ACS 600 SingleDrive Frequency Converters

for Speed and Torque Control of
2.2 to 3000 kW Squirrel Cage Motors

Technical Catalogue

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Chapter 1 – Overview

Introduction

This Catalogue describes the hardware, features, and specifications of the ACS 600 SingleDrive frequency converter. It guides you in selecting the correct ACS 600 type and optional devices as well as planning the installation.

ACS 600 SingleDrive in Brief

ACS 600 SingleDrive is a new generation frequency converter that achieves the ultimate in AC motor control performance. The first AC drive to utilise Direct Torque Control (DTC), the ACS 600 accurately controls the speed and torque of any standard squirrel cage motor.

Suitable for Any Application

ACS 600 frequency converters meet the needs of any application - from the simplest to the most critical and highly demanding.

- Pumps - centrifugal, positive displacement, dosing
- Fans - forced draught, induced draught, centrifugal, axial
- Mixers
- Conveyors, bottling lines, palletisers and other materials handling applications
- Lifts, elevators, cranes, hoists
- Winders - films, paper, wire
- Centrifuges
- Extruders - melt pumps, pelletisers.

ACS 600 Drives for Specific Purposes

ACS 600 MotionControl, ACP 600

ACS 600 MotionControl provides state-of-the-art solution to a high-precision control applications, i.e. positioning, synchronising, torque control and speed control.

ACP 600 frequency converters belong to the ACS 600 product family. The same advanced motor control and hardware solutions are used. There are certain differences, however, due to a specific focus of design:

- special application program including Positioning, Synchronising, Speed Control and Torque Control Application Macros
- Advanced I/O Board with integrated incremental encoder interface
- add-on board for an absolute encoder
- Pulse Encoder Interface Module (NTACP-01) option

For more information, see the *Technical Data* appendix and *ACS 600 Product Catalogue*, code: 3BFE 64162021. The options are described in *Chapter 7 – Optional Equipment*.

ACS 600 CraneDrive, ACC 600

ACS 600 CraneDrive belongs to the ACS 600 product family. The same advanced motor control and hardware solutions are used.

The ACS 600 CraneDrive is equipped with a special application program that includes advanced functions for a standard crane system; torque memory, power optimisation, limit switch supervision, mechanical brake control, torque proving etc.

The special crane functions, together with the unique Direct Torque Control (DTC) technology, used in all ACS 600 family members, guarantee precise control in the most demanding crane applications.

For more information, see the *Technical Data* appendix and *ACS 600 Product Catalogue*, code: 3BFE 64162021. The options are described in *Chapter 7 – Optional Equipment*.

Product Type Designations Used in The Catalogue

See the inside of the backover.

Direct Torque Control

Direct Torque Control (DTC) is a unique motor control method for AC Drives. The inverter switching directly controls the motor core variables: the flux and the torque.

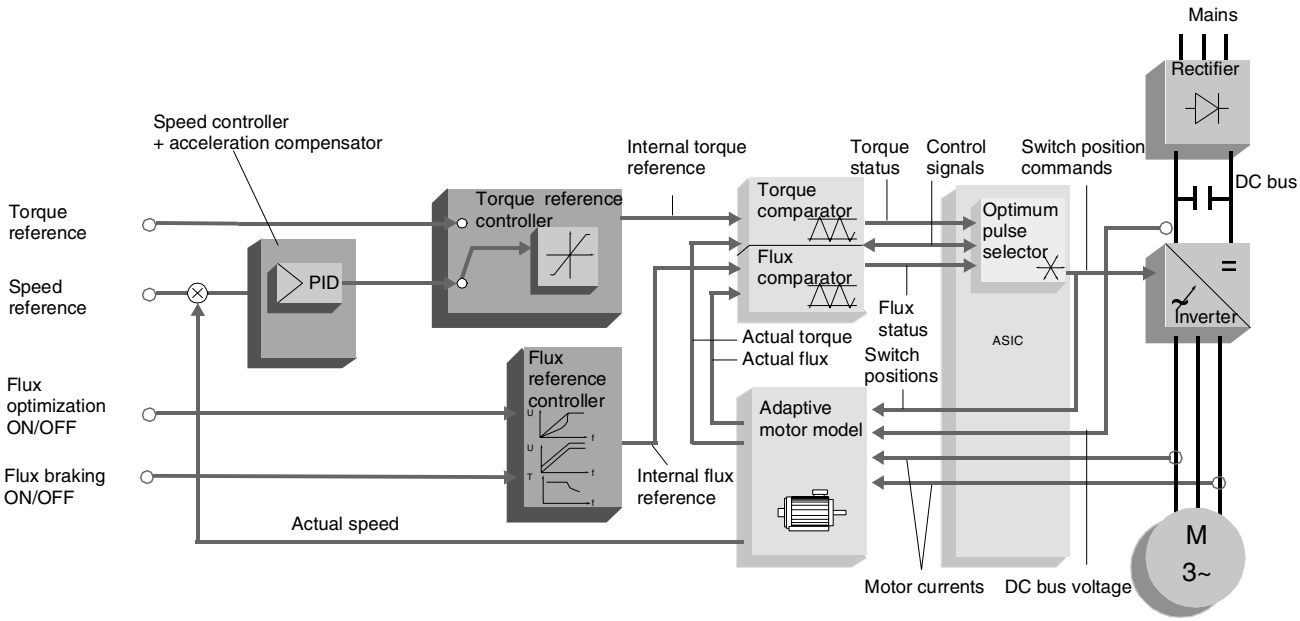


Figure 2-1 DTC block diagram.

The measured motor current and voltage are inputs to an adaptive motor model which produces an exact actual value of torque and flux every 25 microseconds. Motor torque and flux comparators compare actual values to the reference values produced by the torque and flux reference controllers. Depending on the outputs from the two-level controllers, the optimum pulse selector directly determines the optimum inverter switch positions.

Typical performance figures for the speed and torque control are given in *Chapter 6 – Standard Features*.

How Does DTC Differ from PWM Flux Vector Drives?

In DTC, every switching is determined separately based on the values of flux and torque, rather than switching in a predetermined pattern as in conventional PWM flux vector drives.

DTC	Flux Vector
Switching based on core motor variables Flux and Torque	Switching based on separate control of magnetising and torque producing components of current
Shaft speed and position typically not required	Mechanical speed is essential. Requires shaft speed and position (either measured or estimated)
Each inverter switching is determined separately (every 25 μs).	Inverter switching based on average references to a PWM modulator. This results in delays in response and wasted switchings.
Torque Step Rise Time (open loop) is 1 to 5 ms.	Torque Step Rise Time Closed Loop 10 to 20 ms. Sensorless 100 to 200 ms.

For more information on DTC, please refer to the *Technical Guide No. 1 Direct Torque Control* (3AFY 58056685).

Scalar Control

It is also possible to select scalar control as the motor control method. There are some special cases when scalar control should be selected, e.g. when running a multimotor application with variable motor configuration.

For more information on scalar control, see *Chapter 6 – Standard Features*.

Chapter 3 – Hardware Description

ACx 601

The ACx 601 hardware is arranged inside a wall-mountable metal frame. The ACx 601 series comprises six different frames (R2 to R7). The degree of protection of the frame housing is IP 22. IP 54 versions are available as an option, except R7. R7 is available as IP 54 in the ACx 607 series only.

The front section of the frame contains the electronics and the power and control cable terminals. The rear section forms a cooling channel. Two-section construction allows the unit to be installed protruding through a wall, placing the rear section in a cooling air duct (frames R2 to R6). In standard installations the converter is mounted directly onto the wall. The upward cooling air flow is provided by a fan or fans in the bottom part of the frame.

There is room for the Braking Chopper and for one Option Module in frames R4 to R7. Frames R2 and R3 need to have these devices installed outside the converter housing. For information on the optional devices available, see *Chapter 7 – Optional Equipment.*

For the degree of protection, materials etc. see the *Technical Data* appendix.

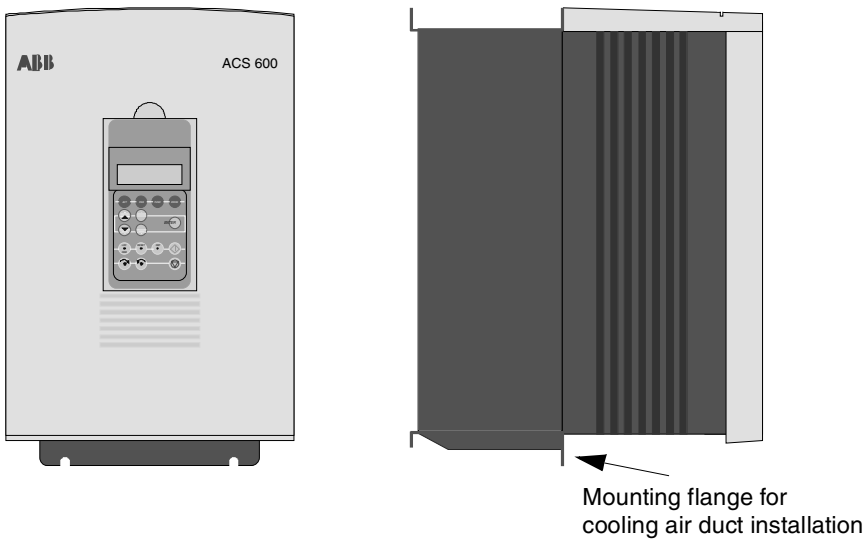


Figure 3-1 The ACx 601. The dimensions and weights are shown in Technical Data appendix.

ACx 604 / ACx 607 / ACS 617 / ACS 677

The ACx 604 is a converter module which is installed into a cabinet and equipped with accessories by the user. The ACx 607 is housed inside a Drives-MNS cabinet.

ACx 604

The ACx 604 hardware is arranged inside a metal frame. There are three frame sizes: R7, R8 and R9. The ACx 604 frame is to be fitted in a cabinet by the user. The degree of protection is IP 22 (ACx 604-0100-3, -0120-3, -0120-5, -0140-5, -0100-6 and -0120-6) or IP 00 (ACx 604-0140-3 to -0320-3 and -0170-5 to -0400-5 and -0140-6 to -400-6). The Control Panel mounting platform, the Control Panel and the other optional devices are supplied separately. Most optional devices are to be installed outside the unit. For more information on the Control Panel, Control Panel Mounting Platform and the other optional add-on kits, see *Chapter 7 – Optional Equipment*.

ACx 607 / ACS 617 / ACS 677

The cabinet of ACx 607 / ACS 617 / ACS 677 is equipped with a hinged front door(s) that holds the mains switch, the Control Panel mounting platform, and some optional devices. Cooling air intake and exhaust vents are covered with grates to keep out unwanted objects. As standard, the cabling is through the bottom of the unit. The mains and motor cable can also be lead in through the roof of the cabinet. See *Chapter 7 – Optional Equipment* for more information.

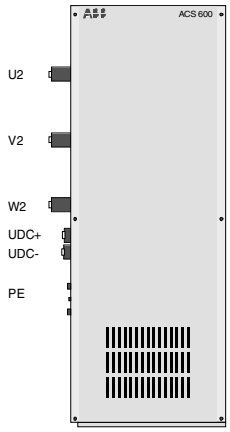
There is room inside the cabinet to allow connections and optional devices. The cabinet can be ordered as an extended version if more space is required.

ACx 607 types up to -0610-3, -0760-5 and -0760-6 use the ACx 604 converter modules/frames.

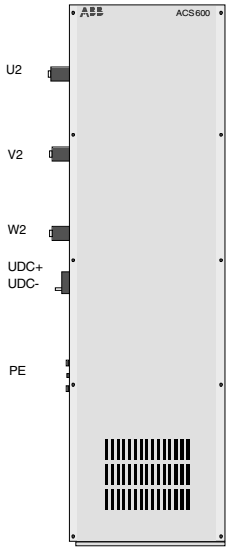
ACS/ACC 607 types -0760-3, -0930-5, -0900-6 or above, and ACS/ACC 617 and ACS/ACC 677 use the supply units and inverter modules/frames of the *ACS 600 MultiDrive*.

For the degree of protection, materials etc. see the *Technical Data* appendix.

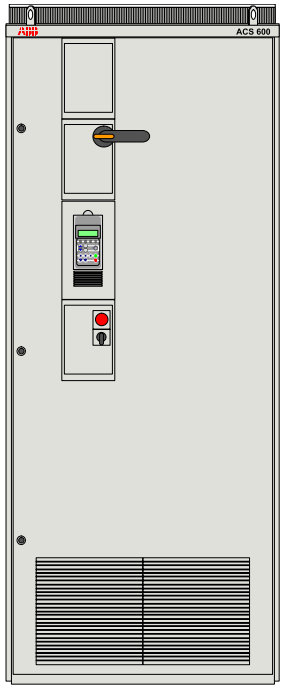
ACx 604-0140-3 to 0210-3
ACx 604-0170-5 to 0260-5
ACx 604-0140-6 to 0260-6



ACx 604-0260-3, 0320-3
ACx 604-0320-5, 0400-5
ACx 604-0320-6, 0400-6



ACx 607-0100-3 to 0320-3
ACx 607-0120-5 to 0400-5
ACx 607-0100-6 to 0400-6



ACx 607-0400-3 to 0610-3
ACx 607-0490-5 to 0760-5
ACx 607-0490-6 to 0760-6

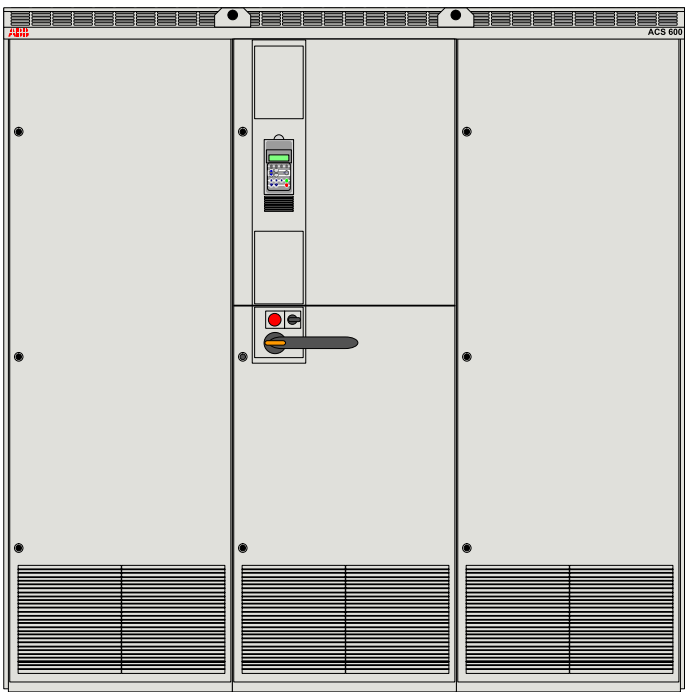


Figure 3-2 The ACx 604 and the ACx 607 (up to -0610-3, -0760-5 and -0760-6). The dimensions and weights are given in the Technical Data appendix.

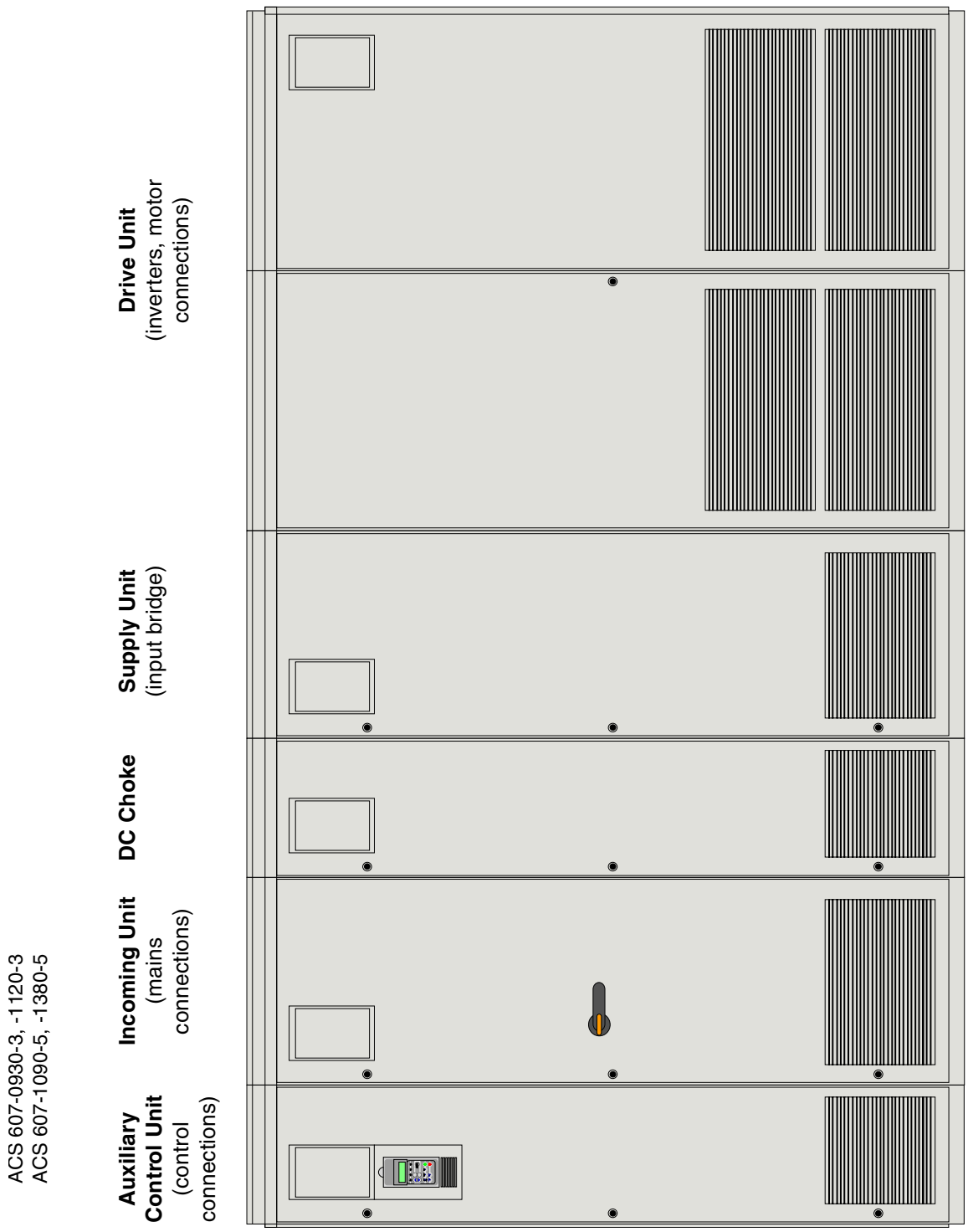


Figure 3-3 The ACS/ACC 607 (-0760-3, -0930-5, -0900-6 or above). The dimensions and weights are given in the Technical Data appendix.

Chapter 4 – User Interfaces

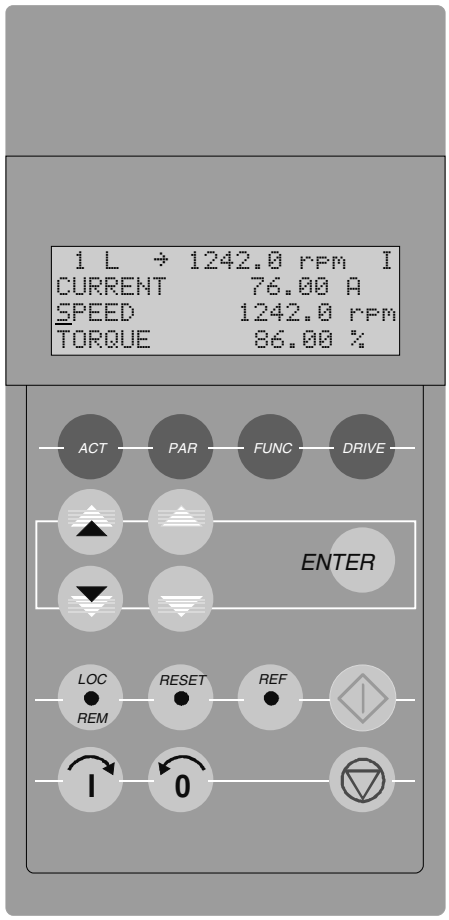
Overview

The ACS 600 can be controlled from several control locations:

- The detachable Control Panel which can be mounted on the ACS 600 enclosure or a remote control desk.
- External control devices that connect to the analogue and digital I/O terminals or Standard Modbus Link (serial RS 485 connection) on the Standard I/O Board, NIOC.
- External control devices that connect to the ACS 600 option modules (Analogue and Digital I/O Extension Modules and Fieldbus Adapter Modules).
- PC that connects via a PC adapter to the Application and Motor Control Board, NAMC.

Control Panel

The Control Panel is the user interface for monitoring, adjusting parameters and controlling the ACS 600 operation.



Control Panel Display

Control Panel Keypad

Degree of protection IP 54 when attached to the Control Panel Mounting Platform

Multilingual Alphanumeric Display (4 lines x 20 characters)
Plain text messages in 10 languages

Depending on the selection, four languages are loaded in the ACS 600.

Control Panel Mode Selection keys

Double Up Arrow, Up Arrow, Enter, Double Down Arrow, Down Arrow keys

Local/Remote, Reset, Reference and Start keys

Forward, Reverse and Stop keys

Figure 4-1 The Control Panel.

Using the panel it is possible to

- enter start-up data into the drive
- control the drive with a reference signal and with Start, Stop and Direction commands
- display the actual values (three values can be read simultaneously)
- display and adjust the parameters
- display information on faults
- upload and download complete parameter settings from one drive to another (this greatly simplifies the start-up procedure of several identical drives).

On the control panel mounting platform, there are two LEDs which indicate the status of the drive while the control panel is detached. The green LED indicates that the ACS 600 is powered, the red LED indicates that a fault is detected.

Standard I/O See the *Technical Data* appendix, subsection *Standard I/O*.

Standard ModBus Link See the *Technical Data* appendix, subsection *Standard I/O*.

I/O Extension Modules See *Chapter 7 – Optional Equipment*.

Fieldbus Adapter Modules See *Chapter 7 – Optional Equipment*.

PC Connection See *Chapter 7 – Optional Equipment*.

Chapter 5 – Parameters and Application Macros

This Chapter describes briefly the Parameters and Macros of the ACS 600 Standard Application Program.

Overview

Parameters are the Control Panel configurable operation instructions of the ACS 600.

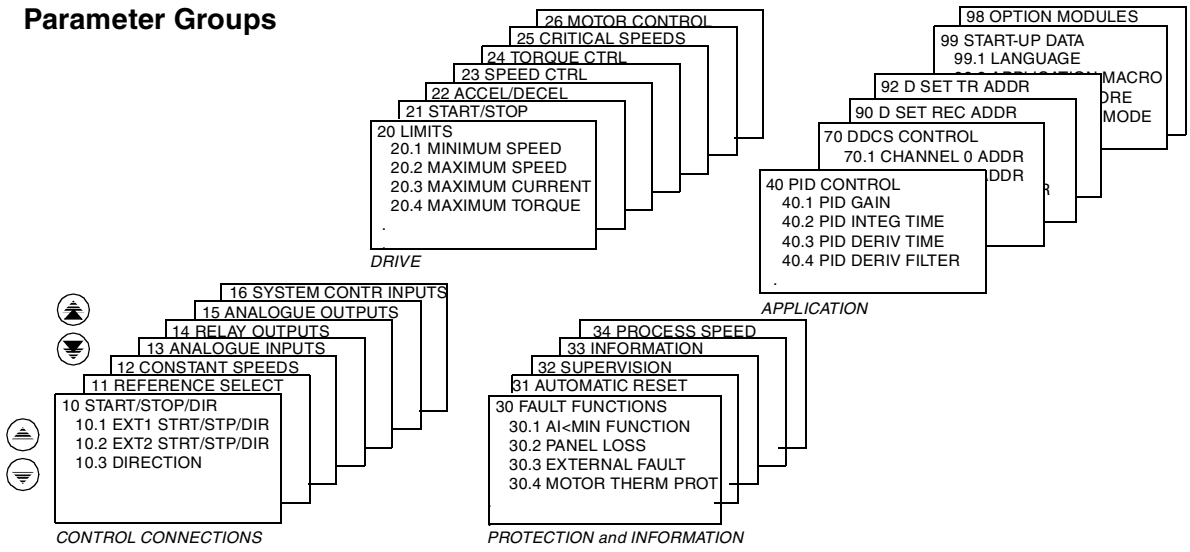
The built-in application macros can be selected at the touch of a button. The macro automatically takes care of configuration of inputs, outputs and signal processing as well as selections of the other parameters.

Available standard application macros:

- FACTORY SETTING for basic industrial applications
- HAND/AUTO CONTROL for local and remote operation
- PID CONTROL for closed loop processes
- TORQUE CONTROL for processes where torque control is required
- SEQUENTIAL CONTROL for operation at preset constant speeds
- USER MACRO 1 & 2 for saving the user's own parameter settings.

If further customisation is needed, the multilingual alphanumeric Control Panel allows quick parameter adjustment without the need to look up codes in a book.

Parameter Groups



The parameters in the ACS 600 are organised into functional groups, allowing the user to step through the groups, rather than having to step through all the parameters one by one. This makes the right parameter much easier and quicker to find.

I/O Settings in Macros

Preprogrammed use of digital inputs (DI), relay outputs (RO), analogue inputs (AI) and analogue outputs (AO) is shown below.

Factory Macro

Input Signals		Output Signals	
DI1,2:	Start, Stop, Direction	AO1:	Speed
AI1:	Speed reference	AO2:	Current
DI5,6:	Constant speed selection (3)	RO1:	Ready
DI4:	Accel/Decel ramp selection (2)	RO2:	Running
		RO3:	Fault (-1)

Hand/Auto Macro

Input Signals		Output Signals	
DI1,2:	Start,Stop,Direction (Hand)	AO1:	Speed
DI5,6:	Start,Stop,Direction (Auto)	AO2:	Current
DI3:	Control location selection (Hand/Auto)	RO1:	Ready
AI1:	Speed reference (Hand)	RO2:	Running
AI2:	Speed reference (Auto)	RO3:	Fault (-1)
DI4:	Constant speed selection		

PID Control Macro

Input Signals		Output Signals	
DI1:	Start, Stop (Speed Control)	AO1:	Speed
DI6:	Start, Stop (Process Control)	AO2:	Current
AI1:	Process reference/Speed Reference	RO1:	Ready
AI2:	Process actual value	RO2:	Running
DI3:	Speed/Process control selection	RO3:	Fault (-1)
DI4:	Constant speed selection		
DI5:	Run enable signal		

Torque Control Macro

Input Signals		Output Signals	
DI1,2:	Start, Stop	AO1:	Speed
AI1:	Speed reference	AO2:	Current
AI2:	Torque reference	RO1:	Ready
DI3:	Speed/Torque control selection	RO2:	Running
DI5:	Accel/Decel ramp selection (2)	RO3:	Fault (-1)
DI4:	Constant speed selection		
DI6:	Run enable signal		

Sequential Control Macro

Input Signals		Output Signals	
DI1,2:	Start, Stop, Direction	AO1:	Speed
AI1:	Speed reference	AO2:	Current
DI3:	Accel/Decel ramp selection (2)	RO1:	Ready
DI4,5,6:	Constant speed selection (7)	RO2:	Running
		RO3:	Fault (-1)

Chapter 6 – Standard Features

This Chapter describes features of the ACS 600 equipped with the Standard Application Program.

Overview

Based on the Direct Torque Control motor control technology, the ACS 600 offers highly advanced features as standard. As a default setting the ACS 600 operates in DTC. There are some special cases when scalar control should be selected, for example when running a multimotor application with variable motor configuration.

The following features are available in DTC mode. The standard features that are not available in the scalar control mode, and the features that are only available in the scalar control mode, are listed in section *Scalar Control* later in this chapter.

Motor Control Features

Motor Identification

The unbeatable performance of Direct Torque Control is based on an accurate motor model determined during the motor start-up.

A quick motor identification is automatically done the first time the Start command is given. During this first start-up the motor is magnetised at zero speed for several seconds to allow the motor model to be created. The First Start is the motor identification method suitable for most applications.

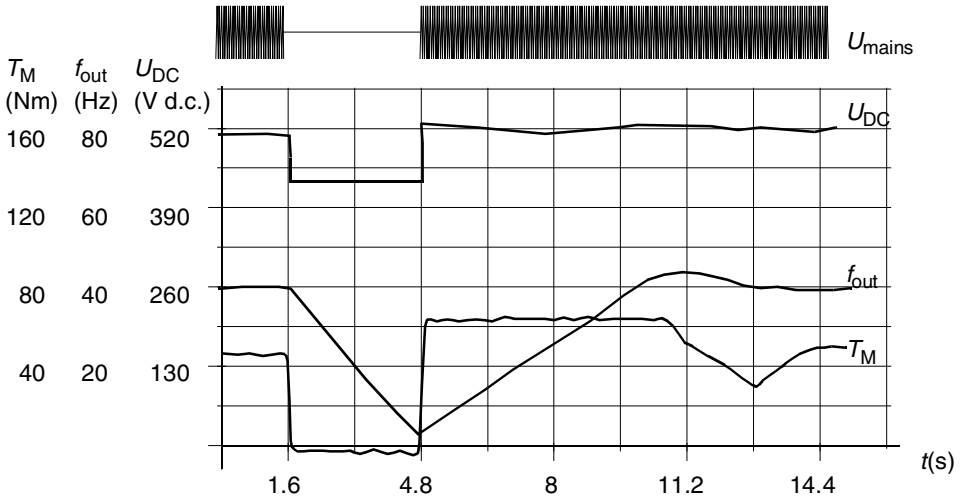
In demanding applications it is possible to perform an Identification Run. The Identification (ID) Run should be performed if:

- operation point is near zero speed
- operation at torque range above the motor nominal torque within wide speed range and without pulse encoder (i.e. without measured speed feedback) is required

There are two ID Run alternatives: the Standard ID Run and the Reduced ID Run. The motor must be uncoupled from the load during the Standard ID Run. The Reduced ID Run is to be used if the load cannot be disengaged from the motor or stator flux reduction is not allowed. Flux reduction is not allowed, for example, with a braking motor in which the brake is switched on if the motor voltage or flux reduces significantly. To achieve the most accurate motor model and the best possible motor control performance, the Standard ID Run should be selected.

Power Loss Ride-through

If the incoming supply voltage is cut off the ACS 600 will continue to operate by utilising the kinetic energy of the rotating motor. The ACS 600 will be fully operational as long as the motor rotates and generates energy to the ACS 600.



U_{DC} = ACS 600 intermediate circuit voltage, f_{out} = ACS 600 output frequency
T_M = Motor torque

Figure 6-1 Loss of supply voltage at nominal load (f_{out} = 40 Hz). The intermediate circuit DC voltage drops to the minimum limit. The controller keeps the voltage steady as long as the mains is switched off. The ACS 600 runs the motor in generator mode. The motor speed falls but the drive is fully operational as long as the motor has enough kinetic energy.

Note: In cabinet assembled units (ACS 607) with a main contactor option there is a “hold circuit” that keeps the contactor control circuit closed during a short main supply break.The allowed duration of the break is adjustable. The factory setting is five seconds.

Controlled Torque at Zero Speed

The ACS 600 can control motor torque at zero speed without any pulse encoder or tachogenerator feedback. E.g. a controlled change of rotation direction can be performed. The feature is essential in several applications including elevators and lifts. However, if long-term operation at zero speed is required, a pulse encoder is used.

DC Magnetizing

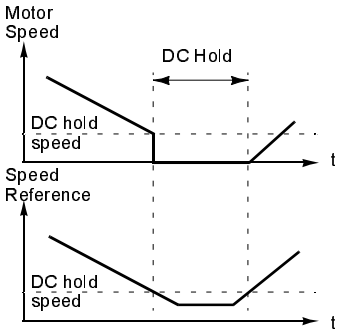
When DC Magnetizing is activated the ACS 600 automatically magnetises the motor before the start. This feature guarantees the highest possible breakaway torque, even 200 % of motor nominal torque. By adjusting the premagnetising time, it is possible to fix the motor start with a mechanical brake release, for example. The Automatic Start feature and DC Magnetizing cannot be activated at the same time.

Automatic Start

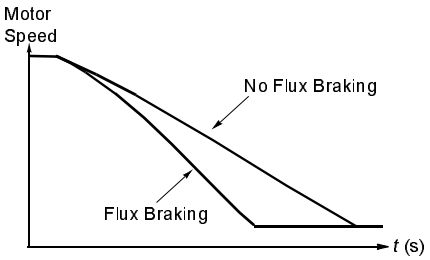
The Automatic Start feature of the ACS 600 outperforms the flying start and ramp start features normally found in frequency converters.

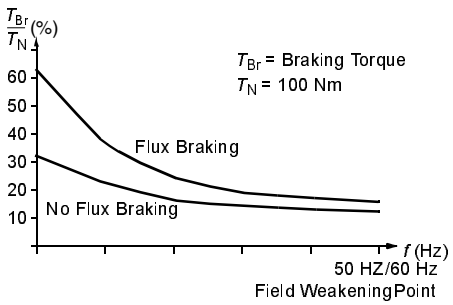
Because ACS 600 can detect the state of the motor within a few milliseconds, starting is immediate under all conditions. There is no restart delay. The starting of turbining pumps or windmilling fans is easy, for example.

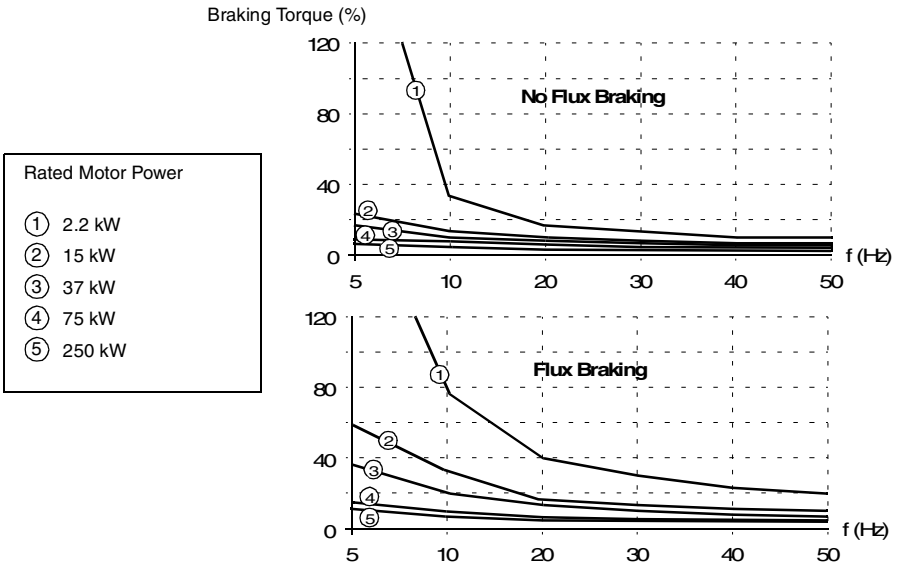
DC Hold By activating the motor DC Hold feature it is possible to lock the rotor at zero speed. When both the reference and the motor speed drop below the preset DC hold speed, the ACS 600 stops the drive and starts to inject DC into the motor. When the reference speed again rises above the DC hold speed, the normal ACS 600 operation resumes.



Flux Braking The ACS 600 can provide greater deceleration by raising the level of magnetisation in the motor. By increasing the motor flux, the energy generated by the motor during braking can be converted to motor thermal energy. The feature is useful in motor power range below 15 kW.







The ACS 600 monitors the motor status continuously, also during Flux Braking. Therefore, Flux Braking can be used both for stopping the motor and for changing from one speed to another. The latter is not possible with DC Injection Braking, which is offered in most frequency converters. The other benefits of Flux Braking compared to DC Injection Braking are:

- The braking starts immediately after the Stop command is given. In DC Injection Braking, there is typically a 500 ms delay after the Stop command before braking can be started. The delay is essential because DC Injection is possible only after the motor flux is sufficiently reduced.
- The cooling of the motor is more efficient.
  The stator current of the motor increases during Flux Braking. With DC Injection Braking the rotor current increases. The stator cools much more efficiently than the rotor.

Flux Optimization

Flux Optimization of the ACS 600 reduces the total energy consumption and motor noise level when the drive operates below the nominal load. The total efficiency (motor and the drive) can be improved by 1 % to 10 %, depending on the load torque and speed.

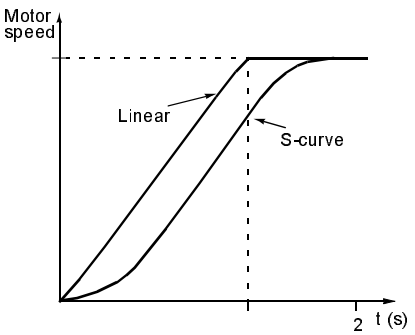
Acceleration and Deceleration Ramps

ACS 600 provides two user-selectable acceleration and deceleration ramps. It is possible to adjust the acceleration/deceleration times (0 to 1800 s) and the ramp shape. Switching between the two ramps can be controlled via a digital input.

The available ramp shape alternatives are linear and S curve.

Linear: Suitable for drives requiring steady or slow acceleration/ deceleration.

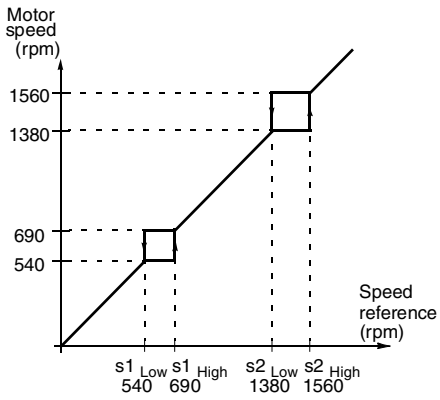
S-curve: Ideal for conveyors carrying fragile loads, or other applications where a smooth transition is required when changing from one speed to another.



Critical Speeds

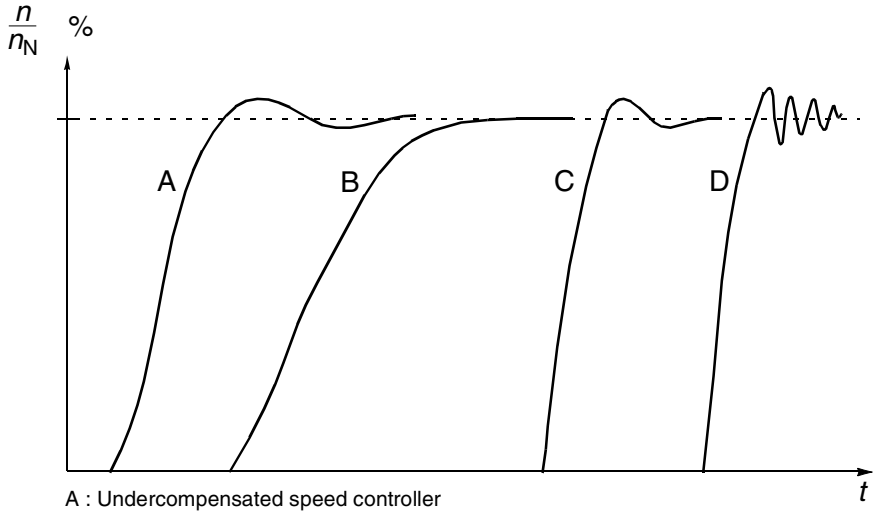
There is a Critical Speeds function available for applications where it is necessary to avoid certain motor speeds or speed bands due to e.g. mechanical resonance problems. The ACS 600 makes it possible to set up 3 different speeds or speed bands which will be avoided during operation.

Each critical speed setting allows the user to define a low and a high speed limit. If the speed reference signal requires the ACS 600 to operate within this speed range the Critical Speeds function will keep the ACS 600 operating at the low (or high) limit until the reference is out of the critical speed range. The motor is accelerated/decelerated through the critical speed band according to the acceleration or deceleration ramp.



Constant Speeds In the ACS 600 it is possible to predefine 15 constant speeds. Constant speeds are selected with digital inputs. Constant speed activation overrides the external speed reference.

Speed Controller Tuning During the motor Identification (ID) Run the ACS 600 speed controller is automatically tuned. However, it is possible to manually adjust the controller gain, integration time and derivation time, or let the ACS 600 perform a separate speed controller Autotune Run. In Autotune Run, the motor is driven through a series of movements and the speed controller is tuned based on the load and inertia of the motor and the machine.



A : Undercompensated speed controller
B : Normally tuned speed controller, autotuning
C : Normally tuned speed controller, manual tuning. Better dynamic performance than with B
D : Overcompensated speed controller

Figure 6-2 Examples of speed response at a speed reference step (typically, 1 to 20 %). Speed step response can be seen by monitoring the actual signal SPEED.

Accurate Speed Control The static speed control error is typically $\pm$ 0.1% to $\pm$ 0.5 % of motor nominal speed, which satisfies most industrial applications. If even more precise speed regulation is required, a pulse encoder can be

connected. With a pulse encoder, the static speed control error is typically ± 0.01% of motor nominal speed.

The dynamic speed control error is typically ± 0.4 %sec. at 100 % load torque step without a pulse encoder or tachogenerator. With a pulse encoder, dynamic speed control error is typically ± 0.1 %sec.

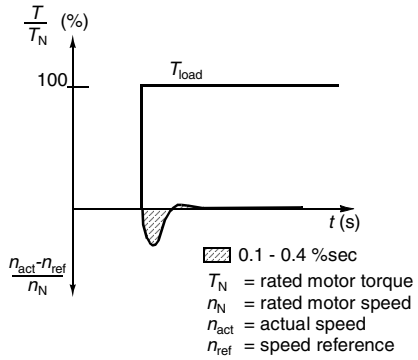


Table 6-1 Typical performance figures for speed control, when Direct Torque Control is used.

Speed Control	ACS 600 no Pulse Encoder	ACS 600 with Pulse Encoder
Static speed error, % of n_N	± 0.1 to 0.5 % (10 % of nominal slip)	± 0.01 %
Dynamic speed error	0.4 %sec.*	0.1 %sec.*

*Dynamic speed error depends on speed controller tuning.

Accurate Torque Control without Speed Feedback

The ACS 600 can perform precise torque control without any speed feedback from the motor shaft. With torque rise time less than 5 ms at 100 % torque reference step compared to over 100 milliseconds in frequency converters using sensorless flux vector control, the ACS 600 is unbeatable.

By applying a torque reference instead of a speed reference, the ACS 600 will maintain a specific motor torque value; the speed will adjust automatically to maintain the required torque.

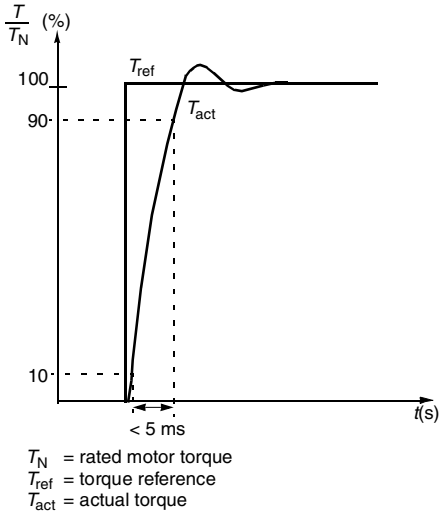


Table 6-2 Typical performance figures for torque control, when Direct Torque Control is used.

Torque Control	ACS 600 no Pulse Encoder	ACS 600 with Pulse Encoder
Linearity error	± 4 %*	± 3 %
Repeatability error	± 3 %*	± 1 %
Torque rise time	1 to 5 ms	1 to 5 ms

*When operated around zero frequency, the error may be greater.

Scalar Control

With the ACS 600 it is possible to select Scalar Control as the motor control method. In the Scalar Control Mode, the drive is controlled with a frequency reference. The outstanding performance of the default motor control method, Direct Torque Control, is not achieved in Scalar Control.

It is recommended to activate the Scalar Control mode in certain special applications:

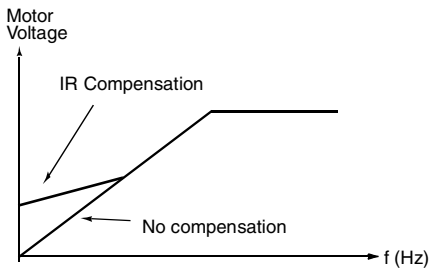
- In multimotor drives 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification.
- If the nominal current of the motor is less than 1/6 of the nominal output current of the ACS 600.
- If the ACS 600 is used without a motor connected (for test purposes, for example).
- If the ACS 600 is used in a step-up transformer application. (ACS 600 is running a medium voltage motor via a step-up transformer.)

In the Scalar Control Mode, the following ACS 600 standard features are not available: Motor ID Run, Automatic Start, Torque Control, DC Magnetizing, Flux Braking, Flux Optimization, DC Hold, Underload Function, Motor Phase Loss Function, Speed Limits, Torque Limits, Speed Controller Tuning, Stall Function.

The following features are available only in Scalar Control: Limits for Frequency (programmable), IR Compensation.

IR Compensation

When IR Compensation is activated, the ACS 600 gives an extra voltage boost to the motor at low speeds. IR Compensation can be used in e.g. Scalar Control applications that require high breakaway torque, for example.



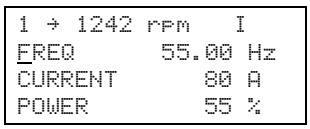
Diagnostics

Actual Signals

Several Actual Signals are available including:

- ACS 600 output frequency, current, voltage and power
- Motor speed and torque
- Mains voltage and intermediate circuit (DC) voltage
- Active control location (Local/External1/External 2)
- Reference values
- ACS 600 temperature
- Operating time counter (h), kWh counter
- DI/O and AI/O status
- PID controller actual values (if the PID Control Macro is selected)

Three signals can be read simultaneously from the control panel display.



Fault History

The Fault History contains information on 64 most recent events (faults or warnings) detected by the ACS 600 (16 remains in the memory over a power switch off). The events are displayed in words along with the total power-on time of the ACS 600.

