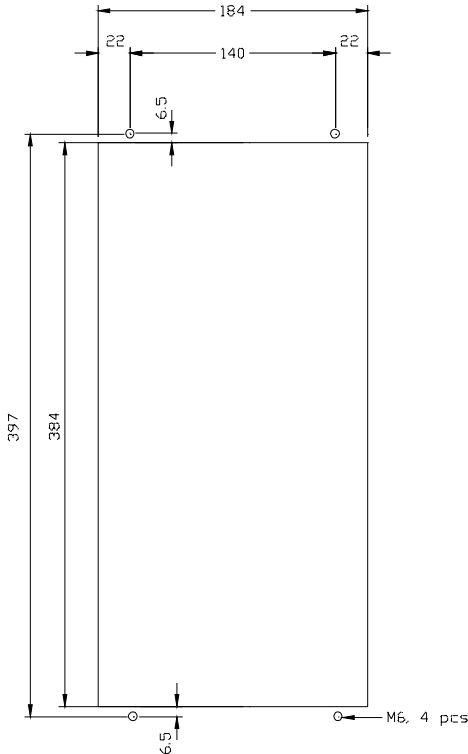
Frame	R2 ACx = ACS/ACC/ACP	R3 ACx = ACS/ACC/ACP	R4 ACx = ACS/ACC/ACP	R5 ACx = ACS/ACC/ACP	R6 ACx = ACS/ACC/ACP	R7 ACx = ACS/ACC/ACP
Hole	ACx 601-0005-3 ACx 601-0006-3 ACx 601-0009-3 ACx 601-0006-5 ACx 601-0009-5 ACx 601-0011-5	ACx 601-0009-6 ACx 601-0011-3/-6 ACx 601-0016-3 ACx 601-0016-5/-6 ACx 601-0020-5/-6	ACx 601-0020-3 ACx 601-0025-3/-6 ACx 601-0025-5 ACx 601-0030-5/-6	ACx 601-0030-3 ACx 601-0040-3 ACx 601-0050-3 ACx 601-0040-5/-6 ACx 601-0050-5/-6 ACx 601-0060-5	ACx 601-0060-3/-6 ACx 601-0070-3 ACx 601-0070-5/-6 ACx 601-0100-5	ACx 601-0100-3/-6 ACx 601-0120-3 ACx 601-0120-5/-6 ACx 601-0140-5
	mm	mm	mm	mm	mm	mm
SIGN	23	23	29	29	29	29
IN/OUT	29	29	37	37	48	60
BR	29	29	29	37	37	60
	23	23	23	23	23	29

Frame R2

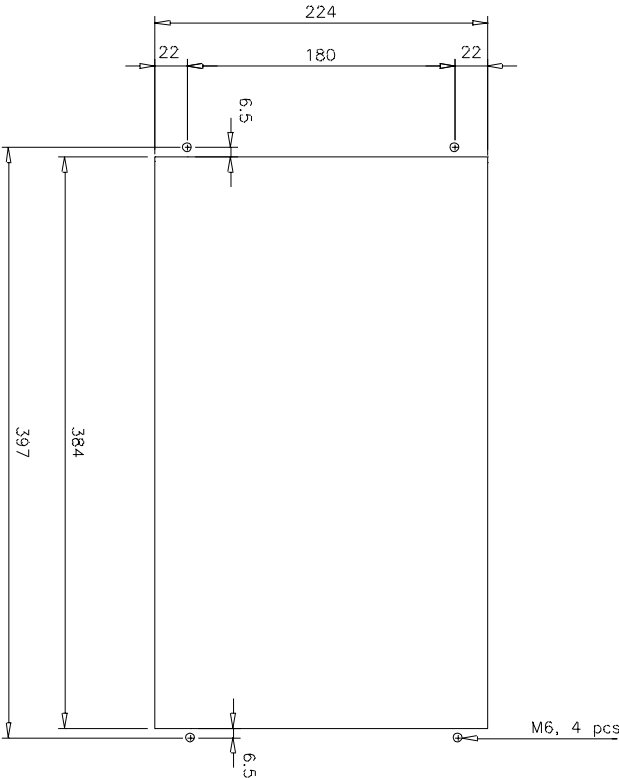
TYPE (ACx = ACS/ACC/ACP)	WEIGHT
ACx 601-0005-3	14 kg
ACx 601-0006-3	14 kg
ACx 601-0009-3	14 kg
ACx 601-0006-5	14 kg
ACx 601-0009-5	14 kg
ACx 601-0011-5	14 kg



