Drive^{IT} Low Voltage AC Drives

User's Manual

ACS550-02 Drives (110...355 kW)
ACS550-U2 Drives (150...550 HP)

ABB

ACS550 Drive Manuals

GENERAL MANUALS

ACS550-01/U1 User's Manual (0.75...90 kW) / (1...150 HP)

- Safety
- Installation
- Start-up
- Diagnostic
- Maintenance
- Technical Data

ACS550-02/U2 User's Manual (110...355 kW) / (150...550 HP)

- Safety
- Installation
- Start-up
- Diagnostic
- Maintenance
- Technical Data

ACS550 Technical Reference Manual

Detailed product description

- Technical product description including Dimension drawings
- Cabinet mounting information including power losses
- Software and control including complete parameter descriptions
- User interfaces and control connections
- Complete options descriptions
- Spare parts

Practical Engineering Guides

- PID and PFC engineering guides
- Dimensioning and sizing guidelines
- Diagnostics and maintenance information

OPTION MANUALS

(Fieldbus Adapters, I/O Extension Modules etc., manuals are delivered with optinal equipment)

Relay Output Extension Module (typical title)

- Installation
- Start-Up
- Diagnostic
- Technical Data

Safety

General

ACS550 in this manual refers, unless otherwise stated, to types ACS550-02 and -U2.

Warning! The ACS550 adjustable speed AC drive should ONLY be installed by a qualified electrician.

Warning! Even when the motor is stopped dangerous voltage is present at the Power Circuit terminals U1, V1, W1 and U2, V2, W2 and U_{C+}, U_{C-}.

Warning! Even when power is removed from the input terminals of the ACS550, there may be dangerous voltage (from external sources) on the terminals of the relay outputs RO1 to RO3.

Warning! The ACS550-02/-U2 is a field repairable unit. In case of service or repair of malfunctioning unit, contact your local Authorized Service Centre for service.

Warning! The ACS550 will start up automatically after an input voltage interruption if the external run command is on.

Warning! When the control terminals of two or more drive units are connected in parallel, the auxiliary voltage for these control connections must be taken from a single source which can either be one of the units or an external supply.

Warning! The heat sink may reach a high temperature, see Technical Data chapter.

Use of Warnings and Notes

There are two types of safety instructions throughout this manual:

- Notes draw attention to a particular condition or fact, or give information on a subject.
- Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment. They also tell you how to avoid the danger. The warning symbols are used as follows:

Dangerous voltage warning warns of high voltage which can cause physical injury and/or damage to the equipment.

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

Table of Contents

Installation

Installation and Commissioning Flowchart

Task	See
Identify the frame size of your drive, R7 or R8.	*Technical Data: Ratings* on page *180* vs application requirements
Plan the installation. Check the ambient conditions, ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data. Select the cables.	*Installation* For compliance with the European Union EMC Directive, see *Technical Data*: *CE / UL Markings / C-Tick* on page *186* Option manual (if optional equipment is included)
Unpack and check the units. Check that all necessary optional modules and equipment are present and correct. Only intact units may be started up.	*Installation*: *Moving the Unit* on page *19.* If the converter has been non-operational for more than one year, the converter DC link capacitors need to be reformed. Ask ABB for instructions.
Check the installation site.	*Installation: Before Installation* on page *21* *Technical Data*
Check the insulation of the motor and the motor cable.	*Installation: Checking the Insulation of the Assembly* on page *23*
If the drive is about to be connected to an IT (ungrounded) system, check that the EMC filter is not connected to the ground.	*Delivery Check*: Type code. For instructions on how to disconnect the EMC filtering, contact ABB.
Route the cables.	*Routing Instructions:* Routing the cables installation on *page 17*
Install the drive. Connect the power cables. Connect the control and the auxiliary control cables.	Resistor Braking (external), contact your local ABB.
Check the installation.	*Installation Checklist* on page *37*
Commission the drive.	User Manual

Preparing for Installation

Checking the Compatibility of the Motor

See *Technical data* for the drive ratings and the motor connection data.

WARNING! Operation is not allowed if the motor nominal voltage is less than 1/2 of the drive nominal input voltage, or the motor nominal current less than 1/6 of the drive nominal output current.

Protecting the Motor Winding and Bearings

The output of the drive comprises – regardless of output frequency – pulses of approximately 1.35 times the mains network voltage with a very short rise time. This is the case with all drives employing modern IGBT inverter technology.

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

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

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

- optional du/dt limitation (protects motor insulation system and reduces bearing currents).
- common mode filter (reducing bearing currents)

The common mode filter is composed of toroidal cores installed onto the output busbars inside the drive at the factory.

Requirements Table

The following table shows how to select the motor insulation system and when external du/dt limitation and insulated N-end (non-driven end) motor bearings are required. The motor manufacturer should be consulted regarding the construction of the motor insulation and additional requirements for explosion-safe (EX) motors. Failure of the motor to fulfil the following requirements or improper installation may shorten motor life or damage the motor bearings. ACS550-02/U2 devices have common mode filters (CMF) as standard accessories.

Manufacturer	Motor type	Nominal mains voltage (AC line voltage)	Requirement for			
			Motor insulation system	ABB du/dt limitation and insulated N-end bearing		
				P_N < 100 kW and frame size < IEC 315	**100 kW ≤ P_N < 350 kW** or frame size ≥ IEC 315	**P_N ≥ 350 kW** or frame size ≥ IEC 400
				P_N < 134 HP and frame size < NEMA 500	**134 HP ≤ P_N < 469 HP** or frame size ≥ NEMA 500	**P_N ≥ 469 HP**
ABB	Random-wound M2_ and M3_	$U_N \leq 500$ V	Standard	-	+ N	+ N
	Form-wound HXR and AM_	380 V < $U_N \leq 480$ V	Standard	n.a.	+ N	+ N
	Old* form-wound HX_ and modular	380 V < $U_N \leq 480$ V	Check with the motor manufacturer.			
	Random-wound HXR and AM_	380 V < $U_N \leq 480$ V	Check with the motor manufacturer.			
NON-ABB	Random-wound and form-wound	$U_N \leq 420$ V	Standard: $\hat{U}_{LL}$ = 1300 V	-	+ N	+ N
		420 V < $U_N \leq 500$ V	Standard: $\hat{U}_{LL}$ = 1300 V	+ du/dt	+ du/dt + N	+ du/dt + N
					or	
					+ du/dt	
			or			
			Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	-	+ N	+ N

* manufactured before 1992

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

Abbreviation	Definition
U_N	nominal voltage of the supply network
$\hat{U}_{LL}$	peak line-to-line voltage at motor terminals which the motor insulation must withstand
P_N	motor nominal power
du/dt	du/dt filter at the output of the drive or internal du/dt limitation. Contact ABB.
CMF	common mode filter toroidal cores, included in ACS550 R7 and R8.
N	N-end bearing: insulated motor non-driven end bearing
n.a.	Motors of this power range are not available as standard units. Consult the motor manufacturer.

Note 2: *Explosion-safe (EX) motors*

The motor manufacturer should be consulted regarding the construction of the motor insulation and additional requirements for explosion-safe (EX) motors.

Note 3: *HXR and AMA motors*

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

Note 4: *ABB motors of types other than M2_, M3_, HX_ and AM_*

Select according to non-ABB motors.

Note 5: *Resistor braking of the drive*

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

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

Supply Connection

Disconnecting Device (Means)

Install a hand-operated input disconnecting device between the AC power source (MCC) and the drive. The disconnecting device must be of a type that can be locked to the open position for installation and maintenance work.

EU

To meet the European Union Directives, according to standard EN 60204-1, Safety of Machinery, the disconnecting device must be one of the following types:

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

US

The disconnecting means must conform to the applicable safety regulations.