Programmable Relay Outputs

The three programmable relay outputs can be used as potential free changeover contacts. With parameter setting it is possible to choose which information to indicate with the RO: ready, running, fault, warning, motor stall, motor temperature, ACS 600 temperature, reversed selected, external control selected, preset speed limits (2 pcs), intermediate circuit voltage limits, preset motor current limit, reference limits (2 pcs), loss of reference signal, ACS 600 started, motor operating at reference speed, process PID controller actual value limits (low, high) etc. It is also possible to control the relay outputs through a communication (e.g. fieldbus adapter) module.

Programmable Analogue Outputs

ACS 600 offers two programmable current outputs. Analogue output signals can be inverted and filtered. The minimum level can be adjusted to 0 mA or to 4 mA.

Depending on parameter selection, the analogue output signals can be proportional to motor speed, process speed (scaled motor speed), output frequency, output current, motor torque, motor power, DC bus voltage, output voltage, application block output (the process PID controller output), the active reference, or reference deviation (difference between the reference and the actual value of the process PID controller) etc.

Also, the output can be proportional to the process PID controller actual value of the ACS 600. The process PID controller actual values can be scaled, inverted and filtered.

It is also possible to control the analogue outputs through a communication (e.g. fieldbus adapter) module.

Input Signal Source Selections and Signal Processing

Two Programmable Control Locations

The ACS 600 (with no optional devices) can receive Start/Stop/Direction commands and reference from the control panel, through digital inputs and analogue inputs or through a serial RS 485 port (Standard Modbus Link).

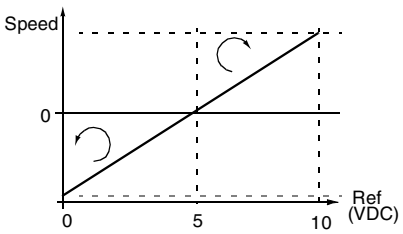
It is possible to predefine two separate External Control Locations (EXT1 and EXT2) for both the Start/Stop/Direction commands and the reference signal. The active External Control Location can be changed with the control panel, through a digital input or through the Standard Modbus Link.

The control panel always overrides the other control signal sources when used in local mode.

Reference Signal Processing

The ACS 600 can accept a variety of speed references in addition to the conventional analogue input signal and control panel signals.

- The ACS 600 reference can be given with two digital inputs: One digital input increases the speed, the other decreases it.
- ACS 600 accepts a “joystick” analogue speed reference. This feature allows both the speed and direction to be controlled with a single analogue input. The minimum signal is full speed reversed and the maximum signal is full speed forward.



- The ACS 600 can form a reference out of two analogue input signals by using mathematical functions: Addition, Subtraction, Multiplication, Minimum selection, and Maximum selection.
- The ACS 600 can form a reference out of an analogue input signal and a signal received through a serial communication interface by using mathematical functions: Addition and Multiplication.

It is possible to scale the external reference so that the signal minimum and maximum values correspond to a speed other than the minimum and maximum speed limits.

Programmable System Control Inputs

The programmable system control inputs include:

- Run enable signal
- Fault reset signal
- User Macro Selection

The system control input signals can be received through a digital input or from the control panel, except the Run enable signal which cannot be given with the panel.

Analogue Input Processing

The ACS 600 has three programmable analogue inputs: one voltage input and two current inputs. Each of these analogue inputs can be processed by adjusting the signal min/max levels, the filtering time constant, and the signal inversion selection.

Min/Max Setting

The minimum setting of 0V/0mA, 2V/4mA or the input tuning can be selected. The tuning allows the ACS 600 to read the value of the applied minimum signal.

The maximum setting of 10V/20 mA or the input tuning can be selected. The tuning allows the ACS 600 to read the value of the applied maximum signal.

Readable range in tuning is 0 mA / 0 V to 20 mA / 10 V.

Filtering

The analogue input signal filtering time constant is user-adjustable from 0.01 to 10 s.

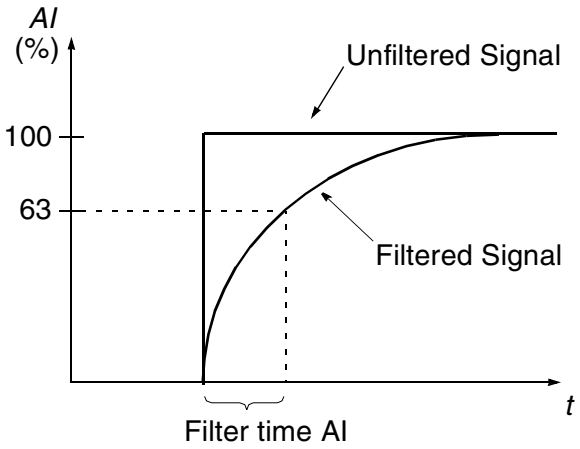


Figure 6-3 Analogue input filtering time constant.

Inversion

With inversion activated, the minimum level of the analogue input signal corresponds to the maximum reference and the maximum analogue input signal corresponds to the minimum reference.

Protection Functions

The ACS 600 offers several Programmable Fault Functions and other non-user adjustable Preprogrammed Protection Functions.

Programmable Fault Functions

AI<Min Function

AI< Min function defines the drive operation if an analogue input signal drops below the preset minimum limit. The options are:

- The drive is stopped and a fault message is displayed.
- The drive continues operation. No indication is given.
- A warning message is displayed and the motor will be run at a predefined continuous speed.
- A warning message is displayed and the motor will be run according to the last speed reference value received.

Panel Loss Function

Panel Loss function defines the operation of the ACS 600 if the control panel selected as control location for the ACS 600 stops communicating. The available selections are the same as with the AI< Min function except that the fault or warning message is always given.

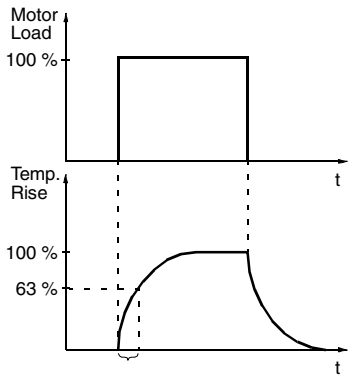
External Fault Function

With the External Fault function it is possible to supervise external faults by defining one digital input as a source for an external fault indication signal.

Motor Thermal Protection Function

The motor can be protected against overheating by activating the Motor Thermal Protection function and by selecting one of the Motor Thermal Protection Modes available.

The Motor Thermal Protection Modes are based either on a Motor Temperature Thermal Model or on Motor Thermistor Element overtemperature indication.

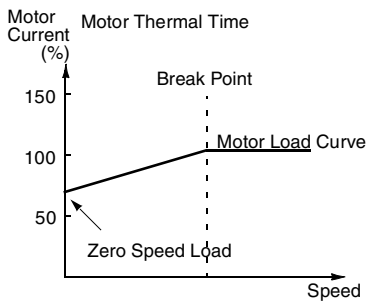


Motor Temperature Thermal Model

The ACS 600 calculates the temperature of the motor using the following assumptions:

1) The motor is in the ambient temperature of 30 °C when power is applied to the ACS 600.

2) Motor temperature is calculated using either the user-adjustable or automatically calculated Motor Thermal Time and Motor Load Curve (see the figures on the right). The load curve should be adjusted in case the ambient temperature is higher than 30 °C, for example.



Note: The user-adjustable model is to be used in ACS 607-0400-3, -0490-5, -0490-6 or above.

The thermal model provides protection equivalent to standard class 10, 20, or 30 overload relays by setting the Motor Thermal Time to 350, 700, or 1050 seconds respectively.

Usage of the Motor Thermistor Element

It is possible to detect motor overtemperature by connecting a motor thermistor (PTC) between the +24 VDC voltage supply offered by the ACS 600 and digital input DI6. In normal motor operation temperature, the thermistor resistance should be less than 1.5 kΩ (current 5 mA). The ACS 600 stops the motor and gives a fault indication if the thermistor resistance rises higher than 4 kΩ.

Note: According to IEC 664 the connection of the thermistor to the DI6 requires double or reinforced insulation between motor live parts and the thermistor.

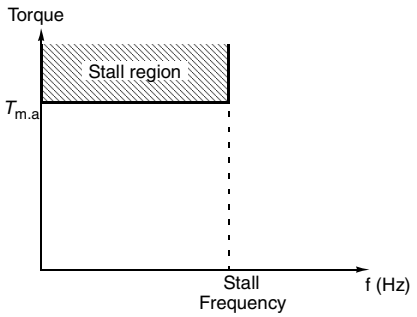
Stall Function

The ACS 600 protects the motor upon a stall situation. It is possible to adjust the supervision limits (frequency, time) and choose how the drive reacts to the motor stall condition (warning indication/fault indication & stop the drive/no reaction).

The protection is activated if all the following conditions are fulfilled at the same time:

1) The ACS 600 output frequency is below the Stall Frequency limit set by the user.

2) The motor torque has risen to the maximum allowed value (the value $T_{m.a}$ in the figure) calculated by the ACS 600 software. This limit is continuously changing depending on variables such as motor temperature calculated by the frequency converter software.



3) Conditions 1 and 2 have been on longer than the period set by the user (Stall Time Limit).

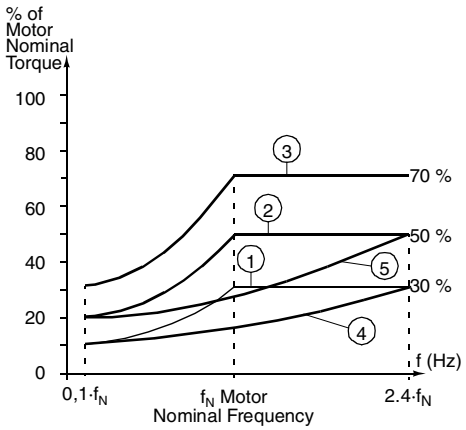
Underload Function

Loss of motor load may indicate a process malfunction. ACS 600 provides an Underload Function to protect the machinery and process in such a serious fault condition. The supervision limits: Underload Curve and Underload Time can be chosen as well as the drive operation in the underload condition (warning indication / fault indication & stop the drive / no reaction).

The protection is activated if all the following conditions are fulfilled at the same time:

1) The motor load is below the Underload Curve selected by the user (five options, see the figure on the right).

2) The motor load has been below the selected Underload Curve longer than the time set by the user (Underload Time).



Motor Phase Loss Function

The Phase Loss function monitors the status of the motor cable connection. The function is useful especially during the motor start: the ACS 600 detects if any of the motor phases has not been connected and refuses to start. The Phase Loss function also supervises the motor connection status during normal operation.

The user can define the drive operation during motor phase loss. The alternatives are either a fault indication and Stop, or no reaction.

Earth Fault Protection

The Earth Fault protection detects earth faults in the motor, the motor cable or the inverter.

In ACS 601, ACS 604, and the 6-pulse versions of ACS 607 up to -0610-3, -0760-5 and -0760-6, the Earth Fault protection is based on earth leakage current measurement with a summation current transformer at the input of the converter. Depending on the user's selection, the Earth Fault function stops the drive and gives a fault indication, or the drive continues operation, ignoring the detected earth fault.

- An earth fault in the mains does not activate the protection.
- In earthed mains, the protection activates in 200 μs.
- In floating mains, the mains capacitance should be 1 μF or more.
- The capacitive currents due to screened copper motor cables up to 300 metres do not activate the protection.

In the12-pulse versions, i.e. ACS 627-0400-3 to -0610-3, -0490-5 to -0760-5 and -0490-6 to -0760-5, the protection is based on the voltage measurement of the supply neutral point. For more information on the protection principle see *Chapter 7 – Optional Equipment.*

For ACS 6x7-0760-3, -0930-5, -0900-6 or above the Earth Fault protection is an optional feature. See *Chapter 7 – Optional Equipment*.

Communication Fault Function

The Communication Fault Function supervises the communication between ACS 600 and an external control device (e.g. a fieldbus adapter module).

The user can define the drive operation during communication loss, and set the time delay for the function. The user can also define the fault states for the ACS 600 relay or analogue outputs that are

controlled via the communication link.

Preprogrammed Protection Functions

The preprogrammed protection functions of the ACS 600 cannot be altered by the user.

Overcurrent

The overcurrent trip limit for the ACS 600 is 3.5 · I_{2hd} (rated output current, heavy-duty use rating).

DC Overvoltage

DC overvoltage trip limit is 1.3 · U_{1max}, where U_{1max} is the maximum value of the mains voltage range. For 400 V units, U_{1max} is 415 V. For 500 V units, U_{1max} is 500 V. For 690 V units, U_{1max} is 690 V. The actual voltage in the intermediate circuit corresponding to the mains voltage trip level is 728 V d.c for 400 V units, 877 V d.c. for 500 V units, and 1210 V d.c. for 690 V units.

DC Undervoltage

DC undervoltage trip limit is 0.65 · U_{1min}, where U_{1min} is the minimum value of the mains voltage range. For 400 V and 500 V units, U_{1min} is 380 V. For 690 V units, U_{1min} is 525 V. The actual voltage in the intermediate circuit corresponding to the mains voltage trip level is 334 V d.c. for 400 V and 500 V units, and 461 V d.c. for 690 V units.

ACS 600 Temperature

ACS 600 supervises the inverter module temperature. If inverter module temperature exceeds 115 °C, a warning is given. Temperature trip level is 125 °C.

Short Circuit

There are separate protection circuits for supervising the motor cable and the inverter short circuits. If a short circuit occurs, the drive will not start and a fault indication is given.

Input Phase Loss

Input Phase Loss protection circuits supervise the mains cable connection status by detecting intermediate circuit ripple. If a phase is lost, the ripple increases. The drive is stopped and a fault indication is given if ripple exceeds 13 %.

Note: The protection is designed by other means in the:

- 6- and 12-pulse versions of ACS 607-0400-3 to -0610-3, -0490-5 to -0760-5, and -0490-6 to -0760-6
- 12-pulse versions of ACS 607-0760-3, -0930-5, -0900-6 or above.

Ambient Temperature

The drive will not start if the ambient temperature is below -5 to 0 °C or above 73 to 82 °C (the exact limits vary within the given ranges depending on ACS 600 type).

Overfrequency

If the ACS 600 output frequency exceeds the preset level, the drive is stopped and a fault indication is given. The preset level is 50 Hz over the operating range absolute maximum speed limit (Direct Torque Control mode active) or frequency limit (Scalar Control active). The operating range limits are set by Parameters 20.1 and 20.2 (DTC mode active) or 20.7 and 20.8 (Scalar control active).

Internal Fault on the I/O Control Board

If the Application and Motor Control Board (NAMC) cannot communicate with the I/O Control Board (NIOC) or the I/O extension modules (Digital I/O Extension Modules or Analogue I/O Extension

Module) connected to the I/O Extension Link, the drive is stopped and a fault indication is given.

Internal Fault If the ACS 600 detects an internal fault the drive is stopped and a fault indication is given.

User Macro The customer can create two own user macros and save them into the permanent memory of the ACS 600. The macro can be loaded simply by parameter selection. The User Macro protection function gives a fault indication if an attempt is made to restore a nonexisting user macro.

Main Circuit

No Fixed Switching Frequency ACS 600 has no fixed switching frequency. As a consequence, there is no high-pitch audible whine that is found in motors driven by a PWM technology frequency converter.

The average switching frequency is 2 or 3 kHz. The low average switching frequency provides higher efficiency because of lower switching losses.

AC Choke The AC choke is employed for harmonic current reduction, i.e. line current waveform improvement purposes. This reduces filter capacitor ripple current and extends capacitor life. The choke is placed on the AC side of the rectifier bridge in order to protect the rectifier semiconductors against power line transients. The choke also attenuates frequency converter electromagnetic emissions.

In large units (ACS 607-0760-3, -0930-5, -0900-6 or above) there is a DC choke. The choke is placed on the DC side of the input bridge.

Wide Mains Voltage Range One of the unique features of the ACS 600 is that it is capable of utilizing a wide range of supply voltages.

The input voltage rating of the 500 V a.c. unit ranges from 380 V a.c to 500 V a.c. The 380 to 440 V a.c. mains voltage can be used with minor adjustments. (In ACS 604 and ACS 607 types the voltage ratio of the internal transformers should be adjusted.)

The reduced output capacity of the 500 V a.c unit with 380 to 460 V a.c. mains connection should be taken into account.

Other Features

Limits The ACS 600 offers adjustable limits for speed, current (max.), torque (max.) and DC voltage.

Power Limit The maximum allowed motor power is $1.5 \cdot P_{hd}$. If the limit is exceeded, the motor torque is automatically restricted. The function protects the input bridge of the ACS 600 against overload.

Automatic Resets The ACS 600 can automatically reset itself after Overcurrent, Overvoltage, Undervoltage and AI<Min faults. The Automatic Resets must be activated by the user.

Supervision Supervisions are a unique feature of the ACS 600 which allows the drive to monitor certain user selectable variables. Each limit can be defined as low or high.

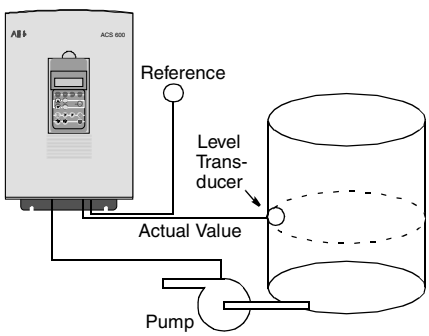
The user may set two speed limits, one current limit, two torque limits, two reference limits and two actual value limits. The indication of the active limit will appear on the control panel display, and can also be supervised through the relay outputs.

ACS 600 Information The ACS 600 software versions and test date can be displayed.

Parameter Lock The user can prevent unwanted parameter adjustment by activating the Parameter Lock.

Built-in PID Controller There is a built-in process PID Controller in the ACS 600. The controller can be used to control process variables such as pressure, flow or fluid level.

Instead of applying a speed reference to the ACS 600, a process reference (setpoint) is applied via an analogue input or the keypad. An actual value (process feedback) is brought back to the ACS 600 through one of the analogue inputs.



The internal PID controller of the ACS 600 eliminates the need to provide, mount, and wire a separate PID controller.

Chapter 7 – Optional Equipment

Overview

This chapter gives general information on optional equipment available for the ACS 600 SingleDrive.

The following are dealt with here:

- I/O Options (I/O Extensions, Pulse Encoder Interfaces, Fieldbus Adapter Modules, other related options)
- Specialised Application Programs
- Drive*Ware* PC Tools
- Braking Choppers and Braking Resistors
- EMC Filters, du/dt Filters, Sine Filters
- Standard Cabinet Options (e.g. cabling direction, line switching equipment, input bridge options, motor temperature supervision)
- Special Cabinet Options
- Control Panel and accessories, Fibre optic cables
- Coated circuit boards.

Applicability Labels

In this chapter, the following labels are used to indicate applicability:

ACS (ACS 600 with the Standard Application Program)
ACP (ACS 600 MotionControl)
ACC (ACS 600 CraneDrive)
ACx (any of the above).

The document *Ordering Information* (3AFY 58977985) specifies the availability of options for each frequency converter type and size.

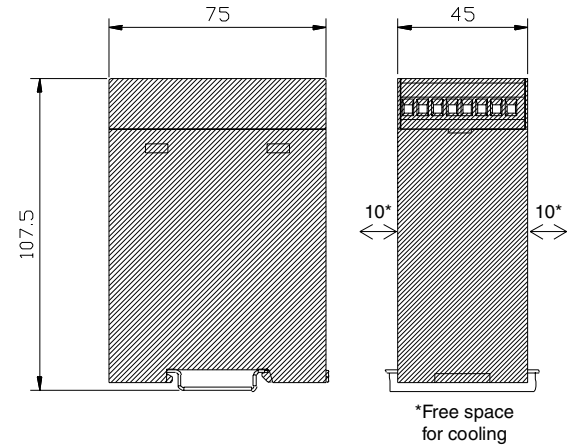
I/O Options

This section includes I/O extensions, pulse encoder interfaces, the Panel Bus interface, fieldbus adapters and related options. All of the I/O options can be ordered as separate add-on kits; most can also be ordered as factory-installed (see text at each option).

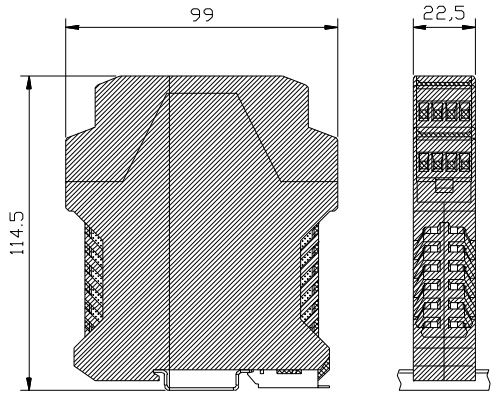
Housing

The I/O options listed in this section mainly use the IP20 plastic housings illustrated below. (The housing type of each option is indicated in the text at their individual descriptions.) The modules can be mounted onto a standard EN 50022/DIN rail without tools.

Housing Type 1

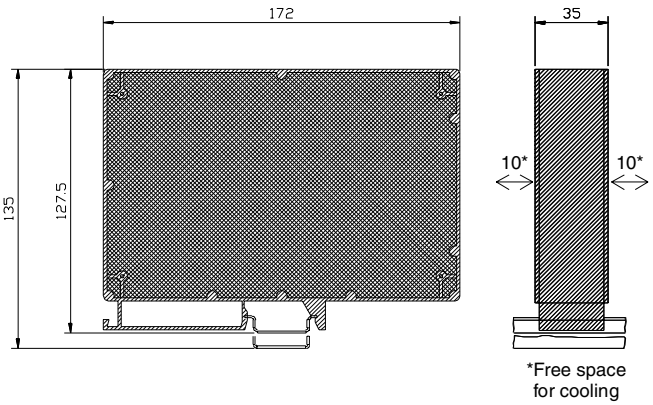


Housing Type 2

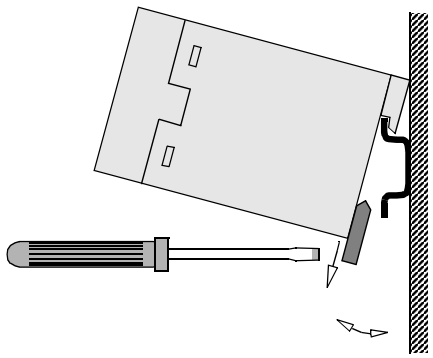


All dimensions in millimetres

Housing Type 3



Mounting/Removal of Module



Module Placement

ACx 601 frame R4 to R7 units can accommodate one module of housing type 1 or 2, while frame R2 and R3 units (ACx 601-0005-3 to -0016-3; ACx 601-0006-5 to -0020-5; ACx 601-0009-6 to -0020-6) require external mounting. ACx 607 cabinets can accommodate six modules as well as a power supply module.

Module Power Supply

The ACx 600 Standard I/O Board (NIOC) provides a 24 V d.c., 250 mA power supply. This is usually sufficient for at least one module. Additional modules require an external 24 V d.c. power supply. A suitable 3 A rail-mountable power supply (NPSM-02) is available.

Analogue I/O Extension Module NAIO-03 (ACS)

The Analogue I/O Extension Module offers two current ±0(4) to ±20 mA or voltage ±0(2) to ±10 V inputs and two current 0(4) to 20 mA outputs. The Module is connected to a high speed (4 Mbit/s) fibre optic I/O link on the ACS 600. The NAIO module provides:

- bipolar inputs, unipolar outputs
- better A/D and D/A decoding accuracy: 12-bit (unipolar) or 11-bit (+ sign bit) (bipolar) signal resolution
- distributed I/O connections through the module
- galvanic isolation thanks to the fibre optic connection.

The standard application program supports one NAIO module. The NAIO module inputs replace the standard analogue inputs AI2 and AI3; the NAIO module outputs add to the standard analogue outputs.

NAIO-03

Housing: Type 1
Weight: 0.2 kg

Front view

Screw terminal block for power supply connection

Fibre optic connectors for ACS 600 I/O link connection:
RXD = Receiver
TXD = Transmitter

Screw terminal block for analogue I/O connection

The module requires 24 V d.c. power (160 mA), which can be supplied by the ACS 600 Standard I/O Board.

Digital I/O Extension Module NDIO-02 (ACS)

The NDIO-02 Digital I/O Extension Module provides two digital inputs (24 to 250 V d.c. or 110 to 230 V a.c.) and two relay outputs (8 A/24 V d.c., 0.4 A/120 V d.c., 2000 VA/250 V a.c.). The inputs are galvanically isolated from each other and from the power supply.

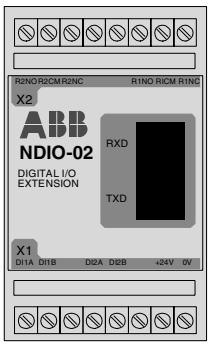
The NDIO module is connected to a high speed (4 Mbit/s) fibre optic I/O link on the ACS 600. The Standard Application Program supports maximum three NDIO modules. The inputs of the first NDIO module replace standard digital inputs DI1 and DI2; the inputs of the second NDIO replace DI3 and DI4; the inputs of the third NDIO replace DI5 and DI6.

The relay outputs of each NDIO module increase the total number of the relay outputs available. The information which the module outputs indicate is preprogrammed and not user-adjustable. The outputs of the first NDIO module indicate the drive states READY and RUNNING. The outputs of the second NDIO indicate the drive states FAULT and WARNING. The outputs of the third NDIO indicate the drive states REF 2 SEL (Reference 2 selected) and AT SPEED (Actual value has reached Reference value).

NDIO-02

Housing: Type 1
Weight: 0.2 kg

Front view



Screw terminal block
for the relay output connection

Fibre optic connectors
for the ACS 600 I/O link connection
RXD = Receiver
TXD = Transmitter

Screw terminal block
for digital input and power supply connection

The NDIO requires 24 V d.c. power (50 mA), which can be supplied by the ACS 600 Standard I/O (NIOC) Board.

Pulse Encoder Interface Module NTAC-01/02 (ACS/ACC)

The NTAC-01 and NTAC-02 Pulse Encoder Interface Modules offer an interface for an incremental pulse encoder connection. By measuring the motor actual speed with a pulse encoder, speed control accuracy can be improved. See the speed control performance figures in *Chapter 6 – Standard Features*.

The NTAC-01 is compatible with Standard Application Program versions 2.7 to 3.x, and the Crane Drive Application Program versions up to 3.x. The NTAC-02 is compatible with the Standard and Crane Application Programs, version 5.0 or later.

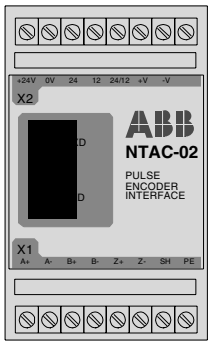
To achieve accurate speed control, special attention should be paid to the pulse encoder resolution/signal accuracy. These are the requirements for the encoder:

- Supply voltage 12 V d.c. (15 V d.c. for NTAC-02) or 24 V d.c. (supplied by the module)
- Available signal channels: 1/A, 2/B, 0/Z/N; for differential connection also $\overline{1}/\overline{A}$, $\overline{2}/\overline{B}$, $\overline{0}/\overline{Z}/\overline{N}$
- 90° (electrical) phase shift between channels 1 and 2
- Minimum recommended output rate: 1024 pulses per revolution
- Recommended output sinking/sourcing capability: 40 mA
- Maximum signal frequency $\leq$ 100 kHz.

NTAC-01/02

Housing: Type 1
Weight: 0.2 kg

Front view



Screw terminal block
for the power supply/source connections

Fibre optic connectors
for the ACx 600 I/O link connection
RXD = Receiver
TXD = Transmitter

Screw terminal block
for pulse encoder connection

The module requires 24 V d.c. power, which can usually be supplied by the ACx 600 Standard I/O Board (max. 250 mA). As the current consumption of the module is dependent on the configuration, it should be checked on each occasion if an additional power supply is needed. The current consumption can be read from the chart or calculated with the formula in Figure 7-1.

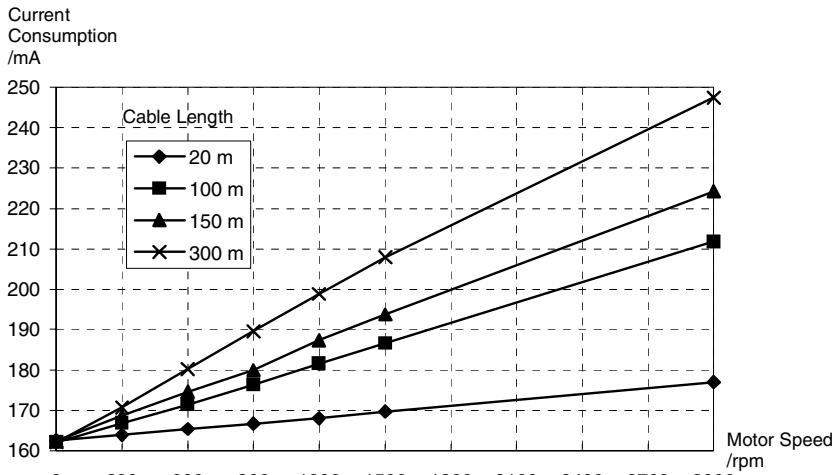
NTAC-xx Current Consumption (approx.):

$$162\ mA + k_c \cdot EPN \cdot \frac{n_{max}}{60 \cdot 10^3}$$

n_{max} = Motor Maximum Speed (rpm)
EPN = Encoder Pulse Number (ppr)
k_c = Coefficient (mA/kHz)
= 1.68 (300 m cable)
= 1.23 (150 m cable)
= 0.98 (100 m cable)
= 0.31 (20 m cable)

Note: The maximum allowed pulse frequency (f_{max}) is 100 kHz.

$f_{max} = EPN \cdot n_{max}/(60 \cdot 10^3)$ kHz



Encoder Pulse Number: 1024 ppr	0	300	600	900	1200	1500	1800	2100	2400	2700	3000
Encoder Pulse Number: 2048 ppr	0	150	300	450	600	750	900	1050	1200	1350	1500
Encoder Pulse Number: 512 ppr	0	600	1200	1800	2400	3000	3600	4200	4800	5400	6000

Figure 7-1 The current consumption for four different encoder cable lengths. The chart is based on a measurement with a 1024 ppr pulse encoder with differential outputs coupled to a 1500 rpm motor shaft.

Double Pulse Encoder Interface Module NTACP-01 (ACP)

The NTACP-01 Double Pulse Encoder Interface Module (for the ACP 600) offers two incremental encoder inputs, one encoder output, four digital inputs and two digital outputs.

Either encoder input can be relayed to the encoder output, which can then be used as a reference source for a follower drive, or as feedback for a higher-level control system.

Typically, the first encoder input is used with a motor encoder, the second with a master encoder for synchronisation.

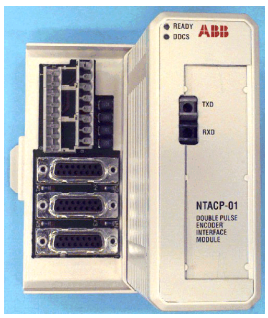
The general encoder requirements are as follows:

- Supply voltage 5 V d.c. (supply cable resistance compensation available)
- Available signal channels: 1/A, 2/B, 0/Z/N, $\overline{1}/\overline{A}$, $\overline{2}/\overline{B}$, $\overline{0}/\overline{Z}/\overline{N}$
- 90° (electrical) phase shift between channels 1 and 2
- Maximum signal frequency ≤ 200 kHz.

Front view

NTACP-01

Dimensions (H x W x D):
120 x 110 x 115 mm



Terminal block for the digital inputs/outputs and power supply connections

Fibre optic connectors
for the ACP 600 I/O link connection
RXD = Receiver
TXD = Transmitter

Three SUBD connectors:
two encoder inputs, one encoder output

The module requires 24 V d.c. power (max. 300 mA).

The NTACP-01 is available as an add-on kit for all ACP 600 types, and factory-installed for ACP 607.

Absolute Encoder Connection Board NSSIP-01 (ACP)

The NSSIP-01 Absolute Encoder Connection Board, available as an add-on kit for ACP 600 frequency converters, is mounted on the NIOCP-01 board (the default I/O interface with ACP 600 frequency converters). The NSSIP-01 offers an interface for an SSI absolute encoder.

The characteristics of the encoder connection are as follows:

- Supply voltage 24 V d.c. max. 250 mA
- Gray code
- Max. number of bits: 25
  e.g. 12 + 13 bits (4096 pulses/revolution × 8192 revolutions)
- Clock frequency 400 kHz
- Maximum cable length 50 m.

Bus Connection Interface Module NBCI-02

The NBCI-02 is used to connect a drive to a panel bus, which is controlled by a CDP 312 Control Panel or a Modbus controller (PLC or PC). PC connection usually requires an RS-232/485 converter, available as NPCU-01.

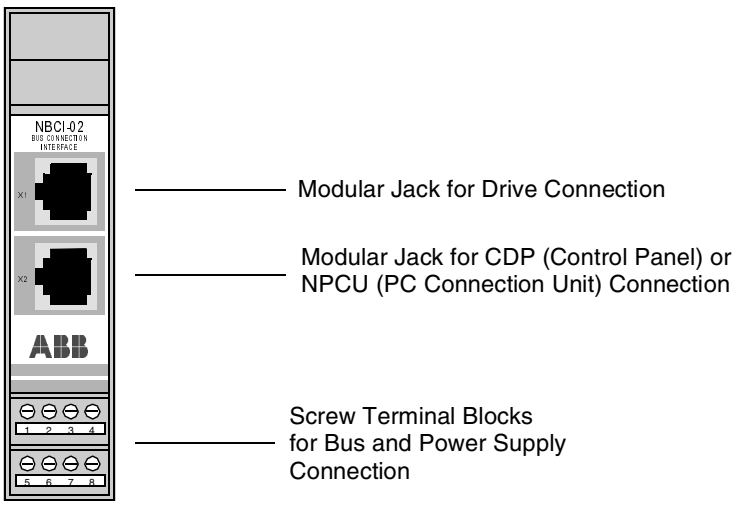
The panel bus is a serial communication bus that uses the RS-485 physical interface. The panel bus employs the Modbus protocol at a transfer rate of 9600 bit/s (max.). Through the use of the panel bus, it is possible to

- install the Control Panel (or a PC with an RS-232/485 converter) at a distance of up to 1200 metres from the drive(s)
- control, supervise and program any drive on the panel bus at a time
  Note: *This function is not supported by the ACC 600.*
- obtain a galvanically isolated connection between the drive and the panel bus.

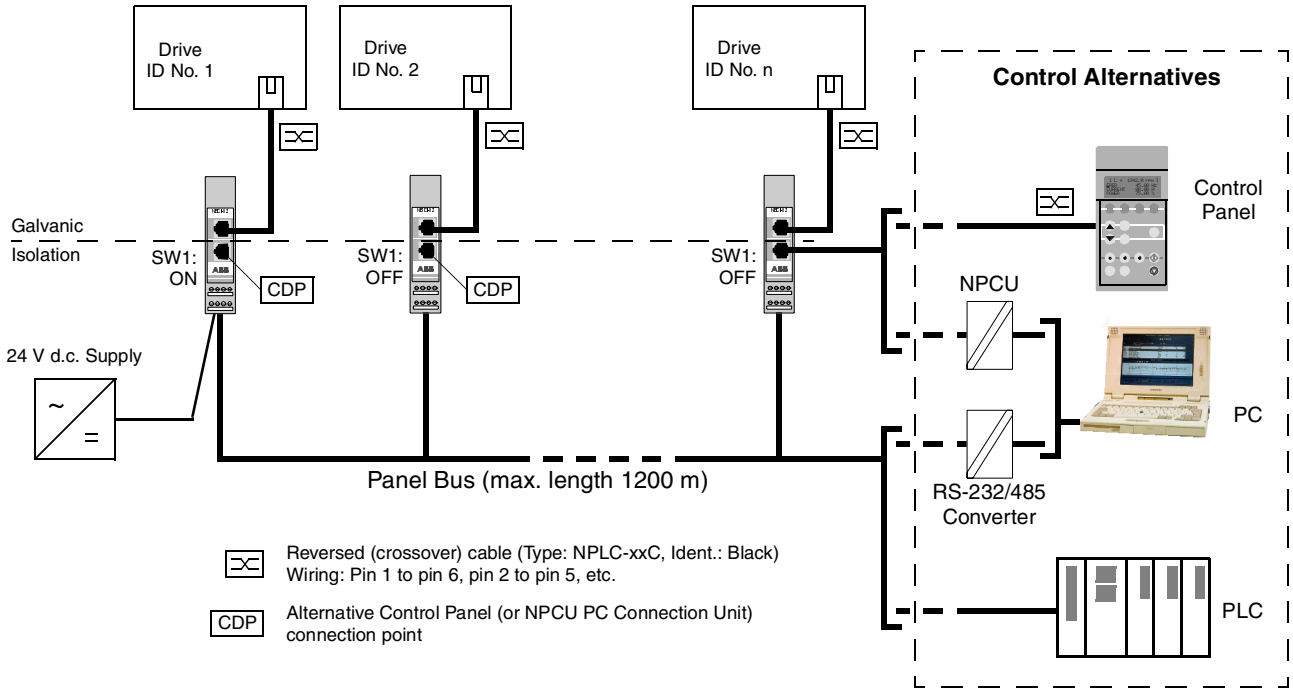
NBCI-02

Housing: Type 2
Weight: 0.2 kg

Front view



The figure below gives an example of a panel bus configuration.

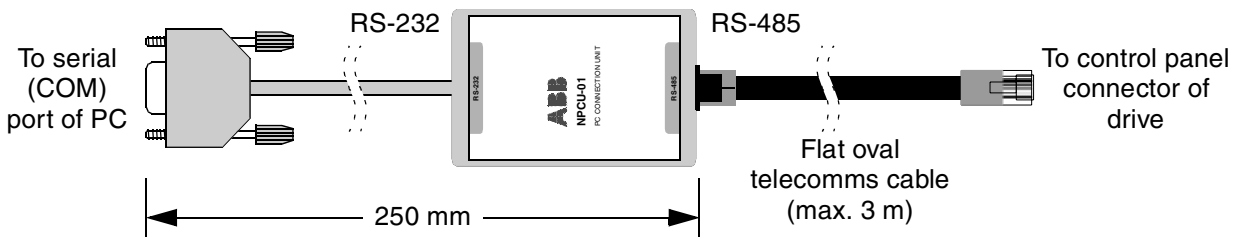


The NBCI-02 requires 24 V d.c. power (20 mA). All modules on the panel bus are powered by an external supply in order to retain galvanic isolation between the panel bus and the drives.

PC Connection Unit NPCU-01

The NPCU-01 PC Connection Unit is a galvanically-isolated RS-232/485 converter that enables the use of a PC – instead of the Control Panel – for controlling the drive.

The NPCU-01 is plugged into a serial port on the PC. The drive is connected to the NPCU-01 using the 3-metre (also the maximum length) flat oval telephone cable included. Locating the PC up to 1200 metres away from the drive is possible by constructing a panel bus using two NBCI Bus Interface Connection Modules.



Fieldbus Adapter Modules Nxxx-0x

There are several fieldbus adapter modules available for the ACx 600, including:

- NAFA-01 Advant Fieldbus AF100 Adapter kit
- NBAA-01 Building Automation Adapter Module
- NCAN-02 CANopen Adapter Module
- NCSA-01 CS 31 Adapter Module
- NDNA-02 DeviceNet Adapter Module
- NIBA-01 InterBus-S Adapter Module
- NLON-01 LONWORKS® Adapter Module
- NMBA-01 Modbus Adapter Module
- NMBP-01 Modbus Plus Adapter Module
- NPBA-02 PROFIBUS Adapter Module.

The fieldbus cable connects to the terminal block(s) on the adapter module. The adapter communicates with the ACx 600 via a fast (4 Mbit/s) half duplex fibre optic link. The fieldbus adapter modules require a 24 V d.c. power supply. See the entry for NPSM-02 below for options.

The table below shows the housing type, weight and current consumption of the fieldbus adapters.

Module Type	Housing	Weight [kg] (Gross)	Current Consumption [mA]
NIBA-01	Type 1	0.2 (0.4)	160
NPBA-02	Type 1	0.2 (0.4)	80
NMBA-01	Type 1	0.2 (0.4)	65
NMBP-01	Type 3	0.3 (0.6)	120
NCSA-01	Type 1	0.2 (0.4)	65
NDNA-02	Type 2	0.2 (0.4)	70
NCAN-02	Type 2	0.2 (0.4)	70
NAFA-01 (CI810)	170 × 84 × 122 mm	0.5 (0.7)	110
NLON-01	Type 2	0.2 (0.4)	30
NBAA-01	Type 1	0.2 (0.4)	65

Power Supply Module NPSM-02

If the total current consumption of optional modules exceeds 250 mA (the maximum output of the ACx 600 Standard I/O Board), an external 24 V d.c. power supply is required. For that purpose, a DIN/EN rail-mountable Power Supply Module (NPSM-02; 230 V a.c./+24 V d.c., 3 A; degree of protection IP 20) is available.

The power supply can be ordered as an add-on kit. For ACx 607, the power supply is automatically added if required by the total current consumption of 24 V d.c. optional equipment.

The dimensions of the NPSM-02 are (H x W x D): 132 x 75 x 71 mm, weight 0.6 kg.

DDCS Communication Options NDCO-01/02/03 (ACS)

The NDCO-xx DDCS Communication Options are add-on boards for the NAMC-11 Application and Motor Control Board. The NAMC-11 is used in ACS 600 frequency converters with the Standard Application Program, manufactured after 5 October 1998.

The NDCO boards include the fibre optic connectors for DDCS channels CH0, CH2 and CH3. (These channels are already present on the NAMC-03 board, used on all ACS 600 units manufactured before the above-mentioned date.)

The NAMC-11 requires the installation of the NDCO for use with devices that connect to DDCS channels CH0, CH2 and CH3, e.g. fieldbus adapters, NTAC-02 Pulse Encoder Interface Module and the Drive*Window* PC program.

The difference between NDCO-01, NDCO-02 and NDCO-03 is in the optical components of the DDCS channels as indicated below.

Board Type	Optical Component Type			
	CH0	CH1	CH2	CH3
NAMC-03 (ACS up to 4 Oct 1998/ACC/ACP)	5 MBd	5 MBd	5 MBd	5 MBd
NAMC-11 (ACS from 5 Oct 1998)	–	5 MBd	–	–
NDCO-01	10 MBd	–	10 MBd	10 MBd
NDCO-02	5 MBd	–	10 MBd	10 MBd
NDCO-03	5 MBd	–	5 MBd	5 MBd

The optical components at each end of a fibre optic link must be of the same type for the light intensity and receiver sensitivity levels to match. 10 MBd optical components enable the use of lower-attenuation cables, and thus longer distances.

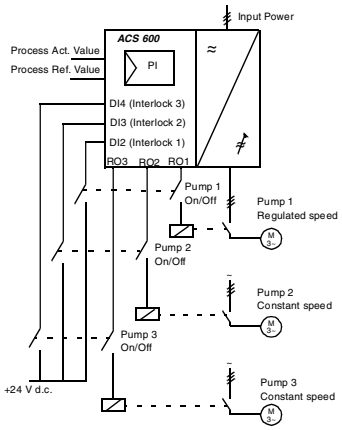
ACS 604 and ACS 607 frequency converters are always fitted with an NDCO-03 at the factory. ACS 601 units ordered with a fieldbus adapter, a pulse encoder interface module, or the Master/Follower Application Macro are automatically fitted with an NDCO-03 board.

The NDCO kits are also available separately, including coated versions designated NDCO-0x**C**.

Specialised Application Macros and Programs

In addition to the standard application program, there are specialised application macros and programs available.

Pump and Fan Control (ACS)



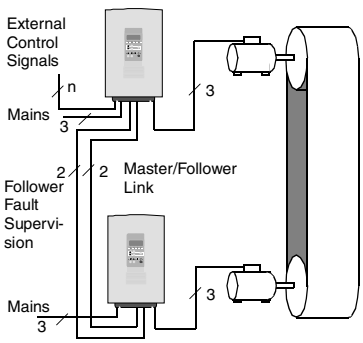
An ACS 600 equipped with the Pump and Fan Control (PFC) Application Macro can operate a pump/fan station with one to four parallel pumps/fans. The principle is as follows:

- The motor of pump no. 1 is connected to the ACS 600. The capacity of the pump is controlled by varying the motor speed.
- The motors of pumps nos. 2 and 3 are connected direct-on-line. These pumps can be switched on and off by the ACS 600 whenever necessary.
- The process reference and actual value are fed to the PI controller included in the PFC macro. The PI controller adjusts the speed of the first pump such that the process actual value follows the reference. When the speed exceeds the limit set by the user, the macro automatically starts the second pump. If even more capacity is required, the third pump is also started.

The PFC macro enables automatic pump alternation. It is also possible to implement an interlocking function where the macro detects the switch-off of a pump and starts another pump instead.

The PFC macro is available for ACS 600 frequency converters up to -0320-3, -0400-5 and -0400-6 inclusive.

Master/Follower (ACS/ACC)*



The Master/Follower Macro is designed for applications in which the equipment is run by several ACS 600 or ACC 600 drives and the motor shafts are coupled to each other via gearing, chain, belt etc. Thanks to the macro, the load can be evenly distributed between the drives.

External control signals are connected to the Master drive only. The Master controls the Follower(s) via a fibre optic serial link. The Master station is typically speed-controlled whereas the other drives follow the torque and/or speed reference of the Master.

*Optional for ACS, standard for ACC

Spinning Control (ACS)

The Spinning Control application program is designed for running spinning bobbins in ring frame textile machines. To achieve the best possible form for the doff, the drive follows a pre-set spinning sequence that can include 12 speed/time periods. These periods can also be offset, facilitating change of material. Yarn breakage is prevented by the wobbulation function, which adjusts the speed of the bobbin on the grounds of the ring rail position and the doff build-up stage.