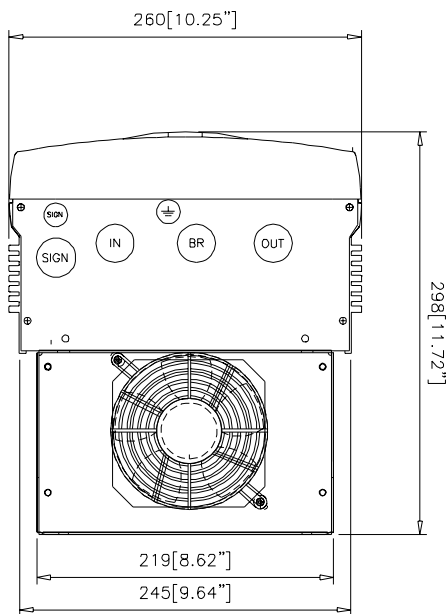
Frame R2 Flange Mounting



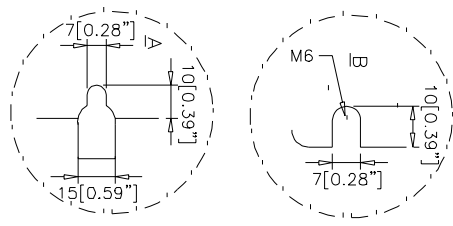
Frame R3 Flange Mounting



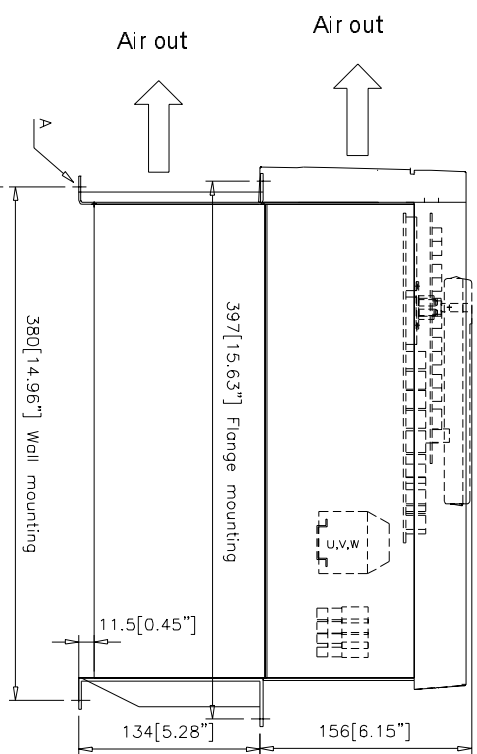
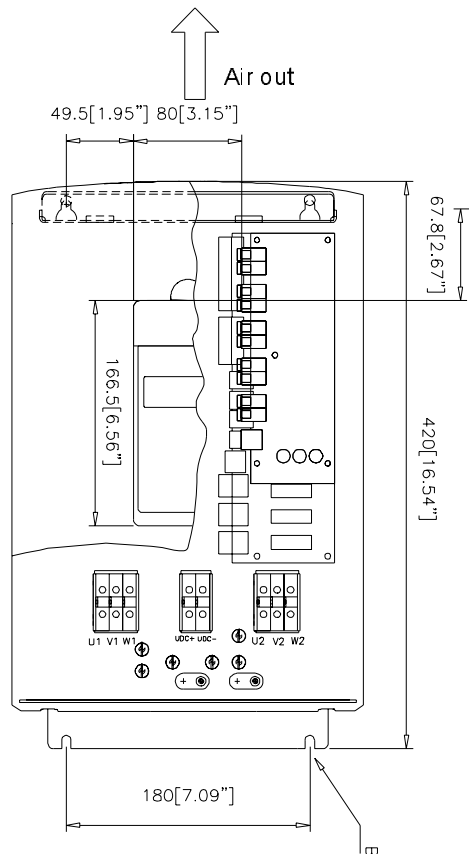
Frame R3



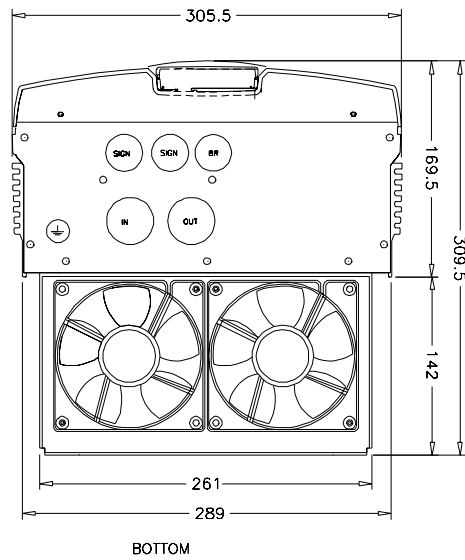
TYPE (ACx = ACS/ACC/ACP)	WEIGHT
ACx 601-0011-3	17.5 kg
ACx 601-0016-3	17.5 kg
ACx 601-0016-5	17.5 kg
ACx 601-0020-5	17.5 kg
ACx 601-0009-6/0011-6	17.5 kg
ACx 601-0009-6/0020-6	17.5 kg