Fuses

See Technical Data: *Input Power Cables and Fuses* on page *182*.

Thermal Overload and Short-circuit Protection

The drive protects itself and the input and motor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. No additional thermal protection devices are needed.

WARNING! If the drive is connected to multiple motors, a separate thermal overload switch or a circuit breaker must be used for protecting each cable and motor. These devices may require a separate fuse to cut off the short-circuit current.

The drive protects the motor cable and the motor in a short-circuit situation when the motor cable is dimensioned according to the nominal current of the drive.

Mains Cable (AC line cable) Short-circuit Protection

Always protect the input cable with fuses. Standard gG (US: T or L) fuses will protect the input cable in short-circuit situations and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Size the fuses according to local safety regulations, appropriate input voltage and the rated current of the drive. For fuse ratings, see *Technical Data*.

WARNING! Circuit breakers are not capable of providing sufficient protection because they are inherently slower than fuses. Always use fuses with circuit breakers, if you are not sure of the circuit breaker braking capacity and mains short circuit power.

Ground Fault Protection

The drive is equipped with an internal ground fault protective function to protect the unit against ground faults in the motor and the motor cable. This is not a personal safety or a fire protection feature. The ground fault protective function can be disabled with a parameter contact ABB for more information.

The EMC filter of the drive includes capacitors connected between the main circuit and the frame. These capacitors and long motor cables increase the ground leakage current and may cause fault current circuit breakers to function.

Emergency Off Devices

For safety reasons, install the emergency off devices at each operator control station and at other operating stations where emergency off may be needed. Pressing the stop key ( ) on the control panel of the drive does not generate an emergency off of the motor or separate the drive from dangerous potential.

Selecting the Power Cables

General Rules

Dimension the mains (input power) and motor cables **according to local regulations**:

- The cable must be able to carry the drive load current. See chapter *Technical Data* for the rated currents.
- The cable must be rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use. For US, follow local codes for cable size.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when an ground fault occurs).
- 600 VAC cable is accepted for up to 500 VAC concerning the whole ACS550 range.

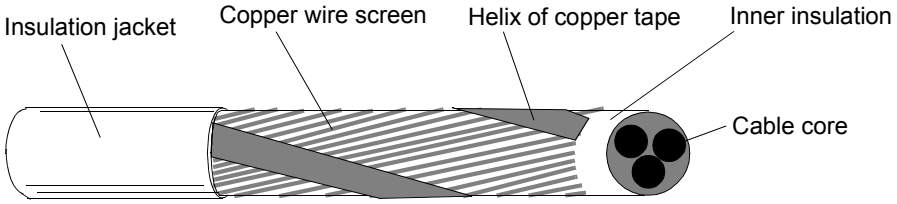
For frame sizes R7 and R8, symmetrical shielded motor cable must be used (figure below). A four-conductor system used up to 30 kW motors cannot be used.

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

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

Motor Cable Shield

To effectively suppress radiated and conducted radio-frequency emissions, the shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminium shield. The minimum requirement of the motor cable shield of the drive is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape. The better and tighter the shield, the lower the emission level and the bearing currents.



Additional US Requirements

Type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable must be used for the motor cables if metallic conduit is not used. For the North American market, 600 VAC cable is accepted for up to 500 VAC. For drives rated over 100 amperes, the power cables must be rated for 70 °C (158 °F).

Conduit

Where conduits must be coupled together, bridge the joint with a ground conductor bonded to the conduit on each side of the joint. Bond the conduits also to the drive enclosure. Use separate conduits for input power, motor, brake resistors, and control wiring. Do not run motor wiring from more than one drive in the same conduit.

Armored cable / shielded power cable

The motor cables can be run in the same cable tray as other 460 V power wiring. Control and signal cables must not be run in the same tray as power cables. Six conductor (3 phases and 3 ground) type MC continuous corrugated aluminum armor cable with symmetrical grounds is available from the following suppliers (trade names in parentheses):

- Anixter Wire & Cable (Philsheath)
- BICC General Corp (Philsheath)
- Rockbestos Co. (Gardex)
- Oaknite (CLX).

Shielded power cables are available from Belden, LAPPKABEL (ÖLFLEX) and Pirelli.

Power Factor Compensation Capacitors

Do not connect power factor compensation capacitors or capacitive surge absorbers to the motor cables (between the drive and the motor). They are not designed to be used with drives, and will degrade motor control accuracy. They can cause permanent damage to the drive or themselves due to the rapid changes in the drive output voltage.

If there are power factor compensation capacitors in parallel with the three phase input of the drive, ensure that the capacitors and the drive are not charged simultaneously to avoid voltage surges which might damage the unit.

Equipment Connected to the Motor Cable

Installation of Safety Switches, Contactors, Connection Boxes, etc.

To minimize the emission level when safety switches, contactors, connection boxes or similar equipment are installed in the motor cable (i.e. between the drive and the motor):

- EU: Install the equipment in a metal enclosure with 360 degrees grounding for the screens of both the incoming and outgoing cable, or connect the screens of the cables otherwise together.
- US: Install the equipment in a metal enclosure in a way that the conduit or motor cable shielding runs consistently without breaks from the drive to the motor.

Bypass connection

WARNING! Never connect the supply power to the drive output terminals U2, V2 and W2. If frequent bypassing is required, employ mechanically connected switches or contactors. Mains (line) voltage applied to the output can result in permanent damage to the unit.

Before Opening a Contactor, Sensorless Vector Control (SVC) Mode Selected

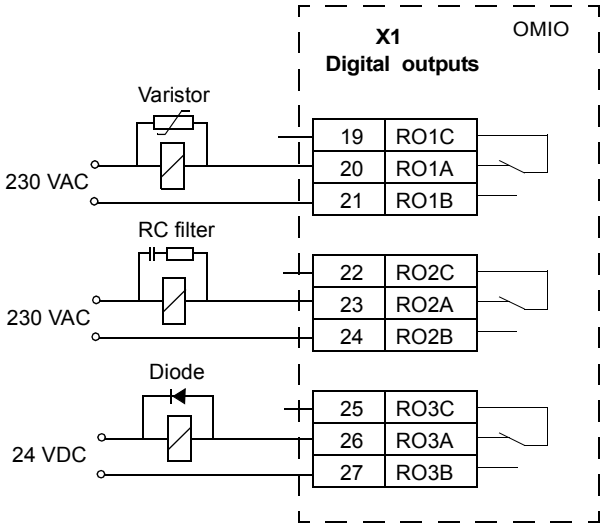
If an output isolator or contactor is used, supply either stop signal or RUN ENABLE (see parameter 1601) signal from an auxiliary contact of the isolator to the ACS550, in order to make sure that the ACS550 will coast to stop immediately when the isolator opens. Improper use of the isolator may damage the ACS550 and the isolator itself.

Protecting the Relay Output Contacts and Attenuating Disturbances in Case of Inductive Loads

Inductive loads (relays, contactors, motors) cause voltage transients when switched off.

It is highly recommended to equip inductive loads with noise attenuating circuits [varistors, RC filters (AC) or diodes (DC)] in order to minimize the EMC emission at switch-off. If not suppressed, the disturbances may connect capacitively or inductively to other conductors in the control cable and form a risk of malfunction in other parts of the system.

Install the protective component as close to the inductive load as possible. Do not install protective components at the OMIO board terminal block.

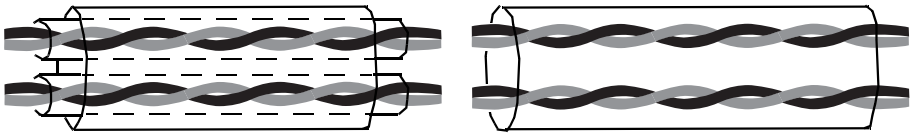


Selecting the Control Cables

All control cables must be shielded.