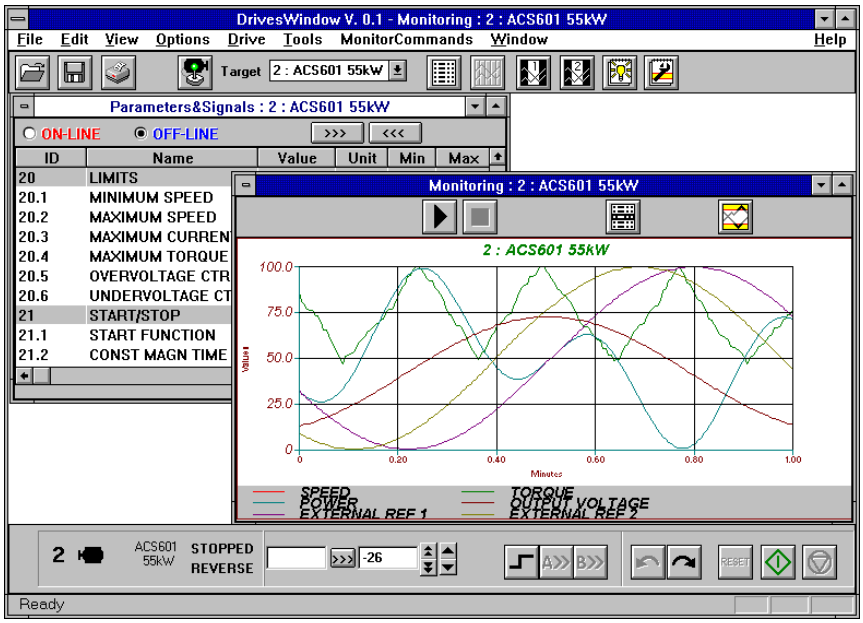
For further information, see the *Spinning Control Application Software* brochure, code: 3BFE 64018965.

Drive*Ware* PC Tools

The Drive*Ware* family of PC tools includes Windows-based applications for commissioning, control and maintenance of ACx 600 drives.

Drive*Window*

Drive*Window* is an application designed for online commissioning and maintenance purposes. It is possible to adjust the parameters, read the actual values and control the drive with Drive*Window* instead of the Control Panel. It is also possible to follow trends, draw graphs and load custom-made application software to the drive.



The Drive*Window* kit includes:

- either an ISA/DDCS or a PCMCIA/DDCS connection kit
- a pair of fibre optic cables
- installation CD-ROM.

Drive*Size*

Drive*Size* is an application designed for dimensioning of motors (ABB or customer-specified AC motors), drives and transformers in a drive system. Drive*Size* comes with Mot*Size,* a dimensioning tool for direct-on-line motors.

Drive*Builder*

Drive*Builder* is a tool for generating bills of material, actual cabinet dimensions and electrical single-line diagrams. In addition, Drive*Builder* produces system-specific customer documentation on the grounds of user input as well as information imported from Drive*Size.*

Drive*Support*

Drive*Support* is a multimedia-based service tool for ABB drives. It provides actual pictures and clear instructions for troubleshooting and servicing the drive. Drive*Support* also creates a maintenance record, including types of faults, operators' names, and service activities performed since start-up.

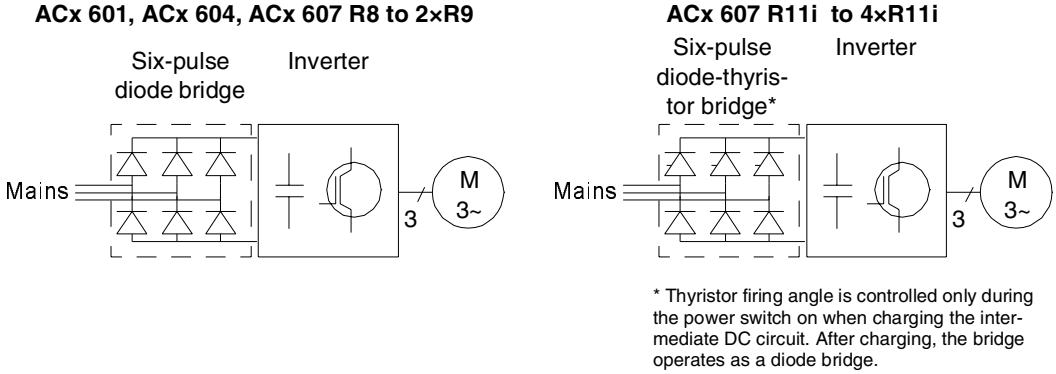
The customer can tailor Drive*Support* to meet the needs of his specific process by adding his own graphics, user language, more detailed instructions, spare part numbers and contact information.

Drive*Link* Drive*Link* is an application for connecting ABB drives with PC-based monitoring systems. Drive*Link* is compatible with all Windows applications that support DDE (Dynamic Data Exchange), such as WonderWare Intouch®, Genesis®, Excel®, Visual Basic®, Drive*Support* and Adva Command®.

Supply Bridge Versions

Six-pulse Diode Supply (ACx 6**0**_)

A six-pulse diode supply is standard in ACx 600. The diode bridge feeds power in one direction only. No regeneration is possible.



* Thyristor firing angle is controlled only during the power switch on when charging the intermediate DC circuit. After charging, the bridge operates as a diode bridge.

Twelve-pulse Diode Supply (ACx 6**2**7)

The twelve-pulse diode supply is available for the cabinet assemblys in range 400 to 3600 kVA (ACx 627 types). The option includes two six-pulse rectifier bridges connected in parallel.

Total harmonics distortion can be remarkably reduced by using a twelve-pulse rectifier, which eliminates the fifth and seventh harmonics. Since a line filter cannot be used with a twelve-pulse rectifier (the secondary side of the transformer is floating), it is recommended to equip the supply transformer with a static screen to reduce conducted emission. Other requirements for the transformer are:

- Connection: Dyn 11 d0
- Voltage difference between secondaries < 0.3%
- Short circuit impedance of secondaries ≥ 5%
- Short circuit impedance difference between secondaries < 3%

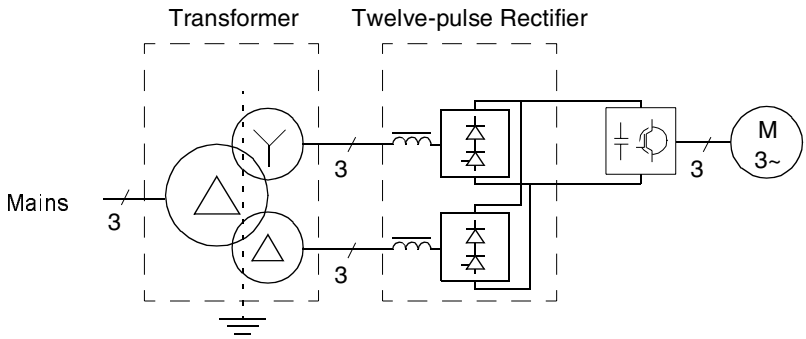


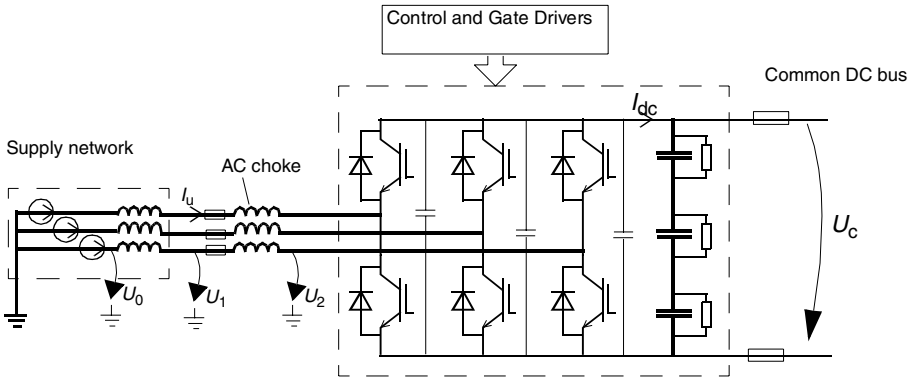
Figure 7-2 Circuit diagram of a Twelve-pulse Rectifier installation. The transformer has one primary and two secondary windings, and is equipped with a static screen. The secondary windings have a phase shift of 30°.

Regenerative IGBT Supply (ACx 6**1**__)

A regenerative IGBT input bridge is available for the wall mounted ACS 600 types in range 25 to 70 kVA (ACx 611 types), and for the cabinet assemblys in range 185 to 1380 kVA (ACx 617 types).

The IGBT bridge has the ability to regenerate back to the network, and it provides considerable energy savings with applications requiring excessive braking power.

IGBT bridge: ACx 611, ACx 617



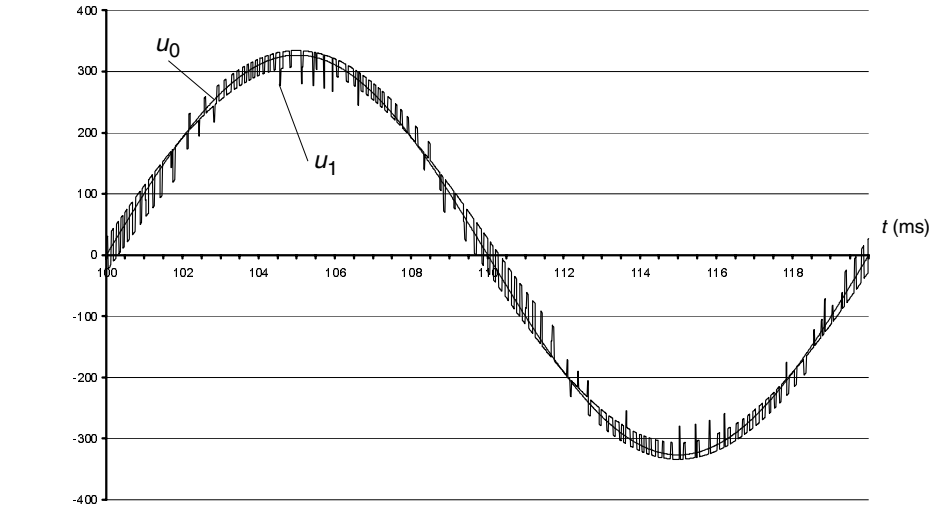
Operation

The ISU is a four-quadrant switching-mode converter. The a.c. current of the ISU is nearly sinusoidal at a unity power factor.

Voltage Waveforms

The high frequency switching and high du/dt slightly distorts the voltage waveform at the input of the converter. The depth of the voltage notches depends on the ratio of network inductance to total line inductance (network + AC choke inductance).

The waveforms of u_0 and u_1 shown below.



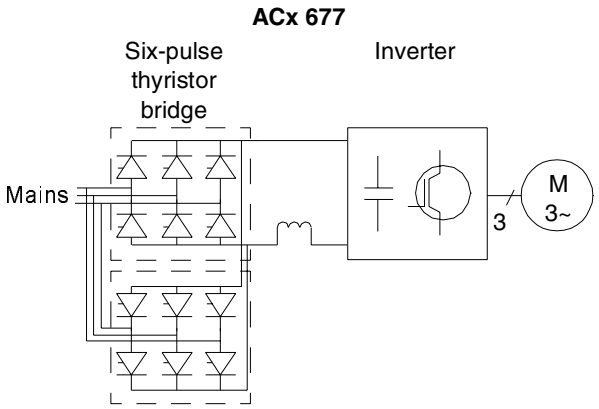
Harmonics

IGBT Supply Unit does not generate characteristic current/voltage overtones the way a traditional 6- or 12-pulse bridge does, because of

the sinusoidal waveform of the line current. The typical spectrum of the line current and line-to-line voltage harmonics is quite wide, but there are no high individual components. The Total Harmonic Distortion (THD) in voltage depends highly on the Short Circuit Ratio in the Point of Common Coupling (PCC).

Regenerative Thyristor Supply (ACx 67_)

A regenerative thyristor supply is available for the cabinet assemblys in range 185 to 3350 kVA (ACx 677 types). It consists of two six-pulse thyristor bridges in antiparallel connection. Thyristor supply has the ability to regenerate back to the network, and provides considerable energy savings with applications requiring excessive braking power.



Resistor Braking

Effective motor braking and short deceleration times can be achieved using resistor braking. In resistor braking, whenever the voltage in the intermediate circuit of a frequency converter exceeds a certain limit, a braking chopper connects the circuit to a braking resistor.

Braking Chopper NBRA-6xx

The NBRA-6xx series includes braking choppers for all ACx 600 types. Some of the choppers are to be mounted inside the converter unit; others are to be mounted outside the converter unit. (See the footnote at Table 7-1.)

The control board of the NBRA-6xx supervises the system status and detects failures such as braking resistor and resistor cable short circuits, chopper short circuit, chopper control card failure, and resistor overtemperature (optional).

There is one digital input, one relay output, and two fibre optic connectors on the chopper control board. The input can be connected to a resistor-mounted temperature sensitive switch to protect the resistor against overtemperature. The relay output indicates the faults listed above. The fibre optic connectors can be used for synchronising two or more choppers.

Braking Resistor SACE/SAFUR

The SACE/SAFUR braking resistors are separately available for all ACx 600 types. Resistors other than the standard resistors may be used providing the specified resistance value is not decreased, and the heat dissipation capacity of the resistor is sufficient for the drive application. For resistor specifications, see Table 7-1.

Cables and Fuses

Screened cable must be used. See the rating tables (Table 7-1 and Table 7-2) for specifications for standard cables. Two-conductor cable may also be used if available. The cable screen is essential for minimising electromagnetic interference. The length of the cable between the ACx 600 and the chopper must not exceed 5 metres; the length of the cable between the chopper and resistor must not exceed 20 metres.

For ACx 601 units, no separate fuses in the braking circuit are required if the following conditions are met:

- the ACx 600 mains cable is protected with fuses
- no mains cable/fuse overrating takes place
- in the braking circuit the specified cable is used (Table 7-3)

For ACx 607 R8 to 2×R9 and ACx 607 R11i to 4×R11i, the cables in the braking circuit must be protected with fuses. (Factory-installed choppers are automatically equipped with fuses when necessary.)

Applicability

The chopper(s) and resistor(s) suitable for each ACx 600 type, as well as technical data for each configuration (maximum braking power, fuses, cable cross-sections, etc.) are detailed in Tables 7-2 and 7-3. Table 7-4 gives the dimensions and weights for each chopper and resistor.

All choppers and resistors are available separately. Factory-installed choppers and resistors are available as follows:

ACx 601, Frames R2 and R3

Braking choppers and resistors are available as add-on kits only. The chopper and the resistor are to be installed outside the converter unit.

ACx 601, Frames R4 to R7

Braking choppers are available as factory-installed inside the converter unit. Braking resistors are available as add-on kits only, and are to be installed outside the converter unit.

ACx 604, Frame R7

Braking choppers and resistors are available as add-on kits only. The chopper is to be installed inside the converter unit; the resistor is to be installed outside the converter unit.

ACx 604, R8, R9, 2×R8, 2×R9

Braking choppers and resistors are available as add-on kits only. All components of the chopper circuit are to be installed outside the converter unit(s).

ACx 607, Frame R7

Braking choppers and resistors are available as factory-installed (line contactor compulsory). The chopper is installed inside the converter unit; the resistor (if ordered) is installed in a 400 mm wide cabinet extension on the right-hand side of the converter cabinet.

ACx 607, Frames R8 and R9

Braking choppers and resistors are available as factory-installed (line contactor compulsory). The chopper circuit is equipped with fuses.

The chopper without resistor option is installed in a 400 mm wide cabinet extension on the right-hand side of the converter cabinet. The chopper with resistor(s) option is installed in a 400 mm wide (one-resistor configurations) or 700 mm wide (two-resistor configurations) cabinet extension on the right-hand side of the converter cabinet.

ACx 607, Frames 2×R8 and 2×R9

Braking choppers and resistors are available as factory-installed (line contactors compulsory). Both chopper circuits are equipped with fuses.

The choppers without resistors option includes two choppers installed in two 400 mm wide cabinet extensions, one on either side of the converter cabinet. The choppers with resistors option includes two choppers with resistors, installed in two 700 mm wide cabinet extensions, one on either side of the converter cabinet.

ACx 607, Frames R11i, R12i, 2×R11i, 2×R12i, 4×R11i

Braking choppers and resistors are available as factory-installed (line contactor/air circuit breaker compulsory). Each chopper circuit is equipped with fuses and RC filtering.

The choppers without resistors option includes 3 to 6 (depending on converter type) choppers, each installed in a 400 mm wide cabinet extension on the right-hand side of the converter cabinet line-up. The choppers with resistors option includes 3 to 6 (depending on converter type) chopper/resistors combinations, each installed in a 400 + 800 mm cabinet extension on the right-hand side of the converter cabinet line-up.

Table 7-1 ACx 600 ratings for resistor braking.

ACx 600/Braking Chopper Combination			Braking Resistor(s)					Cable (Cu)
ACx 600 Type	**Braking Chopper Type**	**Braking Power P_{BRmax} [kW]**	**Type**	***R* [ohm]**	**E_R [kJ]**	**P_{Rcont} [kW]**	**No. of Elements***	***A* [mm^2]**
400 V a.c. Units								
-0005-3	NBRA-653	5.0	SACE08RE44	44.0	210.0	1	2	3x6+6
-0006-3	NBRA-653	6.2	SACE08RE44	44.0	210.0	1	2	3x6+6
-0009-3	NBRA-653	8.3	SACE08RE44	44.0	210.0	1	2	3x6+6
-0011-3	NBRA-653	11.0	SACE15RE22	22.0	420.0	2	4	3x6+6
-0016-3	NBRA-653	14.4	SACE15RE22	22.0	420.0	2	4	3x6+6
-0020-3	NBRA-654	19.7	SACE15RE13	13.0	435.0	2	4	3x6+6
-0025-3	NBRA-654	26.9	SACE15RE13	13.0	435.0	2	4	3x6+6
-0030-3	NBRA-655	33.2	SAFUR90F575	8.0	1800	4.5	9	3x25+16
-0040-3	NBRA-655	39.0	SAFUR90F575	8.0	1800	4.5	9	3x25+16
-0050-3	NBRA-655	52.8	SAFUR90F575	8.0	1800	4.5	9	3x25+16
-0060-3	NBRA-656	65.6	SAFUR80F500	6.0	2400	6	12	3x35+16
-0070-3	NBRA-656	79.5	SAFUR125F500	4.0	3600	9	18	3x35+16
-0100-3	NBRA-657	94.2	SAFUR125F500	4.0	3600	9	18	3x70+35
-0120-3	NBRA-657	128.3	SAFUR200F500	2.7	5400	13.5	27	3x70+35
-0140-3	NBRA-658	154.5	SAFUR200F500	2.7	5400	13.5	27	see Table 7-2
-0170-3	NBRA-658	190.7	2×SAFUR125F500	2.0	7200	18.0	2×18	
-0210-3	NBRA-658	229.5	2×SAFUR210F575	1.70	8400	21.0	2×21	
-0260-3	NBRA-659	282.3	2×SAFUR200F500	1.35	10800	27.0	2×27	
-0320-3	NBRA-659	352.8	2×SAFUR180F460	1.20	12000	30	2×30	
-0400-3	2×NBRA-658	436.1	2×(2×SAFUR210F575)	2×1.70	2×8400	2×21.0	2×(2×21)	
-0490-3	2×NBRA-659	536.3	2×(2×SAFUR200F500)	2×1.35	2×10800	2×27.0	2×(2×27)	
-0610-3	2×NBRA-659	670.3	2×(2×SAFUR180F460)	2×1.20	2×12000	2×30	2×(2×30)	
-0760-3	3xNBRA-659	1060	3x(2×SAFUR180F460)	3x1.20	3x12000	3x30	3x(2×30)	
-0930-3	3xNBRA-659	1060	3x(2×SAFUR180F460)	3x1.20	3x12000	3x30	3x(2×30)	
-1120-3	4×NBRA-659	1411	4×(2×SAFUR180F460)	4×1.20	4×12000	4×30	4×(2×30)	
-1440-3	5xNBRA-659	1764	5x(2×SAFUR180F460)	5x1.20	5x12000	5x30	5x(2×30)	
-1770-3	5xNBRA-659	1764	5x(2×SAFUR180F460)	5x1.20	5x12000	5x30	5x(2×30)	
-2140-3	6xNBRA-659	2117	6x(2×SAFUR180F460)	6x1.20	6x12000	6x30	6x(2×30)	
-2340-3	6xNBRA-659	2117	6x(2×SAFUR180F460)	6x1.20	6x12000	6x30	6x(2×30)	
-2820-3	6xNBRA-659	2117	6x(2×SAFUR180F460)	6x1.20	6x12000	6x30	6x(2×30)	
500 V a.c. Units								
-0006-5	NBRA-653	6.3	SACE08RE44	44.0	210.0	1	2	3x6+6
-0009-5	NBRA-653	7.8	SACE08RE44	44.0	210.0	1	2	3x6+6
-0011-5	NBRA-653	10.4	SACE08RE44	44.0	210.0	1	2	3x6+6
-0016-5	NBRA-653	14.0	SACE15RE22	22.0	420.0	2	4	3x6+6
-0020-5	NBRA-653	18.5	SACE15RE22	22.0	420.0	2	4	3x6+6
-0025-5	NBRA-654	25.2	SACE15RE13	13.0	435.0	2	4	3x6+6
-0030-5	NBRA-654	31.4	SACE15RE13	13.0	435.0	2	4	3x6+6
-0040-5	NBRA-655	42.6	SAFUR90F575	8.0	1800	4.5	9	3x25+16
-0050-5	NBRA-655	50.1	SAFUR90F575	8.0	1800	4.5	9	3x25+16
-0060-5	NBRA-655	62.6	SAFUR90F575	8.0	1800	4.5	9	3x25+16
-0070-5	NBRA-656	72.6	SAFUR80F500	6.0	2400	6	12	3x35+16
-0100-5	NBRA-656	88.4	SAFUR80F500	6.0	2400	6	12	3x35+16
-0120-5	NBRA-657	122.1	SAFUR125F500	4.0	3600	9	18	3x70+16
-0140-5	NBRA-657	147.3	SAFUR125F500	4.0	3600	9	18	3x70+16

ACx = ACS/ACC/ACP

ACx 600/Braking Chopper Combination			Braking Resistor(s)					Cable (Cu)
ACx 600 Type	**Braking Chopper Type**	**Braking Power P_{BRmax} [kW]**	**Type**	***R* [ohm]**	**E_R [kJ]**	**P_{Rcont} [kW]**	**No. of Elements***	***A* [mm^2]**
-0170-5	NBRA-658	181.1	SAFUR200F500	2.7	5400	13.5	27	see Table 7-2
-0210-5	NBRA-658	220.7	SAFUR200F500	2.7	5400	13.5	27	
-0260-5	NBRA-658	268.1	2×SAFUR125F500	2.0	7200	18.0	2×18	
-0320-5	NBRA-659	335.0	2×SAFUR210F575	1.7	8400	21.0	2×21	
-0400-5	NBRA-659	402.8	2×SAFUR200F500	1.35	10800	27.0	2×27	
-0490-5	2×NBRA-658	509.3	2×(2×SAFUR125F500)	2×2.0	2×7200	2×18.0	2×(2×18)	
-0610-5	2×NBRA-659	636.5	2×(2×SAFUR210F575)	2×1.7	2×8400	2×21.0	2×(2×21)	
-0760-5	2×NBRA-659	765.3	2×(2×SAFUR200F500)	2×1.35	2×10800	2×27.0	2×(2×27)	
-0930-5	3xNBRA-659	1208	3x(2×SAFUR200F500)	3x1.35	3x10800	3x27.0	3x(2×27)	
-1090-5	3xNBRA-659	1208	3x(2×SAFUR200F500)	3x1.35	3x10800	3x27.0	3x(2×27)	
-1380-5	3xNBRA-659	1208	3x(2×SAFUR200F500)	3x1.35	3x10800	3x27.0	3x(2×27)	
-1760-5	4×NBRA-659	1611	4×(2×SAFUR200F500)	4×1.35	4×10800	4×27.0	4×(2×27)	
-2160-5	5xNBRA-659	2014	5x(2×SAFUR200F500)	5x1.35	5x10800	5x27.0	5x(2×27)	
-2620-5	6xNBRA-659	2417	6x(2×SAFUR200F500)	6x1.35	6x10800	6x27.0	6x(2×27)	
-2850-5	6xNBRA-659	2417	6x(2×SAFUR200F500)	6x1.35	6x10800	6x27.0	6x(2×27)	
-3450-5	6xNBRA-659	2417	6x(2×SAFUR200F500)	6x1.35	6x10800	6x27.0	6x(2×27)	
(Continued)								

ACx 600/Braking Chopper Combination			Braking Resistor(s)					Cable (Cu)
ACx 600 Type	**Braking Chopper Type**	**Braking Power P_{BRmax} [kW]**	**Type**	***R* [ohm]**	**E_R [kJ]**	**P_{Rcont} [kW]**	**No. of Elements***	***A* [mm^2]**
(Continued) **690 V a.c. Units**								
-0009-6	NBRA-663	8.5	SACE08RE44	44.0	210	1	2	3x6+6
-0011-6	NBRA-663	12.9	SACE08RE44	44.0	210	1	2	3x6+6
-0016-6	NBRA-663	13.8	SACE08RE44	44.0	210	1	2	3x6+6
-0020-6	NBRA-663	19.8	SACE15RE22	22.0	420	2	4	3x6+6
-0025-6	NBRA-664	29.1	SACE15RE13	13.0	435	2	4	3x6+6
-0030-6	NBRA-664	35.0	SACE15RE13	13.0	435	2	4	3x6+6
-0040-6	NBRA-666	40.2	SACE15RE13	13.0	435	2	4	3x25+16
-0050-6	NBRA-666	53.0	SAFUR90F575	8.0	1800	4.5	9	3x25+16
-0060-6	NBRA-666	65.4	SAFUR90F575	8.0	1800	4.5	9	3x25+16
-0070-6	NBRA-666	80.1	SAFUR90F575	8.0	1800	4.5	9	3x35+16
-0100-6	NBRA-667	94.4	SAFUR80F500	6.0	2400	6	12	3x70+16
-0120-6	NBRA-667	132.5	SAFUR125F500	4.0	3600	9	18	3x70+35
-0140-6	NBRA-669	158.1	SAFUR210F575	3.4	4200	10.5	21	see Table 7-2
-0170-6	NBRA-669	193.4	SAFUR200F500	2.7	5400	13.5	27	
-0210-6	NBRA-669	228.5	SAFUR200F500	2.7	5400	13.5	27	
-0260-6	NBRA-669	275.9	2×SAFUR125F500	2.0	7200	18.0	2×18	
-0320-6	NBRA-669	346.7	2×SAFUR210F575	1.7	8400	21.0	2×21	
-0400-6	NBRA-669	403.7	2×SAFUR200F500	1.35	10800	27.0	2×27	
-0490-6	2×NBRA-669	524.2	2×(2×SAFUR125F500)	2×2.0	2×7200	2×18.0	2×(2×18)	
-0610-6	2×NBRA-669	658.7	2×(2×SAFUR210F575)	2×1.7	2×8400	2×21.0	2×(2×21)	
-0760-6	2×NBRA-669	767.0	2×(2×SAFUR200F500)	2×1.35	2×10800	2×27.0	2×(2×27)	
-0900-6	3xNBRA-669	1211	3x(2×SAFUR200F500)	3x1.35	3x10800	3x27.0	3x(2×27)	
-1040-6	3xNBRA-669	1211	3x(2×SAFUR200F500)	3x1.35	3x10800	3x27.0	3x(2×27)	
-1380-6	3xNBRA-669	1211	3x(2×SAFUR200F500)	3x1.35	3x10800	3x27.0	3x(2×27)	
-1710-6	4×NBRA-669	1615	4×(2×SAFUR200F500)	4×1.35	4×10800	4×27.0	4×(2×27)	
-2120-6	5xNBRA-669	2019	5x(2×SAFUR200F500)	5x1.35	5x10800	5x27.0	5x(2×27)	
-2540-6	6xNBRA-669	2422	6x(2×SAFUR200F500)	6x1.35	6x10800	6x27.0	6x(2×27)	
-2800-6	6xNBRA-669	2422	6x(2×SAFUR200F500)	6x1.35	6x10800	6x27.0	6x(2×27)	
-3350-6	6xNBRA-669	2422	6x(2×SAFUR200F500)	6x1.35	6x10800	6x27.0	6x(2×27)	

P_{BRmax} Maximum braking power of the ACx 600 equipped with the standard chopper and the standard resistor. The drive and the chopper will withstand this braking power for one minute every ten minutes. ***Note:*** The braking energy transmitted to the resistor during any period shorter than 400 seconds may not exceed E_R.

R Resistance value for the listed resistor type. ***Note:*** This is also the minimum allowable resistance value for the braking resistor.

E_R Energy pulse that the resistor assembly will withstand (400 s duty cycle). This energy will heat the resistor element from 40 °C to the maximum allowable temperature.

P_{Rcont} Continuous power (heat) dissipation of the resistor when placed correctly. Energy E_R dissipates in 400 seconds.

A Conductor cross-sectional areas for the copper cable to be used for connecting the braking resistor and the chopper (or the chopper and the ACx 600). The cable should have a concentric conductor (screen). The standard cables with three-phase conductors and a concentric conductor are given. A two-conductor screened cable may also be used if available.

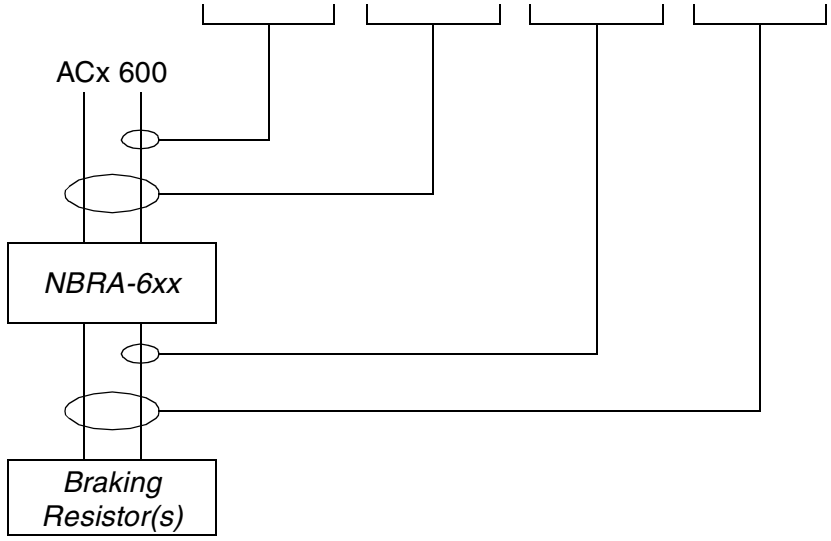
* The SACE04RE44 resistor consists of two resistor elements connected in parallel. The resistance of one element is 88 ohm.
The SACE15RE13 resistor consists of four resistor elements connected in parallel. The resistance of one element is 52 ohm.
The SACE15RE22 resistor consists of four resistor elements connected in parallel. The resistance of one element is 88 ohm.
The SAFUR resistors consist of several resistor elements. The resistance of one element is 8 ohm.

The NBRA-653 and -663 are to be installed outside the converter module. Their degree of protection is IP54.
The NBRA-654, -655, -656, -657, -664, -666 and -667 are to be installed inside the converter module.
The NBRA-658, -659 and -669 are to be installed outside the converter module. Their degree of protection is IP00.

All braking resistors are to be installed outside the converter module.
The SACE braking resistors are built in an IP21 metal housing.
The SAFUR braking resistors are built in an IP00 metal frame.

*Table 7-2 Braking circuit cable and fuse ratings for NBRA-658, NBRA-659 and NBRA-669. (**Note:** All ratings are per one braking chopper.)*

ACx 600 Type	Braking Chopper Type	Fuse (Ultrarapid)		Chopper Cable (Cu)		Resistor Cable (Cu)	
		I_{nom} [A]	[1] DIN 43653 Type	[2] Single-core [mm²]	Multicore [mm²]	[2] Single- core [mm²]	Multicore [mm²]
400 V a.c. Units							
-0140-3	NBRA-658	315	170M5140	50	3x70+35	50	3x70+35
-0170-3	NBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0210-3	NBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0260-3	NBRA-659	500	170M5144	95	3x120+70	50	3x70+35
-0320-3	NBRA-659	630	170M5146	120	3x185+95	70	3x95+50
-0400-3	2×NBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0490-3	2×NBRA-659	500	170M5144	95	3x120+70	50	3x70+35
-0610-3	2×NBRA-659	630	170M5146	120	3x185+95	70	3x95+50
-0760-3 to -2820-3	(3 to 6)x NBRA-659	630	170M5146	120	3x185+95	70	3x95+50
500 V a.c. Units							
-0170-5	NBRA-658	315	170M5140	50	3x70+35	50	3x70+35
-0210-5	NBRA-658	400	170M5142	70	3x95+50	70	3x95+50
-0260-5	NBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0320-5	NBRA-659	500	170M5144	95	3x120+70	50	3x70+35
-0400-5	NBRA-659	630	170M5146	120	3x185+95	70	3x95+50
-0490-5	2×NBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0610-5	2×NBRA-659	500	170M5144	95	3x120+70	50	3x70+35
-0760-5	2×NBRA-659	630	170M5146	120	3x185+95	70	3x95+50
-0930-5 to -3450-5	(3 to 6)x NBRA-659	630	170M5146	120	3x185+95	70	3x95+50
690 V a.c. Units							
-0140-6	NBRA-669	250	170M5138	35	3x50+25	35	3x50+25
-0170-6	NBRA-669	315	170M5140	50	3x70+35	50	3x70+35
-0210-6	NBRA-669	400	170M5142	70	3x95+50	70	3x95+50
-0260-6	NBRA-669	400	170M5142	70	3x95+50	50	3x50+25
-0320-6	NBRA-669	500	170M5144	95	3x150+70	50	3x95+50
-0400-6	NBRA-669	630	170M5146	120	3x185+95	70	3x95+50
-0490-6	2×NBRA-669	400	170M5142	70	3x95+50	50	3x50+25
-0610-6	2×NBRA-669	500	170M5144	95	3x150+70	50	3x95+50
-0760-6	2×NBRA-669	630	170M5146	120	3x185+95	70	3x95+50
-0900-6 to -3350-6	(3 to 6)x NBRA-669	630	170M5146	120	3x185+95	70	3x95+50



1) Ultrarapid Bussmann fuses (U_N = 1250 V). Fuses with the same ratings from other manufacturers can also be used. The type of the base for these fuses is 170H3005 (1400 V, 630 A, 110 mm).

2) In order for the installation to comply with the EMC Directive, unscreened single-core cable can only be used if routed inside a cabinet that efficiently suppresses the radiated RFI emissions.

Table 7-3 Braking Chopper and Resistor Dimensions and Weights.

Braking Chopper / Braking Resistor	Height mm	Width mm	Depth mm	Weight kg (Gross)
NBRA-653/663	198.5	157	149	2.9 (3.5)
NBRA-654/664	135	121	150	1.5 (3.1)
NBRA-655/656/665/666	176	140	156	2.3 (2.9)
NBRA-657/667	212	165	203	2.7 (3.3)
NBRA-658	584	334	240	24 (34)
NBRA-659/669	584	334	240	24 (34)
SACE08RE44	365	290	131	6.1 (6.5)
SACE15RE22	365	290	131	6.1 (6.5)
SACE15RE13	365	290	131	6.8 (7.2)
SAFUR80F500	600	300	345	14 (34)
SAFUR90F575	600	300	345	12 (32)
SAFUR180F460	1320	300	345	32 (52)
SAFUR125F500	1320	300	345	25 (45)
SAFUR200F500	1320	300	345	30 (50)
SAFUR210F575	1320	300	345	27 (47)

EMC Filters

The EMC Filters option minimises the RFI emission of the ACx 600. The option is available factory-installed as follows:

- Internal RFI filter boards for ACx 601 R2 to R7
- Line filter for ACx 607 R8 to 2×R9, and ACx 607 frame R11i.

The option is not available for 690 V units or 12-pulse supplied units.

Also note that it is not allowed to use the EMC Filters option on an unearthed (floating) mains supply network.

du/dt Filters

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 can be almost double at the motor terminals, depending on motor cable properties.

du/dt filtering suppresses inverter output voltage spikes and rapid voltage changes that stress motor insulation. Additionally, du/dt filtering reduces capacitive leakage currents and high frequency emission of the motor cable as well as high frequency losses and bearing currents in the motor.

When to Use?

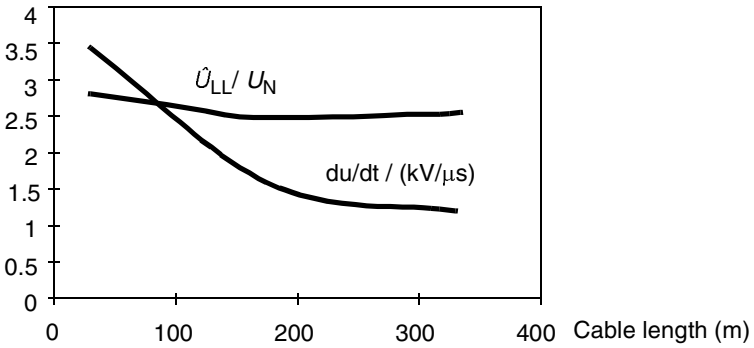
The need of du/dt filtering depends on the motor insulation. (For information on the construction of the motor insulation, consult its manufacturer.) Failure of the motor to fulfil the following requirements may shorten its life.

Motor Type	Nominal Mains Voltage (U_N)	Motor Insulation Requirement
ABB M2_ with IEC Frame	$U_N \leq 500$ V	Standard insulation system.
	500 V < $U_N \leq 600$ V	Standard insulation system in conjunction with du/dt filtering or reinforced insulation system.
	600 V < $U_N \leq 690$ V	Reinforced insulation system in conjunction with du/dt filtering.
ABB M2_ with NEMA Frame	460 V $\leq U_N \leq$ 600 V	Reinforced insulation system.
Random-wound	$U_N \leq 420$ V	Insulation system must withstand $\hat{U}_{LL}$ = 1300 V.
	420 V < $U_N \leq 500$ V	If the insulation system withstands $\hat{U}_{LL}$ = 1600 V and $\triangle t$ = 0.2 μs, du/dt filtering is not required. With du/dt filtering, the insulation system must withstand $\hat{U}_{LL}$ = 1300 V.
	500 V < $U_N \leq 600$ V	Insulation system must withstand $\hat{U}_{LL}$ = 1600 V. du/dt filtering is required.
	600 V < $U_N \leq 690$ V	Insulation system must withstand $\hat{U}_{LL}$ = 1800 V. du/dt filtering is required.
Form-wound	$U_N \leq 690$ V	If the insulation system withstands $\hat{U}_{LL}$ = 2000 V and $\triangle t$ = 0.3 μs, du/dt filtering is not required.

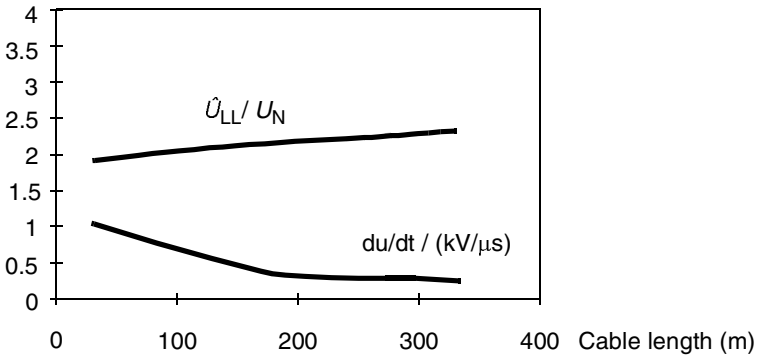
Symbol	Explanation
U_N	Nominal supply voltage.
$\hat{U}_{LL}$	Peak line-to-line voltage at motor terminals.
$\triangle t$	Rise time, i.e. interval during which line-to-line voltage at motor terminals changes from 10% to 90% of full voltage range. **Equals 0.8 · $\hat{U}_{LL}$/(du/dt).** The values of $\hat{U}_{LL}$ and du/dt can be read from the diagrams below.

The following diagrams present $\hat{U}_{LL}$ and *du/dt* as a function of cable length without and with du/dt filtering.

Without du/dt filtering



With du/dt filtering



Applicability Factory-installed du/dt Filters are available for ACx 607, ACx 617 and ACx 677. They are installed inside the converter cubicle (no additional cabinet is required).

The filters are separately available for all ACx 600 types. They need to be mounted externally. Unprotected (IP00) filters must be encased.

*Table 7-4 Applicability of du/dt Filters. The number indicates the quantity of Filters required for the ACx 600 type. (Note that the kits marked * include 3 filters.)*

ACx 601, ACx 604 and ACx 607 Types			ACx 617/677 Types			**du/dt Filter Type** (3 filters included in kits marked *)											
						Unprotected (IP00)							Protected to IP22			Protected to IP54		
						NOCH0016-60	NOCH0030-60	NOCH0070-60	*NOCH0120-60	*NOCH0260-60	*NOCH0400-60	NOCH0760-60	NOCH0016-62	NOCH0030-62	NOCH0070-62	NOCH0016-65	NOCH0030-65	NOCH0070-65
0005-3 0006-3 0009-3 0011-3	0006-5 0009-5 0011-5 0016-5	0009-6 0011-6 0016-6				1							1			1		
0016-3 0020-3	0020-5 0025-5	0020-6 0025-6 0030-6					1							1			1	
0025-3 0030-3 0040-3 0050-3 0060-3	0030-5 0040-5 0050-5 0060-5 0070-5	0040-6 0050-6 0060-6 0070-6						1							1			1
0070-3 0100-3 0120-3	0100-5 0120-5 0140-5	0100-6 0120-6							3									
0140-3 0170-3 0210-3	0170-5 0210-5 0260-5	0140-6 0170-6 0210-6 0260-6	0185-3 0225-3	0215-5 0255-5	0185-6 0205-6 0255-6 0315-6					3								
0260-3 0320-3	0320-5 0400-5	0320-6 0400-6	0265-3 0335-3	0325-5 0395-5	0375-6 0485-6						3							
0400-3	0490-5	0490-6								6								
0490-3 0610-3	0610-5 0760-5	0610-6 0760-6									6							
		0900-6	0405-3 0500-3 0630-3	0495-5 0610-5 0770-5	0600-6 0750-6 0900-6							3						
0760-3 0930-3	0930-5 1090-5	1040-6 1380-6	0765-3 0935-3	0935-5 1095-5	1045-6 1385-6						9							
1120-3	1380-5	1710-6	1125-3	1385-5								6						
1440-3 1770-3	1760-5 2160-5	2120-6 2540-6									18							
2140-3 2340-3	2620-5 2850-5	2800-6 3350-6										12						
2820-3	3450-5										36							

What to Consider

The main items to consider when opting to use du/dt filtering are:

- A slight decrease in motor pull-out torque caused by the voltage drop over the du/dt filter(s)
- Motor cable length restrictions
- The length of the cable between ACx 600 and the filter(s) must not exceed 3 metres
- Cooling requirements when encasing filters.

More information is obtainable from separate publication *du/dt Filters Installation Guide* (3AFY 58933368).

Dimensions and Weights

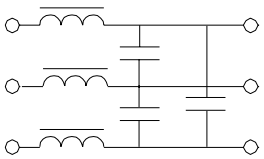
Table 7-5 Dimensions and weights of the du/dt Filters.

du/dt Filter	Height mm	Width mm	Depth mm	Weight kg
NOCH0016-60	195	140	115	2.4
NOCH0016-62/65	323	199	154	6
NOCH0030-60	215	165	130	4.7
NOCH0030-62/65	348	249	172	9
NOCH0070-60	261	180	150	9.5
NOCH0070-62/65	433	279	202	15.5
NOCH0120-60	200	154	106	7
NOCH0260-60	383	185	111	12
NOCH0400-60	383	185	126	17
NOCH0760-60	500	250	176	43

Sine Filter / Step-up Drive

A sine filter is available as standard cabinet option for ACx 607-0210-6 to 0760-6 and -0210-5 to -0760-5. For the other ACx 607 units, ACx 617 and ACx 677, see section *Special Cabinet Options*. For the ACx 601 units, commercial filters have been tested and approved by ABB. For more information please consult your local ABB representative.

Sine Filter



The sine filter option includes:

- a filter connected at the ACx 607 output and installed inside an additional cubicle
- a modified drive software which is loaded at the factory to every ACx 607 with a sine filter

The sine filter efficiently suppresses the high-frequency components of the ACx 607 output; The voltage and current waveforms are sinusoidal. The filter consists of single phase reactors and AC capacitors.

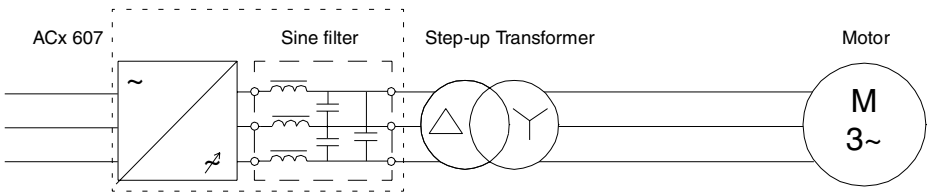
When to Use?

The sine filter makes it possible:

- to control a medium voltage motor using ACx 607 (through an additional step-up transformer)
- to use ACx 607 with a motor which does not have an adequate insulation level required with a frequency converter (i.e. a retrofit of an old direct-on-line motor)
- to use long motor cables (no voltage reflections)

Step-up Drive

The Step-up drive consists of the components shown in the figure below.



The step-up transformer is selected by the user.

Additional Information

See *User's Guide Step-up Sine Filter* (EN code: 64162519) for more information on:

- filter data (ratings, dimensions, losses etc.)
- the sine filter dedicated software features
- allowed motor cable length
- transformer selection instructions
- restrictions to be noted (ACx 607 output frequency range, voltage drop over sine filter)

Factory-installed Standard Cabinet Options

The standard cabinet options form pre-designed packages that are easy to implement to the basic product. Only a little engineering work at the factory is required: the part lists and the delivery drawings are ready-made and easy to tailor for each delivery.