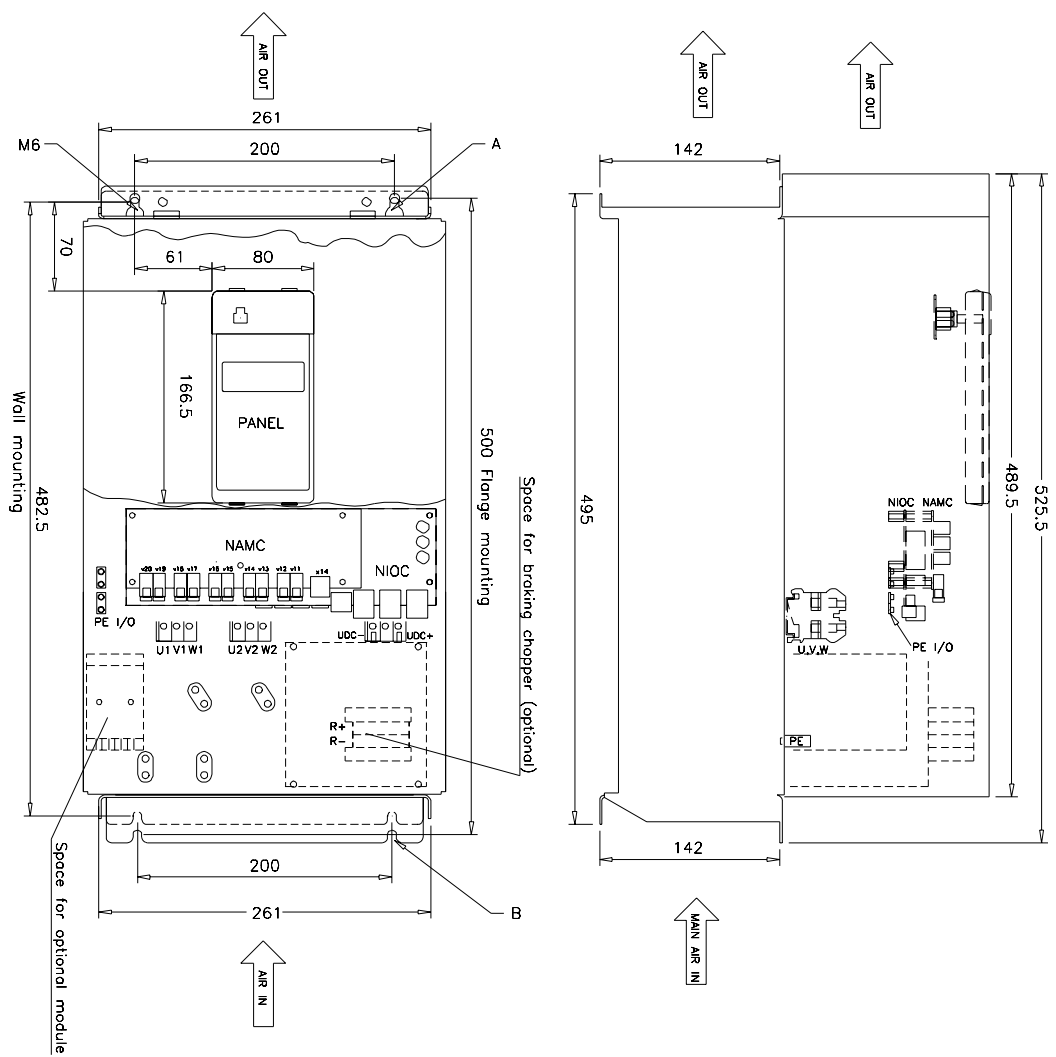
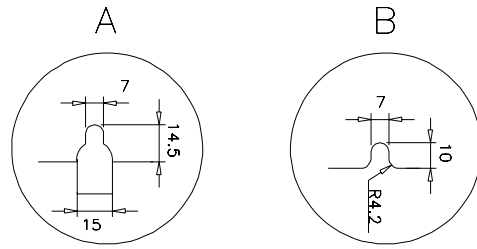
Bottom view