Use a double-shielded twisted pair cable (Figure a, e.g. JAMAK by NK Cables, Finland) for analogue signals. This type of cable is recommended for the pulse encoder signals also. Employ one individually shielded pair for each signal. Do not use common return for different analogue signals.

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



a
A double shielded twisted pair cable

b
A single shielded twisted multipair cable

Run analogue and digital signals in separate, shielded cables.

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

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

Relay Cable

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

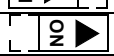
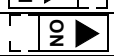
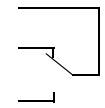
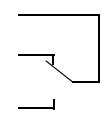
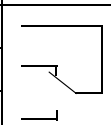
Control Panel Cable

In remote use, the cable connecting the control panel to the drive must not exceed 3 metres (10 ft). The cable type tested and approved by ABB is used in control panel option kits.

Control Connections

To complete the control connections, use:

- Following tables
- *Application Macro: PFC* on page *59*
- *Complete Parameter Descriptions* on page *72*
- Cable recommendations in *Selecting the Control Cables* on page *35*

	X1		Hardware Description
Analog I/O	1	SCR	Terminal for signal cable screen. (Connected internally to chassis ground.)
	2	AI1	Analog input channel 1, programmable. Default[2] = frequency reference. Resolution 0.1%, accuracy ±1%.
			J1:AI1 OFF: 0…10 V (R_i = 312 kΩ) 
			J1:AI1 ON: 0…20 mA (R_i = 100 Ω) 
	3	AGND	Analog input circuit common. (Connected internally to chassis gnd. through 1 MΩ)
	4	+10 V	10 V/10 mA reference voltage output for analog input potentiometer, accuracy ±2%.
	5	AI2	Analog input channel 2, programmable. Default[2] = not used. Resolution 0.1%, accuracy ±1%.
			J1:AI2 OFF: 0…10 V (R_i = 312 kΩ) 
			J1:AI2 ON: 0…20 mA (R_i = 100 Ω) 
	6	AGND	Analog input circuit common. (Connected internally to chassis gnd. through 1 MΩ)
	7	AO1	Analog output, programmable. Default[2] = frequency. 0…20 mA (load < 500 Ω)
	8	AO2	Analog output, programmable. Default[2] = current. 0…20 mA (load < 500 Ω)
	9	AGND	Analog output circuit common (Connected internally to chassis gnd. through 1 MΩ)
Digital Inputs[1]	10	+24V	Auxiliary voltage output 24 VDC / 250 mA (reference to GND). Short circuit protected.
	11	GND	Auxiliary voltage output common. (Connected internally as floating.)
	12	DCOM	Digital input common. To activate a digital input, there must be ≥+10 V (or ≤-10 V) between that input and DCOM. The 24 V may be provided by the ACS550 (X1-10) or by an external 12…24 V source of either polarity.
	13	DI1	Digital input 1, programmable. Default[2] = start/stop.
	14	DI2	Digital input 2, programmable. Default[2] = fwd/rev.
	15	DI3	Digital input 3, programmable. Default[2] = constant speed sel (code).
	16	DI4	Digital input 4, programmable. Default[2] = constant speed sel (code).
	17	DI5	Digital input 5, programmable. Default[2] = ramp pair selection (code).
	18	DI6	Digital input 6, programmable. Default[2] = not used.
Relay Outputs	19	RO1C	 Relay output 1, programmable. Default[2] = Ready Maximum: 250 VAC / 30 VDC, 2 A Minimum: 500 mW (12 V, 10 mA)
	20	RO1A	
	21	RO1B	
	22	RO2C	 Relay output 2, programmable. Default[2] = Running Maximum: 250 VAC / 30 VDC, 2 A Minimum: 500 mW (12 V, 10 mA)
	23	RO2A	
	24	RO2B	
	25	RO3C	 Relay output 3, programmable. Default[2] = Fault Maximum: 250 VAC / 30 VDC, 2 A Minimum: 500 mW (12 V, 10 mA)
	26	RO3A	
	27	RO3B	

[1] Digital input impedance 1.5 kΩ. Maximum voltage for digital inputs is 30 V.

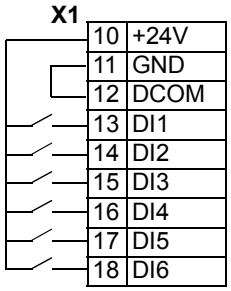
[2] Default values depend on the macro used. Values specified are for the default macro. See *Application Macros* on page *52*.

Note! Terminals 3, 6, and 9 are at the same potential.

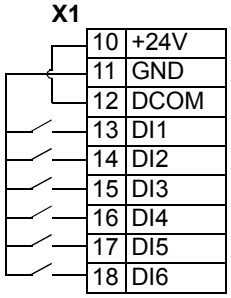
Note! For safety reasons the fault relay signals a “fault” when the ACS550 is powered down.

You can wire the digital input terminals in either a PNP or NPN configuration.

PNP connection (source)



NPN connection (sink)



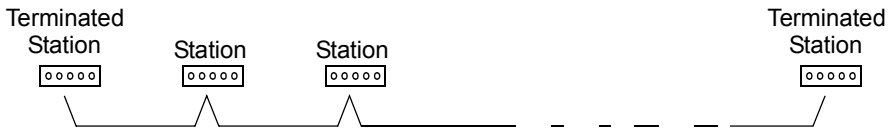
Communications

Terminals 28...32 are for RS485 modbus communications. Use shielded cables.

Do not directly ground the RS485 network at any point. Ground all devices on the network using their corresponding earthing terminals.

As always, the grounding wires should not form any closed loops, and all the devices should be earthed to a common ground.

Terminate the RS485 network using 120 Ω resistors at both ends of the network. Use the DIP switch to connect or disconnect the termination resistors. See following diagram and table.



X1	Identification	Hardware Description[1]
28	Screen	RS485 Multidrop application Other Modbus Devices SCR B A GND B A GND SCR 28 SCR 29 B 30 A 31 AGND 32 SCR **RS485 interface** J2 J5 J2 J5 ON ON ON ON off position on position Bus termination
29	B	
30	A	
31	AGND	
32	Screen	

[1] For functional descriptions, see *Application Macros* on page *52*, *Complete Parameter Descriptions* on page *72*, and *Standard Serial Communication* on page *150*.

Connection of a Motor Temperature Sensor to the Drive I/O

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

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

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

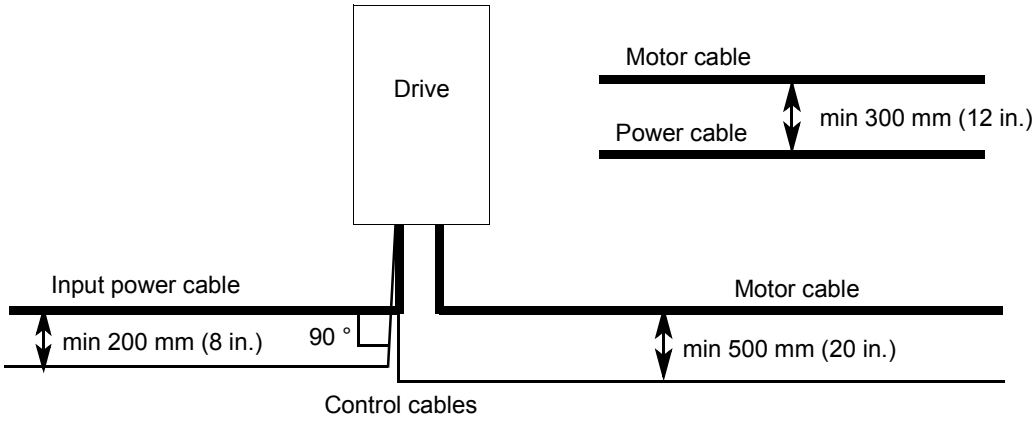
Routing the Cables

Route the motor cable away from other cable routes. Motor cables of several drives can be run in parallel installed next to each other. It is recommended that the motor cable, input power cable and control cables be installed on separate trays. Avoid long parallel runs of motor cables with other cables in order to decrease electromagnetic interference caused by the rapid changes in the drive output voltage.