Cabling Direction Options

As standard, all cables enter the cabinet from below. However, the cabling direction options make it possible e.g. to lead the supply cables into the cabinet from above.

Variant 1 For ACx 607 R7, R8 & R9, it is also possible to lead the supply cables through the roof, or lead both the supply and motor cables through the roof. The cabinet has two signal cable lead-throughs, one at the top, one at the bottom.

Variant 2 For ACx 607 2×R8, 2×R9, the mains supply cables can alternatively be led into the cabinet through the roof. The motor and signal cables are led through the bottom.

Variant 3 For ACx 607 R11i to 4×R11i, bottom or top entry can be selected for the mains supply cables (or busbars). ACS 627 R11i and R12i (when equipped with two B3 size rectifier modules) has two 600 mm additional cubicles for the mains cable entries.

The following motor cabling options are available:

- Motor cables exit the cabinet through the bottom of the inverter cubicle(s). In case of multiple inverter units in parallel, motor cables are run separately from each inverter unit to the motor.
- The outputs of all inverter units are led to an additional common motor terminal cubicle. Bottom or top motor cable exit can be selected. (Note that the common motor terminal cubicle is always required for top motor cable exit.) The widths of the additional cubicles are:
  For R11i: 400 mm
  For R12i: 600 mm
  For 2×R11i: 600 mm
  For 2×R12i: 800 mm
  For 4×R11i: 800 mm

These converters are equipped with signal cable lead-throughs both at the top and at the bottom.

Mains Supply Conductor Types

ACx 607 converters are, as standard, equipped with power cable lead-throughs. A busbar (bus duct) mains supply connection is available for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677.

Earthing Switch

The supply section of ACx 607 R11i to ACx 617 and ACx 677 (apart from 12-pulse types ACx 627-0760-3, -0930-5, -1090-5, -0900-6 and -1040-6) can be optionally equipped with an earthing switch. It is used to earth the AC busbars for maintenance work on the system. The earthing switch is mechanically or electrically interlocked with the main switch.

Line Switching Equipment, Emergency Stop Functions

Variant 1

ACx 607 R7 to 2×R9 are automatically equipped with a switch fuse. A line contactor (two for 2×R8 and 2×R9) is optional. The line contactor(s) option includes an emergency stop push-button and a start/stop switch installed on the cabinet door. (External emergency stop push-buttons can be wired to a terminal block inside the converter cabinet.) Pressing the emergency stop push-button immediately opens the line contactors and the motor coasts to stop. See Immediate Removal of Power (IEC/EN60204-1 / Category 0) in subsection *Variant 2* below.

The Controlled Emergency Stop (IEC/EN60204-1 / Category 1) is a special cabinet option for ACx 607 R7 to 2×R9. See section *Special Cabinet Options*.

Variant 2

ACx 607 R11i to 4×R11i with supply unit type B3 (and type -0900-6) are available equipped either with a manually-operated switch fuse or with a switch fuse/contactor combination. Converters with supply unit type B4 or B5 (excluding -0900-6) are available equipped either with a manually-operated load switch/ disconnector or with an air circuit breaker.

If a contactor or an air circuit breaker is ordered, an emergency stop push-button and a start/stop switch are automatically included. One of the following emergency stop modes can be selected:

- Immediate Removal of Power (IEC/EN60204-1 / Category 0): the Emergency Stop command blocks the inverter semiconductors and opens the main contactor or air circuit breaker. The motor coasts to stop.
- Controlled Emergency Stop (IEC/EN60204-1 / Category 1): the Emergency Stop command stops the drive according to a drive parameter. After the drive is stopped, the main contactor or air circuit breaker is opened. The effective use of the Controlled Emergency Stop function requires a braking device (a chopper with resistors or a regenerative input bridge).

Standards for the Emergency Stop Option

The Emergency Stop option is designed in accordance with the standards:

- IEC/EN60204-1 :1997 “Safety of machinery – Electrical equipment of machines – Part 1: General requirements”
- EN418 :1992 “Safety of machinery – Emergency stop equipment, functional aspects – Principles for design”
- EN292 :1991 “Safety of machinery. Basic concepts, general principles for design. Part 2: Technical principles and specifications”
- EN954-1 :1996 “Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design”
- prEN954-2 :1998

Prevention of Unexpected Start-up

A Prevention of Unexpected Start-up circuitry is available as an option for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677. For the other units see section *Special Cabinet Options*.

Operation

The Prevention of Unexpected Start-up function disables the control voltage of the power semiconductors, thus preventing the inverter from generating the AC voltage required to rotate the motor. The function makes the safe commissioning of the machinery possible without the need to switch off the AC drive power supply. Note that the function does not switch off the main or auxiliary voltages. Thus it does not fulfil the requirements stated for a safety switch: **no maintenance work of the electric parts is allowed**.

IGBT Protection

A control voltage cut off of the loaded power semiconductors might cause damage. To avoid this, an IGBT protection is implemented by:

- connecting an auxiliary contact of the A400 relay unit to the NDIO module digital input DI1, and
- setting the module DI1 as the source for the “emergency stop by coast” command in the drive application program (parameter setting).

If the Prevention of Unexpected Start-up circuit is opened while the drive is running, the drive is first given the “emergency stop by coast” command, only after which the IGBT control voltage is cut off. The emergency stop causes a drive fault trip. Resetting is needed before the restart is possible.

Equipment

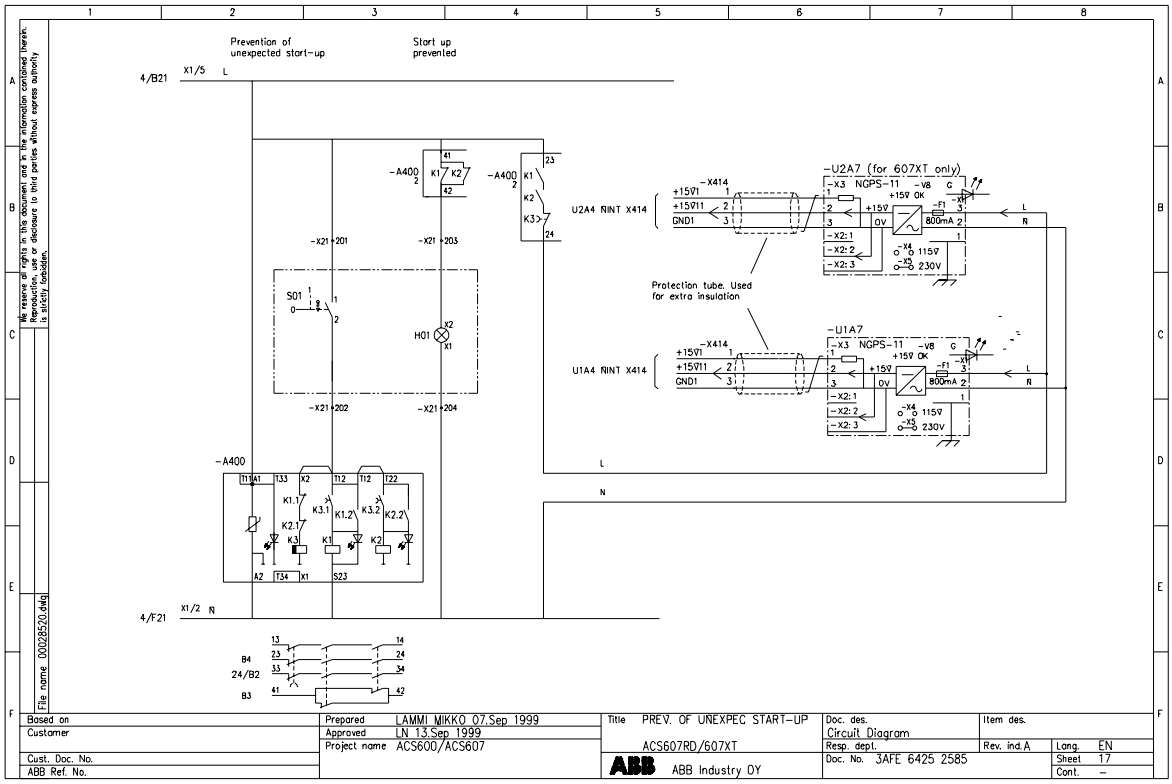
The table below lists the equipment of the Prevention of Unexpected Start-up circuit.

Symbol	**Description** (See the circuit diagrams below.)
A400	Relay unit
NGPS	Gate Driver Power Supply Board supplying inverter IGBT gate drivers
S01	Switching/disconnecting device for the circuitry (to be installed by the user). According to the standard: “Means shall be provided to prevent inadvertent, and/or mistaken closure of the disconnecting device.” For more information on the requirements, see the European standard EN 60204-1.
H01	Pilot light (to be installed by the user). On= Drive is in operation Off= Drive start is prevented
NDIO	Digital I/O Extension Module

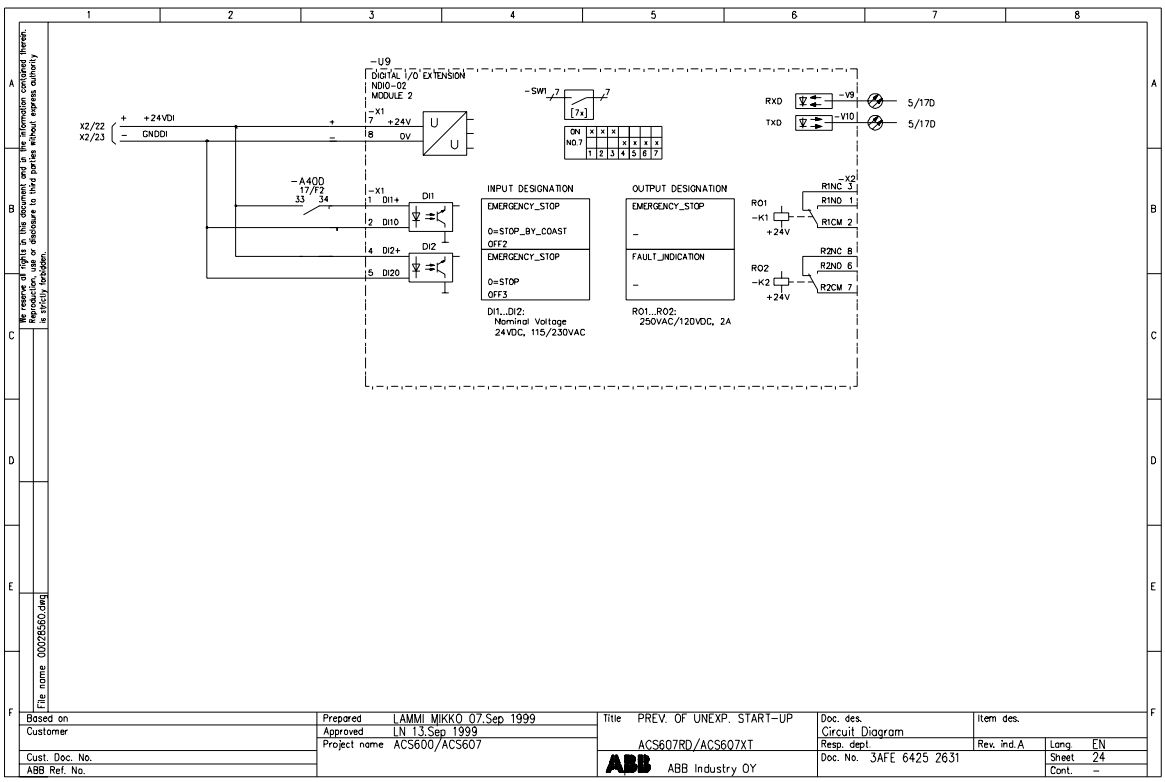
Notes

Note 1: The Prevention of Unexpected Start-up is not intended for stopping the drive.
Note 2: An attempt to start the drive while the Prevention of Unexpected Start-up is active will cause a drive fault trip. Resetting is needed before the restart is possible

Circuit Diagram 1 The figure below shows the Prevention of Unexpected Start-up circuit.



Circuit Diagram 2 The figure below shows the IGBT protection circuit.



DC Busbar Material

Aluminium DC busbars are standard for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677. These converters are optionally available with tin-plated copper DC busbars.

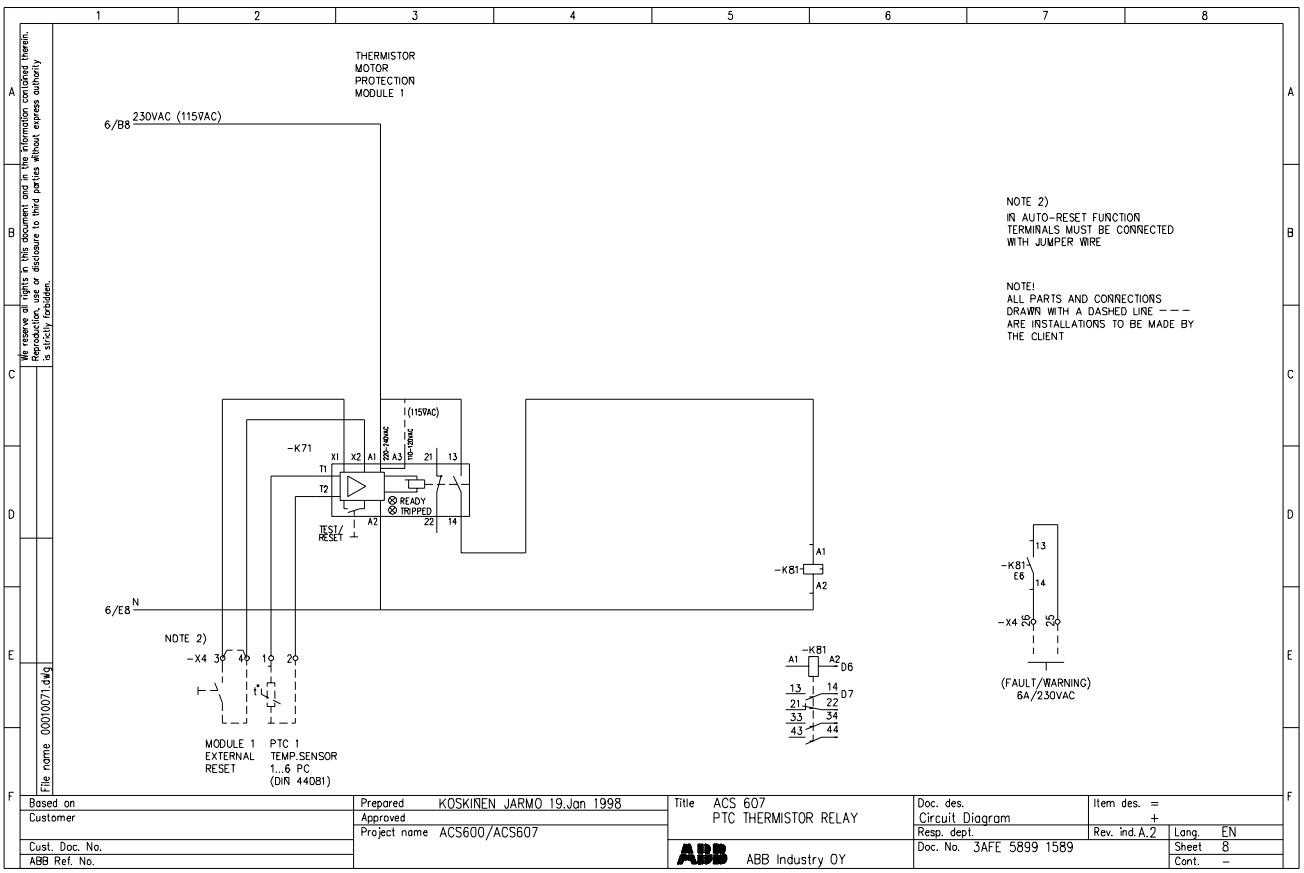
Thermistor (PTC) Relay

The Thermistor Relay is available as an option for all ACx 607, ACx 617 and ACx 677 units.

The option includes a PTC relay and an auxiliary relay wired to a terminal block.

A thermistor relay is used for the overtemperature supervision of motors equipped with the PTC thermistors. When the motor temperature rises to the thermistor wake-up level, the thermistor resistance increases sharply. The relay detects the change and indicates motor overtemperature through its auxiliary contacts.

The figure below shows the factory wirings. The connections to be done by the customer are drawn in dashed lines.



User Wirings, Examples

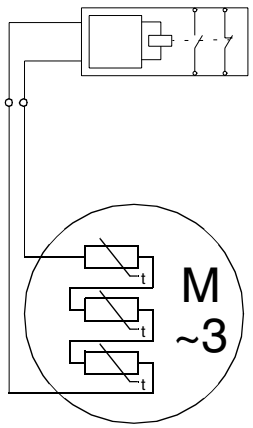
Example 1: Motor overtemperature causes main breaker trip. (See the figures above/below.)

- Connect motor PTC sensor(s) to the relay.
- Connect the normally open contact 13-14 of relay K81 to the main breaker control circuit.
- Connect a reset switch to the relay, or short circuit the reset switch terminals (= autoreset). ***Note:*** Autoreset is not allowed with the type “EEx e” motor used in explosive gas atmosphere.

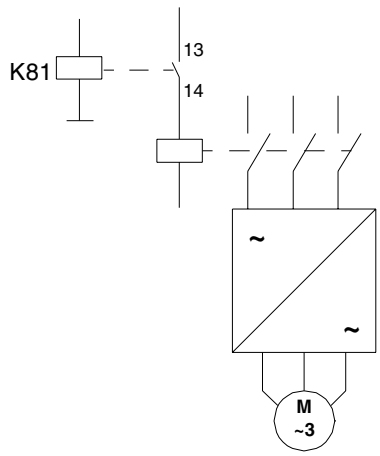
Example 2: Motor overtemperature causes ACS 600 fault trip. Panel display shows a fault message. (See the figures above/below.)

- Connect the motor PTC sensor(s) to the relay.
- Connect the normally open contact 13-14 of relay K81 to a digital input DI6.
- Activate the ACS 600 external fault supervision, and set the digital input DI6 to the fault signal interface.
- Connect a reset switch to the relay, or short circuit the reset switch terminals (= autoreset). ***Note:*** Autoreset is not allowed with the type “EEx e” motor used in explosive gas atmosphere.

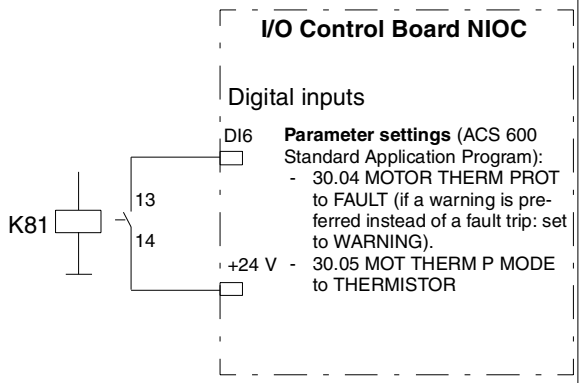
Motor Thermistor Connection



Example 1: Motor overtemperature trips the main breaker



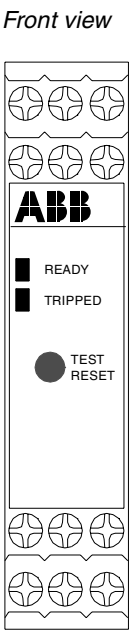
Example 2: Motor overtemperature trips the drive and generates a fault message on the panel display



Technical Data, Thermistor Relay

The table below shows the technical data of the thermistor relay.

Front view

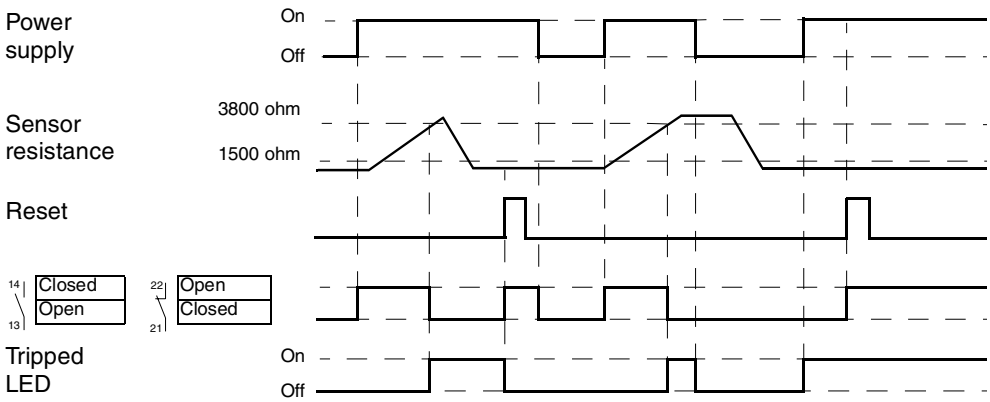


Type	ABB C506.02	
Rated control voltage (U_i)	115 or 230 V a.c.	
Rated frequency	50 Hz / 60 Hz	
Dielectric test voltage	2.5 kV	
Power consumption	< 2 W	
Conductor connection	2 • (0.5 mm^2 to 2.5 mm^2)	
PTC thermistor circuit		
Total cold state resistance per sensor loop	≤ 1.5 kΩ	
Triggering threshold	3.4 kΩ to 3.8 kΩ	
Recovery threshold	1.5 kΩ to 1.65 kΩ	
Measuring circuit load	≤ 5 mW (at cold resistance ≤1.5 kΩ)	
Thermistor circuit voltage	≤ 2 V (at cold resistance ≤ 1.5 kΩ)	
Max conductor length between sensor and relay	2.5 mm^2 1.5 mm^2 0.5 mm^2	2 • 2800 m 2 • 1500 m 2 • 500 m
Auxiliary contacts		
Auxiliary contacts	1 normally open + 1 normally closed	
Rated thermal current	5 A	
Rated operational current (AC-15)	3 A / 240 V	
Mechanical endurance	20 million ops.	

PDM-code: 00032021 - 24 Feb 2000

PTC Relay Operation Diagram

The figure below shows the state of the PTC relay contacts and the “Tripped” LED as a function of the temperature sensor resistance and power supply status.



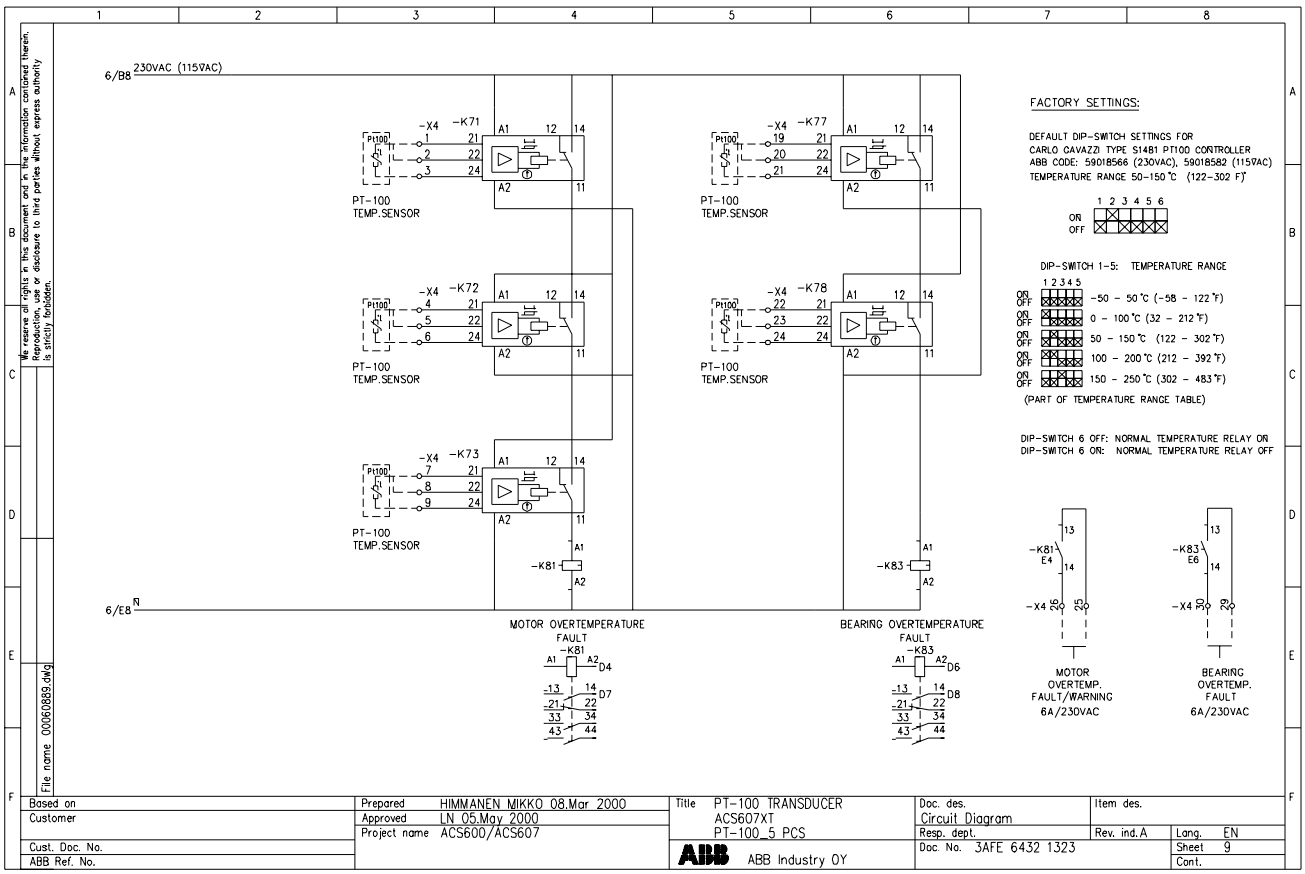
Pt100 Motor Protection

The Pt100 relay is available as an option for all ACx 607, ACx 617 and ACx 677 units. The number of relays is selectable.

The option includes a Pt100 relays and an auxiliary relays wired to a terminal block.

The Pt100 relay is used for the overtemperature supervision of motors equipped with the Pt100 sensors. As the motor temperature rises the sensor resistance increases linearly. At the adjustable wake-up level the relay releases and indicates motor overtemperature through a change-over contact.

The figure below shows the factory wirings of an assembly consisting of five Pt100 and Pt100 relays: Three Pt100s measure the temperature of motor windings, two Pt100s measure the temperature of the bearings. The connections to be done by the customer are drawn using dashed lines.



User Wirings, Examples

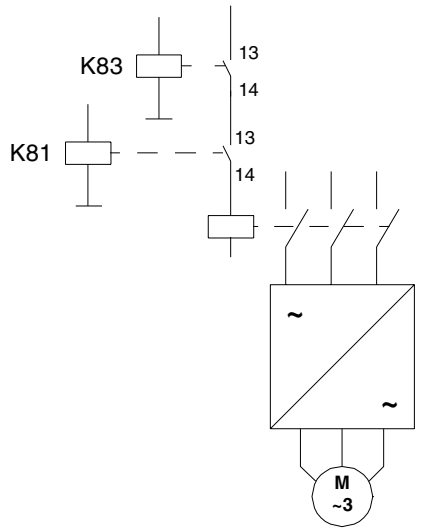
Example 1: Motor overtemperature causes main breaker trip

- Connect the motor Pt100 sensors as shown in the figure above.
- Connect the contact 13-14 of relay K81, and contact 13-14 of relay K83 to the main breaker control circuit as shown in the figure below.

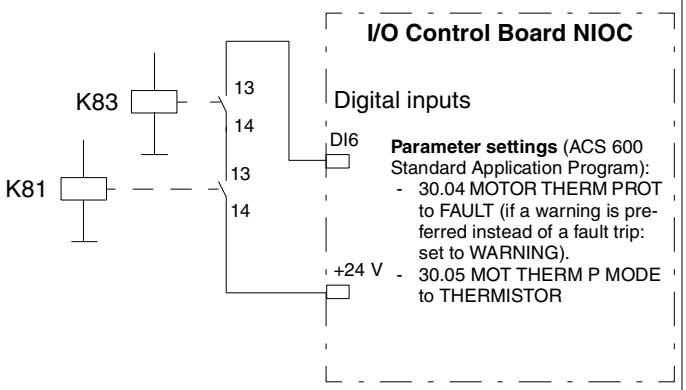
Example 2: Motor overtemperature causes ACS 600 fault trip. Panel display shows a fault message.

- Connect the motor Pt100 sensors as shown in the figure above.
- Connect the contact 13-14 of relay K81, and contact 13-14 of relay K83 to a digital input DI6 as shown in the figure below.
- Activate the ACS 600 external fault supervision, and set the digital input DI6 to the fault signal interface.

Example 1: Motor overtemperature trips the main breaker



Example 2: Motor overtemperature trips the drive and generates a fault message on the panel display



User Settings, Pt100 Relay

Temperature range setting (Five DIP switches)**:** The factory setting is 50 to 150 °C. However, it is a good practise to check the setting on field. For the alternative settings, see the circuit diagram above.

Overtemperature wake-up level (adjusting knob): To be set on field**.**

$$\frac{x}{100} \cdot \text{temperature range maximum °C}$$

x = percent value set with the knob

Hysteresis for the temperature supervision (adjusting knob): To be set on field

$$\frac{x}{100} \cdot 20\ °C$$

x = percent value set with the knob

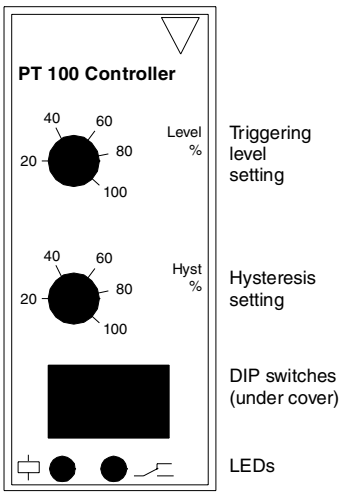
Pt 100 Relay Technical Data

Manufacturer: Carlo Gavazzi

Relay types: S1481 156 230 (for 230 V a.c. aux. voltage), or S1481 156 115 by Carlo Gavazzi (for 115 V a.c. aux. voltage)

LEDs for ”READY” and ”TRIPPED” indications

Front view

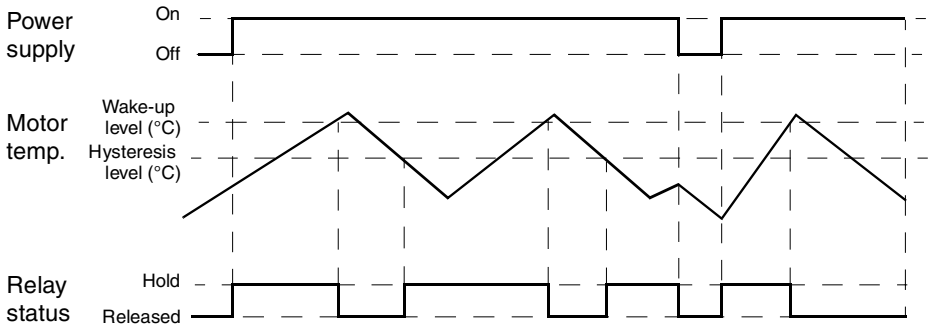


Temperature Settings	
Temperature Range	-50 … +850°C
Range selection	17 ranges, selected by DIP switches
Triggering level	Adjustable relative scale (0 to 100%)
Hysteresis	Adjustable on relative scale (1 to 20°C)
Dimensions and Weight	
WxHxD	35 x 80 x 80 (+ 30 mm mounting socket)
Weight	200 g
Sensor Circuit	
Input	Pt-100 temperature input (EN 60751)
Number of Pt100 channels	1 pc
Measurement range	- 50 to + 850 °C
Sensor connection	3-wire connection (2-wire possibility)
Sensor cable compensation	Up to 10Ω/wire in 3-wire system
Sensor current	< 1 mA
Scale inaccuracy	± 2 °C
Relay Output	
Auxiliary contacts	1 pcs SPDT
Rated insulation voltage	250VAC
Rated thermal current (AC1)	10 A / 250 VAC (2500VA)
Rated operational current (AC15):	2,5 A / 230 VAC
Dielectric voltage	2.0 kVAC
Rated impulse withstand voltage (IEC60664)	4 kV (1.2/50us)
Mechanical life	> 30 million operations
Electrical life (AC1)	> 100 000 operations (at max. load)

Carlo Gavazzi S1481 data sheet 08.03.2000 (PDM code: 00062630.pdf - 27.03.2000)
Specification PDM code: 00054664.doc - 27.01.2000

Pt100 Relay Operation Diagram

The figure below shows the state of the Pt100 relay as a function of the supervised temperature and power supply status. The relay is set to supervise overtemperature limit (DIP switch DI6 is off).



Cubicle Heater

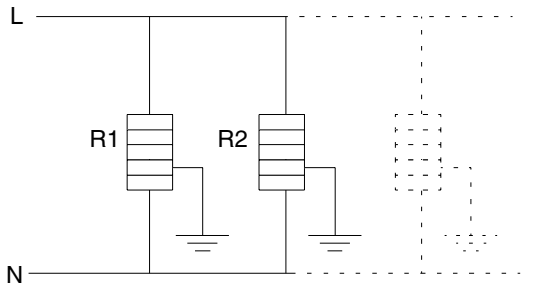
The Cubicle Heater is available as an option for all ACx 607, ACx 617 and ACx 677 units. The heater prevents humidity condensation inside the ACx 607 cabinet in a power-off state.

The Cubicle Heater option includes a heating element in each converter cubicle (in 1000 and 1500 mm wide cubicle there are two). The heater elements are to be supplied from an external 230 V a.c. power supply by the user (50 W per element).

Variant 1

In units up to ACx 607 R7 to 2×R9, the heating circuit must be equipped with external disconnector and protection device(s) by the user. Also the heater on/off control, if needed, should be arranged by the user.

The figure below shows the equipment and wirings.

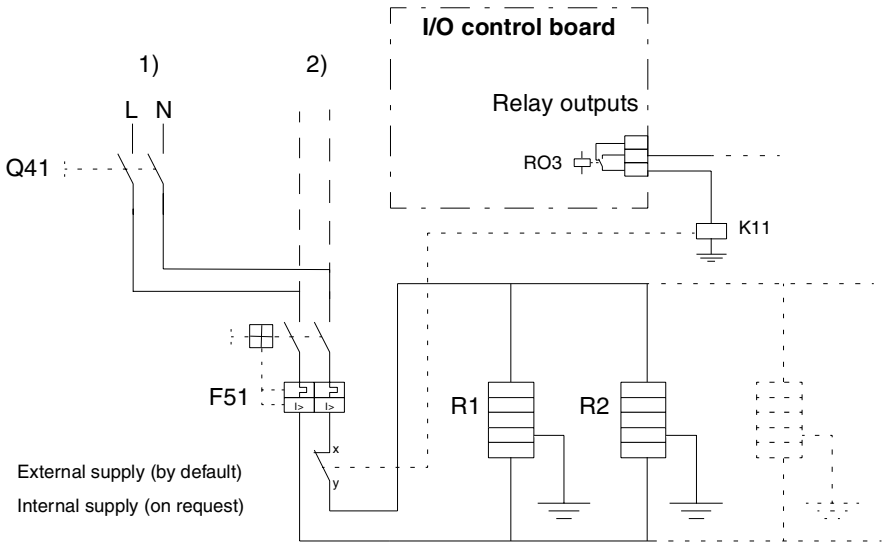


PDM-code: 00011581-C

Variant 2

In ACx 607 R11i to 4×R11i, ACx 617 and ACx 677, the heating circuit is equipped with a load switch and a protective circuit breaker. Heating is switched off when the drive supply bridge is operating i.e. a relay output on the I/O control board has energised relay K11.

The figure below shows the equipment and wirings.



PDM-code: 00011580-C

Starter for Auxiliary Motor Fan

The Starter for Auxiliary Motor Fan option is available as an option for all ACx 607, ACx 617 and ACx 677 units.

The option includes a motor protection switch and a contactor wired to a terminal block. The starter supplies a fan of a separately ventilated motor with a 3-phase supply voltage equal to the ACx 600 input voltage. (1, 2 or 4 auxiliary motor fan starters can be selected for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677)

Table 7-6 Available current ratings for the auxiliary motor fan starters.

ACx 607 frames R7 to R9	ACx 607 frames 2×R8 to 2×R9	ACx 607 R11i to 4×R11i, ACx 617, ACx 677
1 to 1.6 A		1 to 1.6 A
1.6 to 2.5 A	1.6 to 2.5 A	1.6 to 2.5 A
2.5 to 4 A	2.5 to 4 A	2.5 to 4 A
4 to 6 A	4 to 6.3 A	4 to 6.3 A
	6 to 10 A	6 to 10 A
	9 to 14 A	9 to 14 A
	13 to 18 A	13 to 18 A
		18 to 25 A
		25 to 40 A (not for 690 V units)
		40 to 50 A (not for 500 V and 690 V units)

Motor Heater Outputs

The Motor Heater Outputs are available as a standard cabinet option for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677. For the other units see section *Special Cabinet Options*.

The heater prevents humidity condensation inside the motor enclosure in the drive power-off state. When the main breaker of the drive is closed, the heater is off.

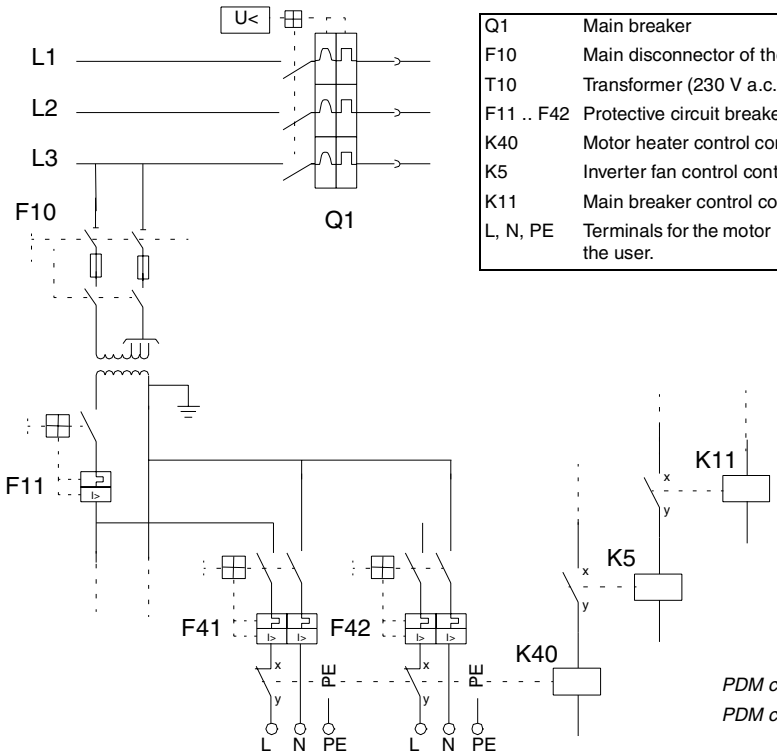
The option includes:

- Heater output terminals
- Terminals for the external power supply (**only** if external power supply is used)
- A protective circuit breaker and an on/off contact wired between the heater power supply and output terminals

Each heater output is rated to max. 230 V a.c., 4 A. The customer specifies:

- the number of heater outputs (two or four)
- the heater power source: internal (from the ACx 607 auxiliary voltage transformer), or external (a user-defined power supply)

The figure below shows the internal wiring of a configuration with two heater outputs. The heater terminals are supplied internally from the ACx 607 auxiliary transformer.



Q1	Main breaker
F10	Main disconnector of the auxiliary circuits
T10	Transformer (230 V a.c. or 115 V a.c. secondary)
F11 .. F42	Protective circuit breakers
K40	Motor heater control contactor
K5	Inverter fan control contactor
K11	Main breaker control contactor
L, N, PE	Terminals for the motor heater: To be connected by the user.

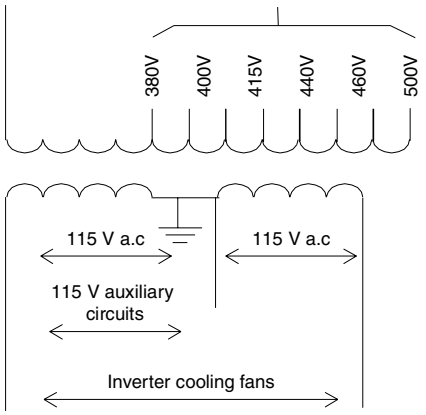
PDM code: 00011574.dwg - C
PDM code: 00011575.dwg - D

Auxiliary Control Voltage

As standard, all ACx 600 units are equipped with 230 V a.c. auxiliary voltage components.

115 V a.c. auxiliary voltage circuitry and components are available as a standard cabinet option for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677. For the other units see section *Special Cabinet Options*.

Note: With combination 115 V a.c. / **50 Hz** control voltage, the inverter cooling fans need 230 V a.c. supply to meet the cooling requirements. The extra arrangement is shown in the figure below.



Auxiliary voltage transformer
- 380 to 500 V / **50 Hz** primary
- 115 V / **50 Hz** secondary (auxiliary circuits)
- 230 V / **50 Hz** secondary (inverter fans)

NAMC/NIOC Power Supply

The NAMC and NIOC boards of the ACx 600 are, as standard, powered from the frequency converter intermediate DC link through a Power Supply Board (NPOW). The NAMC and NIOC boards are live when the DC link is live i.e. the main breaker is closed.

To keep the NAMC and NIOC live also when the main contactor/breaker is open, the drive can be equipped with 230 V a.c. / 24 V d.c. power supply. See section *Power Supply Module NPSM-02*.

The NAMC/NIOC power supply is available as a standard cabinet option for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677. For the other units see section *Special Cabinet Options*.

Terminals for External Control Voltage Supply (e.g. UPS)

The Terminals for External Control Voltage Supply (e.g. UPS) is available as an option for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677. For the other units see section *Special Cabinet Options*.

The external supply backs up the internal control voltage supply i.e. it keeps the auxiliairy circuits live during a ACx 607 mains supply interruption. The supply is to be selected and connected by the user. Ratings:

- 230 or 115 V a.c. (according to the ACx 607 control voltage)
- 1000 VA

Option includes a disconnecting switch, connection terminals, protective circuit breakers and ACx 607 internal wirings.

Note: No Uninterrupted Power Supply (UPS) is included: The user selects (and instals) the UPS if a battery charged back up is needed. The UPS is also to be fed by a user-defined power source.

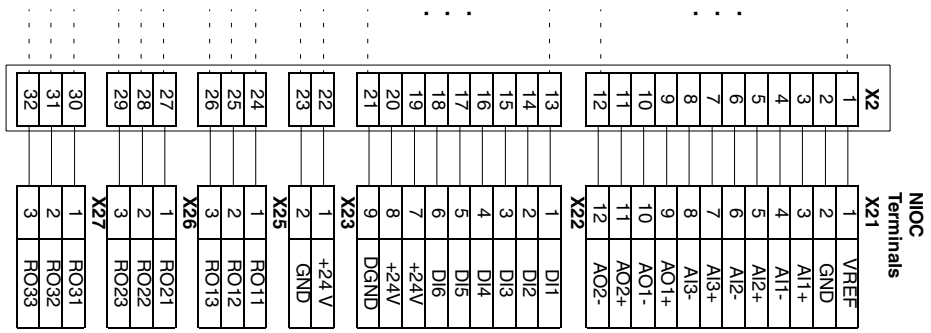
Note: To keep the ACx 607 control live during a mains supply interruption:

- The control voltage supply is to be backed up.
- The Application and Motor Control Board, NAMC, and Standard I/O Control Board, NIOC, are to be fed through an optional 230 V a.c / 24 V d.c. power supply module. See subsection *NAMC/NIOC Power Supply*.

Additional I/O Terminal Block X2

An additional terminal block X2 for the user digital and analogue I/O signal connections is included as default for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677. X2 is available as an option for ACx 607 R7 to 2×R9.

The terminal block X2 is installed beside the NIOC board on a easy-to-access assembly plate. The X2 terminals are wired to the NIOC board I/O terminals at the factory. See the figure below.



X2:

- terminals for the user I/O signal connections
- conductors 0.5 to 2.5 mm^2 (# 20 to # 14 AWG)

X21, X22, X23, X25, X26, X27:

- I/O terminals on the NIOC Board
- conductors 0.5 to 1.5 mm^2 (# 20 to # 16 AWG)

Earth Fault Protection in IT Network (floating mains supply)

The earth fault protection is a standard feature for ACx 607 R7 to 2×R9. See *Chapter 6 – Standard Features*.

The earth fault protection in IT network is available as an option for ACx 607 R11i to 4×R14i, ACx 617 and ACx 677. This section describes the protection for these units.

The option includes an assembly of four resistors (SCAU-Z), a rectifier, an overvoltage relay and an fault indication circuitry wired as shown below.