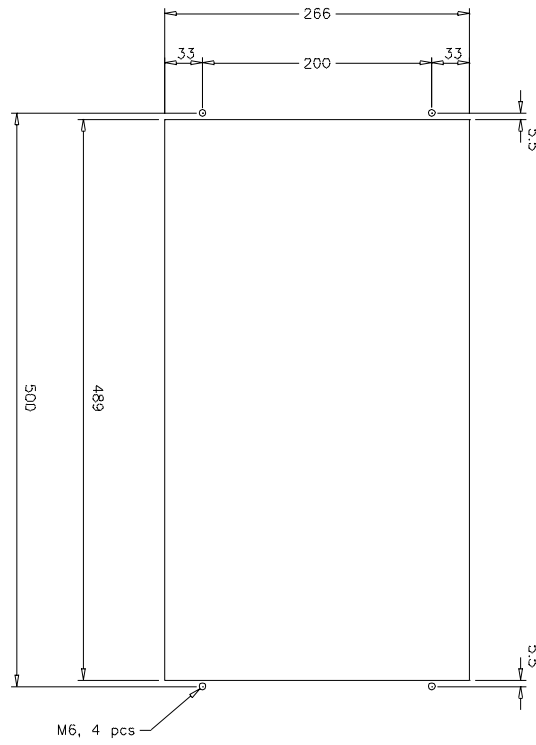
Frame R4



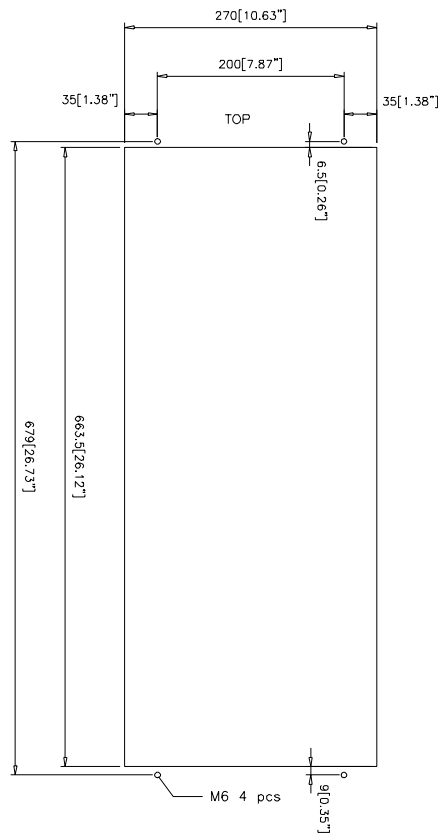
TYPE (ACx = ACS/ACC/ACP)	WEIGHT
ACx 601-0020-3	25 kg
ACx 601-0025-3	25 kg
ACx 601-0025-5	25 kg
ACx 601-0030-5	25 kg
ACx 601-0025-6	25 kg
ACx 601-0030-6	25 kg



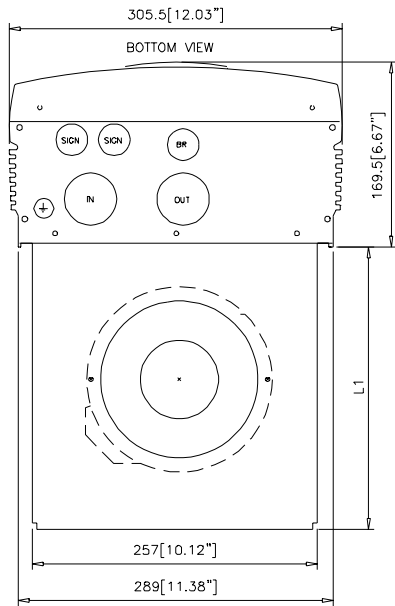
Frame R4 Flange Mounting



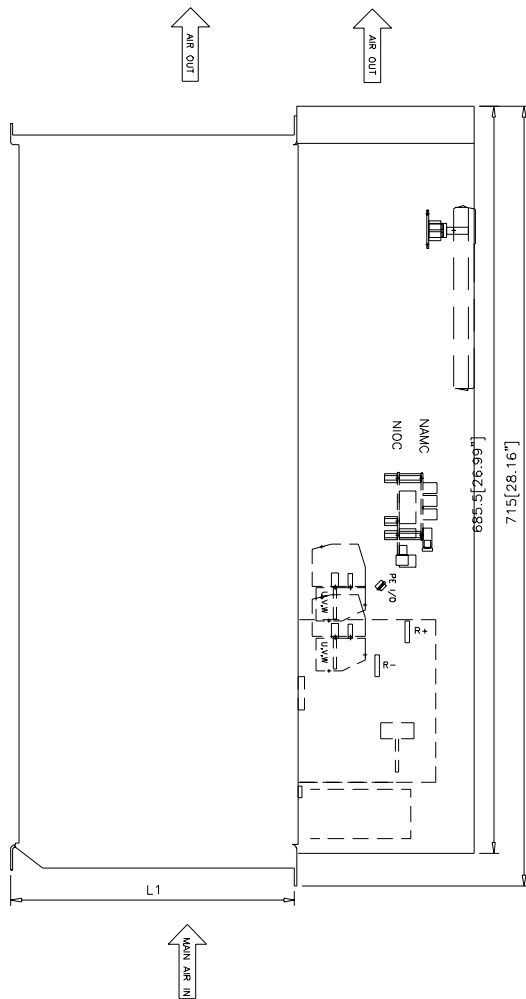
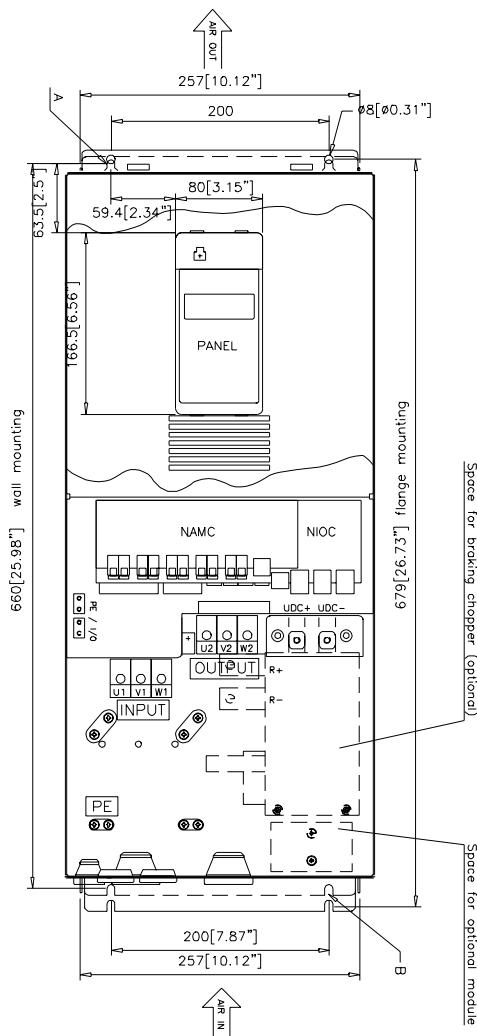
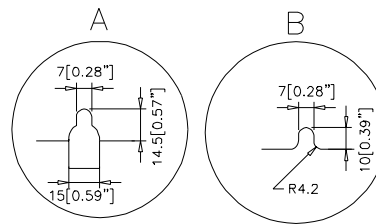
Frame R5/R6 Flange Mounting