Where control cables must cross power cables make sure they are arranged at an angle as near to 90 degrees as possible.

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

A diagram of the cable routing is below.



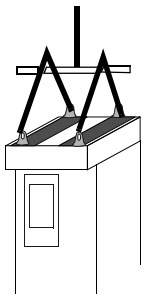
Installing the Drive

WARNING! Only qualified electricians are allowed to carry out the work described in this chapter. Follow the *Safety* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

Moving the Unit

Move the transport package by pallet truck to the installation site. Unpack the package as shown below.

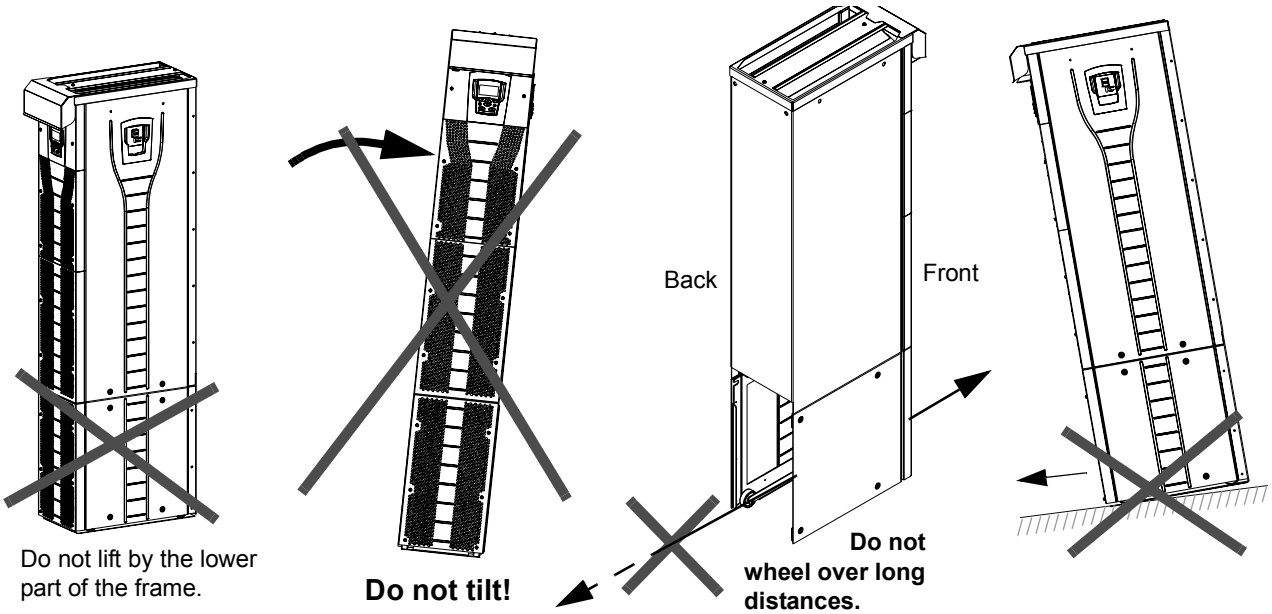
Lifting when the enclosure extension is included



WARNING! The drive is heavy [frame size R7: 100 kg (220 lb), frame size R8: 230 kg (507 lb)]. Lift the drive by the upper part only using the lifting lugs attached to the top of the unit. The lower part will be deformed from lifting. Do not remove the pedestal before lifting.

Do not tilt the drive. The centre of gravity of the unit is high. The unit will overturn from a tilt of about 6 degrees.

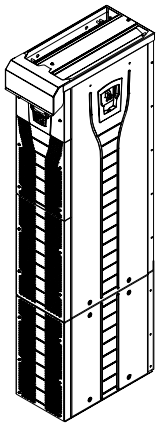
Do not wheel the drive except for installation (the front direction is preferable because the front wheels are steadier). The drive frame may be deformed from wheeling when the pedestal is removed. If the drive is moved over long distances, place it on its back on a pallet and move it by fork-lift.

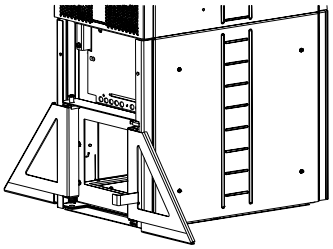


Do not lift by the lower part of the frame.

Do not tilt!

Do not wheel over long distances.





Frame size R8:

The support legs must be locked to open position during the installation and always when wheeling the unit.

Before Installation

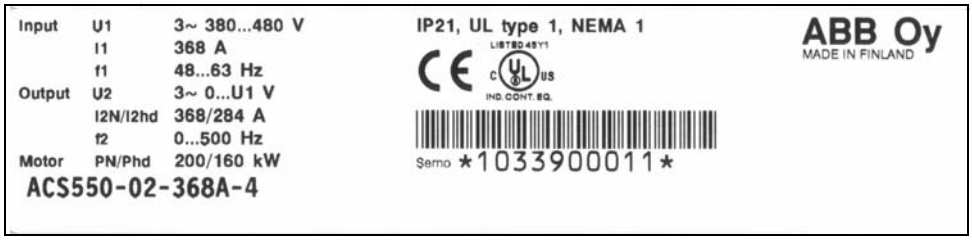
Delivery Check

The drive is delivered in a box that also contains:

- appropriate user manual
- optional module manuals
- delivery documents

Check that there are no signs of damage. Before attempting installation and operation, check the information on the type designation label of the drive to verify that the unit is of the correct type. The label includes an IEC and NEMA rating, UL, C-UL, CSA and CE markings, a type code and a serial number, which allow individual recognition of each unit. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week respectively. The remaining digits complete the serial number so that there are no two units with the same serial number.

The type designation label is located under the front visor and the serial number label inside the unit. Example labels are shown below.



Type designation label

Serial number label

Requirements For the Installation Site

The drive must be installed in an upright position on floor (or wall). Check the installation site according to the requirements below. Refer to *Dimension Drawings* on pages *188* and *189* for frame details. See *Technical Data* for the allowed operation conditions of the drive.

Wall

The wall/material near the unit must be of non-flammable material. Check that there is nothing on the wall to inhibit the installation.

If a unit is mounted on the wall, the wall must be as close to vertical as possible, and strong enough to carry the weight of the unit. The drive must not be installed without the pedestal on wall.

Floor

The floor/material below the installation should be non-flammable. The floor must be horizontal.

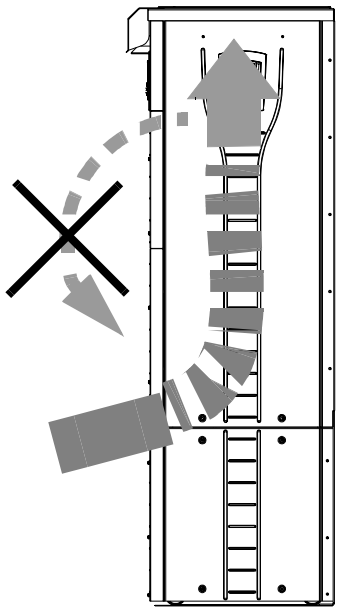
Free space around the unit

See section *Installation Procedure*: *Choose the mounting orientation (a, b, c or d)* on page *25*.

Cooling Air Flow

Provide the drive with the amount of fresh cooling air given in *Technical Data* / *Ratings* on page *180*.