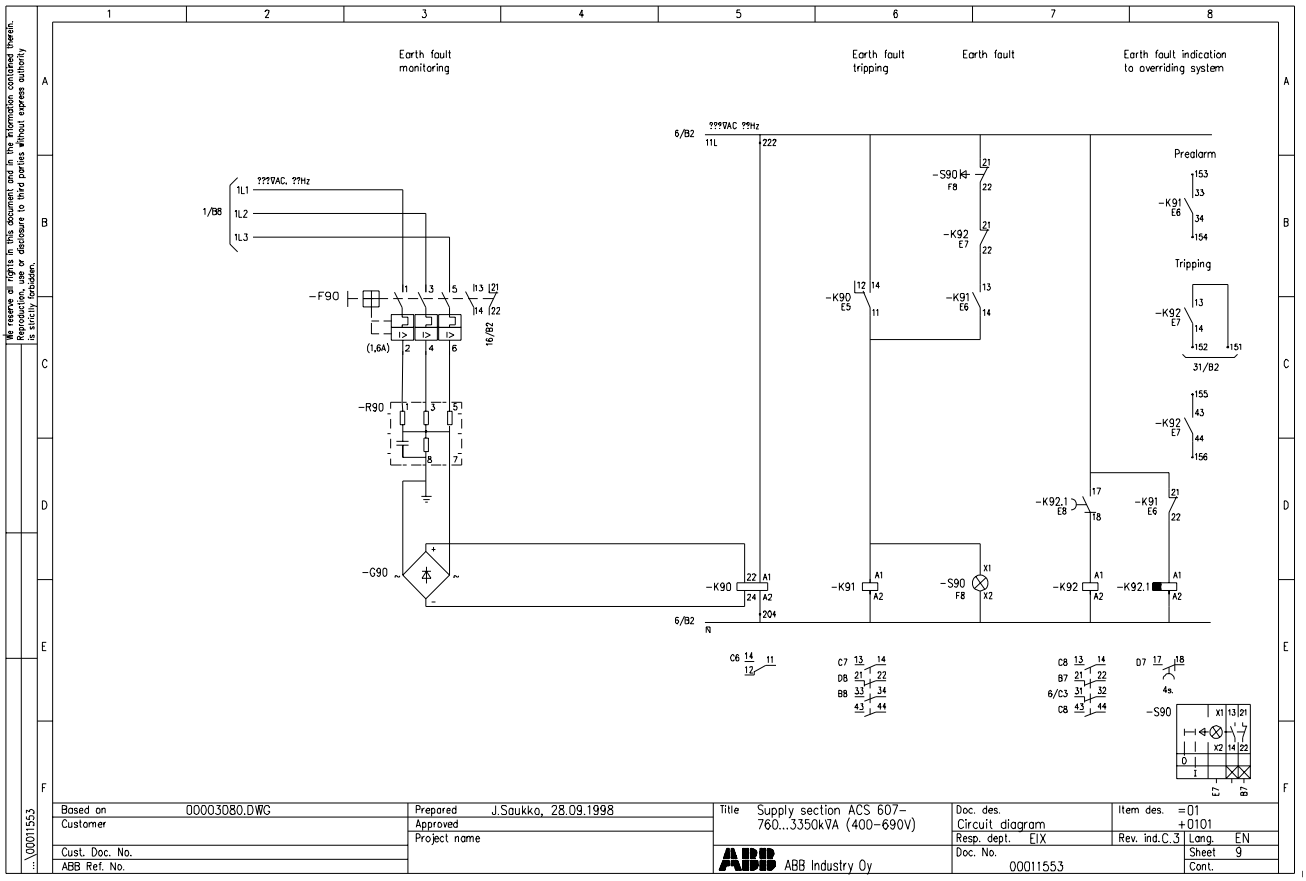
Operation

Three symmetrically connected resistors form an artificial neutral point to the 3-phase system. A high resistance resistor is connected between the artificial neutral point and the earth. The overvoltage relay supervises the rectified voltage over the high resistance resistor. An earth fault at the inverter output causes an asymmetry to the 3-phase system and a voltage difference between the neutral point and the earth. The overvoltage relay detects the voltage difference and wakes up.

Stage	Description
1. Earth fault occurs	Overvoltage relay K90 operates. Relay K91 operates. K91/21-22 de-energises time relay K92.1. K91/33-34 gives a prealarm to an external system (if wired by the user).
2. a) Earth fault condition ceases in less than 4 s.	K90 releases. K91 releases. K92.1 operates. Prealarm contact reset (K91/33-34).
2. b) Earth fault lasts longer than 4 seconds.	K92.1 releases. K92 releases. K92/13-14 opens the main contactor/breaker control circuit. Main contactor/breaker trips. (Factory-wired, not shown below). K92/31-32 connects earth fault indication to a converter module digital input causing a module fault trip. (Factory-wired, not shown below). K92 contact 21-22 closes the K91 holding circuit. The earth fault indications remain until K90 releases (=no earth fault) and the reset switch S90 is pushed.

The overvoltage relay is pre-tuned at the factory. When necessary, the relay can be retuned on field. For information on the tuning procedure contact your local ABB representative.

Circuit Diagram 1 The figure below shows the Earth Fault Protection circuit.



Earth Fault Protection in an TN Network (earthed mains supply)

The earth fault protection is a standard feature for ACx 607 R7 to 2×R9. See *Chapter 6 – Standard Features*.

The earth fault protection in TN network is available as an option for ACx 607 R11i to 4×R14i, ACx 617 and ACx 677. This section describes the protection for these units.

The option includes a current transformer which is wired to an analogue input which is either on a supply control board (diode supply bridge) or an additional board (thyristor supply bridge). In addition the earth fault supervision function in the rectifier control program is activated.

Operation

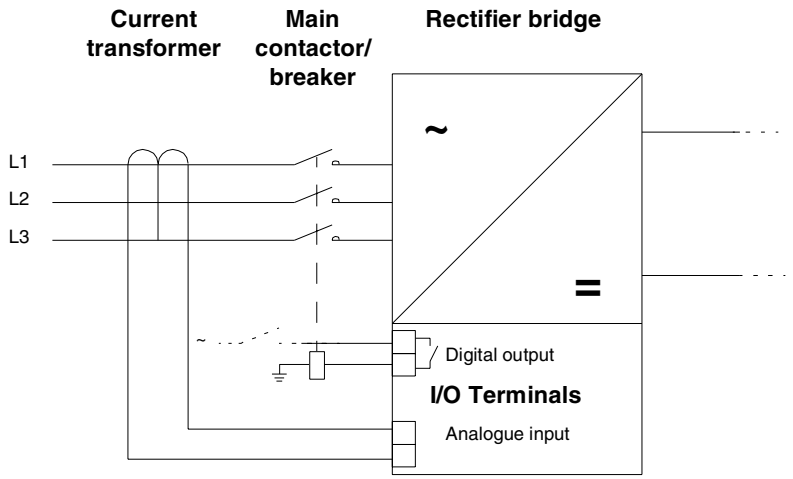
The earth fault protection in a TN network is based on a summation current transformer, monitoring the sum of the three-phase supply currents. Transformer output is monitored through an analogue input of the rectifying bridge.

In normal operation conditions the current sum is approximately zero. An earth fault leads to an imbalance in the 3-phase system and to a current sum which is greater than zero. If the current induced to the transformer secondary winding exceeds the limit set in the software, the main contactor/breaker is tripped and a fault message is generated.

The transformer transformation ratio is fixed. The protection is tuned by a rectifier control program parameter. The factory presetting (4 A) can be retuned on field.

Circuit Diagram

The figure below shows the wiring principle of the “Earth Fault Protection in an TN Network” option based on the summation current transformer.



Cable Markings

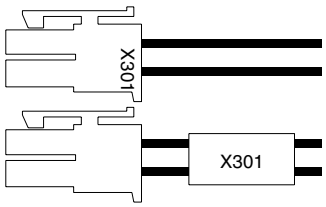
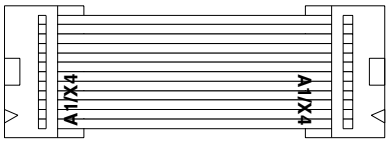
As standard the conductors and terminals in ACS 600 frequency converters are marked in accordance with the Standard Class as described below.

In the cabinet assemblys, the conductors outside the converter module can also be equipped with additional markings. For information on the optional marking types, contact a factory representative.

Standard Class

PDM-code: 00012745.doc

In Standard Class, only input and output terminals, plug-in connectors, fibre optic connectors and ribbon cables are marked. Conductor bundles may have markings printed on the insulation. The table below shows the marking principle.

Item	Description	Figure
Plug-In Connectors	Terminal identifier is marked either on the side of the plug-in connector or on a sleeve slid over the conductors or on adhesive tape. Marking rings are not used on conductors that cannot be detached from the connector otherwise than by a special tool.	
Ribbon Cables	On ribbon cables, apparatus and terminal identifiers are marked direct on the cable or on adhesive tape by means of waterproof ink.	
Fibreoptics	On fibreoptics, apparatus and terminal identifiers are marked using marking rings or adhesive tape.	
Busbars and Cables	Main circuit terminals are marked either directly on the busbar or beside the connector, with the terminal or busbar identifier printed on the insulating material. Earthing cables are marked with yellow-and-green tape.	

Cabinet Option Weights

Additional weight caused by some factory-installed cabinet options are given in the tables below.

Option	Weight kg	Transformer Add kg [1]	Power Supply Add kg [2]	X1 Term.Block Add kg
Thermistor Relay	0.5	7	-	0.5
Cubicle Heater	0.5	-	-	0.5
Auxiliary Motor Fan Starter	0.5	-	-	0.5
I/O; Fieldbus Adapter Module	0.2	7	1.9	0.5
Cabinet Extension	Weight/Width 190 kg/m	-	-	-

[1] ACx 607 units up to -0320-3, -0400-5, -0400-6 only.
[2] One power supply supplies one to six modules.

ACx 607			EMC Line Filter kg	IP54[1] kg	Line Cont. & Emer. Stop Devices [2] kg
0100-3	0120-5	0100-6	-	30	10
0120-3	0140-5	0120-6	-	30	10
0140-3	0170-5	0140-6/0170-6	18	50	13
0170-3	0210-5	0210-6	18	50	13
0210-3	0260-5	0260-6	18	50	14
0260-3			49	50	21
0320-3			49	50	21
	0320-5	0320-6	49	50	21
	0400-5	0400-6	49	50	21
0400-3	0490-5	0490-6	49	70	24
0490-3	0610-5	0610-6	90	70	35
0610-3	0760-5	0760-6	90	70	35

[1] Special roof construction, extra fan(s).
[2] Contactor(s), control switch, emergency stop switch, terminal block, transformers, protection switch.

Special Cabinet Options

The special cabinet options form no pre-designed packages as the standard cabinet options i.e. they cannot be specified using the type code key. Instead they require additional engineering work at the factory: the part lists and the delivery drawings are done case by case for each delivery. The actual connections and used components may vary.

The special cabinet options are available only on request.

Note: It is also possible to have other special options than the ones described in this document. Please consult a factory representative.

Controlled Emergency Stop

The Controlled Emergency Stop is available as a special cabinet option for ACx 607 R7 to 2×R9.

The design is the same as for the ACx 617 and ACx 677. See section *Factory-installed Standard Cabinet Options*.

Prevention of Unexpected Start-up

The Prevention of Unexpected Start-up is available as a special cabinet option for ACx 607 R7 to 2×R9.

The design is the same as for the larger units. See section *Factory-installed Standard Cabinet Options*.

Auxiliary Control Voltage

115 V a.c. auxiliary voltage circuitry and components are available as a special cabinet option for ACx 607 R7 to 2×R9.

Note: The converter module fans are always supplied from the intermediate circuit DC link.

NAMC/NIOC Power Supply

The internal power supply is available as a special cabinet option for ACx 607 R7 to 2×R9.

The design is the same as for the ACx 617 and ACx 677. See section *Factory-installed Standard Cabinet Options*.

Sine Filter / Step-up Drive

The sine filter is available as a special cabinet option for ACx 607 R11i to 4×R11i, ACx 617 and ACx 677.

The design is the same as described in section *Sine Filter / Step-up Drive*.

Empty Cabinet

Empty cabinet is available as special cabinet option for all ACx 607, ACx 617 and ACx 677 units.

The cabinet is identical into which the ACx 607, ACx 617 and ACx 677 are assembled:

- The same materials
- The joints between the cover plates and the frame are sealed to fulfil the Electromagnetic Compatibility requirements (European EMC Directive).
- The roof construction is the same including the air outlet (openings, fabric filter, brass grid, and louvre).

The following needs to be specified using the document “Empty Cabinet Specification” (EN code: 61411542) when ordering:

- Loose cabinet or an additional empty cubicle attached to the drive (left or right side).
- Degree of protection: IP 21, IP 22, IP 42, IP 54 or IP54R
- Door: With or without air inlet openings, with or without the panel mounting platform
- Blank (no holes) assembly plates inside the cabinet: None, one on the back or one on the back and one on a side
- Cable lead-through:

  1. No cable lead-through needed.

  2. Standard lead-through from above. See section *Customer-defined Cable Lead-through Plate*.

  3. Standard lead-through from below. See section *Customer-defined Cable Lead-through Plate*.

  4. Customer-defined lead-through (holes or without holes). See section *Customer-defined Cable Lead-through Plate*.

- Cabinet width: 400, 600, 700 or 800 mm

Terminals for External Control Voltage Supply (e.g. UPS)

The terminals for external control voltage supply (e.g. UPS) are available as a special cabinet option for ACx 607 R7 to 2×R9.

The option includes connection terminals, protective circuit breakers and ACx 607 internal wirings.

The external supply backs up the internal control voltage supply i.e. it keeps the customer-selected auxiliary circuit live during an ACx 607 mains supply interruption. In the basic design the external supply backs up the power supply of the optional modules: Digital I/O extensions, analogue I/O extension, and/or fieldbus adapter. On request other circuits can also be backed up.

The external power supply is to be selected and connected by the user. Ratings:

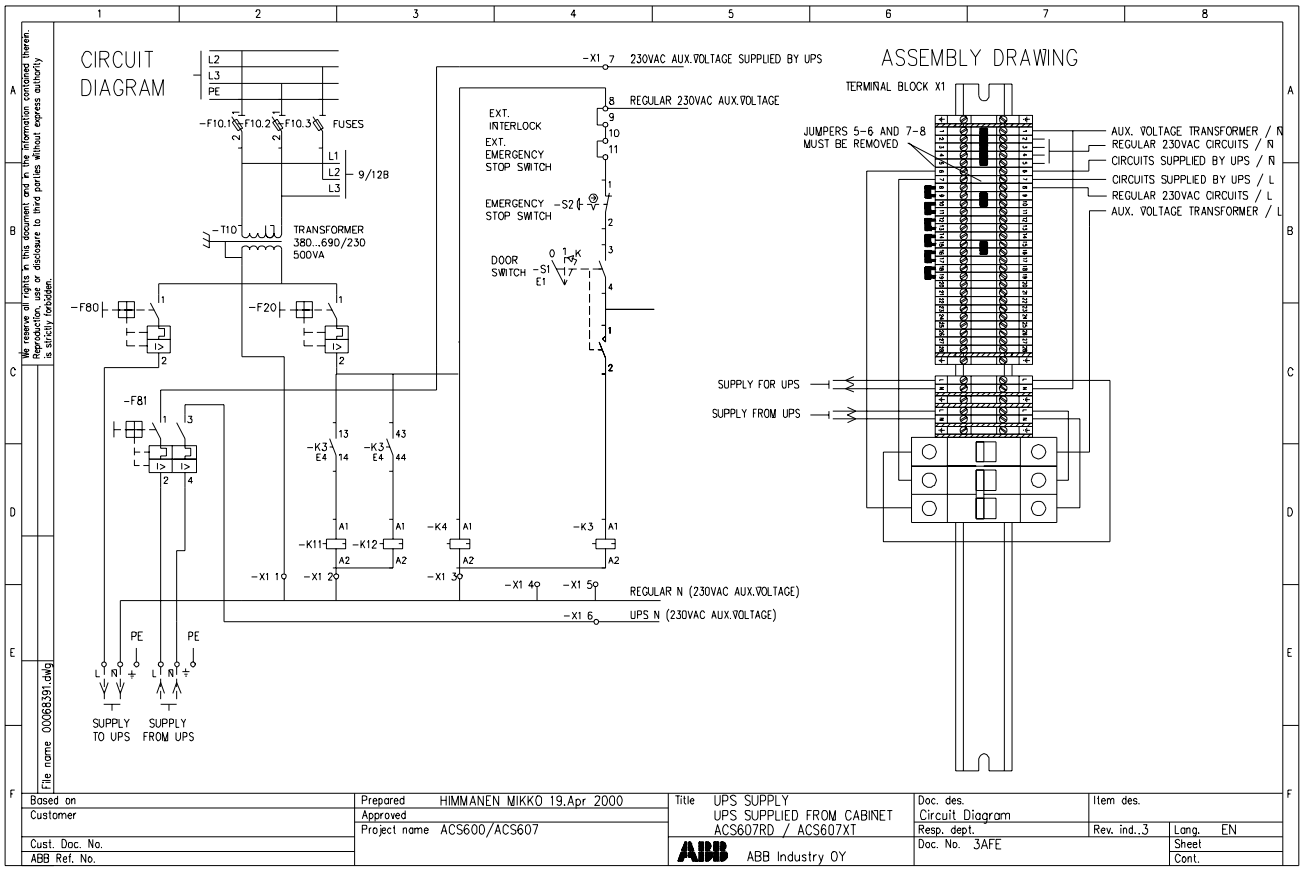
- 230 or 115 V a.c. (according to the ACx 607 control voltage)
- power depends on the power consumption of the circuits backed up

Note: No Uninterrupted Power Supply (UPS) is included: The user selects and instals the UPS if a battery charged back up is needed. However, it is possible to feed the user-defined UPS from the ACx 607 auxiliary voltage transformer.

Note: To keep the ACx 607 control live during a mains supply interruption:

- The control voltage supply is to be backed up.
- The Application and Motor Control Board, NAMC, and Standard I/O Control Board, NIOC, are to be fed through an optional 230 V a.c / 24 V d.c. power supply module. See subsection *NAMC/NIOC Power Supply*.

Basic Wiring Diagram The figure below shows the internal wirings of the UPS connection.



Motor Heater Output

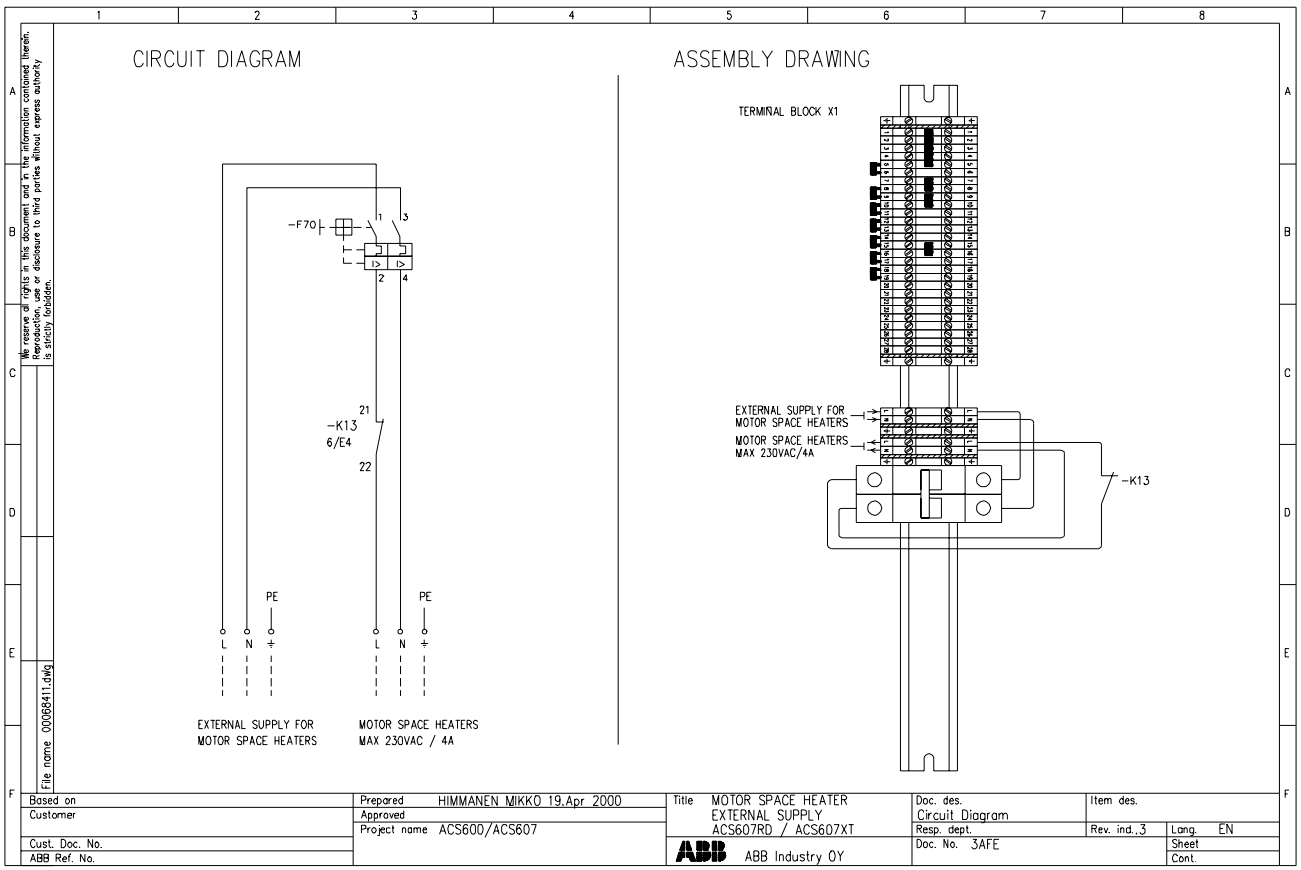
The motor heater output is available as a special cabinet option for ACx 607 R7 to 2×R9.

The heater prevents humidity condensation inside the motor enclosure in the drive power-off state. When the ACx 607 main breaker is closed, the heater is off.

The option includes:

- terminals for the motor heater (max. 230 V a.c., max. 4 A)
- terminals for an external heater supply that needs to be connected by the user: max. 230 V a.c., max. 4 A
- a protective circuit breaker and an on/off contact wired between the power supply and heater terminals

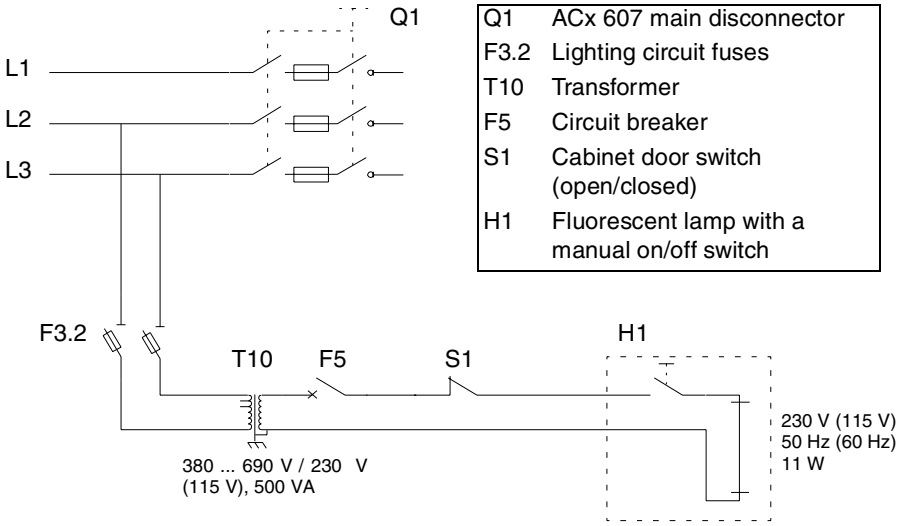
The figure below shows the ACx 607 internal wirings.



Cabinet Lighting

The cabinet lighting is available as a special cabinet option for all ACx 607, ACx 617 and ACx 677 units.

An example of the cabinet lighting is shown in the figure below.



Q1	ACx 607 main disconnector
F3.2	Lighting circuit fuses
T10	Transformer
F5	Circuit breaker
S1	Cabinet door switch (open/closed)
H1	Fluorescent lamp with a manual on/off switch

Customer-defined Cable Lead-through Plate

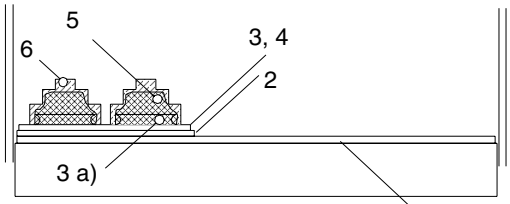
The customer-defined cable lead-through plate is available as a special cabinet option for all ACx 607, ACx 617 and ACx 677 units

If the standard lead through does not meet the specific local requirements, it is also possible to equip the cabinet with a brass or steel cable lead-through plate with no holes, with holes or with holes and threads. For more information, please contact a factory representative.

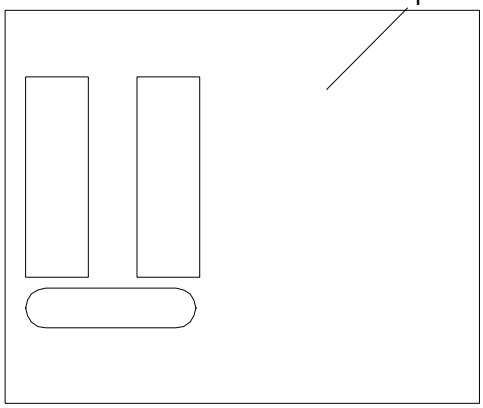
Standard Cabinet Lead-Through

The principle of the standard cable lead-through is shown in the figure below. The amount and size of the holes vary depending on the unit.

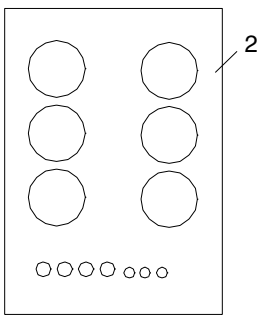
Front view



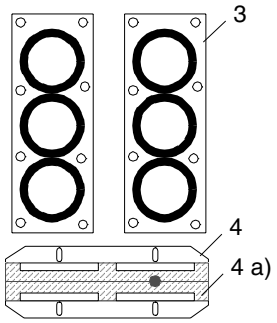
Top view



Top view



Top view

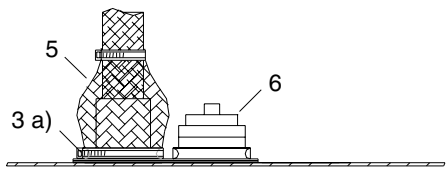


1	Base plate	1.5 - 2 mm steel
2	Lead-through plate[1)]	1.5 - 2 mm steel
3	EMC lead-through plate(s) for power cables	1.5 - 2 mm steel
3 a)	EMC sleeve fixing collar	1.5 - 2 mm steel
4	EMC lead-through plate for control cables	1.5 - 2 mm steel
4 a)	Conductive cushions	
4 b)	Grommet[2)]	Rubber
5	EMC-sleeve	Metal-wire mesh
6	Grommet	Rubber

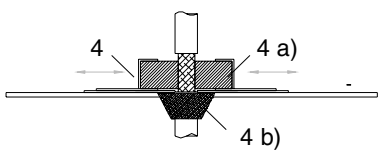
[1)] Not in all units.
[2)] Only with degree of protection IP 54.
The steel plates have a zinc surface treatment FE/Zn 8 c 2.

Cable Shield Grounding at Lead-through

Front view Power Cable

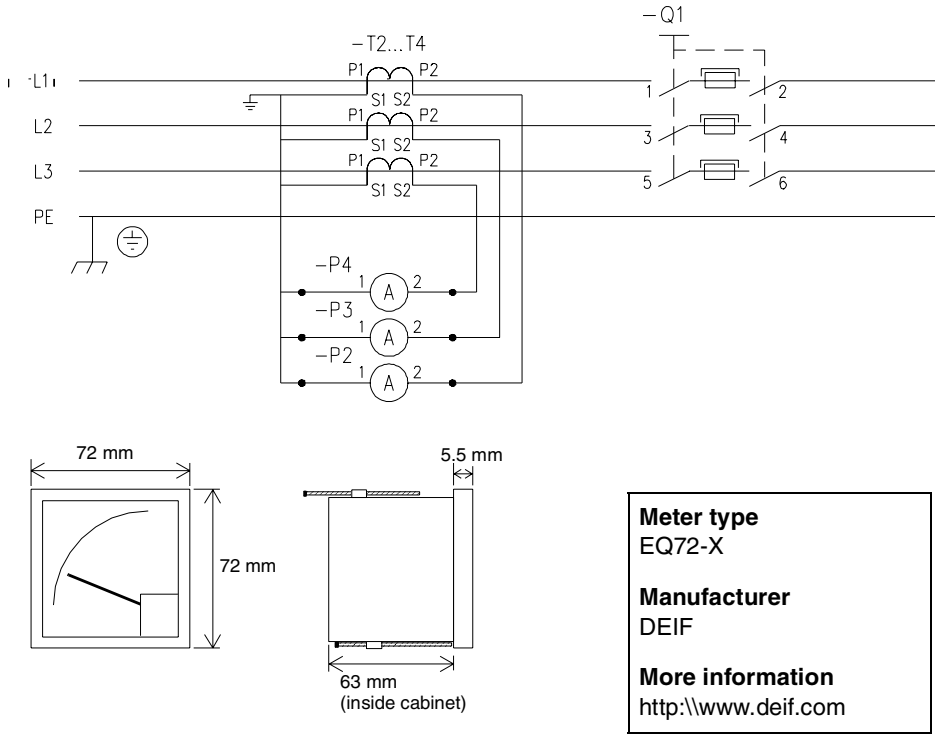


Side view Control Cable



Ammeters One to three ammeters are available as a special cabinet option for all ACx 607, ACx 617 and ACx 677 units.

The ammeters are installed on the front door. The equipment and wiring of the current meters are shown in the figure below.



Meter type
EQ72-X

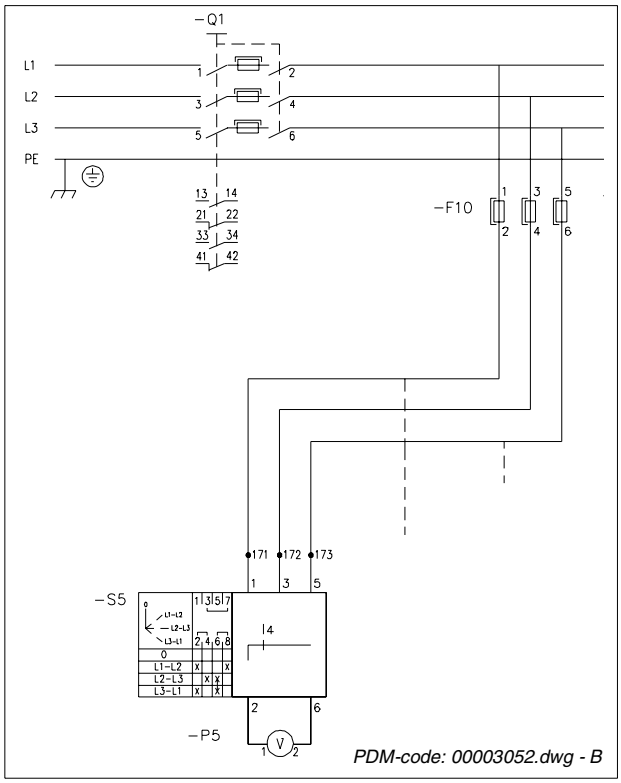
Manufacturer
DEIF

More information
http:\\www.deif.com

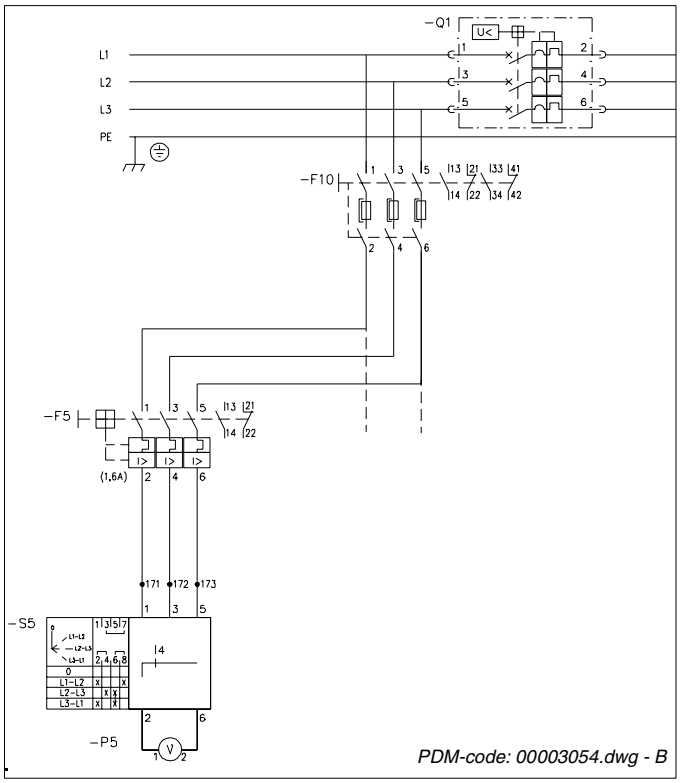
Voltmeter A voltmeter is available as a special cabinet option for all ACx 607, ACx 617 and ACx 677 units.

The voltmeter and the phase selection switch are installed on the front door. The equipment and wiring of the voltmeter option are shown in the figure below.

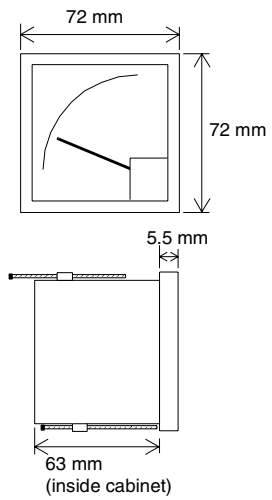
Drive equipped with a fuse switch



Drive equipped with an air circuit breaker



F10	Fuses
S5	Phase selection switch
P5	Voltage meter
Q1	Main supply disconnector / air circuit breaker
F5	Protection switch (needed only if the rating of F10 exceeds 16 A)



Meter type
EQ72-X

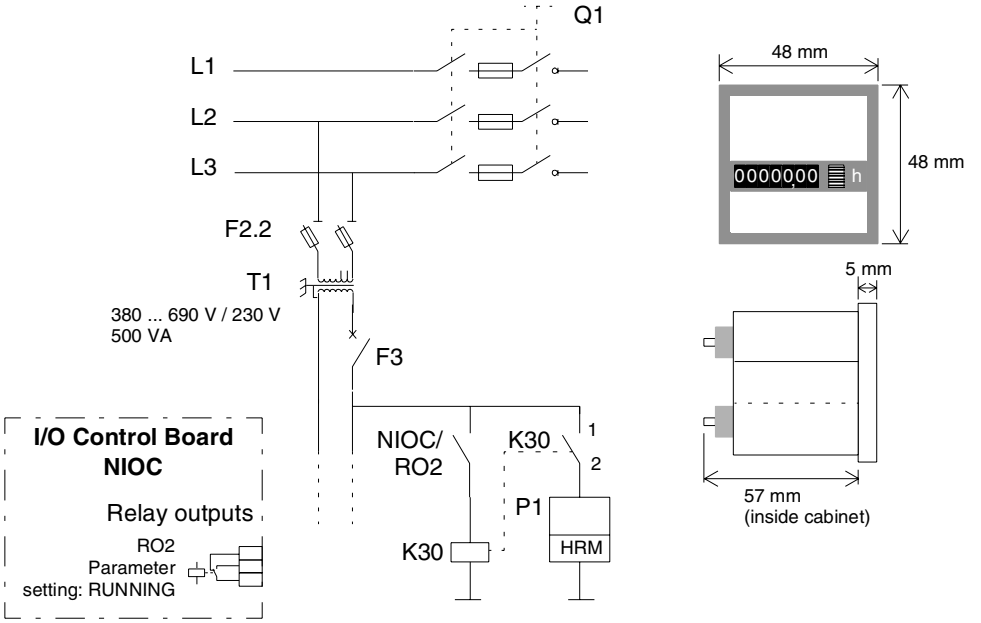
Manufacturer
DEIF

More information
http:\\www.deif.com

Running Hour Counter

A running hour counter is available as a special cabinet option for all ACx 607, ACx 617 and ACx 677 units.

The counter is installed on the front door above the main disconnecting switch. The counter runs when the drive is running (start signal and run enable signals are on, no fault). The figure below shows the equipment and the wiring.



Meter type
HCQ48

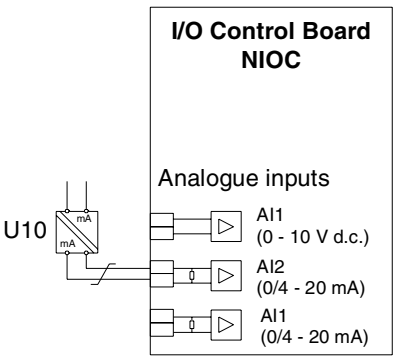
Manufacturer
DEIF

More information
http:\\www.deif.com

AI/O Galvanic Isolation

The current analogue inputs and or outputs can be equipped with galvanic isolators. The isolators are available as a special cabinet option for all ACx 607, ACx 617 and ACx 677 units.

In the figure below a 0 to 20 mA reference signal is connected to analogue input 2 via a galvanic isolator.



Type	SXRH GE20
Manufacturer	Scanfil
U_{inmax}	16 V
I_{in}	0 -20 mA
	4 - 20 mA
	0 - 5 mA
Tr. ratio	1:1

Analogue Output Signal Meters

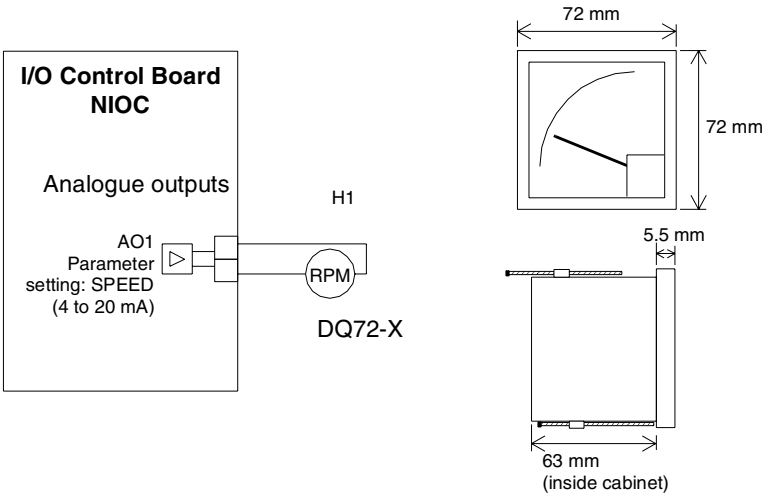
Analogue output signal meters are available as special cabinet options for all ACx 607, ACx 617 and ACx 677 units.

The meter type is selected according to the value to be monitored. Various scales/units are available. For example the following units can be selected:

- current
- direct voltage
- rotating speed
- percentage
- power

The meter is installed on the front door above the main disconnecting switch. The drive actual value to be indicated through an analogue output is selected with an application program parameter.

The figure below shows the wiring and the drive application program parameter setting for an RPM-meter. Also the meter dimensions and the very basic data is given below.



Meter type
DQ72-X

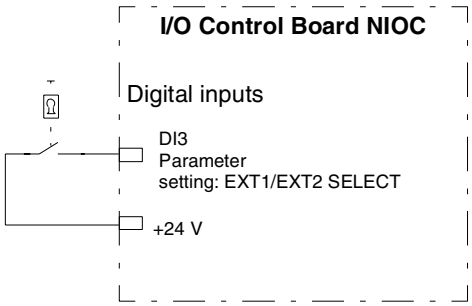
Manufacturer
DEIF

More information
http:\\www.deif.com

Key-operated Switch

A key-operated switch is available as a special cabinet option for all ACx 607, ACx 617 and ACx 677 units.

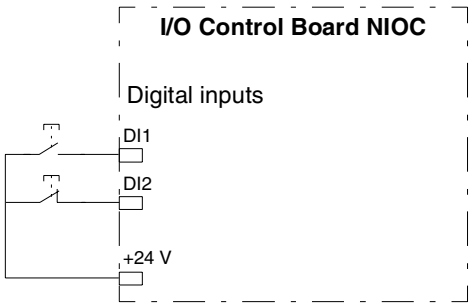
The switch is installed on the front door. The figure below shows an example of the usage of the switch. The switch selects between two control signal interfaces, i.e. the I/O signal terminals and the serial communication link (fieldbus control). Accidental control interface change is prevented by locking the switch.



Push Buttons

Push buttons are available as a special cabinet option for all ACx 607, ACx 617 and ACx 677 units.

The push buttons are installed on the front door. The figure below shows an example of the usage of the buttons.

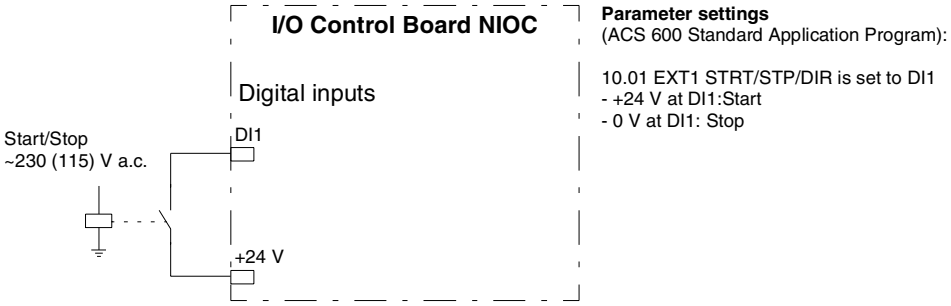


Parameter settings
(ACS 600 Standard Application Program):

10.01 EXT1 STRT/STP/DIR is set to DI1P,2P
- pulse start through digital input DI1
- pulse stop through digital input DI2

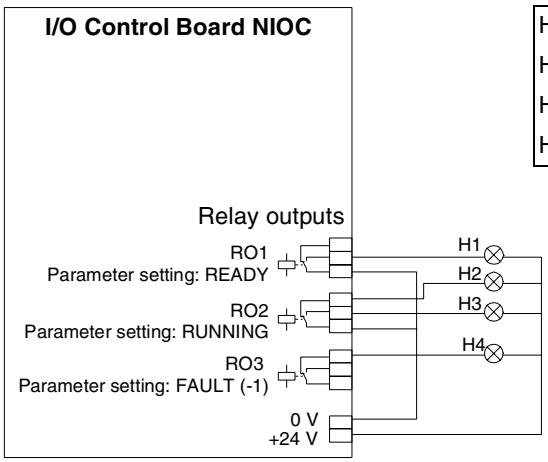
Additional Relay(s) Additional relay(s) is available as a special cabinet option for all ACx 607, ACx 617 and ACx 677 units.

The figure below shows an example of the usage of the additional relay: A 230 V a.c. circuit is used as the source for the start and stop commands. An additional relay is needed between the external 230 V circuit and the ACx 607 digital input DI1 terminal (24 V d.c).



Signal Lamp(s) Signal lamps are available as special cabinet options for all ACx 607, ACx 617 and ACx 677 units.

The signal lamps are installed on the front door above the main disconnecting switch. The figure below shows an example of the use of signal lamps.



H1	ready	green
H2	stopped	white
H3	running	blue
H4	fault	red

Other Options

Control Panel CDP 312

The detachable Control Panel is available as factory-installed and as an add-on kit for ACx 601 and ACx 607. For ACx 604, the panel is available as an add-on kit only. The dimensions of the CDP 312 are (H x W x D): 170 x 80 x 21 mm, weight 0.2 kg.

Panel Link Cables NPLC-0xy

The NPLC series consists of screened telecommunications cables with crossover wiring (suffix **C**) or straight-through wiring (suffix **S**).

The following types are available:

Type	Length [m]	Wiring	Example Application
NPLC-00C	0.5	Crossover (1 to 6, 2 to 5, etc.)	Control Panel connection
NPLC-02C	2		
NPLC-03C	3		
NPLC-00S	0.5	Straight-through (1 to 1, 2 to 2, etc.)	Linking of NIOC boards for common control
NPLC-01S	1		
NPLC-02S	2		

Control Panel Mounting Platform Kit NPMP-01/02/03

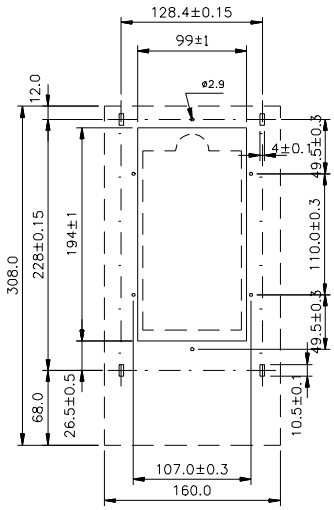
The Panel Mounting Platform add-on kit NPMP-01 includes the Control Panel Mounting Platform, a telephone connector, NDPI-02 Connection Board, and a 3-metre telephone cable. Gaskets are also included for IP54 protection.

NPMP-02 contains the above parts and a CDP 311 Control Panel.

NPMP-03 contains the above parts and a CDP 312 Control Panel.

Mounting Platform

Dimensions (H x W x D):
320 x 193 x 47.5 mm
Protrusion: 22 mm



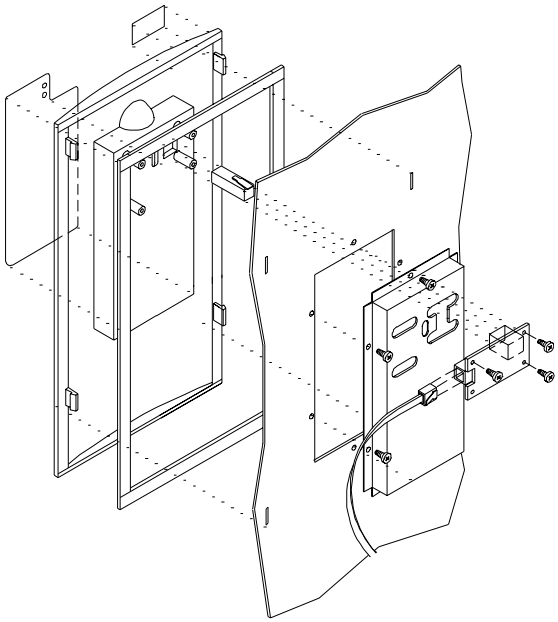


Figure 7-3 Installation of the Control Panel Mounting Platform kit.

The NPMP-xx kits can be used with all ACx 600 types for installing the Control Panel on a cabinet door or a remote control desk. The NDPI-02 Connection Board (supplied with the kit) is wired to the Standard I/O Board (NIOC) of the ACx 600. (See also section *Bus Connection Interface Module NBCI-02* above.) The NDPI-02 has two LEDs which indicate the status of the drive while the control panel is detached. The green LED indicates that the ACx 600 is powered, the red LED indicates that a fault is detected. The Control Panel is attached to the Control Panel Mounting Platform on the cabinet door by pushing it into the recess.