Frame R5/R6

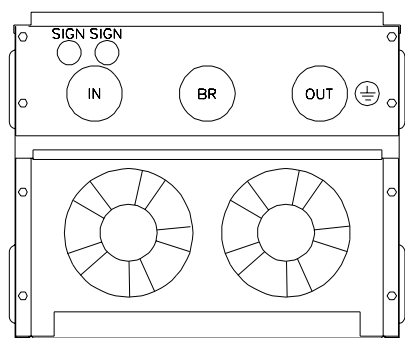
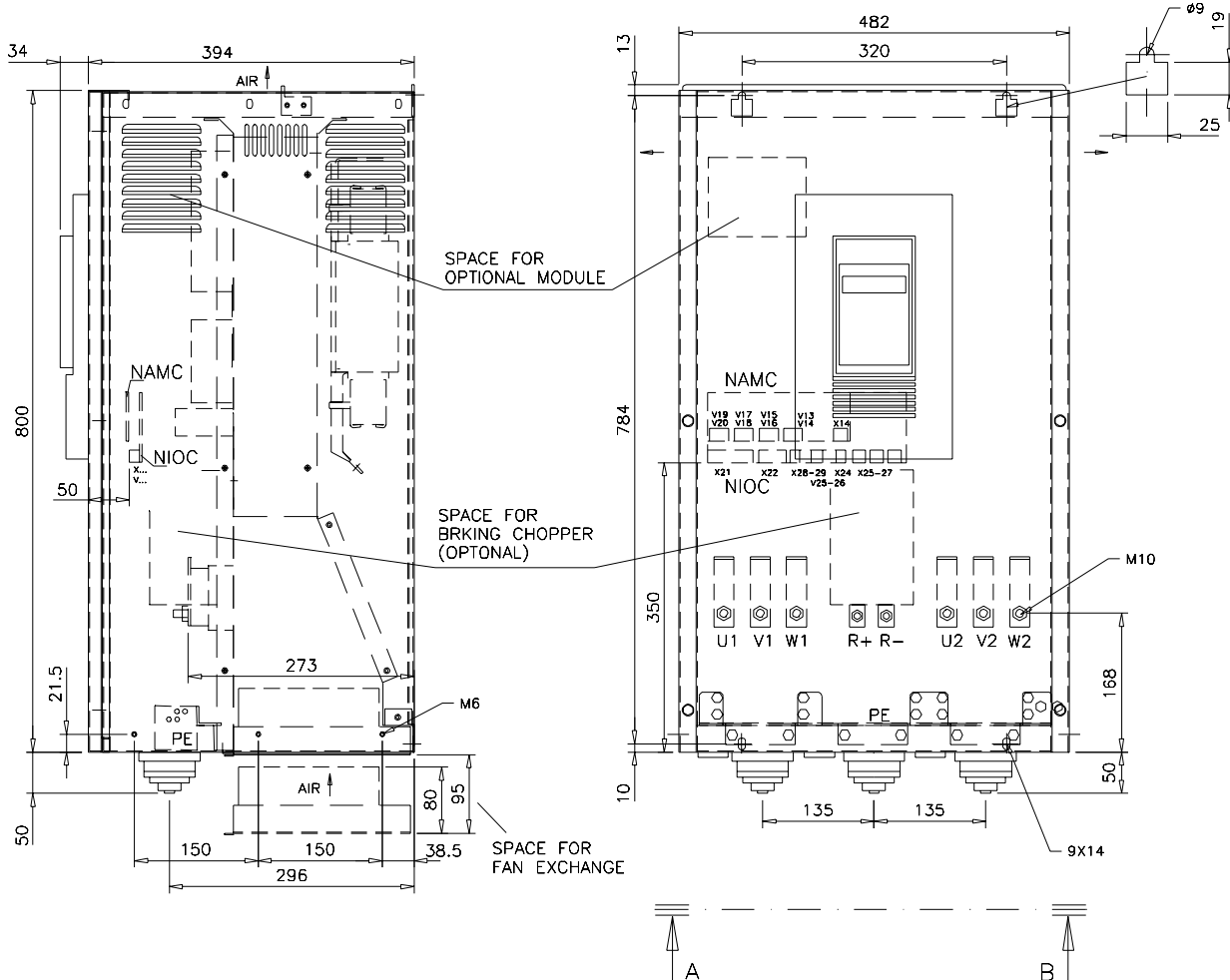