The cooling air will enter the unit from the front air grating and flow upwards inside the unit. Re circulating cooling air into the unit is not allowed.



IT (ungrounded) Systems

The ACS550 drive is suitable for IT (ungrounded systems). Disconnect the filter before connecting the drive to an ungrounded system. For detailed instructions on how to do this, please contact your local ABB representative.

WARNING! If a drive is installed on an IT system [an ungrounded power system or a high resistance-grounded (over 30 ohms) power system], the system will be connected to earth potential through the EMC filter capacitors of the drive. This may cause danger or damage the unit.

Required Tools

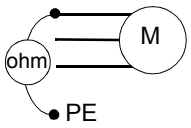
- 3 mm (0.12 in) screw driver
- 10 mm (3/8 in) Torx screw driver
- torque wrench with 500 mm (20 in) or 2 x 250 mm (2 x 10 in) extension bar
- 19 mm (3/4 in) socket
  for frame size R7: 13 mm (1/2 in) magnetic end socket
  for frame size R8: 17 mm (11/16 in) magnetic end socket.

Checking the Insulation of the Assembly

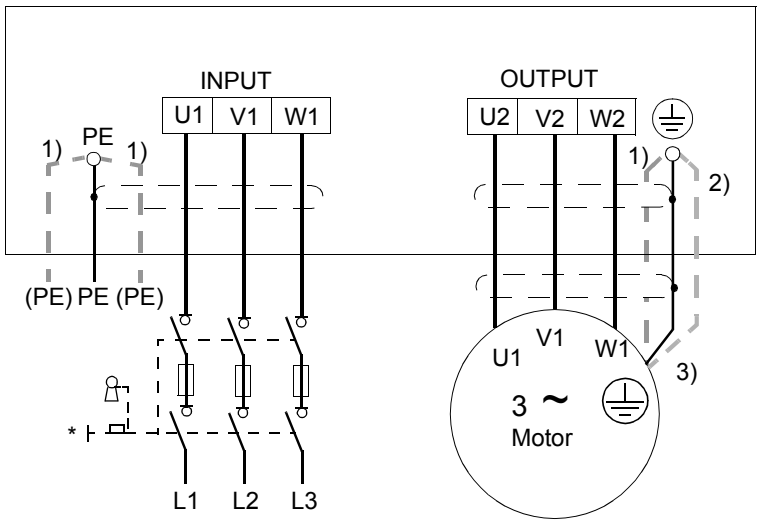
Every drive has been tested for insulation between the main circuit and the chassis (2500 V rms 50 Hz for 1 second) at the factory. Therefore, do not make any voltage tolerance or insulation resistance tests (e.g. hi-pot or megger) on any part of the drive. When checking the insulation of the assembly, proceed in the following manner:

WARNING! Check the insulation before connecting the drive to the mains. Make sure that the drive is disconnected from the mains (input power).

1. Check that the motor cable is disconnected from the drive output terminals U2, V2 and W2.
2. Measure the insulation resistance of the motor cable and the motor between each phase and the Protective Earth by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.

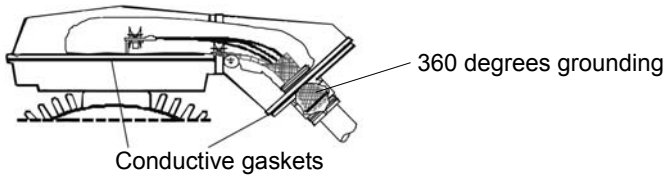


Power Cable Connection Diagram

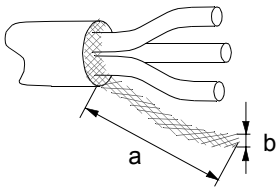


Ground the other end of the input cable shield / PE conductor at the distribution board.

1) an alternative to the grounding of the drive and the motor through the cable shield or armour
   Note: Connecting the fourth conductor of the motor cable at the motor end increases bearing currents and causes extra wear.
2) used if the conductivity of the cable shield is < 50 % of the conductivity of the phase conductor.
3) For minimum radio frequency interference at the motor end:
   - ground the cable shield 360 degrees at the lead-through of the motor terminal box

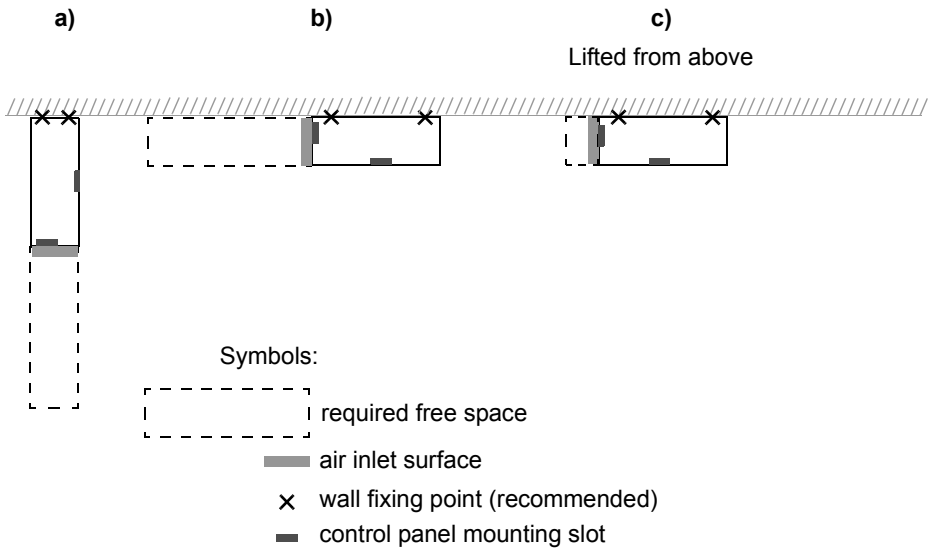


   - or ground the cable by twisting the shield as follows: flattened width $\geq$ 1/5 · length. In the figure below, b $\geq$ 1/5 · a.



Installation Procedure

Choose the mounting orientation (a, b, c or d)



Frame size	Mounting orientation	Required free space around the unit for mounting, maintenance, service and cooling *					
		Front		Side		Above	
		mm	in.	mm	in.	mm	in.
R7	a, d	500	20	-	-	200	7.9
	b	-	-	500	20	200	7.9
	c	-	-	200**	7.9**	lifting space	lifting space
R8	a, d	600	24	-	-	300	12
	b	-	-	600	24	300	12
	c	-	-	300**	12**	lifting space	lifting space