Fibre Optic Cables NLWC-xx

The Fibre Optic Cables option includes two single-core plastic fibre optic cables with connectors at the ends. The option is available as an add-on kit in five lengths:

- 2 metres (NLWC-02)
- 3 metres (NLWC-03)
- 5 metres (NLWC-05)
- 7 metres (NLWC-07)
- 10 metres (NLWC-10)

Fibre optic cables are needed e.g. when connecting an I/O Extension or a fieldbus adapter module to the ACx 600. As standard, the module package contains cable pairs of which the longest one is two metres. If longer cables are required, a suitable type from the available NLWC-xx Fibre Optic Cables options can be chosen.

Coated Circuit Boards

The Coated Circuit Boards option can be ordered as factory-installed for all ACx 600 types. (Coated boards are also available separately as spare parts.) The following boards are coated when this option is selected:

- NAMC (Application and Motor Control Board)
- NIOC (Standard I/O Control Board)
- NINT (Main Circuit Interface Board)
- NGDR (Gate Driver Board)
- NDCO (DDCS Communication Option), if present
- NBRC (Braking Chopper Control Board), if present.

The boards are varnished with a UL-approved acrylic coating for protection against hazards like humidity, dust and dirt, and airborne contaminants. Conformal coating remarkably increases the corrosion resistance of the ACx 600.

To further improve the protection, it is recommended to combine the Coated Circuit Boards option with IP54 protection of the ACx 600.

The allowable contamination levels for the boards are given in the *Technical Data* appendix.

Chapter 8 – Selecting the Motor and the ACS 600

Overview

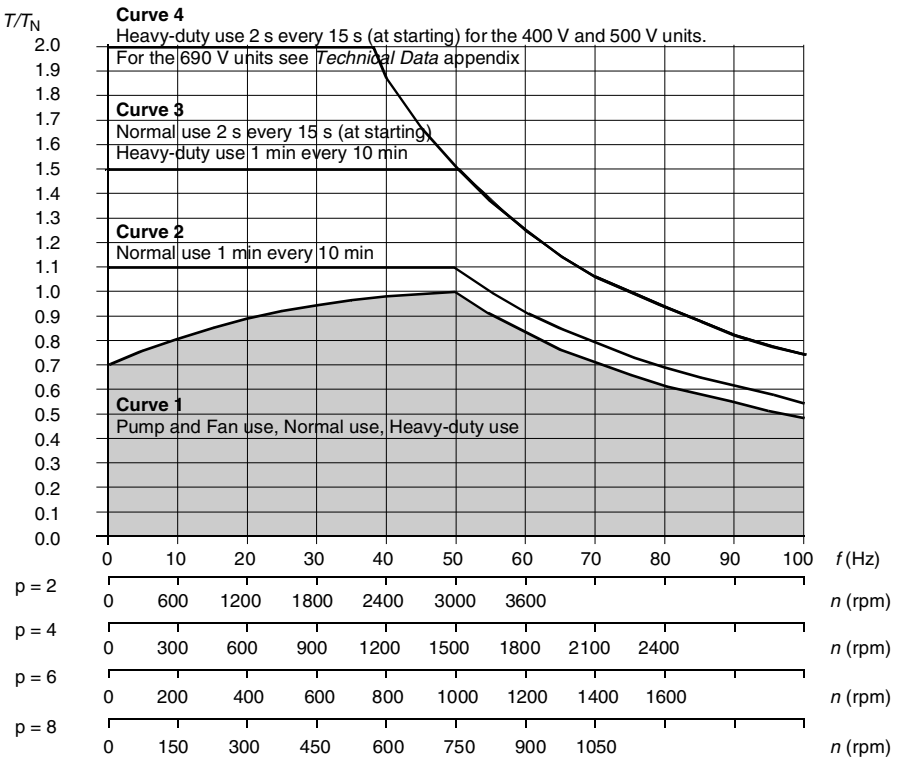
The excellent performance of the ACS 600 makes it suitable for most applications.

To specify your ACS 600 drive, select the ACS 600 rating according to the overload capacity required. Then choose a motor and a suitable ACS 600 for your motor.

There is a Drive*Size* PC tool available for optimal motor and ACS 600 selection. See *Chapter 7 – Optional Equipment* for more information.

Load Capacity Curves

The motor rated frequency and the field weakening point are at 50 Hz.



p = number of poles
T = load torque
T_N = rated motor torque
n = speed
f = output frequency of ACS 600

Figure 8-1 ***Curve 1****: Typical continuous load capacity curve of an IEC 34 self-ventilated motor controlled by the ACS 600.*
Curves 2 and 3*: Short term overload capacity and peak overload (starting torque boost) capacity of a typical IEC 34 motor and ACS 600 combination. The ACS 600 is rated for normal use.*
Curves 3 and 4: *Short term overload capacity and peak overload capacity of a typical IEC 34 motor and ACS 600 combination. The ACS 600 is rated for heavy-duty use.*

Note: If the ACS 600 is operated at high speeds (output frequency over 90 Hz), it should be observed that the motor maximum torque is not exceeded.

At low frequencies, the reduction in the continuous load capacity is due to the fact that the cooling capacity of a self-ventilated motor is reduced. In the field weakening range (f > 50 Hz), the load capacity is reduced because the output voltage of the ACS 600 cannot be increased.

At frequencies above 37.5 Hz, the reduction in the 200 % peak overload capacity (Figure 8-1, Curve 4) is due to the fact that the internal power limit ($1.5 \cdot P_{hd}$) restricts the allowed motor torque.

Selecting the ACS 600 Rating

There are three ratings for the ACS 600, the pump and fan use rating, the normal use rating and the heavy-duty use rating. Typically, the ACS 600 rated for pump and fan use or for normal use is selected. The pump and fan rating provides no overload capacity but the highest possible continuous load capacity. It is suitable for the squared torque applications (pump and fan drives). With the normal use rating ACS 600 provides 110 % short term overload capacity and 150 % peak overload capacity, which fulfils most requirements. If even higher overload capacity is needed the ACS 600 rated for heavy-duty use is selected.

Exception: If Scalar Control is used, the heavy-duty use rated ACS 600 must be selected for constant torque applications, even if no high overload capacity is required. Scalar Control must be used instead of Direct Torque Control in special applications, such as variable configuration multimotor drives. For more information on Scalar Control, see *Chapter 2 – Motor Control Methods* and *Chapter 6 – Standard Features*.

Motor Selection

As a general rule, the motor rated speed should be selected so that the motor continuous load capacity throughout the required speed range is as high as possible.

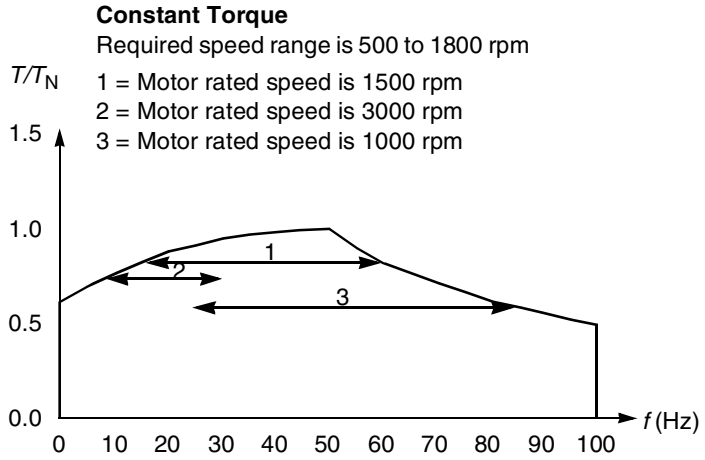


Figure 8-2 Continuous load capacities for three motors controlled by the ACS 600; required speed range is 500 to 1800 rpm. A four-pole motor, synchronous speed 1500 rpm, is selected.

The rated motor power must be higher than the continuous power required by the driven machine. In addition, the following factors must be considered:

- the continuous load capacity of the motor controlled by the ACS 600,
- the short-term overload capacity of the motor controlled by the ACS 600,
- the peak overload capacity of the motor controlled by the ACS 600.

The relation between the motor power and the torque is given by:

$$P = n \cdot T / 9550 \text{ kW}$$

P = power (kW)
n = speed (rpm)
T = torque (Nm)
$9550 = 1000 \cdot 60/(2 \cdot \pi)$

ACS 600 Selection

The ACS 600 is selected according to the rated motor power. It must be then checked that the rated output current of the ACS 600 is higher than, or equal to, the rated motor current.

In certain situations, it is possible to use an oversize motor. Please consult an ABB representative for more information.

To Be Noted

This chapter contains the general rating instructions for the motor and the ACS 600. It is assumed that the motor overload capacities correspond to the figures given for the ACS 600.

In applications requiring an exceptionally high short term overload capacity, the simplification above may lead to selection of a motor with higher rating to what is actually required. However, the ACS 600 is correctly selected also in these cases. If in any doubt about the preliminary motor selection, please refer to the actual overload capacity figures given by the motor manufacturer.

In applications requiring high peak overload capacities (up to 200 %), it should always be observed that the motor maximum torque is not exceeded.

Example 1.a
Constant Torque Drive

The minimum and maximum speeds are 600 rpm and 1900 rpm. The continuous torque required on the motor shaft is constant at 20 Nm, and the breakaway torque (during start for about one second) is 30 Nm. The supply voltage is 400 V.

Selecting the ACS 600 Rating

The ACS 600 is selected according to the normal use rating since the breakaway torque is not exceptionally high and no short term overload capacity is required.

Motor Selection

A four-pole motor is chosen. Its synchronous speed is 1500 rpm at 50 Hz.

The motor power rating is calculated:

- The power corresponding to the continuous load torque (20 Nm) is $P = 1900 \cdot 20/9550 = 4.0$ kW.
- The continuous load capacity of the motor controlled by ACS 600 is 89 % at 600 rpm and 80 % at 1900 rpm. See Figure 8-1, Curve 1.
- The peak overload capacity of the motor controlled by ACS 600 is 150 %. See Figure 8-1, Curve 3.
- No short term overload capacity is required.

Table 8-1 The required motor torque rating at critical points.

Critical Point	Load Capacity Restriction	Required Motor Rated Torque
Start	150 % (Curve 3)	30/1.5 = 20 Nm
600 rpm (20 Hz)	89 % (Curve 1)	20/0.89 = 22.5 Nm
1900 rpm (63.3 Hz)	80 % (Curve 1)	20/0.80 = 25 Nm

The motor is rated according to the most critical point. The required motor power is $P = 1500 \cdot 25/9550 = 3.9$ kW. The next larger standard motor from a motor catalogue is chosen. The rated power is 4 kW and the rated current is 9 A.

ACS 600 Selection

For the 4.0 kW motor, the ACS 601-0006-3 is selected. The rated currents are checked. Since the rated motor current is lower than the rated output current of the ACS 600, the selection is accepted.

Example 1.b *Constant Torque Drive High Breakaway Torque*

The requirements are the same as in *Example 1.a*, except that a 70 Nm breakaway torque is required.

Selecting the ACS 600 Rating

The ACS 600 is chosen according to the heavy-duty use rating since a breakaway torque higher than 150 % of continuous load torque is required.

Motor Selection

A four-pole motor is selected. Its synchronous speed is 1500 rpm at 50 Hz.

The motor power rating is calculated:

- The power corresponding to the continuous load torque of 20 Nm is $P = 1900 \cdot 20/9550 = 4.0$ kW.
- The continuous load capacity of the motor controlled by ACS 600 is 89 % at 600 rpm and 80 % at 1900 rpm. See Figure 8-1, Curve 1.
- The peak overload capacity of the motor controlled by ACS 600 is 200 %. See Figure 8-1, Curve 4.
- No short term overload capacity is required.

Table 8-2 The required motor torque rating at critical points.

Critical Point	Load Capacity Restriction	Required Motor Rated Torque
Start	200 % (Curve 4)	70/2.00 = 35 Nm
600 rpm (20 Hz)	89 % (Curve 1)	20/0.89 = 22.5 Nm
1900 rpm (63.3 Hz)	80 (Curve 1)	20/0.80 = 25 Nm

The motor power is rated according to the most critical point. The required motor power is $P = 1500 \cdot 35/9550 = 5.5$ kW. A standard motor is chosen from a motor catalogue. The rated power is 5.5 kW and the rated current is 12 A.

ACS 600 Selection

For the 5.5 kW motor, the ACS 601-0011-3 is selected. The rated currents are checked. Since the rated motor current is lower than the rated output current of the ACS 600, the selection is accepted.

Example 2 *Squared Torque Drive*

The power requirement of a centrifugal fan is 40 kW at 3000 rpm. The maximum fan speed is 3600 rpm and the minimum speed is 1200 rpm. The supply voltage is 400 V.

Selecting the ACS 600 Rating

The ACS 600 is selected according to the pump and fan use rating since no overload capacity is required.

Motor Selection

A two-pole motor is chosen. Its synchronous speed is 3000 rpm at 50 Hz.

Since the torque of a centrifugal fan increases according to the square of the speed and the power according to the cube of the speed, the required motor power is calculated only on the basis of the required power at maximum speed.

$P = (3600/3000)^3 \cdot 40$ kW = 69.1 kW.

The continuous load capacity of the motor controlled by the ACS 600 is 83 % (Figure 8-1, Curve 1) at 3600 rpm. The required motor torque is $T = 9550 \cdot 69.1/(3600 \cdot 0.83) = 220.9$ Nm and the required motor power is $P = 3000 \cdot 220.9/9550 = 69.4$ kW.

The next larger standard motor from a motor catalogue is selected. The rated power is 75 kW and the rated current is 135 A.

ACS 600 Selection

For the 75 kW motor, the ACS 601-0100-3 is selected. The rated currents are checked. Since the rated motor current is lower than the rated output current of the ACS 600, the selection is accepted.

***Example 3** Constant Torque Drive High Short Term Overload Required*

The drive is run at a constant 800 rpm speed. The load torque on the motor shaft varies in 10 minute cycles: the torque is 800 Nm for nine minutes and 1500 Nm for one minute. The starting torque is 1800 Nm (needed for about one second). The supply voltage is 400 V.

Selecting the ACS 600 Rating

The ACS 600 is selected according to the heavy-duty use rating since short term overload capacity more than 110% of continuous load torque is required.

Motor Selection

An eight-pole motor is chosen. Its synchronous speed is 750 rpm at 50 Hz.

The continuous power required by the driven machine is $P = 800 \cdot 800/9550 = 67$ kW.

- The continuous load capacity of the motor controlled by the ACS 600 is 94 % at 800 rpm. See Figure 8-1, Curve 1.
- The peak overload capacity of the motor controlled by the ACS 600 is 200 % (during the start). See Figure 8-1, Curve 3.
- The short term overload capacity of the ACS 600 is 140 % at 800 rpm during a one minute step. See Figure 8-1, Curve 3.

Table 8-3 The required motor torque rating at critical points:

Critical Point	Load Capacity Restrictions	Required Motor Rated Torque
Start	200 % (Curve 4)	1800/2.00 = 900 Nm
800 rpm (continuous)	94 % (Curve 1)	800/0.94 = 851 Nm
800 rpm (1 min step)	140 % (Curve 3)	1500/1.4 = 1071 Nm

The motor is rated according to the most critical point. The required motor power is $P = 750 \cdot 1071/9550 = 84.1$ kW. The next larger standard motor from a motor catalogue is chosen. The rated power is 90 kW and the rated current is 178 A.

ACS 600 Selection

For the 90 kW motor, the ACS 607-0140-3 is selected. The rated currents are checked. Since the rated motor current is lower than the rated output current of the ACS 600, the selection is accepted.

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Chapter 9 – Installation Guidelines

Input Fuses

The fuses are needed for input bridge and mains cable short circuit protection. The ACx 600 protects the installation against overload.

ACx 601

For frame sizes R5, R6 and R7, ultrarapid fuses must be used. Ultrarapid fuses are recommended also for frame sizes R2, R3 and R4. Fuses are to be installed outside the unit, one for each phase conductor. The ultrarapid fuses protect the ACx 600 input bridge in internal short circuits. When installed at the distribution board, they also protect the mains cable against short-circuits.

ACx 604 / ACx 607 / ACx 617 / ACx 677

The ACx 607, ACx 617 and ACx 677 are equipped with internal ultrarapid fuses that protect the input bridge against short-circuits. The ACx 604 is not equipped with input fuses. When installing the ACx 604, the supply must always be connected via ultrarapid fuses. When the ultrarapid fuses are installed at the distribution board, they also protect the mains cable against short-circuits.

Supply Disconnecting Device

The ACx 601 and ACx 604 are not equipped with a disconnector or main switch. According to European Standard EN 60204-1, *Safety of Machinery*, a hand-operated supply disconnecting device shall be installed in each power supply. The disconnecting device must be one of the following types:

- a switch-disconnector in accordance with EN 60947-3; utilization category AC-23B or DC-23B;
- a disconnector which has an auxiliary contact which in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector;
- a circuit-breaker in accordance with EN 60947-2 suitable for isolation in accordance with EN 60947-3.

The ACx 607, ACx 617 and ACx 677 can be equipped with a hand operated main switch, which fulfils the above requirements for the supply disconnecting device. The ACx 607 can also be equipped with line contactor, start-stop switch and emergency stop switch.

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ACS 600

Technical Data

ACS 600 Standard
ACS 601
ACS 604/607/627 R7 to 2×R9 (up to -0610-3, -0760-5, -0760-6)
ACS 607/627 R11i to 4×R11i (-0760-3, -0930-5, -0900-6 or above)
ACS 617
ACS 677

ACS 600 CraneDrive
ACC 601
ACC 604/607/627 R7 to 2×R9 (up to -0610-3, -0760-5, -0760-6)
ACC 607/627 R11i to 4×R11i (-0760-3, -0930-5, -0900-6 or above)
ACC 617
ACC 677

ACS 600 MotionControl
ACP 601
ACP 604/607/627 R7 to 2×R9 (up to -0320-3, -0400-5)

ACS/ACC/ACP 600
Frequency Converters

Technical Data

3AFY 61523014 R0325
EN
EFFECTIVE: 2000-06-09
SUPERSEDES: 1998-10-23

Table of Contents

Technical Data – ACS/ACC 607/627 R11i to 4×R11i, ACx 617 and ACx 677

General Technical Data – ACx 601, ACx 604 and ACx 607/627/677 R7 to 2×R9

Mains Connection

Voltage (U_1):
380/400/415 VAC 3-phase ± 10 % for 400 VAC units
380/400/415/440/460/480/500 VAC 3-phase ± 10 % for 500 VAC units
525/550/575/600/660/690 VAC 3-phase ± 10 % for 690 VAC units
(690 VAC 3-phase -10...+ 5 % for ACx 607/627/677 units)

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

Units up to -0320-3, -0400-5 and -0400-6 are measured according to UL requirements. They are 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. ± 3 % of nominal phase to phase input voltage

Fundamental Power Factor (cos φ_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 · f_{FWP} ($f_{FWP} = \frac{U_{Nmains}}{U_{Nmotor}} \cdot f_{Nmotor}$), and max. 300 Hz
Scalar Control mode (not for ACP 600): 0 to 300 Hz

With du/dt Filter (DTC and Scalar Control modes): 0 to 120 Hz
f_{FWP}: Frequency at field weakening point; U_{Nmains}: Mains voltage;
U_{Nmotor}: Rated motor voltage; f_{Nmotor}: Rated motor frequency

Frequency Resolution: 0.01 Hz

Power Limit: 1.5 · P_{hd}

Overcurrent Trip: 3.5 · I_{2hd}

Field Weakening Point: 8 to 300 Hz

Switching Frequency:

	400/500 V Units	690 V units
3 kHz (average)	ACx 601, ACx 604, ACx 607 (up to -0610-3, -0760-5)	
2 kHz (average)	ACx 607/627/677 (-760-3, -930-5 or above)	ACx 601, ACx 604, ACx 607/627/677

Maximum Recommended Motor Cable Length: This is the cumulative length in case of parallel connected motors. Note also the restrictions given in section *Compliance with the EMC Directive*.

- 300 m (980 ft): ACx 601, ACx 604, ACx 607/627 (up to -0610-3, -0760-5, -0760-6). For ACx 601-0005-3 to ACx 601-0016-3, ACx 601-0006-5 to ACx 601-0020-5, ACx 601-0009-6 to ACx 601-0020-6, if the motor cable length exceeds 70 metres, an ABB representative should be consulted.
- 500 m (1640 ft): ACx 607/627/677-0760-3, -0930-5, -0900-6 or above

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

Efficiency and Cooling Method

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/ACS/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 607/627/677, 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.

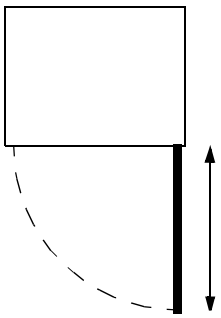
[2)] See subsection *Output Current Temperature Derating*.

Degree of Protection and Free Space

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
607/627/ 677	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 2×R8 and 2×R9
[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.



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

NIOC and NIOCP Board Specifications

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

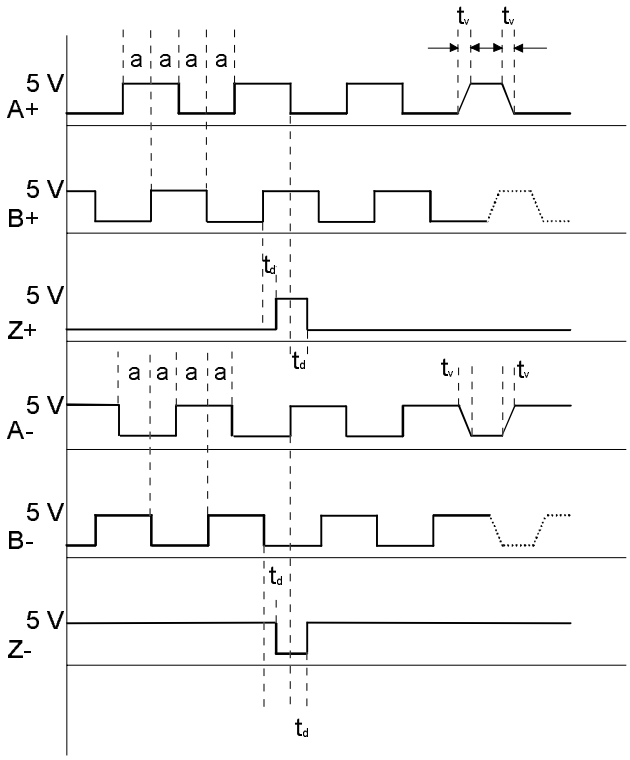
	ACS/ACC/ACP 600 NIOC-01 Board	**ACP 600 NIOCP-01 Board**
Analogue Inputs The advantage of the differential analogue input is that the earth potential of the device or transmitter sending an analogue signal can differ up to ± 15 V from the earth potential of the ACx 600 chassis without disturbing the signal. Differential input also efficiently attenuates common mode disturbances coupled to control cables.	**ACS 600: Two Programmable Differential Current Inputs:** 0 (4) to 20 mA, R_{in} = 100 Ω **ACC 600: Two Differential Current Inputs:** 0 to 20 mA, R_{in} = 100 Ω **ACP 600: One Programmable Differential Current Input:** 0 to 20 mA, R_{in} = 100 Ω **ACS/ACP 600: One Programmable Differential Voltage Input:** ACS 600: 0 (2) to 10 V, R_{in} > 200 kΩ; ACP 600: 0 to 10 V, R_{in} > 200 kΩ **ACC 600: One Differential Voltage Input:** 0 to 10 V, R_{in} > 200 kΩ **Common Mode Voltage:** ± 15 VDC, max. **Common Mode Rejection Ratio:** ≥ 60 dB at 50 Hz **Resolution:** 0.1 % (10 bit) **Inaccuracy:** ± 0.5 % (Full Scale Range) at 25 °C. Temperature Coefficient: ± 100 ppm/°C, max. **Input Updating Time:** 12 ms (ACS 600), 44 ms (ACC 600), 1 ms (ACP 600)	**Two Bipolar Differential Voltage Inputs:** ± 10 V, R_{in} = 30 kΩ **Common Mode Voltage:** ± 20 VDC, max. **Common Mode Rejection Ratio:** ≥ 60 dB at 50 Hz **Resolution:** 0.02 % (12 bit) **Accuracy:** 11 bit **Inaccuracy:** ± 0.1 % (Full Scale Range) at 25 °C. Temperature Coefficient: ± 100 ppm/°C, max. **Input Updating Time:** 1 ms
Constant Voltage Output	**Voltage:** 10 VDC ± 0.5 % (Full Scale Range) at 25 °C. Temperature Coefficient: ± 100 ppm/°C, max. **Maximum Load:** 10 mA **Applicable Potentiometer:** 1 kΩ to 10 kΩ	**Voltage:** ± 10 VDC ± 0.5 % (Full Scale Range) at 25 °C. Temperature Coefficient: ± 100 ppm/°C, max. **Maximum Load:** 10 mA **Applicable Potentiometer:** ≥ 1 kΩ
Auxiliary Power Output	**Voltage:** 24 VDC ± 10 %, Short circuit proof **Maximum Current:** 250 mA (130 mA with NLMD-01 option)	**Voltage:** 24 VDC ± 10 %, Short circuit proof **Maximum Current:** 300 mA
Analogue Outputs	**ACS/ACC 600: Two Programmable Current Outputs:** 0 (4) to 20 mA, R_L ≤ 700 Ω **ACP 600: One Programmable Current Output:** 0 to 20 mA, R_L ≤ 700 Ω **Resolution:** 0.1 % (10 bit) **Inaccuracy:** ± 1 % (Full Scale Range) at 25 °C. Temperature Coefficient: ± 200 ppm/°C, max. **Output Updating Time:** 24 or 100 ms (ACS 600), 44 ms (ACC 600), 8 ms (ACP 600)	**One Bipolar Programmable Voltage Output:** ± 10 V, R_L ≥ 2 kΩ **Resolution:** 0.02 % (12 bit) **Accuracy:** 10 bit **Inaccuracy:** ± 0.1 % (Full Scale Range) at 25 °C. Temperature Coefficient: ± 200 ppm/°C, max. **Output Updating Time:** 2 ms **Output Rising Time:** 3 ms

	ACS/ACC/ACP 600 NIOC-01 Board	**ACP 600 NIOCP-01 Board**
Digital Inputs	**ACS/ACP 600: Six Programmable Digital Inputs (Common Ground):** 24 VDC, -15 % to +20 % **ACC 600: Six Digital Inputs (Common Ground):** 24 VDC, -15 % to +20 % **Logical Thresholds:** < 8 VDC ≙ "0", > 12 VDC ≙ "1" **Input Current:** DI1 to DI 5: 10 mA, DI6: 5 mA **Filtering Time Constant:** 1 ms **Thermistor Input:** 5 mA, < 1.5 kΩ ≙ "1" (normal temperature), > 4 kΩ ≙ "0" (high temperature), Open Circuit ≙ "0" (high temperature) **Internal Supply For Digital Inputs (+24 VDC):** Short circuit proof, group isolated **Isolation Test Voltage:** 500 VAC, 1 minute **Input Updating Time:** 12 ms (ACS 600), 44 ms (ACC 600), 4 ms (ACP 600) An external 24 VDC supply can be used instead of the internal supply.	**12 Programmable Digital Inputs (Common Ground):** 24 VDC, -15 % to +20 % **Logical Thresholds:** < 8 VDC ≙ "0", > 12 VDC ≙ "1" **Filtering Time Constant:** ≤ 50 µs DI 11 and DI 12 can be used for time measurement between two external events (PROBE1 and PROBE2). **Internal Supply For Digital Inputs (+24 VDC):** Short circuit proof, group isolated **Isolation Test Voltage:** 500 VAC, 1 minute **Input Updating Time:** 1 ms An external 24 VDC supply can be used instead of the internal supply. **Filtering Time Constant:** ≤ 100 µs
Digital Outputs	-	**Four Programmable Digital Outputs:** Short circuit proof, Overload protection **Maximum Load:** 10 mA with internal 24 V supply, 100 mA with external supply **Output Updating Time:** 2 ms
Relay Outputs	**Three Programmable Relay Outputs** **Switching Capacity:** 8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC **Minimum Continuous Current:** 5 mA rms at 24 VDC **Maximum Continuous Current:** 2 A rms **Contact Material:** Silver Cadmium Oxide (AgCdO) **Isolation Test Voltage:** 4 kVAC, 1 minute **Output Updating Time:** 100 ms (ACS 600), 44 ms (ACC 600), 8 ms (ACP 600)	**One Relay Output** **Switching Capacity:** 8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC **Minimum Continuous Current:** 5 mA rms at 24 VDC **Max Continuous Current:** 2 A rms **Contact Material:** Silver Cadmium Oxide (AgCdO) **Isolation Test Voltage:** 4 kVAC, 1 minute **Output Updating Time:** 2 ms
DDCS Fibre Optic Link	**Protocol:** DDCS (ABB Distributed Drives Communication System)	
Modbus Communication Link	**RS 485** **Transmission Rate:** Max. 9600 bit/s **Parity:** Selectable **Connectors:** Shielded modular telecommunication socket	

	ACS/ACC/ACP 600 NIOC-01 Board	ACP 600 NIOCP-01 Board
Encoder Input		**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. **Required Encoder Type:** the type listed here or equivalent: · GI 356 (IRION & VOSSELER) · ROD 426A (Heidenhain) **Encoder Signals:** Signal level/Load capacity: 5 V rectangular-pulse signals; Time between edges: a > 0,8 µs 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_{max} = 200 kHz.

Encoder Signals at NIOCP

The diagram below shows typical encoder output waveforms. The encoder output channel that leads when the motor is turning forward should be connected to input A of the NIOCP board terminal X8, the output channel that trails to input B of the NIOCP board terminal X8.



ACS 600 Control Connections on the NIOC Board

Below are the ACS 600 standard control connections on the NIOC board. For the control connections of ACC and ACP see the firmware manuals.

Terminal Block Size
X21, X22, X23, X25, X26, X27: cables 0.5 to 1.5 mm^2
Control Cable Lead-through Size:
Ø: 2 x 3x2...11 mm

Factory settings of application software selection B (type code):
DI1: Start, DI2: Stop, DI3: Reverse, DI4: Acc/Dec 2, DI5,6: Constant speed 1 to 3 select.

1) If Par. 10.3 is REQUEST.

2) Operation: 0 = Open, 1 = Closed

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

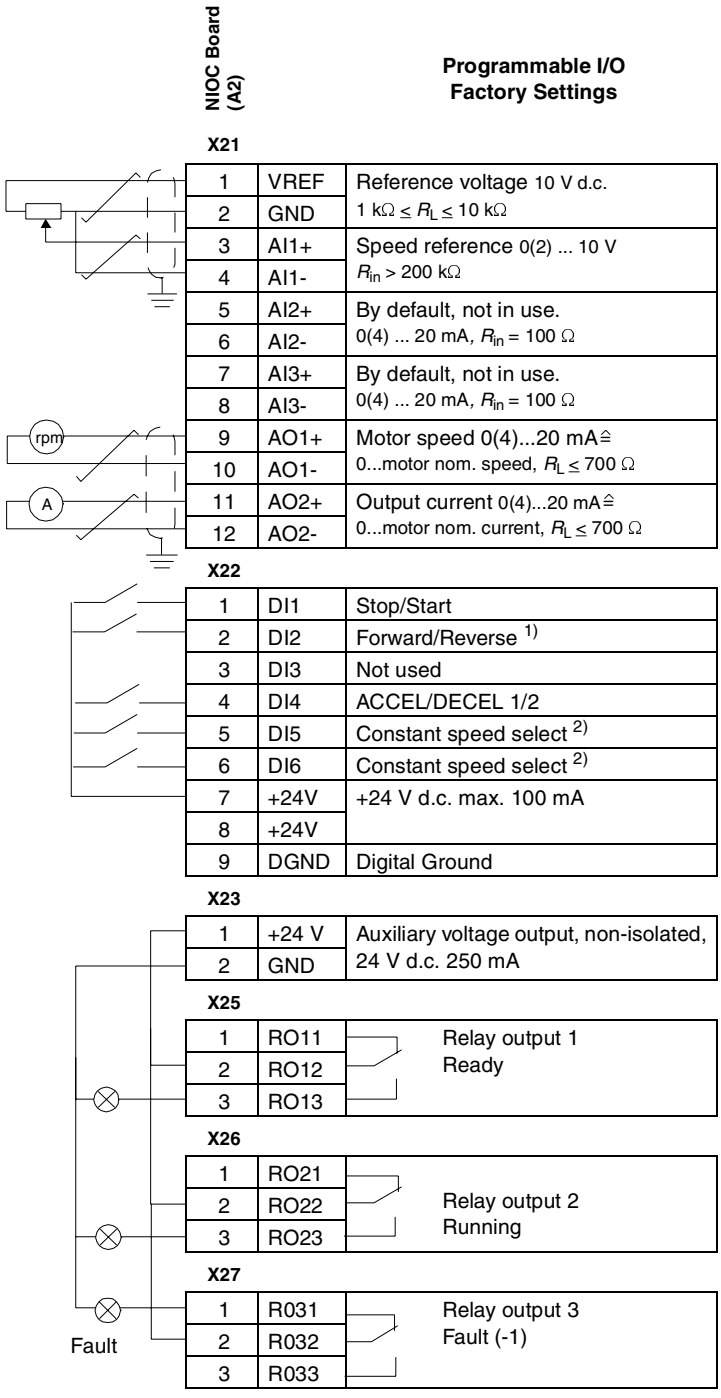
Connector X28 for RS 485 connection*

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

Connector X29 for RS 485 connection*

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

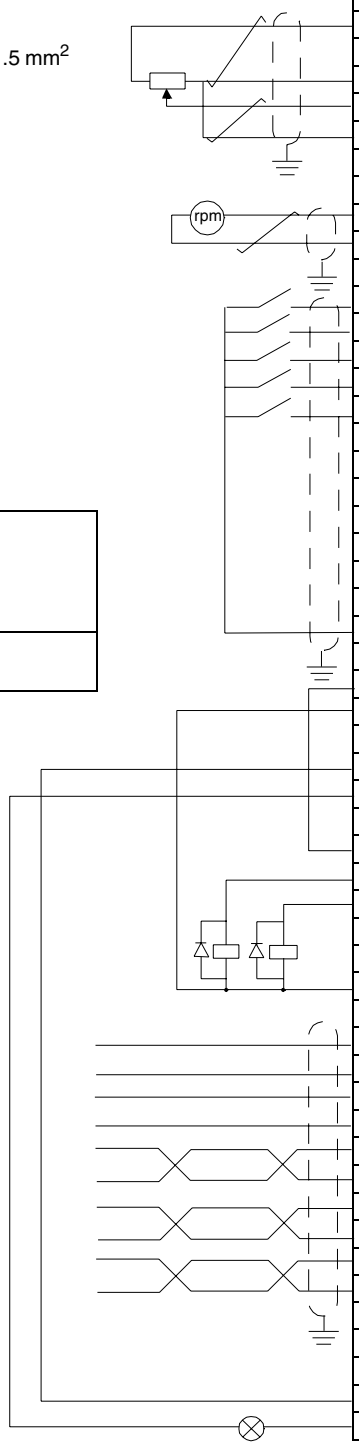
* Connector shield is connected via RC filter to frame.



ACP 600 Control Connections on the NIOCP Board

External control connections of ACP 600 with NIOCP board (and Speed Control Application Macro) are shown below. External control connections are different with other application macros (see *Firmware Manual*). ACP 600 can be equipped with the NIOCP or with the NIOC board.

Terminal Block Size
X21, X22, X23, X25, X26, X27: cables 0.5 to 1.5 mm^2
Control Cable Lead-through Size:
Ø: 2 x 3x2...11 mm



Terminal Block X1		Function
1	+10 V	Reference Voltage +10 VDC
2	AGND	Analogue Ground
3	–10 V	Reference Voltage –10 VDC
4	AI1+	External Reference 1: Speed Reference
5	AI1–	
6	AI2+	External Reference 2: Not defined
7	AI2–	
8	AO1+	SPEED ACT 1
9	AO1–	
Terminal Block X2		
1	DI1	START/STOP
2	DI2	Not defined
3	DI3	FAULT RESET
4	DI4	SPEED REF SW2
5	DI5	ACC/DEC 1/2 SEL
6	DI6	Not defined
7	DI7	
8	DI8	
9	DI9	
10	DI10	
11	DI11	
12	DI12	
13	+24 DV	Control Voltage Output +24 V d.c. max. 135 mA
14	+24 DV	
15	+24 DV	
16	DGND	Digital Ground
Terminal Block X4		
1	+24 V	Auxiliary Voltage Output
2	DGND	0 V
Terminal Block X5		
1	+24 DV	Control Voltage Input
2	DO1	ACT SPEED=0
3	DO2	RUNNING
4	DO3	FAULT (-1)
5	DO4	ACT SPEED=REF
6	DGND	Digital Ground
Terminal Block X8		
1	UENC+	Power Supply
2	SENSE+	Sense+
3	SENSE–	Sense–
4	UENC–	0 V
5	A+	Channel A+
6	A–	Channel A–
7	B+	Channel B+
8	B–	Channel B–
9	Z+	Channel Z+
10	Z–	Channel Z–
Terminal Block X7		
1	RO1 NCC	1 Relay Output, READY Signal
2	RO1 CM	
3	RO1 NOC	

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	

Application Program

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. See below for the application programs and the application macros included in them.

Application Macros

The macros of the application programs are introduced below.

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

Macro/Language Combinations

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

Application Program	Type code char. 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	English

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

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

Preprogrammed Faults	Standard PFC, M/F	Crane	Motion Control	System
ACx 600 temperature	●	●	●	●
Overcurrent	●	●	●	●
Short circuit	●	●	●	●
DC overvoltage	●	●	●	●
Supply phase	●	●	●	●
DC undervoltage	●	●	●	●
Overfrequency	●	●		●
Loss of Control Panel			●	
Internal fault	●	●	●	●
Internal fault on the I/O control board	●	●	●	●
Ambient temperature	●	●	●	●
User Macro	●	●	●	●
Braking chopper (in fieldbus mode)		●		
Inverter overload		●		
No motor data	●	●		●
ID Run fail	●	●		●
Motor fan control and diagnostics				●

Programmable Fault Functions	Standard PFC, M/F	Crane	MotionControl	System
Analogue input below minimum value	●			
Loss of Control Panel	●	●		●
External fault	●	●	●	●
Motor overtemperature	●	●	●	●
Thermistor/Pt 100	●	●	●	●
Motor stalled	●		●	●
Motor underload	●		●	●
Loss of motor phase	●	●	●	●
Earth fault	●	●	●	●
Speed measurement			●	
Motor overspeed		●		
Torque		●		
Torque proving		●		
Master/Follower communication	●	●		
Brake		●		
Communication test			●	
Following error			●	
Position limits	○	○	●	○
Communication error				
Encoder interface module	○	○	●	○
Overspeed			●	

Programm. Supervision Functions	Standard PFC, M/F	Crane	Motion Control	System
Speed	2		2	2
Motor current	●			●
Motor torque	2		●	2
Motor speed	●			●
Reference 1	●			
Reference 2	●			
Actual value 1	●			
Position error			●	
Synchron error			●	
Position threshold			4	
Joystick		●		
Brake long falling time		●		

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

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

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

Applicable Standards

The ACS 600 complies with the following standards:

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

CE Marking

A CE mark is attached to ACx 601/607/627/677 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**lectro**m**agnetic **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.

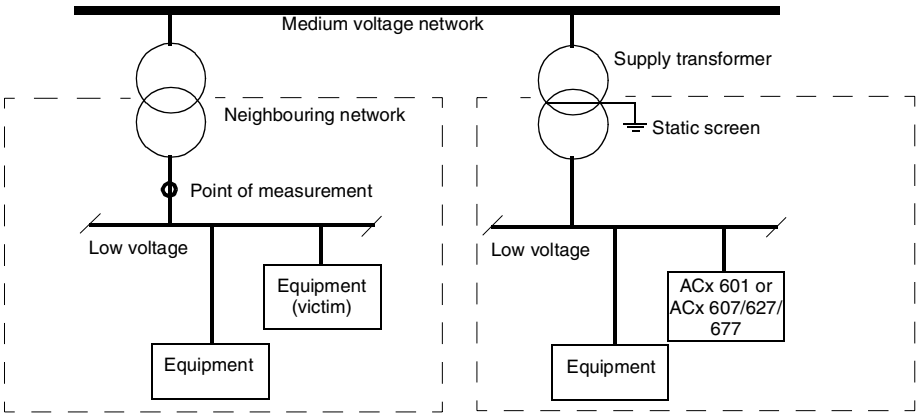
The EMC Directive defines the requirements for immunity and emissions of electrical equipment used in European Economic Area. The EMC product standard EN 61800-3 covers the requirements stated for frequency converters.

The ACx 601 and ACx 607/627/677 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 601 or ACx 607/627 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 or ACx 607/627/677 is installed with motor and control cables as specified in installation manual.

Note: It is recommended to equip the the ACx 601 or ACx 607/627 with the EMC filtering if there is equipment sensitive to conducted emission connected to the same supply transformer as the the ACx 601 or ACx 607/627.



Use of the ACx 601 or ACx 607/627/677 in Second Environment without EMC filtering (EN 61800-3: second environment includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.)

*Table A-1 The EMC filtering of the ACx 601 or ACx 607/627 units is marked in the type code as follows. * du/dt Filters + EMC Filters, ** du/dt Filters + No EMC Filters, *** EMC Cabinet with EMC Filters.*

ACS 600 Type	**Type Code**		
	Character no.	EMC Filter Selections	No EMC Filter Selections
ACS/ACC/ACP 601	ACxxxxxxxxxxxxxxxxxxx 20	0	9
ACS/ACC/ACP 604	ACxxxxxxxxxxxxxxxxxxx 20	0	9
ACS/ACC/ACP 607/627 (up to -0610-3, -0760-5, -0760-6)	ACxxxxxxxxxxxxxxxxxxx 20	0, 3*	5**, 9
ACS/ACC 607/627 (-0760-3, -0930-5, -0900-6 or above)	ACxxxxxxxxxxxxxxxxxxxxxxxx... 26	1, 2***	0,
ACS 600 MultiDrive Supply Section	ACA63xxxxxxxxxxxx... 16	1, 2***	0
Drive Section	ACA610xxxxxxxxxxx... 16	1	0

Public Low-Voltage Network

ACS/ACC 607/627 (-760-3, -0930-5, -0900-6 or above) nor ACx 677 types are not designed for the public low-voltage nertworks.

Other ACx 601 or ACx 607/627 types:

1. The ACx 601 or ACx 607/627 is equipped with EMC filtering (refer to Table A-1).
2. The ACx 601 or ACx 607/627 is installed with motor and control cables as specified in installation manual.
3. Maximum cable length is 100 metres.

Without considering the EMC requirements, do not use the ACx 601 or ACx 607/627 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 or ACx 607/627/677 is installed with motor and control cables as specified in installation manual.

Note: The ACx 601 or ACx 607/627 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 and ACx 604 and ACx 607/627/677 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/CSA markings are required in North America. The UL/UL_C/ CSA markings of the ACS 600 frequency converters are listed below (x).

ACS 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.

"C-tick" Marking

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

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

1. The ACx 601 or ACx 607 is equipped with EMC filtering (refer to Table A-1).
2. The ACx 601 or ACx 607 is installed according to the instructions given in the manual.
3. The motor and control cables are selected as specified in the manual.
4. Maximum cable length is 100 metres.

Note: The ACx 601 or ACx 607 must not be equipped with EMC filtering (refer to Table A-1) when installed to IT networks. The mains becomes connected to earth potential through the EMC filter capacitors. In IT networks this may cause danger or damage the unit.

Materials

The table below lists the enlosure and package materials.

	Enclosure			Package
	Material	**Thickness of Coating**	**Color**	**Material**
ACx 601	PS (polystyrene) 3 mm		NCS 1502-Y (RAL 90021 / PMS 420 C)	Corrugated board (frames R2 to R5 and option modules), plywood (R6). Plastic covering of the package: PE-LD, bands PP or steel.
	hot-dip zink 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	
ACx 604 ACx 607/627/ 677	hot-dip zink coated steel sheet 1.5 to 2 mm with polyester thermosetting powder coating	60 µm	RAL 7035	Wood or plywood (seaworthy package). Plastic covering of the package: PE-LD, bands PP or steel.

Disposal

ACx 601, ACx 604, and ACx 607/627/677 contain raw materials that should be recycled, thus preserving energy and natural resources. Package materials 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.