TYPE (ACx = ACS/ACC/ACP)	WEIGHT	L1	
		mm	in
ACx 601-0030...0050-3	35 kg	190.5	7.48
ACx 601-0040...0060-5	35 kg	190.5	7.48
ACx 601-0040-6/-0060-6	35 kg	190.5	7.48
ACx 601-0060...0070-3	50 kg	262.5	10.31
ACx 601-0070...0100-5	50 kg	262.5	10.31
ACx 601-0060-6/-0070-6	50 kg	262.5	10.31



Frame R7

TYPE (ACx = ACS/ACC/ACP)	WEIGHT
ACx 601-0100-3/6	88 kg
ACx 601-0120-3	88 kg
ACx 601-0120-5/6	88 kg
ACx 601-0140-5	88 kg

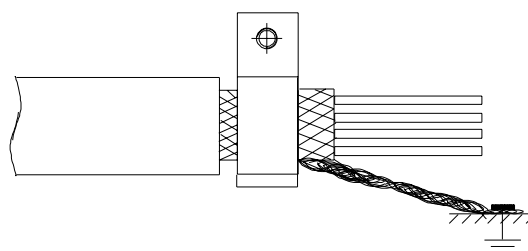


A-B

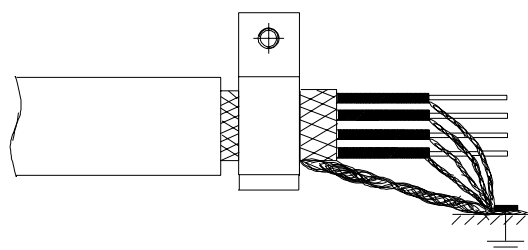
ACP 601 Control Cable Connections

The deliveries include a bag with four clamps, screws and copper tape (frame size R4 also an assembly plate). Clamp the control and encoder cables as explained below. If more than four cables are needed, connect the twisted screen (earthing wires) of the additional cables as short as possible to the earthing rail \oplus next to the NIOC(P) board. Clamping is very important with the encoder cable but less so with relay and other digital signal cables.

1. Strip the cable according to figure below.
2. Frame size R4 only: fasten the assembly plate with screws to the frame.
3. Connect the conductors to the appropriate terminals on the NIOC/ NIOCP board.
4. Ensure 360 degrees earthing by coiling copper tape onto the stripped part of the cable underneath the clamp.
5. Fasten the clamps to the frame with screws.
6. Twist the screen (earthing wires) of the outer shield and connect it through the shortest possible route (max. 2 cm) to the nearest earthing terminal. With double shielded cables, connect each conductor shield (twisted earthing wires) separately to the nearest earthing terminal. Conductor shields of other than encoder cables can be twisted together.