* space for the installer not included

** space for fan and capacitor replacement not included

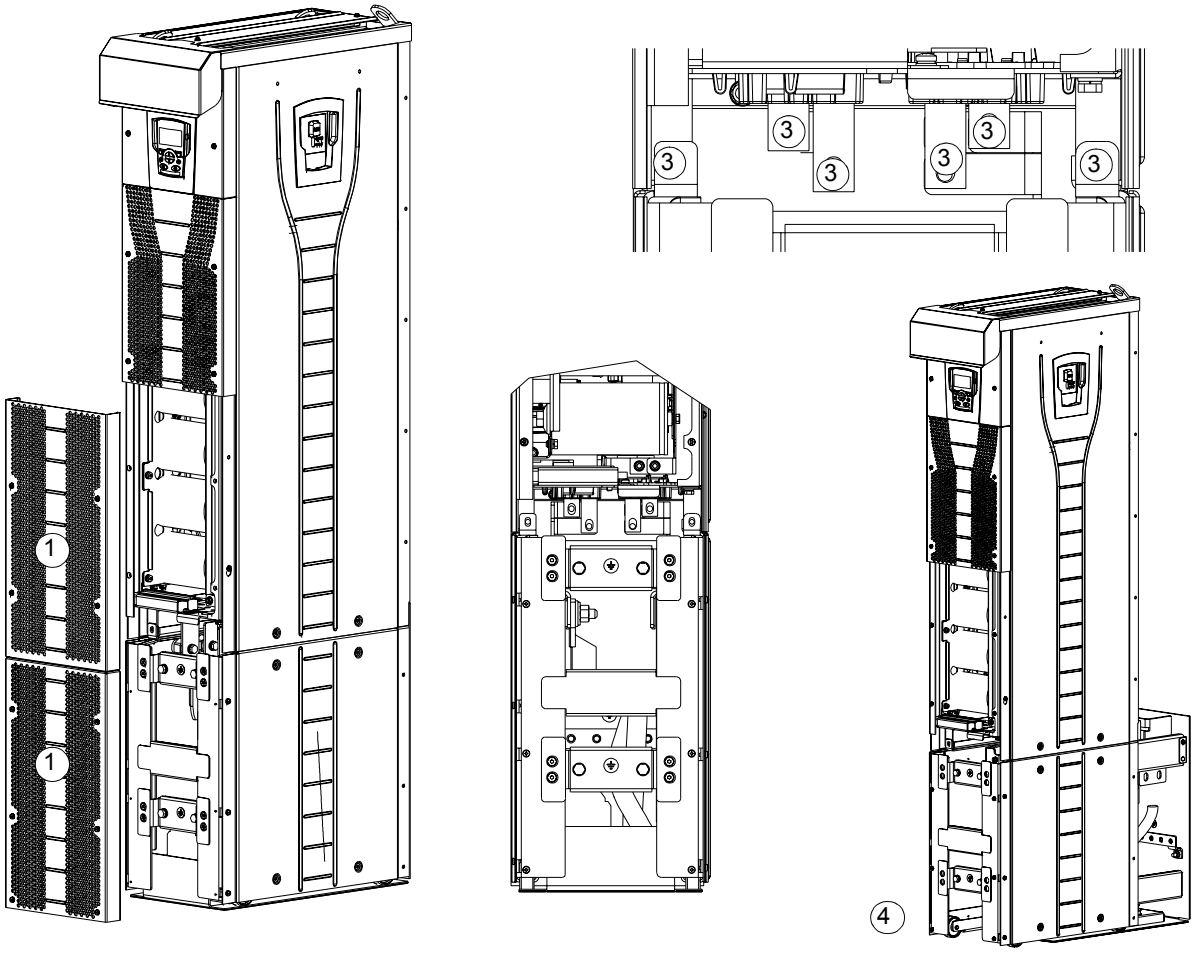
Mounting orientations a and b

Make holes in the wall (recommended):

1. Lift the unit against the wall into the mounting place.
2. Mark the locations for the two fixing points in the wall.
3. Mark the bottom edges of the unit to the floor.

Remove the pedestal (frame size R7):

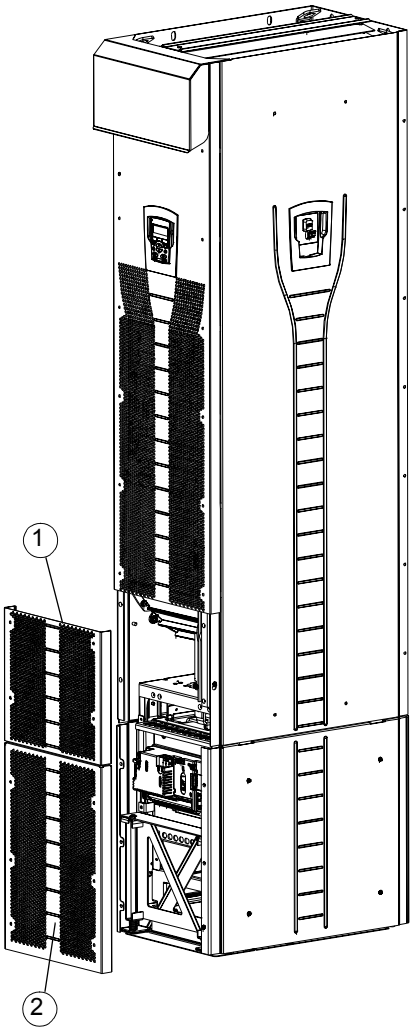
1. Remove the lower two parts of the front cover by undoing the fixing screws.
2. Undo the screws that fix the pedestal to the frame from front.
3. Undo the M8 combi screws (6 pcs) that connect the busbars of the pedestal to the upper frame. Use a torque wrench with an extension bar.
4. Wheel the drive frame out by using the handle.

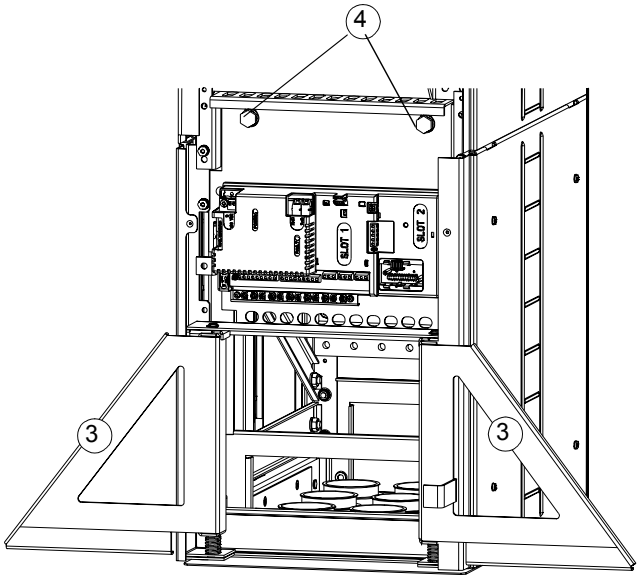


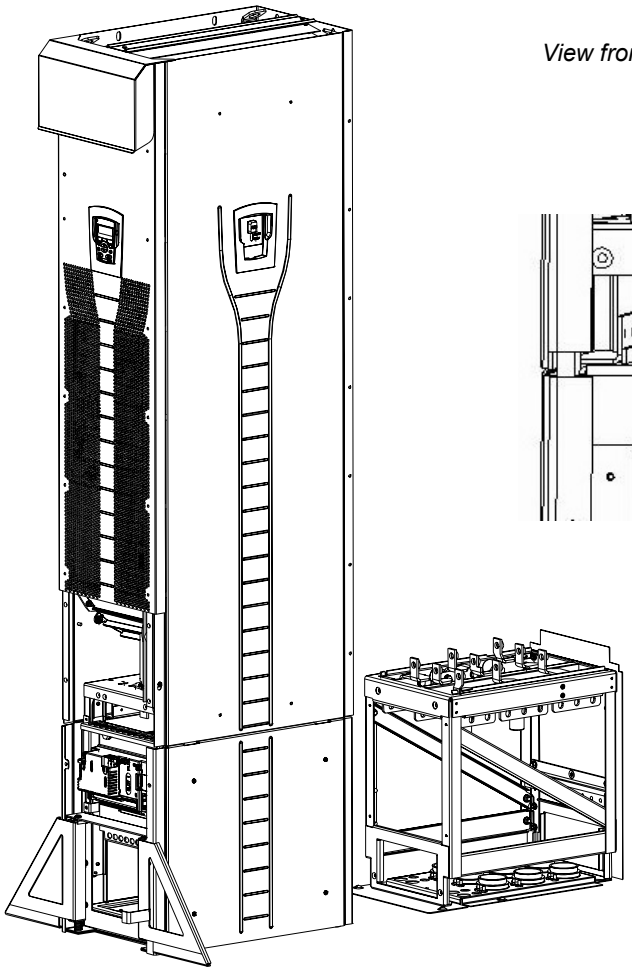
Wheeling the frame out

Remove the pedestal (frame size R8):

1. Remove the middle front cover by undoing the fixing screws.
2. Remove the lower front cover by undoing the fixing screws.
3. Lift the right support leg a little up and turn it right. Let it lock down. Turn the left leg aside in the same way. The legs will prevent the unit from falling down during the installation.
4. Remove the OMIO board by undoing the fixing screws and disconnecting the control panel, power supply and the fibre optic cables. **Note:** Mark down the connection terminals before disconnecting the cables.
5. Undo the screws that connect the busbars of the pedestal to the upper frame with a torque wrench with an extension bar.
6. Wheel the drive frame out by using the handle.