ACx 601 Specific 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					Duty Cycle 1/5 min		Duty Cycle [1] 2/15 s					
	I_{2N} 4/5min [A]	I_{2Nmax} 1/5min [A]	S_N [kVA]	P_N [kW]	P_N [HP]	I_{2hd} 4/5min [A]	I_{2hdmax} 1/5min [A]	I_{2hd} 13/15s [A]	I_{2hdmax} 2/15s [A]	S_{hd} [kVA]	P_{hd} [kW]	P_{hd} [HP]	
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	R5
ACx 601-0050-5	58	64	50	37	40	47	71	47	94	40	30	30	
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	R6
ACx 601-0100-5	112	123	100	75	75	84	126	84	168	70	55	60	
ACx 601-0120-5	135	149	120	90	100	112	168	112	224	100	75	75	R7
ACx 601-0140-5	164	180	140	110	125	135	203	135	270	120	90	100	
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	
ACx 601-0011-6	11	12	11	7.5	10	7.6	11	7.6	11	9	5.5	7.5	R3
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	
ACx 601-0025-6	25	28	25	18.5	25	20	30	20	30	20	15	20	R4
ACx 601-0030-6	28	31	30	22	30	25	38	25	38	25	18.5	25	
ACx 601-0040-6	36	40	40	30	40	28	42	28	42	30	22	30	R5
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 · 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 3.*

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

Notes concerning Pump and Fan Use only

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

( ) typically achieved 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 min) = 1.1 · I_{2N}

I_{2Nmax} (2/15 s) = 1.5 · 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 min) = 1.5 · I_{2hd}
I_{2hdmax} (2/15 s) = 2.0 · I_{2hd} (400 and 500 VAC units) or 1.5 · 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			Duty Cycle 1/5 min		Duty Cycle [1] 2/15 s			
	I_{2N} 4/5min [A]	I_{2Nmax} 1/5min [A]	P_N [HP]	I_{2hd} 4/5min [A]	I_{2hdmax} 1/5min [A]	I_{2hd} 13/15s [A]	I_{2hdmax} 2/15s [A]	P_{hd} [HP]	
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

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

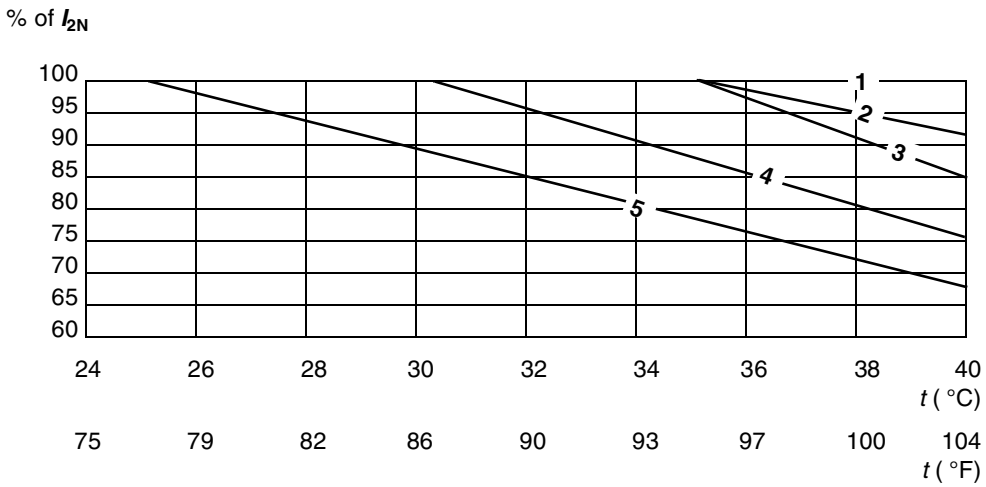
  The output current is then $0.65 \cdot I_{2N}$, $0.65 \cdot I_{2hd}$ or $0.65 \cdot I_{2Nsq}$.

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 $0.92 \cdot 0.65 \cdot I_{2N}$.

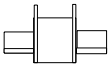
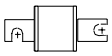
Diagram Output current for ACS/ACC/ACP 601 with degree of protection IP 54 and with ambient temperature from 25 °C (77 °F) to 40 °C (104 °F) is presented in the diagram below. I_{2N} total rms output current for normal use.
Note: The output current in heavy-duty use (I_{2hd}) must be smaller or equal 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		

Fuses

Recommended input fuse ratings of the ACx 601 are below.
A minimum rated current in amperes, **A^2s** maximum I^2t value, **V** rated voltage in volts.

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

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

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.

Example: For ACx 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 · 178 A = 195.8 A and 1.5 · 147 A = 220.5 A and 1.0 · 200 A = 200 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		
	mm^2	AWG	mm	in	Nm	Ft/lbs	mm^2	AWG	mm	in	mm^2
ACx 601-0005-3/0006-5 ACx 601-0006-3/0009-5 ACx 601-0009-3/0011-5	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 601-0009-6/0011-6 ACx 601-0011-3/0016-5/0016-6 ACx 601-0016-3/0020-5/0020-6	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 601-0020-3/0025-5/0025-6 ACx 601-0025-3/0030-5/0030-6	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 601-0030-3/0040-5/0040-6 ACx 601-0040-3/0050-5/0050-6 ACx 601-0050-3/0060-5	Cu35 *) Al 50	Cu2 *)	20...26	0.79...1.0	8	6	35	2	10...14	0.39...0.55	M6
ACx 601-0060-3/0070-5/0060-6 ACx 601-0070-3/0100-5/0070-6	70	2/0	26...35	0.79...1.4	8	6	35	2	10...14	0.39...0.55	M6
ACx 601-0100-3/0120-5/0100-6 ACx 601-0120-3/0140-5/0120-6	M10 1)				30	22	70	2/0			M8

*) 35 mm^2 copper cable or 50 mm^2 aluminium conductor

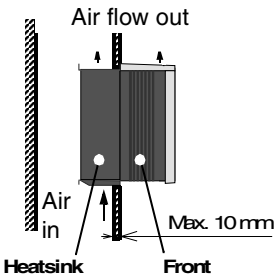
1) The maximum acceptable size of the mains and motor cable is 3x120+70 (3x(AWG 0000) + AWG 00); cross-sectional areas of copper conductors in mm^2, 3 x phase conductor + PE conductor). Aluminium cable cannot be connected due to cable lug size.

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					

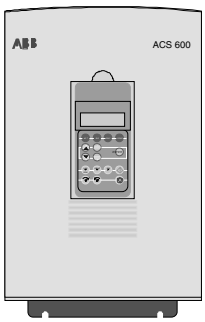
Cooling Air Duct



Heat dissipations and cooling air flows of ACS/ACC/ACP 601 in a cooling air duct installation are below.

Degree of Protection	Heat Dissipation		Cooling Air Flow Out	
	Heatsink	Front	Heatsink	Front
IP 22	85 %	15 %	80 %	20 %
IP 54	90 %	10 %	100 %	0 %

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

Noise

The noise values of the ACx 601 units are given in Table below.

ACx 600 type			Noise	
			No Load [dB]	Nominal Load [dB]
-0005-3	-0006-5		54.5	61.1
-0006-3	-0009-5			
-0009-3	-0011-5			
-0011-3	-0016-5	-0009-6	45.1	49.0
-0016-3	-0020-5	-0011-6		
		-0016-6		
		-0020-6		
-0020-3	-0025-5	-0025-6	56.2	61.5
-0025-3	-0030-5	-0030-6		
-0030-3	-0040-5	-0040-6	59.8	65.0
-0040-3	-0050-5	-0050-6		
-0050-3	-0060-5			
-0060-3	-0070-5	-0060-6		
-0070-3	-0100-5	-0070-6		
-0100-3	-0120-5	-0100-6	60.4	65.8
-0120-3	-0140-5	-0120-6		

ACx 604/624 and ACx 607/627 R7 to 2×R9 Specific Technical Data

IEC Ratings

The IEC ratings for ACx 604/624 and ACx 607/627 R7 to 2×R9 with 50 Hz and 60 Hz supplies are below. ACx = ACS/ACC/ACP. See next page for symbols.

ACx 6x4, ACx 6x7= The ratings are also valid for the corresponding 12 pulse units which have a doubled rectifying bridge (type designations ACx 624 and ACx 627). The ACx 607/627 is housed in a cabinet. The ACx 604/627 is to be installed in a cabinet by the user. The 690 V series and 2 x R8 and 2 x R9 frame sizes are not available for ACP 600.

Frequency Converter Type	Normal Use					Heavy-duty Use							Frame Size
	Duty Cycle 1/5 min					Duty Cycle 1/5 min		Duty Cycle [1] 2/15 s					
	I_{2N} 4/5min [A]	I_{2Nmax} 1/5min [A]	S_N [kVA]	P_N [kW]	P_N [HP]	I_{2hd} 4/5min [A]	I_{2hdmax} 1/5min [A]	I_{2hd} 13/15s [A]	I_{2hdmax} 2/15s [A]	S_{hd} [kVA]	P_{hd} [kW]	P_{hd} [HP]	
Three-phase supply voltage 380 V, 400 V or 415 V													
ACx 604/607-0100-3	147	162	100	75	100	112	168	112	224	70	55	75	R7
ACx 604/607-0120-3	178	196	120	90	125	147	221	147	294	100	75	100	
ACx 604/607-0140-3	216	238	140	110	150	178	267	178	356	120	90	125	R8
ACx 604/607-0170-3	260	286	170	132	200	216	324	216	432	140	110	150	
ACx 604/607-0210-3	316	348	210	160	250	260	390	260	520	170	132	200	
ACx 604/607-0260-3	395	435	260	200	300	316	474	316	632	210	160	250	R9
ACx 604/607-0320-3	480	528	320	250	350	395	593	395	790	260	200	300	
ACx 6x4/6x7-0400-3	600	661	400	315	400	494	741	494	988	320	250	350	2xR8
ACx 6x4/6x7-0490-3	751	827	490	400	500	600	901	600	1200	400	315	400	2xR9
ACx 6x4/6x7-0610-3	912	1003	610	500	600	751	1127	751	1502	490	400	500	
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or 500 V													
ACx 604/607-0120-5	135	149	120	90	100	112	168	112	224	100	75	75	R7
ACx 604/607-0140-5	164	180	140	110	125	135	203	135	270	120	90	100	
ACx 604/607-0170-5	200	220	170	132	150	164	246	164	328	140	110	125	R8
ACx 604/607-0210-5	240	264	210	160	200	200	300	200	400	170	132	150	
ACx 604/607-0260-5	300	330	260	200	250	240	360	240	480	210	160	200	
ACx 604/607-0320-5	365	402	320	250	300	300	450	300	600	260	200	250	R9
ACx 604/607-0400-5	460	506	400	315	350	365	548	365	730	320	250	300	
ACx 6x4/6x7-0490-5	570	627	490	400	500	456	684	456	912	400	315	400	2xR8
ACx 6x4/6x7-0610-5	694	764	610	500	600	570	855	570	1140	490	400	500	2xR9
ACx 6x4/6x7-0760-5	874	961	760	630	700	694	1041	694	1388	610	500	600	
Three-phase supply voltage 525 V, 550 V, 575 V, 600 V, 660 V or 690 V													
ACx 604/607-0100-6	88	97	100	75	100	65	98	65	98	70	55	75	R7
ACx 604/607-0120-6	105	116	120	90	125	88	132	88	132	100	75	100	
ACx 604/607-0140-6	127	140	140	110	150	105	158	105	158	120	90	125	R8
ACx 604/607-0170-6	150	165	170	132	150	127	191	127	191	140	110	150	
ACx 604/607-0210-6	179	197	210	160	200	150	225	150	225	170	132	150	
ACx 604/607-0260-6	225	248	260	200	250	179	269	179	269	210	160	200	
ACx 604/607-0320-6	265	292	320	250	300	225	338	225	338	260	200	250	R9
ACx 604/607-0400-6	351	386	400	315	350	265	398	265	398	320	250	300	
ACx 6x4/6x7-0490-6	428	470	490	400	450	340	511	340	510	400	315	350	2 x R8
ACx 6x4/6x7-0610-6	504	555	610	500	500	428	642	428	642	490	400	450	2 x R9
ACx 6x4/6x7-0760-6	667	734	760	630	700	504	756	504	756	610	500	500	

ACS 604/607 Type	Pump and Fan Use (Squared Load)		Frame Size
	I_{2Nsq} [A]	P_N [kW]	
Three-phase supply voltage 380 V, 400 V or 415 V			
ACS 604/607-0100-3	178	90	R7
ACS 604/607-0120-3	200	110 (100)	
ACS 604/607-0140-3	260	132	R8
ACS 604/607-0170-3	300	160	
ACS 604/607-0210-3	375	200	
ACS 604/607-0260-3	480	250	R9
ACS 604/607-0320-3	510	315 (265)	
ACS 6x4/6x7-0400-3	712	400	2xR8
ACS 6x4/6x7-0490-3	912	500	2xR9
ACS 6x4/6x7-0610-3	969	560	
Three-phase supply voltage 380 V, 400 V, 415 V, 440 V, 460 V, 480 V or 500 V			
ACS 604/607-0120-5	164	110	R7
ACS 604/607-0140-5	193	132	
ACS 604/607-0170-5	240	160	R8
ACS 604/607-0210-5	285	200	
ACS 604/607-0260-5	345	250	
ACS 604/607-0320-5	460	315	R9
ACS 604/607-0400-5	490	400 (335)	
ACS 6x4/6x7-0490-5	656	450	2xR8
ACS 6x4/6x7-0610-5	874	630	2xR9
ACS 60x4/6x7-0760-5	990	710	

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

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

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

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

Notes concerning Pump and Fan Use only

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

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

Normal use (10 % overload capacity):

I_{2N}	rated rms output current
I_{2Nmax}	rms overload current (allowed for one minute every 5 minutes): I_{2Nmax} (1/5 min) = 1.1 · I_{2N} I_{2Nmax} (2/15 s) = 1.5 · 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 min) = 1.5 · I_{2hd} I_{2hdmax} (2/15 s) = 2.0 · I_{2hd} (400 and 500 VAC units) or 1.5 · I_{2hd} (690 VAC units)
S_{hd}	rated apparent output power
P_{hd}	typical motor power. The power ratings in kW apply to most IEC 34 motors. The power ratings in HP apply to most four pole NEMA rated motors.

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

I_{2Nsq}	rated rms output current

NEMA Ratings

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

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

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

Output Current Temperature Derating

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

- *General rule:* Above +40 °C / +104 °F (+35 °C / +95 °F for types ACS 60x-0120-03 and ACS 60x-0140-3 with I_{2Nsq} rating), the rated output current is decreased 1.5 % for every additional 1 °C / 1.8 °F (up to +50 °C / +122 °F). This applies to I_{2N} and I_{2Nsq} (for I_{2hd} no derating is needed).

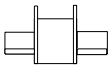
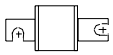
Example 1. If the ambient temperature is 50 °C / +122 °F the derating factor is

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

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

Fuses

Input fuse ratings of the ACxP 607/627 and recommended input fuse ratings of the ACx 604/624 are below. **A** minimum rated current in amperes, **A^2s** maximum I^2t value, **V** rated voltage in volts. Only ultra rapid fuses guarantee proper protection for the rectifier semiconductors.

ACx 604/624 ACx 6207/627 Types	Fuses							
	A	A^2s	V	Manufacturer	Type DIN 43620 	Size	Type DIN 43653 	Size
-0100-3/-0120-5	400	105000	660	Bussmann	170M3819	1*	170M3019	1*
-0120-3/-0140-5	400	105000	660	Bussmann	170M3819	1*	170M3019	1*
-0140-3/-0170-5	400	105000	660	Bussmann	170M3819	1*	170M3019	1*
-0170-3/-0210-5	550	190000	660	Bussmann	170M5811	2	170M5011	2
-0210-3/-0260-5	700	405000	660	Bussmann	170M5813	2	170M5013	2
-0400-3/-0490-5	700	405000	660	Bussmann	170M5813	2	170M5013	2
-0260-3/-0320-5	700	405000	660	Bussmann	170M5813	2	170M5013	2
-0490-3/-0610-5	700	405000	660	Bussmann	170M5813	2	170M5013	2
-0320-3/-0400-5	800	465000	660	Bussmann	170M6812	3	170M6012	3
-0610-3/-0760-5	800	465000	660	Bussmann	170M6812	3	170M6012	3
-0100-6	125	3700	660	Bussmann	170M1568	000	170M1368	000
-0120-6	200	15000	660	Bussmann	170M1570	000	170M1370	000
-0140-6/-0170-6	250	28500	660	Bussmann	170M3816	1*	170M3016	1*
-0210-6	315	46500	660	Bussmann	170M3817	1*	170M3017	1*
-0260-6	400	105000	660	Bussmann	170M3819	1*	170M3019	1*
-0320-6/-0400-6	550	190000	660	Bussmann	170M5811	2	170M5011	2
-0490-6	400	105000	660	Bussmann	170M3819	1*	170M3019	1*
-0610-6/-0760-6	550	190000	660	Bussmann	170M5811	2	170M5011	2

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

Example: For ACS 604-0260-3, the recommended fuses for the input bridge protection are 700 A ultrarapid fuses. The values I_{2N}, I_{2hd} and I_{2Nsq} for ACS 604-0260-3 are 395 A, 316 A and 480 A respectively. 1.1 · 395 A = 434.5 A and 1.5 · 316 A = 474 A and 1.0 · 480 A = 480 A. Normal fuses with nominal currents higher than 434.5 A, 474 A or 480 A can be used to protect the input cable; thus, 450 A or 500 A fuses are selected depending on the use (normal, heavy-duty or pump and fan, respectively).

Cable Entries

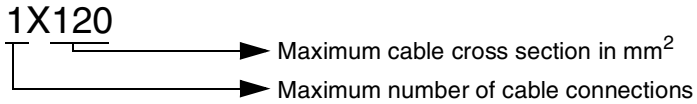
Input power and motor cable terminal wire size capabilities and tightening torques for the ACx 604/624 and ACx 607/627 are in the table below.

The capability is specified based on wire lug that the terminal accepts (according to DIN 46234 for copper cables and DIN 46329 for aluminium cables), cable cross section that will fit through the European lead-through plate hole, and maximum electrically needed European cable cross section. NEMA two hole lugs (1/2 inch in diameter and 1.75 inches on center) can be used in frame sizes R8 and R9 and R7 output.

NEMA two hole lugs (1/2 inch in diameter and 1.75 inches on center) can be used in frame sizes R8 and R9 and R7 output.

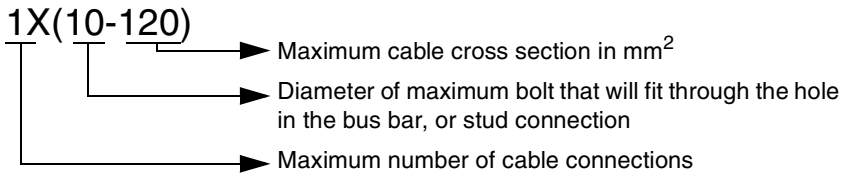
Markings in the Table

1. **Terminal kit (crush-down)**



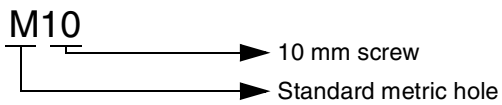
This kit is used in frame size R7 frequency converters (input cable terminal) and includes screws. The conductor is plugged into the kit without a cable lug.

2. **Bus bar connection 1**



Busbar connection requires bolt, washer, nut, and wire lug to be supplied by others. The other style connection using the same reference is an insulated stud connection, washer and nut.

3. **Bus bar connection 2**



Substitution Metric to US Standard

M8 - 5/16 inch diameter bolt

M10 - 3/8 inch diameter bolt

M12 - 1/2 inch diameter bolt

Terminal Sizes and Tightening Torques

Input power and motor cable terminal wire size capabilities (per phase) and tightening torques for the ACx 604/624 and ACx 604/607 are below. For terms used see above. T = Tightening torgue.

ACx 600 Type	Mains Terminals			Motor Terminals			Earthing Terminals		Cabinet (Frame)
	U1,V1,W1		T	U2,V2,W2		T	Earthing PE	T	
	Cu	Al	Nm	Cu	Al				
ACx 607/627									
-0100-3/0120-5/0100-6	1x120 [3]	1x120 [3]	30	1x(12-120)	1x(12-120)	30	M12	30	MNS (R7)
-0120-3/0140-5/0120-6	1x185 [3]	1x185 [3]	22	1x(12-185)	1x(12-185)	30	M12	30	
-0140-3/0170-5/0140-6	2x(12-185)	2x(12-185)	44	2x(12-185)	2x(12-185)	44	M12	30	MNS (R8)
-0170-3/0210-5/0170-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	
-0210-3/0260-5/0210-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	
-0260-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	
-0260-3/0320-5/0320-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	MNS (R9)
-0320-3/0400-5/0400-6	2x(12-185)	2x(12-240)	44	2x(12-185)	2x(12-240)	44	M12	30	
-0400-3/0490-5/0490-6	4x(12-185)	4x(12-240)	55	4x(12-185)	4x(12-240)	55	M10 (2x2 pcs)	35	MNS (2xR8)
-0490-3/0610-5/0610-6	4x(12-185)	4x(12-240)	55	4x(12-185)	4x(12-240)	55	M10 (2x2 pcs)	35	MNS (2xR9)
-0610-3/0760-5/0760-6	4x(12-185)	4x(12-240)	55	4x(12-185)	4x(12-240)	55	M10 (2x2 pcs)	35	
ACx 604/624									
-0100-3/0120-5/0100-6	1x(10-120)[4]	[1]	30	1x(10-120)	[1]	30	41 mm^2 [2] [3]	30	- (R7)
-0120-3/0140-5/0120-6	1x(10-120)[4]	[1]	30	1x(10-120)	[1]	30	41 mm^2 [2] [3]	30	
-0140-3/0170-5/0140-6	1x(10-240)[4]	1x(10-240)[4]	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs)[2]	30	- (R8)
-0170-3/0210-5/0170-6	1x(10-240)[4]	1x(10-240)[4]	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs)[2]	30	
-0210-3/0260-5/0210-6	1x(10-240)[4]	1x(10-240)[4]	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs)[2]	30	
-0260-6	1x(10-240)[4]	1x(10-240)[4]	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs)[2]	30	
-0260-3/0320-5/0320-6	1x(10-240)[4]	1x(10-240)[4]	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs)[2]	30	- (R9)
-0320-3/0400-5/0400-6	1x(10-240)[4]	1x(10-240)[4]	30	3x(12-240)	3x(12-240)	44	M10 (2 pcs)[2]	30	

[1] The maximum acceptable size of the cable is 3x120+70 (3x(AWG 0000) + AWG 00); cross-sectional areas of copper conductors in mm^2, 3 x phase conductor + PE conductor). Aluminium cable cannot be connected due to cable lug size.
[2] This is the earthing terminal for the PE bus and the frame of the ACx 604/624 module. The terminal is to be connected to the PE bus of the cabinet the module is installed in.
[3] Cable size: 6 AWG...300 MCM
[4] Isolated Stud terminal

Cooling Air Flow Requirements

Heat loss and cooling air flow requirements are given below**.**

ACx 604/624 and ACx 607/627 Type			Heat Loss / kW
0100-3		0100-6	1.9
0120-3	0120-5	0120-6	2.3
0140-3	0140-5	0140-6	2.8
0170-3	0170-5	0170-6	3.3
0210-3	0210-5	0210-6	4.0
0260-3	0260-5	0260-6	5.0
0320-3	0320-5	0320-6	6.3
-0400-3	0400-5	0400-6	7.9
-0490-3	-0490-5	-0490-6	10.0
-0610-3	7-0610-5	-0610-6	12.5
	-0760-5	-0760-6	15.8

ACx 604/624 and ACx 607/627	Flow m^3/h
0100-3/0120-5/0100-6	660
0120-3/0140-5/0120-6	660
0140-3/0170-5/0140-6/0170-6	1640
0170-3/0210-5/0210-6	1640
0210-3/0260-5/0260-6	1640

ACx 604/624 and ACx 607/627	Flow m^3/h
0260-3/0320-5/0320-6	1840
0320-3/0400-5/0400-6	1840
0400-3/0490-5/0490-6	3580
0490-3/0610-5/0610-6	3980
0610-3/0760-5/0760-6	3980

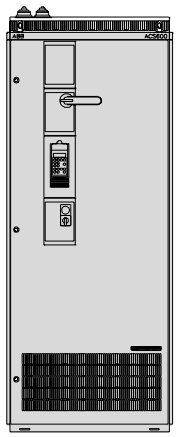
Dimensions and Weights (ACx 604/624)

Dimensions and weights of the ACx 604/624s are given below.

ACS 604/624 Type			Height mm (in)	Width mm (in)	Depth mm (in)	Weight kg (lbs)
0100-3	0120-5	0100-6	860 (33.86)	480 (18.89)	428 (16.85)	88 (194)
0120-3	0140-5	0120-6	860 (33.86)	480 (18.89)	428 (16.85)	88 (194)
0140-3	0170-5	0140-6/ 0170-6	1250 (49.2)	462*/524 (18.19/20.63)	407 (16)	135 (297)
0170-3	0210-5	0210-6	1250 (49.2)	462*/524 (18.19/20.63)	407 (16)	140 (308)
0210-3	0260-5	0260-6	1250 (49.2)	462*/524 (18.19/20.63)	407 (16)	140 (308)
0260-3			1600 (63)	462*/524 (18.19/20.63)	407 (16)	166 (365)
0320-3			1600 (63)	462*/524 (18.19/20.63)	407 (16)	166 (365)
	0320-5	0320-6	1600 (63)	462*/524 (18.19/20.63)	407 (16)	171 (376)
	0400-5	0400-6	1600 (63)	462*/524 (18.19/20.63)	407 (16)	171 (376)
0400-3	0490-5	0490-6	2 x Dimensions of ACx 604-0210-3			
0490-3	0610-5	0610-6	2 x Dimensions of ACx 604-0260-3			
0610-3	0760-5	0760-6	2 x Dimensions of ACx 604-0320-3			

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

Dimensions and Weights (ACx 607/627)



Dimensions and weights of the ACx 607/627s are given below.

ACx 607/627 Type			Height [1] mm (in)	Width mm (in)	Depth mm (in)	Weight [4] kg (lbs)
0100-3	0120-5	0100-6	2078[1]/2316[2] (81.8)/(91.2)	830 (32.7)	644 (25.35)	275/300[5] (605)/(660)
0120-3	0140-5	0120-6	2078[1]/2316[2] (81.8)/(91.2)	830 (32.7)	644 (25.35)	275/300[5] (605)/(660)
0140-3	0170-5	0140-6/ 0170-6	2078[1]/2316[2] (81.8)/(91.2)	830/1230[3] (32.7)/(48.4)	644 (25.35)	340/390[5] (748)/(858)
0170-3	0210-5	0210-6	2078[1]/2316[2] (81.8)/(91.2)	830/1230[3] (32.7)/(48.4)	644 (25.35)	345/390[5] (749)/(858)
0210-3	0260-5	0260-6	2078[1]/2316[2] (81.8)/(91.2)	830/1230[3] (32.7)/(48.4)	644 (25.35)	345/390[5] (749)/(858)
0260-3			2078[1]/2316[2] (81.8)/(91.2)	830/1230[3] (32.7)/(48.4)	644 (25.35)	370 (814)
0320-3			2078[1]/2316[2] (81.8)/(91.2)	830/1230[3] (32.7)/(48.4)	644 (25.35)	370 (814)
	0320-5	0320-6	2078[1]/2316[2] (81.8)/(91.2)	830/1230[3] (32.7)/(48.4)	644 (25.35)	375/435[5] (825)/(957)
	0400-5	0400-6	2078[1]/2316[2] (81.8)/(91.2)	830/1230[3] (32.7)/(48.4)	644 (25.35)	375/435[5] (825)/(957)
0400-3	0490-5	0490-6	2078[1]/2215[2] (87.3)/(87.2)	2130[6] (83.9)	644 (25.35)	710 (1562)
0490-3	0610-5	0610-6	2078[1]/2215)[2] (87.3)/(87.2)	2130[6] (83.9)	644 (25.35)	870 (1914)
0610-3	0760-5	0760-6	2078[1]/2215[2] (87.3)/(87.2)	2130[6] (83.9)	644 (25.35)	870 (1914)

[1] Height of bottom entry/exit, degree of protection IP 21 / IP 22 / IP 42. Heights include the lifting lugs. Hight of top entry/ exit is 2132 (83.9 in).

[2] Degree of protection IP 54

[3] EMC Line Filter version

[4] Weight of the IP 21 / IP 22 / IP 42 version

[5] Weight of the 690 V unit with du/dt filter

Braking Chopper The widths of ACx 607/627 units with braking choppers are below.

ACx 607/627 Type	Width with Braking Chopper mm (in)	Width with Braking Chopper and Resistor(s) mm (in)	ACS 607 Type	Width with Braking Chopper mm (in)	Width with Braking Chopper and Resistor(s) mm (in)	ACS 607 Type	Width with Braking Chopper mm (in)	Width with Braking Chopper and Resistor(s) mm (in)
0100-3	830 (32.7)	1230 (48.4)	0120-5	830 (32.7)	1230 (48.4)	0100-6	830 (32.7)	1230 (48.4)
0120-3	830 (32.7)	1230 (48.4)	0140-5	830 (32.7)	1230 (48.4)	0120-6	830 (32.7)	1230 (48.4)
0140-3	1230 (48.4)	1230 (48.4)	0170-5	1230 (48.4)	1230 (48.4)	0140-6	1230 (48.4)	1230 (48.4)
0170-3	1230 (48.4)	1530 (60.2)	0210-5	1230 (48.4)	1230 (48.4)	0170-6	1230 (48.4)	1230 (48.4)
0210-3	1230 (48.4)	1530 (60.2)	0260-5	1230 (48.4)	1530 (60.2)	0210-6	1230 (48.4)	1230 (48.4)
0260-3	1230 (48.4)	1530 (60.2)	0320-5	1230 (48.4)	1530 (60.2)	0260-6	1230 (48.4)	1530 (60.2)
0320-3	1230 (48.4)	1530 (60.2)	0400-5	1230 (48.4)	1530 (60.2)	0320-6	1230 (48.4)	1530 (60.2)
0400-3	2930 (115.4)	3530 (139)	0490-5	2930 (115.4)	3530 (139)	0400-6	1230 (48.4)	1530 (60.2)
0490-3	2930 (115.4)	3530 (139)	0610-5	2930 (115.4)	3530 (139)	0490-6	2930 (115.4)	3530 (139)
0610-3	2930 (115.4)	3530 (139)	0760-5	2930 (115.4)	3530 (139)	0610-6	2930 (115.4)	3530 (139)
						0760-6	2930 (115.4)	3530 (139)

Noise

The noise values of the ACx 604/624 and 607/627 units are given in Table below.

ACx 604/624/ and ACx 607/627 type			Noise	
			No Load [dB]	Nominal Load [dB]
-0100-3	-0120-5	-0100-6	60.4[1)]	65.8[1)]
-0120-3	-0140-5	-0120-6		
-0140-3	-0170-5	-0140-6	61.4[2)]	61.8[2)]
-0170-3	-0210-5	-0170-6		
-0210-3	-0260-5	-0210-6		
		-0260-6		
-0260-3	-0320-5	-0320-6	64.8[2)]	67.6[2)]
-0320-3	-0400-5	-0400-6		
-0400-3	-0490-5	-0490-6	61.8[2)]	65[2)]
-0490-3	-0610-5	-0610-6	67.6[2)]	71[2)]
-0610-3	-0760-5	-0760-6		

[1)] Converter module not installed in a cabinet (ACx 604/624).

[2)] Converter module(s) installed in a cabinet (ACx 607/624).

Technical Data – ACS/ACC 607/627 R11i to 4×R11i, ACx 617 and ACx 677

Ratings

The ratings for the ACx 607/617/627/677 with 50 Hz and 60 Hz supplies are given below. ACx = ACS/ACC.

Frequency Converter Type	Drive Frame Size	Normal Use			Duty Cycle 1/5min		Duty Cycle 10/60s	
		I_{2N}	S_N	P_N	I_{2hd} 4/5min	I_{2hd} 1/5min	I_{2hd} 50/60s	I_{2hd} 10/60s
		[A]	[kVA]	[kW]	[A]	[A]	[A]	[A]
Supply voltage range 380, 400 or 415 V								
ACx 617/677-0185-3	R8i	259	185	132	194	291	178	356
ACx 617/677-0225-3	R8i	312	225	160	234	351	216	432
ACx 617/677-0265-3	R8i	379	265	200	284	426	260	520
ACx 617/677-0335-3	R9i	474	335	250	356	533	316	632
ACx 617/677-0405-3	R9i	576	405	315	432	648	395	790
ACx 617/677-0500-3	R10i	720	500	400	540	810	494	988
ACx 617/677-0630-3	R11i	907	630	500	680	1020	600	1200
ACx 607/617/627/677-0760/0765-3	R11i	1094	760/765	630	821	1231	751	1502
ACx 607/617/627/677-0930/0935-3	R12i	1336	930/935	710	1002	1503	901	1802
ACx 607/617/627/677-1120/1125-3	R12i	1624	1120/1125	900	1218	1827	1126	2252
ACx 607/627/677-1440-3	2xR11i	2079	1440	1120	1559	2339	1501	3002
ACx 607/627/677-1770-3	2xR12i	2558	1770	1400	1919	2878	1801	3602
ACx 607/627/677-2140-3	2xR12i	3085	2140	1750	2314	3471	2252	4504
ACx 627-2340-3	4xR11i	3374	2340	1900	2531	3796	2402	4804
ACx 627-2820-3	4xR11i	4070	2820	2300	3053	4579	3002	6004
Supply voltage range 380, 400, 415, 440, 460, 480 or 500 V								
ACx 617/677-0215-5	R8i	246	215	160	185	277	164	328
ACx 617/677-0255-5	R8i	295	255	200	221	332	200	400
ACx 617/677-0325-5	R8i	368	325	250	276	414	240	480
ACx 617/677-0395-5	R9i	448	395	315	336	504	300	600
ACx 617/677-0495-5	R9i	565	495	400	424	636	365	730
ACx 617/677-0610-5	R10i	700	610	500	525	788	456	912
ACx 617/677-0770-5	R11i	887	770	630	665	998	570	1140
ACx 607/617/627/677-0930/0935-5	R11i	1073	930/935	710	805	1208	694	1388
ACx 607/617/627/677-1090/1095-5	R12i	1263	1090/1095	900	947	1421	855	1710
ACx 607/617/627/677-1380/1385-5	R12i	1593	1380/1385	1120	1195	1793	1040	2080
ACx 607/627/677-1760-5	2xR11i	2039	1760	1400	1529	2294	1387	2774
ACx 607/627/677-2160-5	2xR12i	2501	2160	1800	1876	2814	1710	3420
ACx 607/627/677-2620-5	2xR12i	3026	2620	2200	2270	3405	2081	4162
ACx 627-2850-5	4xR11i	3300	2850	2400	2475	3713	2280	4560
ACx 627-3450-5	4xR11i	3992	3450	2900	2994	4491	2774	5548
-0765-3, -0935-x, 1125-3, 1385-5 are ACx 617 types								

Continues on the next page

Frequency Converter Type	Drive Frame Size	Normal Use			Duty Cycle 1/5min		Duty Cycle 10/60s	
		I_{2N} [A]	S_N [kVA]	P_N [kW]	I_{2hd} 4/5min [A]	I_{2hd} 1/5min [A]	I_{2hd} 50/60s [A]	I_{2hd} 10/60s [A]
Supply voltage range 525, 550, 575, 600, 660 or 690 V								
ACx 617/677-0205-6	R8i	176	205	160	132	198	127	254
ACx 617/677-0255-6	R8i	210	255	200	158	236	150	300
ACx 617/677-0315-6	R8i	264	315	250	198	297	179	358
ACx 617/677-0375-6	R9i	310	375	315	233	349	225	450
ACx 617/677-0485-6	R9i	410	485	400	308	461	265	530
ACx 617/677-0600-6	R10i	502	600	500	377	565	340	680
ACx 617/677-0750-6	R11i	630	750	630	473	709	428	856
ACx 607/617/627/677-0900-5	R11i	755	900	710	566	849	504	1008
ACx 607/617/627/677-1090/1095-5	R12i	874	1040/1045	800	656	983	641	1282
ACx 607/617/627/677-1380/1385-5	R12i	1156	1380/1385	1120	867	1301	755	1510
ACx 607/627/677-1710-6	2xR11i	1435	1710	1400	1076	1614	1007	2014
ACx 607/627/677-2120-6	2xR12i	1777	2120	1800	1333	1999	1283	2566
ACx 607/627/677-2540-6	2xR12i	2129	2540	2000	1597	2395	1511	3022
ACx 607/627/677-2800-6	4xR11i	2344	2800	2300	1758	2637	1710	3420
ACx 607/627/677-3350-6	4xR11i	2809	3350	2800	2107	3160	2014	4028
-1045-6 and -1385-6 are ACx 617 types								

Normal Use

I_{2N} Rated rms output current (= maximum continuous output current)
S_N Rated apparent output power
P_N Typical motor power. The power ratings in kW apply to most IEC 34 motors.

Duty Cycle

I_{2hd} Rated rms output current

The current ratings are the same regardless of the supply voltage within one voltage range. The rated current of the ACx 600 must be higher than or equal to the rated motor current to achieve the rated motor power given in the table.

Note 1: The load capacity (current and power) decreases if the installation site altitude exceeds 1000 metres, or if the ambient temperature exceeds 40 °C (units with degree of protection IP 21/22/42/54).

Note 2: Usually du/dt filters are 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.

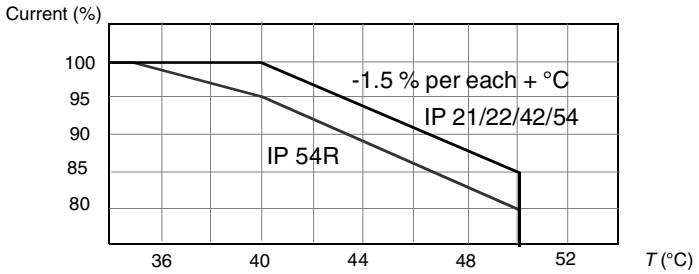
Note 3: For units with regenerative braking, the ratings are 90 percent of the values given in the table.

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 21/22/42/54:

- *General rule:* Above +40 °C, the rated output current is decreased 1.5 % for every additional 1 °C (up to +50 °C).
- *Example 1:* If the ambient temperature is 50 °C the derating factor is 100 % - 1.5 $\%_C \cdot$ 10 °C = 85 % or 0.85. The output current is then 0.85 · I_{2N} or I_{2hd}.



Derating Diagram: the effect of ambient temperature on the ACx 607, ACx 617 and ACx 677 continuous load capacity.

Input Power Connection

Voltage (U_1):
380/400/415 VAC 3-phase ± 10 % for 400 VAC units
380/400/415/440/460/480/500 VAC 3-phase ± 10 % for 500 VAC units
525/550/575/600/660/690 VAC 3-phase ± 10 % for 690 VAC units

Short Circuit Capability IEC 439-1**:** The rated short time withstand current of ACx 607, ACx 617 and ACx 677 is given below.

Frame Size	$I_{cw\,/\,1\,s}$ / kA	I_{pk} / kA
B3	37	78
B4, B5	50	105

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

Input Voltage Unbalance: ± 2 % (EN 60204-1)

Power Factor:

Diode and Thyristor Supply Units

- (cos φ1): 0.97 (fundamental at nominal load)
- (cos φ): 0.93...0.95 (total)

IGBT Supply Units

- cos φ1 = 1.00 (fundamental at nominal load)
- $\lambda = I_1/I_{rms} \cdot \cos\varphi$ > 0.98 (total) , where
- λ is power factor,
- I_1 is fundamental input current rms value,
- I_{rms} is total input current rms value.

Motor Connection

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

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

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

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

Scalar Control mode (not for ACP 600): 0 to 300 Hz
With du/dt Filter (DTC and Scalar Control modes): 0 to 120 Hz

Frequency Resolution: 0.01 Hz

Continuous Current: 1.0 · I_{2N} (normal use)

Short Term Overload Capacity: according to rating tables on pages A-1 and A-2.

Field Weakening Point: 8 to 300 Hz

Switching Frequency: 2 kHz (average).

Maximum Recommended Motor Cable Length: For cables longer than 500 metres / 1640 ft (cumulative length in case of parallel connected motors), an ABB representative must be consulted. With pulse encoder speed measurement, the maximum cable length is 300 m. With du/dt filters refer to *du/dt Installation Guide* (code: 58933368). For additional EMC requirements on cable length refer to section *CE Marking* below.

Motor Bearings: Insulated bearing at non-driven end is recommended.

Cable Types: The tables below give the copper and aluminium cable types for different load currents (I_{Lmax}). A correction factor of K = 0.70 has been used (max. 9 cables laid on a cable ladder side by side, three ladders on top of each other, ambient temperature 30 °C (86 °F), EN 60204-1 and IEC 364-5-523)

COPPER CABLES WITH A COPPER SCREEN		
I_{Lmax} [A]	**Cable Type**	**Diameter [mm]**
255	3×185 + 95	50
274	2 × (3×70 + 35)	2 × 32
301	3×240 + 120	55
334	2 × (3×95 + 50)	2 × 38
386	2 × (3×120 + 70)	2 × 41
446	2 × (3×150 + 70)	2 × 44
510	2 × (3×185 + 95)	2 × 50
579	3 × (3×120 + 70)	3 × 41
602	2 × (3×240 + 120)	2 × 55
669	3 × (3×150 + 70)	3 × 44
765	3 × (3×185 + 95)	3 × 50
772	4 × (3×120 + 70)	4 × 41
892	4 × (3×150 + 70)	4 × 44
903	3 × (3×240 + 120)	3 × 55
1020	4 × (3×185+ 95)’	4 × 50

ALUMINIUM CABLES WITH A COPPER SCREEN		
I_{Lmax} [A]	**Cable Type**	**Diameter [mm]**
260	2 × (3×95Al + 29Cu)	2 × 38
302	2 × (3×120Al + 41Cu)	2 × 41
348	2 × (3×150Al + 41Cu)	2 × 44
398	2 × (3×185Al + 57Cu)	2 × 49
470	2 × (3×240Al + 72Cu)	2 × 54
522	3 × (3×150Al + 41Cu)	3 × 44
597	3 × (3×185Al + 57Cu)	3 × 49
696	4 × (3×150Al + 41Cu)	4 × 44
705	3 × (3×240Al + 72Cu)	3 × 54
796	4 × (3×185Al + 57Cu)	4 × 49
940	4 × (3×240Al + 72Cu)	4 × 54
995	5 × (3×185Al + 57Cu)	5 × 49
1175	5 × (3×240Al + 72Cu)	5 × 54

Efficiency and Cooling Method

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 ACx 607, ACx 617 and ACx 677 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 21/22/42/54) 0 to +35 °C (32 to 95 °F) [2)] (IP 54R)	-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 as follows. 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.

$I_{max} = I_{N40C} \cdot (100\ \% - 1\ \% \cdot (h - 1000\ m)/(100\ m) + 1.5\ \% \cdot (40\ °C - T_{amb}))$

h altitude above sea level

T_{amb} maximum ambient temperature

I_{N40C} ACS 600 nominal current at 40 °C

Note: $I_{max} < I_{N40C}$ and $T_{amb} < 40$ °C. At 2000...4000 m optional “varistors” are needed.

2) See subsection *Output Current Temperature Derating*.

Fuses

Only ultra rapid fuses guarantee proper protection for the rectifier semiconductors.

AC Fuses

The a.c. fuses (Bussmann) used in the supply section of the ACx 607, and ACx 677 are listed below. The a.c. fuses for the ACx 617 types are given in the *IGBT Supply Sections User's Manual*. See the IGBT supply types from the dimension table given in the subsection *Cooling Air, Dimensions*.

6-pulse Diode Supply (ACx 607) **12-pulse Diode Supply** (ACx 627)	**Fuse**				**Thyristor Supply** (ACx 677)	**Fuse**			
	U_N V	**I_N A**	**Type**	**Size**		**U_N V**	**I_N A**	**Type**	**Size**
ACx 627-0760-3 ACx 627-0930-5 ACx 627-1090-5	660	1000	170M6207	3SHT	ACx 677-0185-3 ACx 677-0215-5 ACx 677-0255-5	660	450	170M5371	2SHT
ACx 607-0900-6 ACx 627-0900-6 ACx 627-1040-6	660	800	170M6812	3	ACx 677-0225-3 ACx 677-0265-3 ACx 677-0325-5	660	700	170M6206	3SHT
					ACx 677-0335-3 ACx 677-0405-3 ACx 677-0395-5 ACx 677-0495-5	660	900	170M6207	3SHT
					ACx 677-0205-6 ACx 677-0255-6	1250	315	170M5403	2SHT
					ACx 677-0315-6 ACx 677-0375-6	1250	400	170M5404	2SHT
					ACx 677-0485-6	1250	630	170M6205	3SHT

Branch Fuses The branch fuses (Bussmann) used in the supply section of the ACx 607 and ACx 677 are listed below.

Type	Fuse				Type	Fuse			
	U_N V	I_N A	Type	Size		U_N V	I_N A	Type	Size
400 V and 500 V Supply					690 V Supply				
ACx 677-0500-3 ACx 677-0630-3 ACx 677-0610-5 ACx 677-0770-5 ACx 627-0930-3 ACx 627-1120-3 ACx 627-1380-5 ACx 627-1760-5	660	900	170M6163	3/110	ACx 677-0600-6 ACx 677-0750-6 ACx 607-0900-6 ACx 627-1380-6 ACx 627-1710-6	1250	630	170M6144	3/110
ACx 607-0760-3 ACx 607-0930-3 ACx 607-1120-3 ACx 627-1440-3 ACx 627-1770-3 ACx 627-2140-3 ACx 607-0930-5 ACx 607-1090-5 ACx 607-1380-5 ACx 627-2160-5 ACx 627-2620-5 ACx 627-2850-5	660	1500	170M6168	3/110	ACx 607-1040-6 ACx 607-1380-6 ACx 627-2120-6 ACx 627-2540-6 ACx 627-2800-6	1250	1100	170M6149	3/110
ACx 607-1440-3 ACx 607-1770-3 ACx 627-2340-3 ACx 627-2820-3 ACx 607-1760-5 ACx 607-2160-5 ACx 627-3450-5	660	1500	170M6168	3/110	ACx 607-1710-6 ACx 607-2120-6 ACx 607-2540-6 ACx 627-3350-6	1250	1100	170M6149	3/110
ACx 607-2140-3 ACx 607-2620-5	660	1500	170M6168	3/110	ACx 607-2800-6 ACx 607-3350-6	1110	1400	170M6151	3/110

Drive Section DC Fuses The Bussmann fuses used in the inverters of the ACx 607, ACx 617 and ACx 677 are listed below. U_N and I_N are nominal voltage and current of the fuse.

415 V and 500 V Drive Sections					690 V Drive Sections				
Frame	U_N [V]	Size	I_N [A]	Type	Frame	U_N [V]	Size	I_N [A]	Type
2×R11i, 4xR11i 2×R12i	660V	3	1000	170M6814	2×R11i, 4×R11i 2×R12i	1250V	3SHT	630	170M6205

Braking Section DC Fuses The d.c. fuses (Bussmann) for the braking sections are listed below.