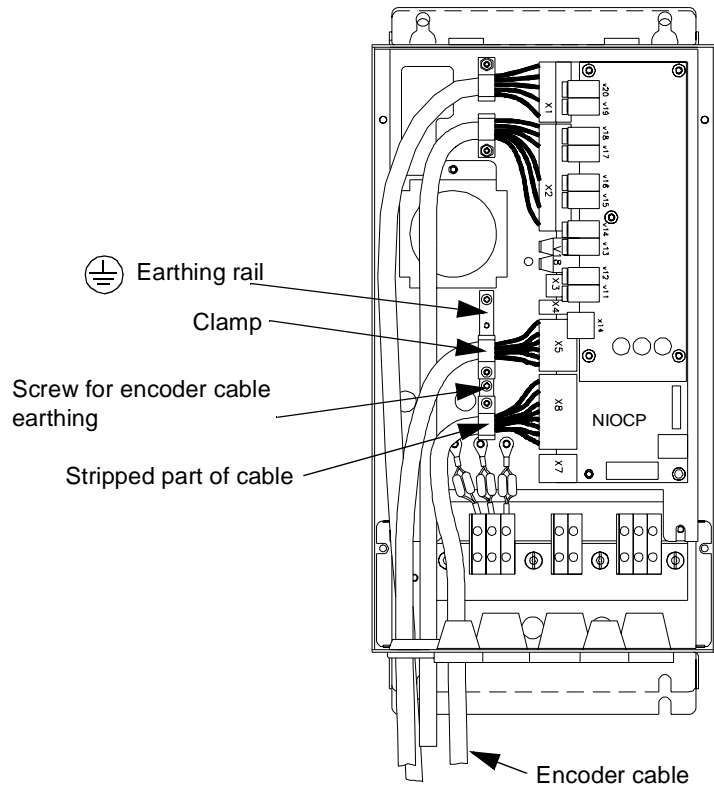


Single shielded cable

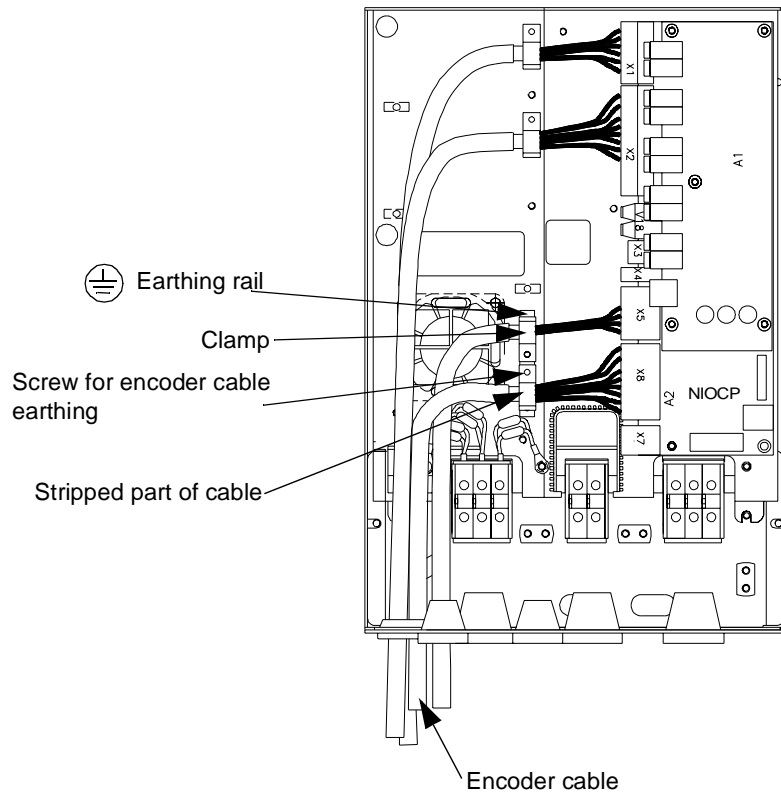


Double shielded cable

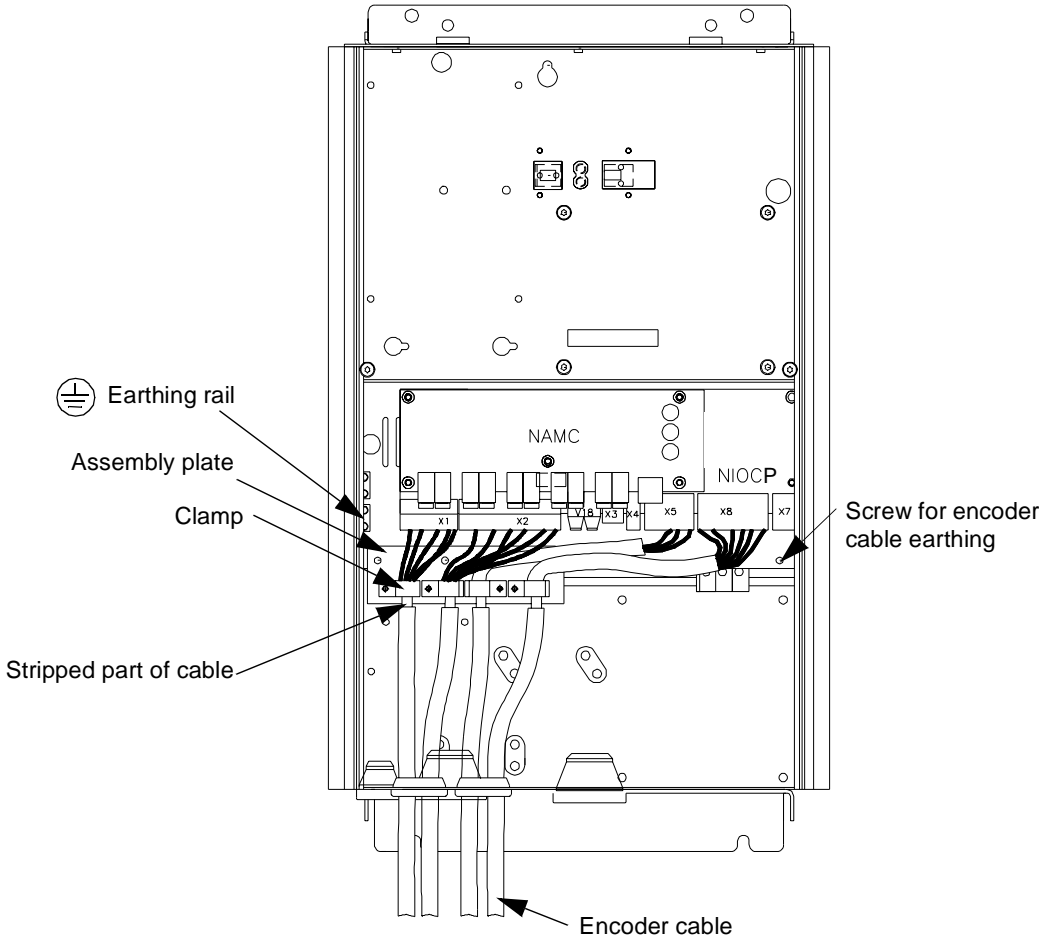
ACP 601 Frame R2



ACP 601 Frame R3