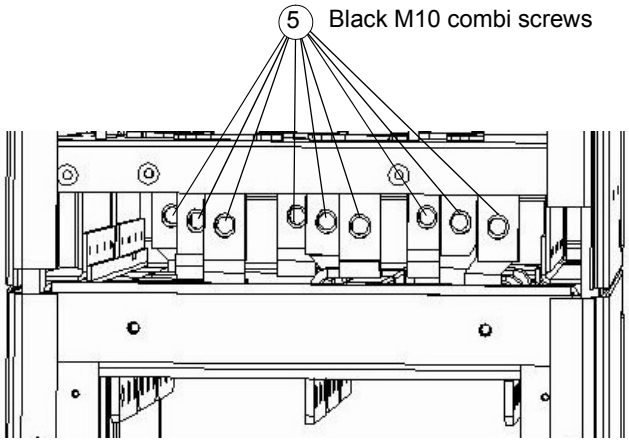






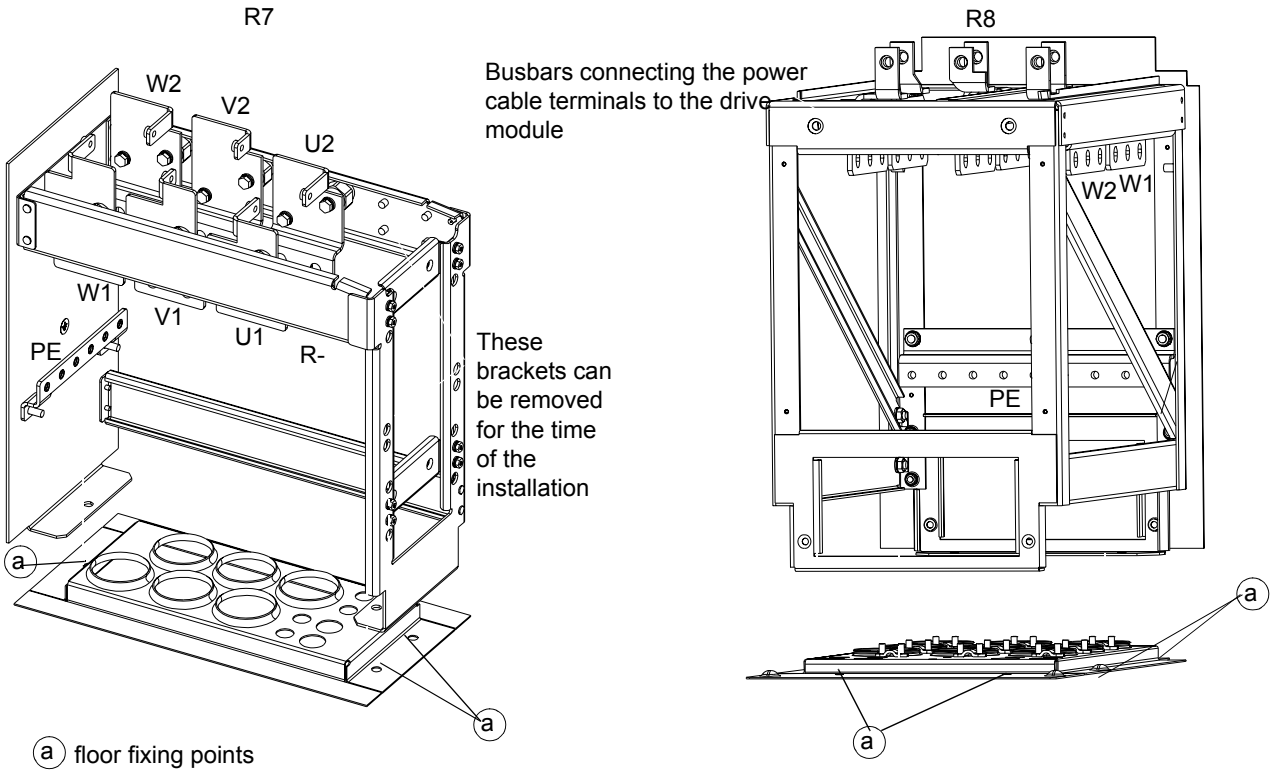
6

View from front when the OMIO board has been removed



Pedestal disconnected

Remove the lead-through plate from the pedestal:



a floor fixing points

Fix the lead-through plate to the floor:

1. Make a hole in the floor or cable conduit cover below the lead-through plate. See *Dimension Drawings* on page *188* and *189*.
2. Check that the floor is horizontal with a spirit level.
3. Fasten the lead-through plate with screws or bolts.
   Note: The screws/bolts will be removed and refastened when the pedestal is fastened through the same holes later on. The lead-through plate can be fastened after leading the cables through it if the cabling procedure is more convenient in that way.

Lead the power (input, motor and optional brake) cables through the lead-through plate:

1. Make adequate holes in the grommets to fit them tightly on the cables.
2. Lead the cables through the holes and slide the grommets onto the cables.

Prepare the power cables:

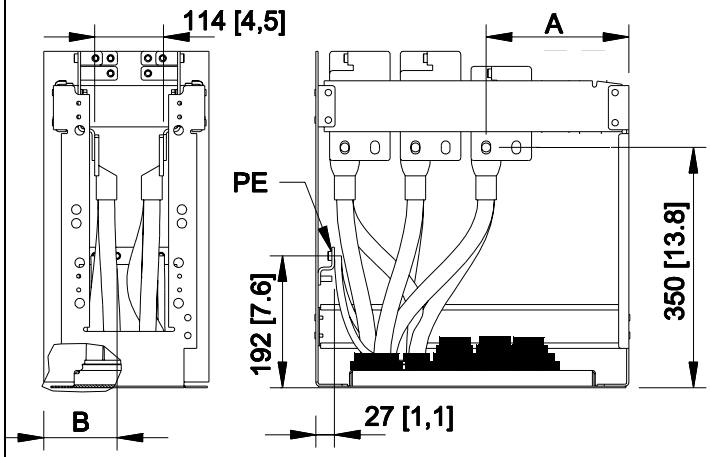
1. Strip the cables.
2. Twist the shield wires.
3. Bend the conductors to the terminals.
4. Cut the conductors to adequate length. Put the pedestal onto the lead-through plate and check the length of the conductors. Remove the pedestal.
5. Press cable lugs in the conductors, or screw in connectors.

WARNING! The maximum allowed width of the cable lug is 38 mm (1.5 in.). Wider cable lugs may cause a short-circuit.

6. Connect the twisted shields of the cables to the PE terminal (frame size R7), or to the grounding clamps or PE terminal (frame size R8).

Note: 360 degrees grounding is not needed at the cable entry. The short twisted shield provides, in addition to the protective grounding, also sufficient disturbance suppression.