ACx 607, ACx 617 or ACx 677 Type	Dynamic Braking Section	Fuse			
		U_N (V)	I_N (A)	Type	Size
-0760-3...-2820-3	ACA 622-0320-3...-1920-3	1000–1250	630	170M 5146	2/110
-0930-5...-3450-5	ACA 622-0400-5...-2400-5	1000–1250	630	170M 5146	2/110
-0900-6...3350-6	ACA 622-0400-6...-2400-6	1000–1250	630	170M 5146	2/110
					PDM code 00025310-A

Cable Entries

Tightening Torque

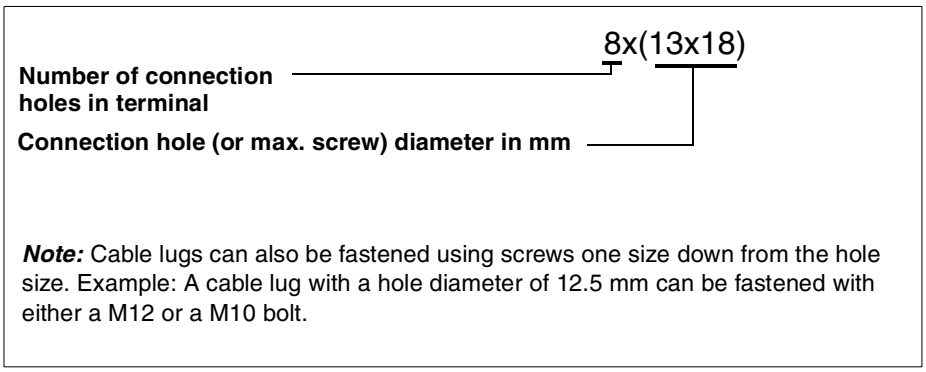
The tightening torques for screw connections, applicable to zinc and chrome platings and screw strength class 8.8 are listed below.

Screw	Torque (Nm) *	
	Soft aluminium	Alloyed aluminium and copper
M5	3.5	3.5
M6	6	9
M8	17	20
M10	35	40
M12	55	70
M16	130	180

* valid also for greased screws

Marking

Cable connections are marked in the following tables as explained below. The terminals accept cable lugs according to DIN 46234 for copper cables and DIN 46329 for aluminium cables.



Note: Cable lugs can also be fastened using screws one size down from the hole size. Example: A cable lug with a hole diameter of 12.5 mm can be fastened with either a M12 or a M10 bolt.

Diode Supply Sections The largest cable core and cable lug sizes accepted by the diode supply sections are presented below.

Type	Holes for cable lugs per phase	No. of cable entries at bottom (diameter 60 mm)	Bottom plate opening dimensions (mm)	No. of cable entries at top (diameter 60 mm)	Holes for bus duct connection
U_N = 400V (380V...415V)					
ACx 627-0760-	4x14	2x6	502x280 (2 pcs)	2x6	-
ACx 607-0760-	8x(13x18)	12	502x280	12	4x(13x24)
ACx 627-0930-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-0930-	8x(13x18)	12	502x280	12	4x(13x24)
ACx 627-1120-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-1120-	8x(13x18)	12	502x280	12	4x(13x24)
ACx 627-1140-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-1140-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-1770-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-1770-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-2140-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-2140-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-2340-	12x(13x18)	2x18	502x280 (2 pcs)	2x18	4x(13x24)
ACx 627-2820-	12x(13x18)	2x18	502x280 (2 pcs)	2x18	4x(13x24)
U_N = 500V (380V...500V)					
ACx 627-930-5	4x14	2x6	502x280 (2 pcs)	2x6	-
ACx 607-0930-	8x(13x18)	12	502x280	12	4x(13x24)
ACx 627-1090-	4x14	2x6	502x280 (2 pcs)	2x6	-
ACx 607-1090-	8x(13x18)	12	502x280	12	4x(13x24)
ACx 627-1380-	8x(13x18)	2x12	502x280 (2 pcs)	12	4x(13x24)
ACx 607-1380-	8x(13x18)	12	502x280	12	4x(13x24)
ACx 627-1760-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-1760-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-2160-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-2160-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-2620-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-2620-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-2850-	12x(13x18)	2x18	502x280 (2 pcs)	2x18	4x(13x24)
ACx 627-3450-	12x(13x18)	2x18	502x280 (2 pcs)	2x18	4x(13x24)
U_N = 690V (525V...690V)					
ACx 627-0900-	4x14	2x6	502x280 (2 pcs)	2x6	-
ACx 607-0900-	4x(13x18)	12	502x280	12	4x(13x24)
ACx 627-1040-	4x14	2x6	502x280 (2 pcs)	2x6	-
ACx 607-1040-	8x(13x18)	12	502x280	12	4x(13x24)
ACx 607-1380-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-1380-	8x(13x18)	12	502x280	12	4x(13x24)
ACx 627-1710-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-1710-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-2120-	8x(13x18)	12	502x280	12	4x(13x24)
ACx 607-2120-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-2540-	8x(13x18)	2x12	502x280 (2 pcs)	2x12	4x(13x24)
ACx 607-2540-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-2800-	12x(13x18)	2x18	502x280 (2 pcs)	2x18	4x(13x24)
ACx 607-2800-	12x(13x18)	18	502x280	18	4x(13x24)
ACx 627-3350-	12x(13x18)	2x18	502x280 (2 pcs)	2x18	4x(13x24)
ACx 607-3350-	12x(13x18)	18	502x280	18	4x(13x24)

Thyristor Supply Section The largest cable core and cable lug sizes accepted by regenerative thyristor supply sections are presented below.

Type	Holes for cable lugs per phase	Number of cable entries at bottom (diameter 60 mm)	Bottom plate opening dimensions (mm)	Number of cable entries at top (diameter 60 mm)	Holes for bus duct connection
U_N = 400V (380V...415V)					
ACx 677-0185-3	2x14	3	310x240	3	-
ACx 677-0225-3	4x14	6	502x280	6	-
ACx 677-0265-3					
ACx 677-0335-3					
ACx 677-0405-3					
ACx 677-0500-3	4x(13x18)	12	502x280	12	4x(13x24)
ACx 677-0630-3					
ACx 677-0760-3	8x(13x18)	12	502x280	12	4x(13x24)
ACx 677-0930-3					
ACx 677-1120-3					
ACx 677-1440-3	12x(13x18)	18	502x280	18	4x(13x24)
ACx 677-1770-3					
ACx 677-2140-3	12x(13x18)	18	502x280	18	4x(13x24)
U_N = 500V (380V...500V)					
ACx 677-0215-5	2x14	3	310x240	3	-
ACx 677-0255-5					
ACx 677-0325-5	4x14	6	502x280	6	-
ACx 677-0395-5					
ACx 677-0495-5					
ACx 677-0610-5	4x(13x18)	12	502x280	12	4x(13x24)
ACx 677-0770-5					
ACx 677-0930-5	8x(13x18)	12	502x280	12	4x(13x24)
ACx 677-1040-5					
ACx 677-1380-5					
ACx 677-1760-5	12x(13x18)	18	502x280	18	4x(13x24)
ACx 677-2160-5					
ACx 677-2620-5	12x(13x18)	18	502x280	18	4x(13x24)
U_N = 690V (525V...690V)					
ACx 677-0205-6	2x14	3	310x240	3	-
ACx 677-0255-6					
ACx 677-0315-6	4x14	6	502x280	6	-
ACx 677-0375-6					
ACx 677-0485-6					
ACx 677-0600-6	4x(13x18)	12	502x280	12	4x(13x24)
ACx 677-0750-6					
ACx 677-0900-6	4x(13x18)	12	502x280	12	4x(13x24)
ACx 677-1040-6	8x(13x18)	12	502x280	12	4x(13x24)
ACx 677-1380-6					
ACx 677-1710-6	12x(13x18)	18	502x280	18	4x(13x24)
ACx 677-2120-6					
ACx 677-2540-6					
ACx 677-2800-6	12x(13x18)	18	502x280	18	4x(13x24)
ACx 677-3350-6					

IGBT Supply Section The largest cable core and cable lug sizes accepted by IGBT thyristor supply sections are given in the *IGBT Supply Section User's Manual (EN code:* 64013700).

Drive Sections The largest cable core and cable lug sizes accepted by drive sections are presented below.

ACx 607, ACx 617 or ACx 677	Holes for cable lugs per phase	No. of cable entries at bottom (diameter 60 mm)	Bottom plate opening dimensions (mm)	No. of cable entries at top (diameter 60 mm)
380 V, 400 V, 415 V				
-0760-3	6x(13x18)	6	270x911	6
-0930-3	8x(13x18)	12	195x501	12
-1120-3	8x(13x18)	12	195x501	12
-1440-3	16x(13x18)	18	270x711	18
-1770-3	16x(13x18)	18	270x711	18
-2140-3	16x(13x18)	18	270x711	18
-2340-3	16x(13x18)	18	270x711	18
-2820-3	16x(13x18)	18	270x711	18
440 V, 460 V, 500 V				
-0930-5	6x(13x18)	6	270x911	6
-1090-5	8x(13x18)	12	195x501	12
-1380-5	8x(13x18)	12	195x501	12
-1760-5	16x(13x18)	18	270x711	18
-2160-5	16x(13x18)	18	270x711	18
-2620-5	16x(13x18)	18	270x711	18
-2850-5	16x(13x18)	18	270x711	18
-3450-5	16x(13x18)	18	270x711	18
575 V, 660 V, 690 V				
-0900-6	6x(13x18)	6	270x911	6
-1040-6	8x(13x18)	12	195x501	12
-1380-6	8x(13x18)	12	195x501	12
-1710-6	8x(13x18)	12	195x501	12
-2120-6	16x(13x18)	18	270x711	18
-2540-6	16x(13x18)	18	270x711	18
-2800-6	16x(13x18)	18	270x711	18
-3350-6	16x(13x18)	18	270x711	18

External Control Connection Diagrams

For the external control connections see the subsection *ACS 600 Control Connections on the NIOC Board* in *General Technical Data – ACx 601, ACx 604 and ACx 607/627/677 R7 to 2×R9*.

External control wiring is connected to terminals on the NIOC board through a terminal block X2 (IEC standard designation) or an optional terminal block 2TB (ANSI standard designation, for US manufactured units only). For the terminal markings see the Hardware Manual (EN code: 61329005)

NIOC Board Specifications

For the specification of the Standard I/O Control Board, NIOC, see subsection *NIOC and NIOCP Board Specifications* in *General Technical Data – ACx 601, ACx 604 and ACx 607/627/677 R7 to 2×R9*.

Cabinet

Below are the cabinets, degrees of protection and free space requirements of ACx 607, ACx 617 and ACx 677 types.

Cabinet	Degree of Protection	Space above mm	Space below mm	Space on left/right mm	Space in front/back mm
Drives-MNS cabinet / Common cabinet	IP 21, IP 22, IP 42, IP 54, IP 54 R[1)]	500	0	0	200/100[2)]

[1)] IP 21 = standard, R = air outlet duct

[2)] 200 between cabinets when installed back to back

Note: The additional space requirement for the door opening is 800 mm

Drive Section Hardware

The frequency converter types contain inverters given below.

Frequency Converter Type	Inverter	Drive Frame Size
Supply voltage 380, 400 or 415V		
ACx 617/677-0185-3	ACN 634-0185-3	R8i
ACx 617/677-0225-3	ACN 634-0225-3	R8i
ACx 617/677-0265-3	ACN 634-0265-3	R8i
ACx 617/677-0335-3	ACN 634-0335-3	R9i
ACx 617/677-0405-3	ACN 634-0405-3	R9i
ACx 617/677-0500-3	ACN 634-0500-3	R10i
ACx 617/677-0630-3	ACN 634-0630-3	R11i
ACx 607/617/627/677-0760/0765-3	ACN 634-0755-3	R11i
ACx 607/617/627/677-0930/0935-3	ACN 634-0935-3	R12i
ACx 607/617/627/677-1120/1125-3	ACN 634-1125-3	R12i
ACx 607/627/677-1440-3	ACN 634-1445-3	2xR11i
ACx 607/627/677-1770-3	ACN 634-1775-3	2xR12i
ACx 607/627/677-2140-3	ACN 634-2145-3	2xR12i
ACx 627-2340-3	ACN 634-2345-3	4xR11i
ACx 627-2820-3	ACN 634-2825-3	4xR11i
Supply voltage 380, 400, 415, 440, 460, 480 or 500V		
ACx 617/677-0215-5	ACN 634-0215-5	R8i
ACx 617/677-0255-5	ACN 634-0255-5	R8i
ACx 617/677-0325-5	ACN 634-0325-5	R8i
ACx 617/677-0395-5	ACN 634-0395-5	R9i

Frequency Converter Type	Inverter	Drive Frame Size
ACx 617/677-0495-5	ACN 634-0495-5	R9i
ACx 617/677-0610-5	ACN 634-0610-5	R10i
ACx 617/677-0770-5	ACN 634-0770-5	R11i
ACx 607/617/627/677-0930/0935-5	ACN 634-0925-5	R11i
ACx 607/617/627/677-1090/1095-5	ACN 634-1095-5	R12i
ACx 607/617/627/677-1380/1385-5	ACN 634-1385-5	R12i
ACx 607/617/627/677-0930/0935-5	ACN 634-1765-5	2xR11i
ACx 607/617/627/677-1090/1095-5	ACN 634-2165-5	2xR12i
ACx 607/617/627/677-1380/1385-5	ACN 634-2625-5	2xR12i
ACx 627-2850-5	ACN 634-2855-5	4xR11i
ACx 627-3450-5	ACN 634-3455-5	4xR11i
Supply voltage 525, 550, 575, 600, 660 or 690V		
ACx 617/677-0205-6	ACN 634-0205-6	R8i
ACx 617/677-0255-6	ACN 634-0255-6	R8i
ACx 617/677-0315-6	ACN 634-0315-6	R8i
ACx 617/677-0375-6	ACN 634-0375-6	R9i
ACx 617/677-0485-6	ACN 634-0485-6	R9i
ACx 617/677-0600-6	ACN 634-0600-6	R10i
ACx 617/677-0750-6	ACN 634-0750-6	R11i
ACx 607/617/627/677-0900-6	ACN 634-0905-6	R11i
ACx 607/617/627/677-1040/1045-6	ACN 634-1045-6	R12i
ACx 607/617/627/677-1380/1385-6	ACN 634-1385-6	R12i
ACx 607/627/677-1710-6	ACN 634-1715-6	2xR11i
ACx 607/627/677-2120-6	ACN 634-2125-6	2xR12i
ACx 607/627/677-2540-6	ACN 634-2545-6	2xR12i
ACx 607/627/677-2800-6	ACN 634-2805-6	4xR11i
ACx 607/627/677-3350-6	ACN 634-3355-6	4xR11i

Cooling Air, Dimensions

Below are the heights and depths of ACx 607, ACx 617, ACx 627 and ACx 677.

Degree of Protection	Height [mm]	Depth [mm]
IP 21 to IP 42	2119	723/821[1)]
IP 54	2317	684/780[1)]
IP 54R	2002[2)]	684/780[1)]

[1)]Units equipped with an air circuit breaker.

[2)] Without lifting lugs

Below are cooling air flow requirements, heat losses, dimensions and weights of ACx 607, ACx 617, ACx 627 and ACx 677.

Notes for all tables:

[1)]With cable top exit an additional 400 mm wide cubicle

[2)]With cable top exit (and/or common motor connection terminal units (B)) an additional 600 mm wide cubicle

[3)]With cable top exit and/or common motor connection terminal units an additional 800 mm wide cubicle

[4)]With cable top entry an additional 1200 mm wide cubicle

[5)]With EMC filter an additional 600 mm wide cubicle

Frequency Converter Type	Frame Type Supply	Frame Type Drive	Air Flow [m3/h]	Heat Loss [kW]	Width [mm]	Weight [kg]
Supply voltage 400V Six-pulse Diode Supply						
ACx 607-0760-3	B4	R11i	5090	20 est.	400+600+400+600+1000+30=3030 (1 (5	1780
ACx 607-0930-3	B4	R12i	6930	24 est.	400+600+400+600+1500+30=3530 (2	2250
ACx 607-1120-3	B4	R12i	6930	29 est.	400+600+400+600+1500+30=3530 (2	2250
ACx 607-1440-3	B5	2xR11i	9790	39 est.	400+600+400+600+1000+1000+30=4030 (2 (B	2800
ACx 607-1770-3	B5	2xR12i	13470	47 est.	400+600+400+600+200+1500+1500+30=5230 (3	3500
ACx 607-2140-3	B5	2xR12i	13470	55 est.	400+600+400+600+200+1500+1500+30=5230 (3	3500
Supply voltage 500V Six-pulse Diode Supply						
ACx 607-0930-5	B4	R11i	5090	22 est.	400+600+400+600+1000+30=3030 (1 (5	1780
ACx 607-1090-5	B4	R12i	6930	26 est.	400+600+400+600+1500+30=3530 (2	2250
ACx 607-1380-5	B4	R12i	6930	33 est.	400+600+400+600+1500+30=3530 (2	2250
ACx 607-1760-5	B5	2xR11i	9790	43 est.	400+600+400+600+1000+1000+30=4030 (2 (B	2800
ACx 607-2160-5	B5	2xR12i	13470	53 est.	400+600+400+600+200+1500+1500+30=5230 (3	3500
ACx 607-2620-5	B5	2xR12i	13470	63 est.	400+600+400+600+200+1500+1500+30=5230 (3	3500
Supply voltage 690V Six-pulse Diode Supply						
ACx 607-0900-6	B4	R11i	5090	22 est.	400+600+400+600+1000+30=3030 (1 (5	1780
ACx 607-1040-6	B4	R12i	6930	25 est.	400+600+400+600+1500+30=3530 (2 (5	2250
ACx 607-1380-6	B4	R12i	6930	33 est.	400+600+400+600+1500+30=3530 (2	2250
ACx 607-1710-6	B5	2xR11	9790	39 est.	400+600+400+600+1000+1000+30=4030 (2 (B	2800
ACx 607-2120-6	B5	2xR12i	13470	49 est.	400+600+400+600+200+1500+1500+30=5230 (3	3500
ACx 607-2540-6	B5	2xR12i	13470	52 est.	400+600+400+600+200+1500+1500+30=5230 (3	3500
ACx 607-2800-6	B5	4xR11i	17150	60 est.	400+600+400+600+200+1000+1000+1000+1000+30=6230 (3	4000
ACx 607-3350-6	B5	4xR11i	17150	72 est.	400+600+400+600+200+1000+1000+1000+1000+30=6230 (3	4000

Frequency Converter Type	IGBT Supply Section		Drive Frame Type	Air Flow [m3/h]	Heat Loss [kW]	Width [mm]	Weight [kg]
	Frame Size	Type					
Supply voltage 400V IGBT Supply							
ACx 617-0185-3	R8i	ACA 635-0265-3	R8i	3850	7.7	2600	900
ACx 617-0225-3	R8i	ACA 635-0265-3	R8i	3850	9.6	2600	900
ACx 617-0265-3	R8i	ACA 635-0265-3	R8i	3850	11.7	2600	900
ACx 617-0335-3	R9i	ACA 635-0405-3	R9i	3850	14.5	2800	970
ACx 617-0405-3	R9i	ACA 635-0405-3	R9i	3850	18	2800	970
ACx 617-0500-3	R10i	ACA 635-0500-3	R10i	7750	12.5	3800	1550
ACx 617-0630-3	R11i	ACA 635-0765-3	R11i	7750	26	4200	1730
ACx 617-0765-3	R11i	ACA 635-0765-3	R11i	7750	32	4200	1730
ACx 617-0935-3	R12i	ACA 635-1125-3	R12i	10850	39	5200	2800
ACx 617-1125-3	R12i	ACA 635-1125-3	R12i	10850	48	5200	2800
Supply voltage 500V IGBT Supply							
ACx 617-0215-5	R8i	ACA 635-0325-5	R8i	3850	9.0	2600	900
ACx 617-0255-5	R8i	ACA 635-0325-5	R8i	3850	10.9	2600	900
ACx 617-0325-5	R8i	ACA 635-0325-5	R8i	3850	14.4	2600	900
ACx 617-0395-5	R9i	ACA 635-0495-5	R9i	3850	17	2800	970
ACx 617-0495-5	R9i	ACA 635-0495-5	R9i	3850	22	2800	970
ACx 617-0610-5	R10i	ACA 635-1610-5	R10i	7750	28	3800	1550
ACx 617-0770-5	R11i	ACA 635-0935-5	R11i	7750	32	4200	1730
ACx 617-0935-5	R11i	ACA 635-0935-5	R11i	7750	40	4200	1730
ACx 617-1090-5	R12i	ACA 635-1385-5	R12i	10850	43	5200	2800
ACx 617-1385-5	R12i	ACA 635-1385-5	R12i	10850	59	5200	2800
Supply voltage 690V IGBT Supply							
ACx 617-0205-6	R8i	ACA 635-0315-6	R8i	3850	8.7	2600	900
ACx 617-0255-6	R8i	ACA 635-0315-6	R8i	3850	10.9	2600	900
ACx 617-0315-6	R8i	ACA 635-0315-6	R8i	3850	14.0	2600	900
ACx 617-0375-6	R9i	ACA 635-0485-6	R9i	3850	16	2800	970
ACx 617-0485-6	R9i	ACA 635-0485-6	R9i	3850	22.1	2800	970
ACx 617-0600-6	R10i	ACA 635-0600-6	R10i	7750	27.0	3800	1550
ACx 617-0750-6	R11i	ACA 635-0900-6	R11i	7750	31.0	4200	1730
ACx 617-0900-6	R11i	ACA 635-0900-6	R11i	7750	38.0	4200	1730
ACx 617-1045-6	R12i	ACA 635-1385-6	R12i	10850	42.0	5200	2800
ACx 617-1385-6	R12i	ACA 635-1385-6	R12i	10850	59.0	5200	2800

Frequency Converter Type	Frame Type Supply	Frame Type Drive	Air Flow [m3/h]	Heat Loss [kW]	Width [mm]	Weight [kg]
Supply voltage 400V Twelve-pulse Diode Supply						
ACx 627-0760-3	2xB3	R11i	5880	19 est.	400+2x(600)+1000+30=2630 (1 (4	1120
ACx 627-0930-3	2xB4	R12i	8340	28 est.	400+2x(600+400+600)+200+1500+30=5330 (2	3350
ACx 627-1120-3	2xB4	R12i	8340	34 est.	400+2x(600+400+600)+200+1500+30=5330 (2	3350
ACx 627-1440-3	2xB4	2xR11i	10180	38 est.	400+2x(600+400+600)+200+1000+1000+30=5830 (2 (B	3600
ACx 627-1770-3	2xB4	2xR12i	13860	46 est.	400+2x(600+400+600)+200+1500+1500+30=6830 (3	4300
ACx 627-2140-3	2xB4	2xR12i	13860	56 est.	400+2x(600+400+600)+200+1500+1500+30=6830 (3	4300
ACx 627-2340-3	2xB5	4xR11i	19580	63 est.	400+2x(600+400+600)+200+1000+1000+1000+1000+30=7830 (3	5400
ACx 627-2820-3	2xB5	4xR11i	19580	76 est.	400+2x(600+400+600)+200+1000+1000+1000+1000+30=7830 (3	5400
Supply voltage 500V Twelve-pulse Diode Supply						
ACx 627-0930-5	2xB3	R11i	5880	22 est.	400+2x(600)+1000+30=2630 (1 (4	1120
ACx 627-1090-5	2xB3	R12i	7720	25 est.	400+2x(600)+1500+30=3130 (2 (4	3350
ACx 627-1380-5	2xB4	R12i	8340	38 est.	400+2x(600+400+600)+200+1500+30=5330 (2	3350
ACx 627-1760-5	2xB4	2xR11i	10180	47 est.	400+2x(600+400+600)+200+1000+1000+30=5830 (2 (B	3600
ACx 627-2160-5	2xB4	2xR12i	13860	52 est.	400+2x(600+400+600)+200+1500+1500+30=6830 (3	4300
ACx 627-2620-5	2xB4	2xR12i	13860	63 est.	400+2x(600+400+600)+200+1500+1500+30=6830 (3	4300
ACx 627-2850-5	2xB5	4xR11i	17540	68 est.	400+2x(600+400+600)+200+1000+1000+1000+1000+30=7830 (3	5400
ACx 627-3450-5	2xB5	4xR11i	19580	85 est.	400+2x(600+400+600)+200+1000+1000+1000+1000+30=7830 (3	5400
Supply voltage 690V Twelve-pulse Diode Supply						
ACx 627-0900-6	2xB3	R11i	5880	21 est.	400+2x(600)+1000+30=2630 (2 (4	1120
ACx 627-1040-6	2xB3	R12i	7720	24 est.	400+2x(600)+1500+30=3130 (2 (4	3350
ACx 627-1380-6	2xB4	R12i	8340	38 est.	400+2x(600+400+600)+200+1500+30=5330 (2	3350
ACx 627-1710-6	2xB4	2xR11i	10180	47 est.	400+2x(600+400+600)+200+1000+1000+30=5830 (2 (B	3600
ACx 627-2120-6	2xB4	2xR12i	13860	51 est.	400+2x(600+400+600)+200+1500+1500+30=6830 (3	4300
ACx 627-2540-6	2xB4	2xR12i	13860	61 est.	400+2x(600+400+600)+200+1500+1500+30=6830 (3	4300
ACx 627-2800-6	2xB5	4xR11i	17540	67 est.	400+2x(600+400+600)+200+1000+1000+1000+1000+30=7830 (3	5400
ACx 627-3350-6	2xB5	4xR11i	19580	77 est.	400+2x(600+400+600)+200+1000+1000+1000+1000+30=7830 (3	5400

Frequency Converter Type	Supply Section		Drive Frame Type	Air Flow [m3/h]	Heat Loss [kW]	Width [mm]	Weight [kg]
	Frame Size	6-pulse Supply Type					
Supply voltage 400V Four-quadrant Thyristor Supply							
ACx 677-0185-3	B2	ACA 632-0200-3	R8i	1920	4.6	1400	550
ACx 677-0225-3	B3	ACA 632-0300-3	R8i	2320	5.6	1400	630
ACx 677-0265-3	B3	ACA 632-0300-3	R8i	2320	6.6	1600	630
ACx 677-0335-3	B3	ACA 632-0420-3	R9i	2320	8.4	1600	630
ACx 677-0405-3	B3	ACA 632-0420-3	R9i	2320	10	1600	630
ACx 677-0500-3	B4	ACA 632-0680-3	R10i	5600	12	3600	1950
ACx 677-0630-3	B4	ACA 632-0680-3	R11i	5600	16	3800	1980
ACx 677-0760-3	B4	ACA 632-1120-3	R11i	5600	20	400+600+400+2x600+1000+30=3630 (1	1980
ACx 677-0930-3	B4	ACA 632-1120-3	R12i	7150	24	400+600+400+2x600+1500+30=4130 (2	2450
ACx 677-1120-3	B4	ACA 632-1120-3	R12i	7150	30	400+600+400+2x600+1500+30=4130 (2	2450
ACx 677-1440-3	B5	ACA 632-1700-3	2xR11i	10700	39	400+600+400+2x600+200+1000+1000+30=4830 (2 (B	3100
ACx 677-1770-3	B5	ACA 632-1700-3	2xR12i	13800	48	400+600+400+2x600+200+1500+1500+30=5830 (3	3800
ACx 677-2140-3	B5	ACA 632-2100-3	2xR12i	13800	55	400+600+400+2x600+200+1500+1500+30=5830 (3	3800
Supply voltage 500V Four-quadrant Thyristor Supply							
ACx 677-0215-5	B2	ACA 632-0250-5	R8i	1920	5.1	1400	550
ACx 677-0255-5	B3	ACA 632-0250-5	R8i	2320	6.0	1400	630
ACx 677-0325-5	B3	ACA 632-0375-5	R8i	2320	7.7	1600	630
ACx 677-0395-5	B3	ACA 632-0525-5	R9i	2320	9.4	1600	630
ACx 677-0495-5	B3	ACA 632-0525-5	R9i	2320	12	1600	630
ACx 677-0610-5	B4	ACA 632-0850-5	R10i	5600	14	3600	1950
ACx 677-0770-5	B4	ACA 632-0850-5	R11i	5600	18	3800	1980
ACx 677-0930-5	B4	ACA 632-1400-5	R11i	5600	22	400+600+400+2x600+1000+30=3630 (1	1980
ACx 677-1090-5	B4	ACA 632-1400-5	R12i	7150	26	400+600+400+2x600+1500+30=4130 (2	2450
ACx 677-1380-5	B4	ACA 632-1400-5	R12i	7150	34	400+600+400+2x600+1500+30=4130 (2	2450
ACx 677-1760-5	B5	ACA 632-2120-5	2xR11i	10700	43	400+600+400+2x600+200+1000+1000+30=4830 (2 (B	3100
ACx 677-2160-5	B5	ACA 632-2120-5	2xR12i	13800	53	400+600+400+2x600+200+1500+1500+30=5830 (3	3800
ACx 677-2620-5	B5	ACA 632-2600-5	2xR12i	13800	62	400+600+400+2x600+200+1500+1500+30=5830 (3	3800
Supply voltage 690V Four-quadrant Thyristor Supply							
ACx 677-0205-6	B2	ACA 632-0250-6	R8i	1920	4.9	1400	550
ACx 677-0255-6	B3	ACA 632-0250-5	R8i	2320	5.8	1400	630
ACx 677-0315-6	B3	ACA 632-0375-5	R8i	2320	7.5	1600	630
ACx 677-0375-6	B3	ACA 632-0375-5	R9i	2320	9	1600	630
ACx 677-0485-6	B3	ACA 632-0525-5	R9i	2320	12	1600	630
ACx 677-0600-6	B4	ACA 632-0850-5	R10i	5600	14	3600	1950
ACx 677-0750-6	B4	ACA 632-0850-5	R11i	5600	18	3800	1980
ACx 677-0900-6	B4	ACA 632-0850-5	R11i	5600	19	400+600+400+2x600+1000+30=3630 (1	1980
ACx 677-1040-6	B4	ACA 632-1400-5	R12i	7150	25	400+600+400+2x600+1500+30=4130 (2	2450
ACx 677-1380-6	B4	ACA 632-1400-5	R12i	7150	33	400+600+400+2x600+1500+30=4130 (2	2450
ACx 677-1710-6	B5	ACA 632-2600-5	2xR11	10700	39	400+600+400+2x600+200+1000+1000+30=4830 (2 (B	3100
ACx 677-2120-6	B5	ACA 632-2600-5	2xR12i	13800	49	400+600+400+2x600+200+1500+1500+30=5830 (3	3800
ACx 677-2540-6	B5	ACA 632-2600-5	2xR12i	13800	58	400+600+400+2x600+200+1500+1500+30=5830 (3	3800
ACx 677-2800-6	B5	ACA 632-3600-5	4xR11i	16900	60	400+600+400+2x600+200+1000+1000+1000+1000+ 30 = 6830 (3	4300
ACx 677-3350-6	B5	ACA 632-3600-5	4xR11i	16900	73	400+600+400+2x600+200+1000+1000+1000+1000+3 0=6830 (3	4300

Noise

The noise values of the ACx 607, ACx 617, ACx 627 and ACx 677 units are given below.

Type	Noise (dB)	Type	Noise (dB)	Type	Noise (dB)
ACx 617-0185-3	65	ACx 617-0215-5	65	ACx 617-0205-6	65
ACx 617-0225-3	65	ACx 617-0255-5	65	ACx 617-0255-6	65
ACx 617-0265-3	65	ACx 617-0325-5	65	ACx 617-0315-6	65
ACx 617-0335-3	65	ACx 617-0395-5	65	ACx 617-0375-6	65
ACx 617-0405-3	65	ACx 617-0495-5	65	ACx 617-0485-6	65
ACx 617-0500-3	70	ACx 617-0610-5	70	ACx 617-0600-6	70
ACx 617-0630-3	70	ACx 617-0770-5	70	ACx 617-0750-6	70
ACx 617-0765-3	70	ACx 617-0935-5	70	ACx 617-0900-6	70
ACx 617-0935-3	73	ACx 617-1090-5	73	ACx 617-1045-6	73
ACx 617-1125-3	73	ACx 617-1385-5	73	ACx 617-1385-6	73
ACx 677-0185-3	63	ACx 677-0215-5	63	ACx 677-0205-6	63
ACx 677-0225-3	66	ACx 677-0255-5	66	ACx 677-0255-6	66
ACx 677-0265-3	66	ACx 677-0325-5	66	ACx 677-0315-6	66
ACx 677-0335-3	66	ACx 677-0395-5	66	ACx 677-0375-6	66
ACx 677-0405-3	66	ACx 677-0495-5	66	ACx 677-0485-6	66
ACx 677-0500-3	73	ACx 677-0610-5	73	ACx 677-0600-6	73
ACx 677-0630-3	73	ACx 677-0770-5	73	ACx 677-0750-6	73
ACx 607-0760-3	71	ACx 607-0930-5	71	ACx 607-0900-6	71
ACx 627-0760-3	68	ACx 627-0930-5	68	ACx 627-0900-6	68
ACx 677-0760-3	73	ACx 677-0930-5	73	ACx 677-0900-6	73
ACx 607-0930-3	73	ACx 607-1090-5	73	ACx 607-1040-6	73
ACx 627-0930-3	74	ACx 627-1090-5	70	ACx 627-1040-6	70
ACx 677-0930-3	74	ACx 677-1090-5	74	ACx 677-1040-6	74
ACx 607-1120-3	73	ACx 607-1380-5	73	ACx 607-1380-6	73
ACx 627-1120-3	74	ACx 627-1380-5	74	ACx 627-1380-6	74
ACx 677-1120-3	74	ACx 677-1380-5	74	ACx 677-1380-6	74
ACx 607-1440-3	75	ACx 607-1760-5	75	ACx 607-1710-6	75
ACx 627-1440-3	74	ACx 627-1760-5	74	ACx 627-1710-6	74
ACx 677-1440-3	76	ACx 677-1760-5	76	ACx 677-1710-6	76
ACx 607-1770-3	76	ACx 607-2160-5	76	ACx 607-2120-6	76
ACx 627-1770-3	75	ACx 627-2160-5	75	ACx 627-2120-6	75
ACx 677-1770-3	76	ACx 677-2160-5	76	ACx 677-2120-6	76
ACx 607-2140-3	76	ACx 607-2620-5	76	ACx 607-2540-6	76
ACx 627-2140-3	75	ACx 627-2620-5	75	ACx 627-2540-6	75
ACx 677-2140-3	76	ACx 677-2620-5	76	ACx 677-2540-6	76
ACx 627-2340-3	76	ACx 627-2850-5	75	ACx 607-2800-6	76
			71	ACx 627-2800-6	75
			72	ACx 677-2800-6	76
ACx 627-2820-3	76	ACx 627-3450-5	76	ACx 607-3350-6	76
				ACx 627-3350-6	76
				ACx 677-3350-6	76

Dynamic Braking

Below are Dynamic Braking Sections for the ACx 607, ACx 627, ACx 617, ACx 627 and ACx 677.

ACx 607, ACx 617 ACx 627 or ACx 677	Dynamic Braking Section Type	Section Width (mm)	Chopper Type	Resistor			
				Type	R_{min} (ohm)	E_r (kJ)	$P_{br,max}$ (kW)
Supply voltage 400V							
-0760-3	ACA 622-0960-3	3x(400+800)	3xNBRA-659	3x(2xSAFUR180F460)	3x(1.20)	36000	1060
-0930-3	ACA 622-0960-3	3x(400+800)	3xNBRA-659	3x(2xSAFUR180F460)	3x(1.20)	36000	1060
-1120-3	ACA 622-1280-3	4x(400+800)	4xNBRA-659	4x(2xSAFUR180F460)	4x(1.20)	48000	1411
-1440-3	ACA 622-1600-3	5x(400+800)	5xNBRA-659	5x(2xSAFUR180F460)	5x(1.20)	60000	1764
-1770-3	ACA 622-1600-3	5x(400+800)	5xNBRA-659	5x(2xSAFUR180F460)	5x(1.20)	60000	1764
-2140-3	ACA 622-1920-3	6x(400+800)	6xNBRA-659	6x(2xSAFUR180F460)	6x(1.20)	72000	2117
-2340-3	ACA 622-1920-3	6x(400+800)	6xNBRA-659	6x(2xSAFUR180F460)	6x(1.20)	72000	2117
-2820-3	ACA 622-1920-3	6x(400+800)	6xNBRA659	6x(2xSAFUR180F460)	6x(1.20)	72000	2117
Supply voltage 500V							
-0930-5	ACA 622-1200-5	3x(400+800)	3xNBRA-659	3x(2xSAFUR200F500)	3x(1.35)	32400	1208
-1090-5	ACA 622-1200-5	3x(400+800)	3xNBRA-659	3x(2xSAFUR200F500)	3x(1.35)	32400	1208
-1380-5	ACA 622-1200-5	3x(400+800)	3xNBRA-659	3x(2xSAFUR200F500)	3x(1.35)	32400	1208
-1760-5	ACA 622-1600-5	4x(400+800)	4xNBRA-659	4x(2xSAFUR200F500)	4x(1.35)	43200	1611
-2160-5	ACA 622-2000-5	5x(400+800)	5xNBRA-659	5x(2xSAFUR200F500)	5x(1.35)	54000	2014
-2620-5	ACA 622-2400-5	6x(400+800)	6xNBRA-659	6x(2xSAFUR200F500)	6x(1.35)	64800	2417
-2850-5	ACA 622-2400-5	6x(400+800)	6xNBRA-659	6x(2xSAFUR200F500)	6x(1.35)	64800	2417
-3450-5	ACA 622-2400-5	6x(400+800)	6xNBRA-659	6x(2xSAFUR200F500)	6x(1.35)	64800	2417
Supply voltage 690V							
-0900-6	ACA 622-1200-6	3x(400+800)	3xNBRA-669	3x(2xSAFUR200F500)	3x(1.35)	32400	1211
-1040-6	ACA 622-1200-6	3x(400+800)	3xNBRA-669	3x(2xSAFUR200F500)	3x(1.35)	32400	1211
-1380-6	ACA 622-1200-6	3x(400+800)	3xNBRA-669	3x(2xSAFUR200F500)	3x(1.35)	32400	1211
-1710-6	ACA 622-1600-6	4x(400+800)	4xNBRA-669	4x(2xSAFUR200F500)	4x(1.35)	43200	1615
-2120-6	ACA 622-2000-6	5x(400+800)	5xNBRA-669	5x(2xSAFUR200F500)	5x(1.35)	54000	2019
-2540-6	ACA 622-2400-6	6x(400+800)	6xNBRA-669	6x(2xSAFUR200F500)	6x(1.35)	64800	2422
-2800-6	ACA 622-2400-6	6x(400+800)	6xNBRA-669	6x(2xSAFUR200F500)	6x(1.35)	64800	2422
-3350-6	ACA 622-2400-6	6x(400+800)	6xNBRA-669	6x(2xSAFUR200F500)	6x(1.35)	64800	2422

Application Programs

See the subsection *Application Program* in *General Technical Data – ACx 601, ACx 604 and ACx 607/627/677 R7 to 2×R9*.

Applicable Standards

See the subsection *Applicable Standards* in *General Technical Data – ACx 601, ACx 604 and ACx 607/627/677 R7 to 2×R9*.

Materials (Cabinet & Busbars)

Table below shows the cabinet and busbar materials.

Enclosure	**Coating Thickness**	**Color**
hot-dip zinc coated steel sheet 1.0 to 2.5 mm with polyester thermosetting powder coating in visible surfaces	60 µm	RAL 7035 light beige semigloss
Flat Busbars: aluminium (standard), copper (optional), tin plated copper (optional)		
Package: wood or plywood (seaworthy package). Plastic covering of the package: PE-LD, bands PP or steel.		

Transportation Lenghts and packages

Length: max. 4 metres, weight max. 2400 kg, **Position:** upright

Max. crate dimensions:

length shipping length + 100 mm

depth shipping split depth + 150 mm

height height + 80 mm

Max. seaworthy dimensions:

length shipping length + 200 mm

depth shipping split depth + 185 mm

height 2200 mm

Disposal

See subsection *Disposal* in *General Technical Data – ACx 601, ACx 604 and ACx 607/627/677 R7 to 2×R9*.

CE Marking

A CE mark is attached to ACx 607/627/677 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). The CE marking is pending for the ACx 617 and the ACx 677-0185-3 to ACx 677-0630-3, ACx 677-0215-5 to ACx 677-0770-5 and ACx 677-0205-6 to -0750-6.

Compliance with the EMC Directive

EMC stands for **E**lectro**m**agnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

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

The ACx 607/627/677 frequency converters (630 kW to 3000 kW) comply with the EMC Directive in industrial low-voltage network, and IT networks (unearthed mains) with the following provisions:

Industrial Low-Voltage Network

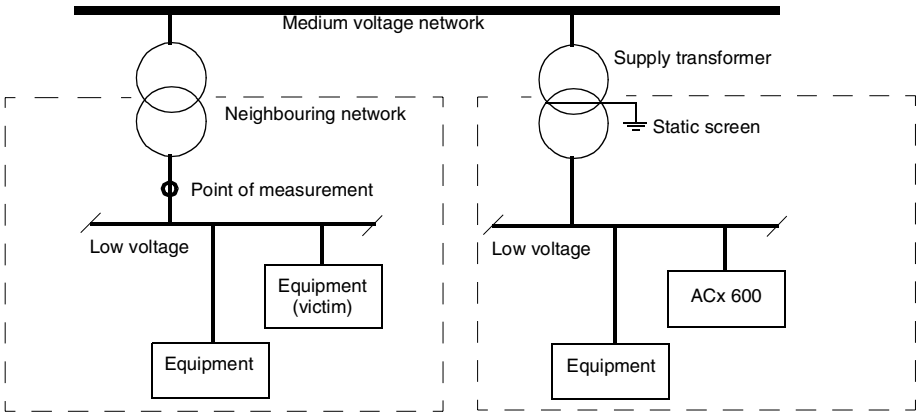
1. It is ensured that no excessive emission is propagated to neighbouring low-voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, the ACx 607/627 can be equipped with EMC filtering (refer to Table A-1), or a supply transformer with static screening between the primary and secondary windings can be used.
2. The ACx 607, ACx 627 or ACx 677 is installed according to the instructions given in the Hardware Manual (EN code: 61329005).
3. The motor and control cables are selected as specified in this manual.

Note 1: It is recommended to equip the ACx 607/627 with EMC filtering if there is equipment sensitive to conducted emission connected to the same supply transformer as the ACx 600.

Note 2: The ACx 617 and ACx 677 must not be equipped with the EMC filtering.

*Table A-1 The EMC filtering of the ACx 600 units is marked in the type code as follows. *** EMC Cabinet with EMC Filters.*

ACS 600 Type	Type Code		
	Character no.	EMC Filter Selections	No EMC Filter Selections
ACS/ACC 607, ACx 627 or ACx 677	ACxxxxxxxxxxxxxxxxxxxxxxxxx... (26)	1, 2***	0,
ACS 600 MultiDrive Supply Section	ACA63xxxxxxxxxxxxx... (16)	1, 2***	0
Drive Section	ACA610xxxxxxxxxxxx... (16)	1	0



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

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 607, ACx 627 or ACx 677 is installed according to the instructions given in the Hardware Manual (EN code: 61329005)..
3. The motor and control cables are selected as specified in this manual.

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

Machinery Directive

ACx 607/617/627/677 frequency converters comply with the European Union Machinery Directive (89/392/EEC) requirements for an equipment intended to be incorporated into machinery.

CSA Marking

The CSA marking is often required in North America. CSA marked ACx 607, ACx 617 and ACx 677 frequency converters (630 kW to 3000 kW) are available on request.

"C-tick" Marking

"C-tick" marking is required in Australia and New Zealand.

A "C-tick" mark is attached to ACx 607 frequency converters (630 kW to 3000 kW) to verify that the unit follows the provisions of

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

- Radiocommunication Regulations of New Zealand (1993).

Compliance with AS/ NZS 2064

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

The ACx 607 frequency converters (630 kW to 3000 kW) 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 607 is equipped with EMC filtering (refer to Table A-1).
2. The ACx 607 is installed according to the instructions given in this manual.
3. The motor and control cables are selected as specified in this manual.
4. Maximum cable length is 100 metres.

Note: The ACx 607 must not be equipped with EMC filtering (refer to Table A-1) when installed to IT networks. The mains becomes connected to earth potential through the EMC filter capacitors. In IT networks this may cause danger or damage the unit.

Equipment Warranty and Liability

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

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

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

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

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

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

Limitation of Liability

IN NO EVENT SHALL ABB, ITS SUPPLIERS OR SUBCONTRACTORS BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY

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

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

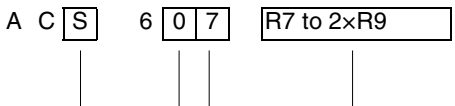
In no event, regardless of cause, shall ABB assume responsibility for or be liable for penalties or penalty clauses of any description or for indemnification of customer or others for costs, damages, or expenses each arising out of or related to the goods or services of the order.

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

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

Product Type Designations Used in The Catalogue

The figure below describes the product type designations used in this catalogue. The complete 22 to 39 digit type code key for the ACS 600 SingleDrive is given in the *Ordering Information* document (EN code 58977985).



Drive type [1]

S	Standard drive
C	Crane drive
P	Position drive

Input bridge

0	Six-pulse diode bridge
1	IGBT diode bridge
2	Twelve-pulse diode bridge
7	Thyristor bridge

Construction

1	Wall-mounted drive
4	Converter module to be installed into cabinet by user
7	Drive assembled inside a cabinet

Converter or inverter module size [2]

R7	Drive includes a size R7 converter module
2×R9	Drive includes two size R9 converter modules
R11i	Drive includes a size R11i inverter module
4×R11i	Drive includes four parallel size R11i inverters

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[1] ACx is used instead of a marking “ACS, ACC or ACP”, or marking “ACS or ACC”. The actual meaning is explained at the context of use.

[2] The module sizes for each ACS 600 type are given in the rating tables. See *Technical Data* appendix.

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