ACP 601 Frame R4



ACP 601 Frame R5/R6

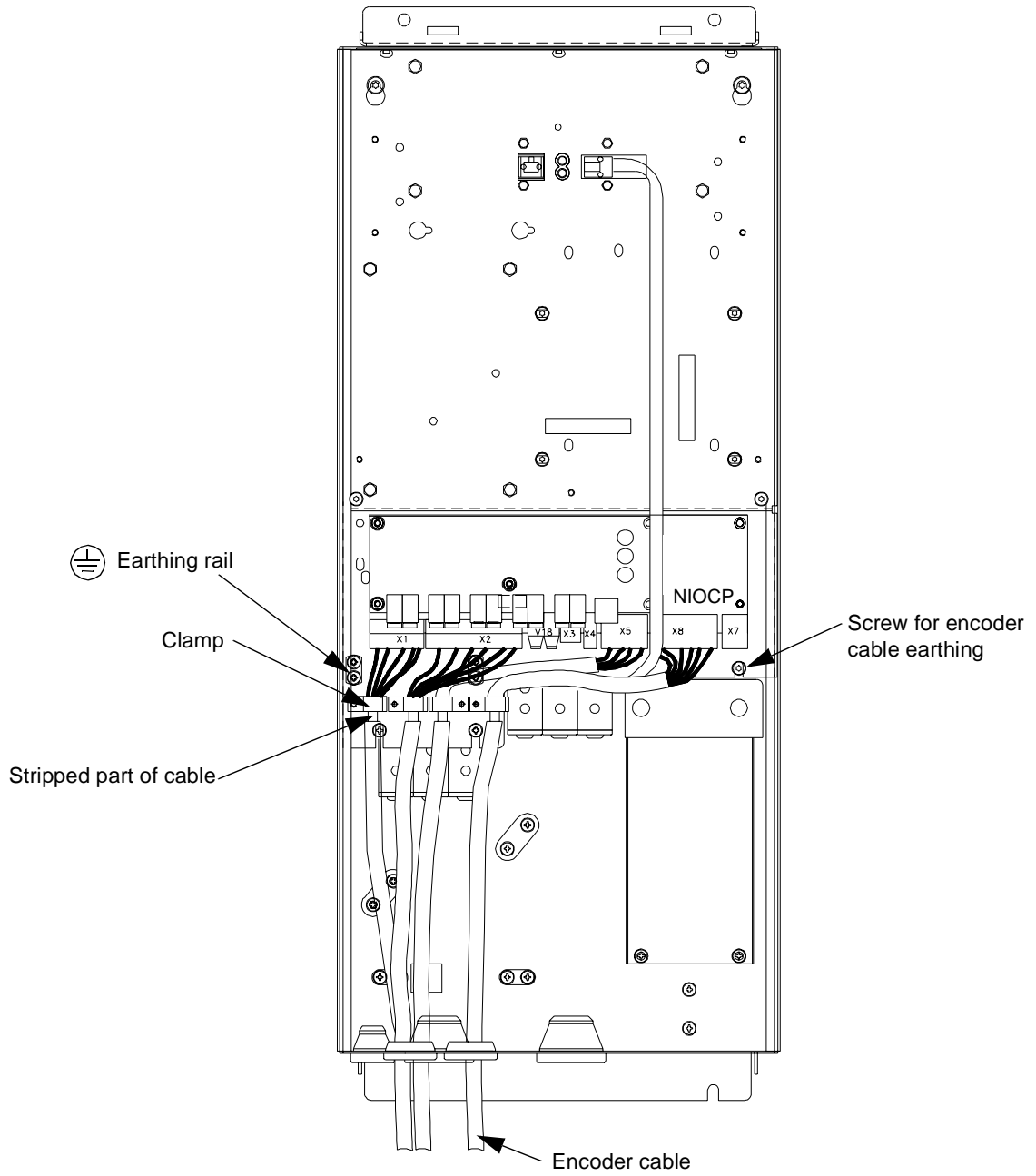




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3AFY 61201360 R0425 REV B
EFFECTIVE: 6.9.1999 EN

Appendix B: 6.9.1999