Frame size R7



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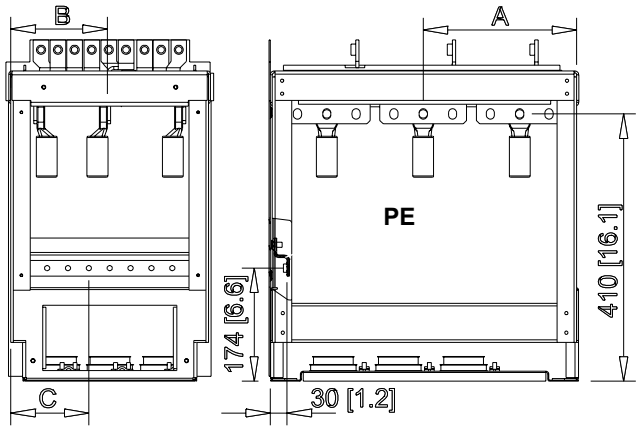
Terminal	U1, U2	V1, V2	W1, W2	UDC+/UDC-	
A (hole 1) / mm [in.]	159 [6.3]	262 [10.3]	365 [14.4]	-	3 [0.1]
A (hole 2) / mm [in.]	115 [4.5]	218 [8.5]	321 [12.6]	-	-

PE terminal hole	1	2	3	4	5	6
B / mm [in.]	43 [1.7]	75 [3.0]	107 [4.2]	139 [5.5]	171 [6.7]	203 [8.0]

Frame size R8



Terminal	A			B	A			B
	hole 1	hole 2	hole 3		hole 1	hole 2	hole 3	
	mm	mm	mm	mm	in.	in.	in.	in.
Frame size R8								
U1	432	387	342	40	17.0	15.2	13.5	1.6
V1				148				5.8
W1				264				10.4
U2	284	239	194	40	11.2	9.4	7.6	1.6
V2				148				5.8
W2				264				10.4

PE terminal hole	1	2	3	4	5	6	7	8	9
C / mm [in.]	24 [0.9]	56 [2.2]	88 [3.5]	120 [4.7]	152 [6.0]	184 [7.2]	216 [8.5]	248 [9.8]	280 [11.0]

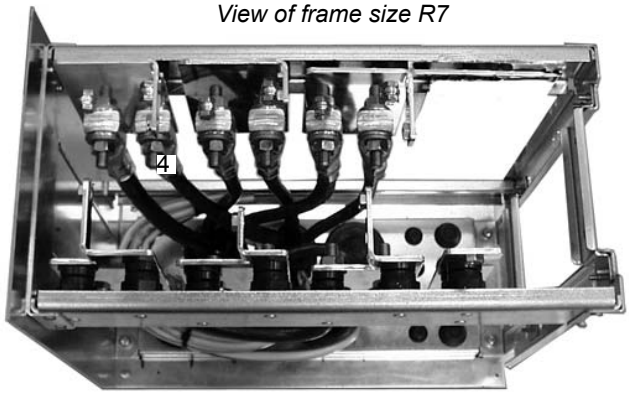
Lead the control cables through the lead-through plate:

1. Cut holes in the grommets to fit them tightly onto the control cables.
2. Lead the control cables through the lead-through plate and slide the grommets onto the cables.

Connect the cable lugs to the pedestal:

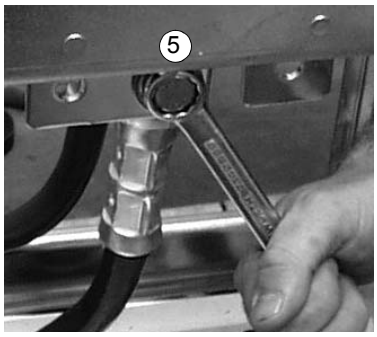
1. If the lead-through plate is fixed to the floor, undo the fixing screws.
2. Place the pedestal onto the lead-through plate.
3. Fasten the pedestal and the lead-through plate to the floor with the screws through the same holes.
4. Connect the cable lugs to the pedestal (U1, V1, W1, U2, V2, W2 and PE).
5. Tighten the connections.

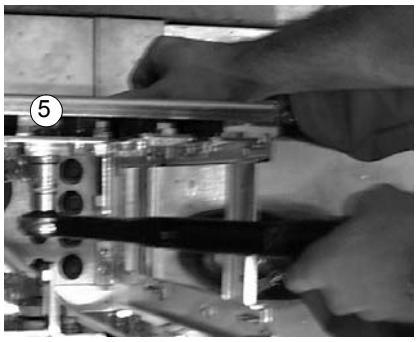
View of frame size R7



Frame sizes R7 and R8:

M12 (1/2 in.) bolt
Tightening torque: 50...75 Nm
(37...55 lbf ft)





WARNING! It is not allowed to connect the cables directly to the drive module terminals. The lead through insulation material is not strong enough to carry the mechanical stress exerted by the cables. The cable connections must be performed in the pedestal.

Wheel the drive frame back on the pedestal (See step ***Remove the pedestal***).

Fix the pedestal to the drive frame in reverse order to step *Remove the pedestal*:

1. Fix the fastening screws.

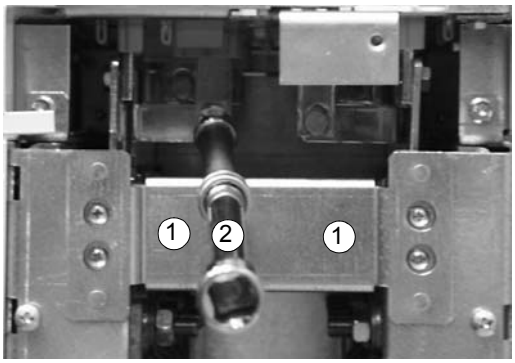
WARNING! The fixing is important because the screws are required for the grounding of the drive.

2. Connect the terminals at the top of the pedestal to the terminals at the bottom of the upper part of the drive frame.

WARNING! Be careful not to drop screws inside the pedestal. Loose metal pieces inside the unit may cause damage.

3. Tighten the connections.

View of frame size R7



Terminal connection screws

R7: M8 (5/16 in.) combi screws
Tightening torque: 15...22 Nm (0.59...0.87 lbf ft)

R8: M10 (3/8 in.) combi screws
Tightening torque: 30...44 Nm (22...32 lbf ft)

R8: Fasten the OMIO board in reverse order to step *Remove the pedestal*.

Fasten the drive frame to the wall (recommended):

Fasten unit with screws or bolts to the holes in the wall.

Connect the control cables as described in section *Connecting the Control Cables* on page 35**.**

Fasten the covers:

1. Connect the control panel cables. See step ***Remove the Pedestal***.
2. Fasten the upper front cover.
3. R7: Fasten the roof.
4. Fasten the lower front cover.

Routing the Control/Signal Cables Inside the Cubicle

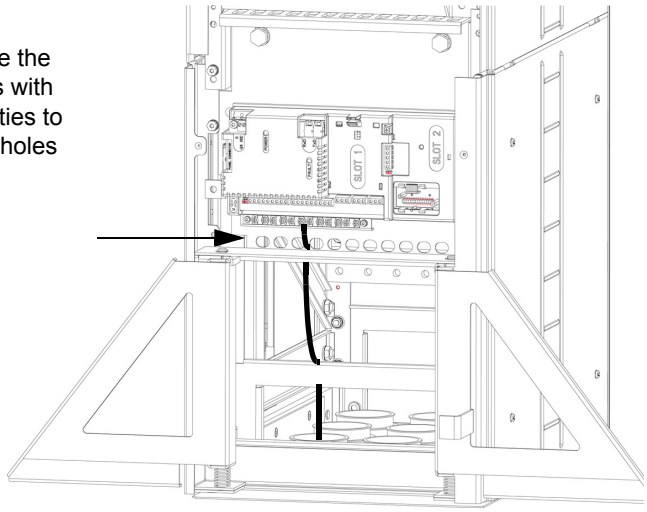
R7

Secure the cables with cable ties to the holes in the capacitor pack frame

Lead the cables through the cushions. This is for mechanical support only. (No 360 degrees EMC grounding is needed here.)

R8

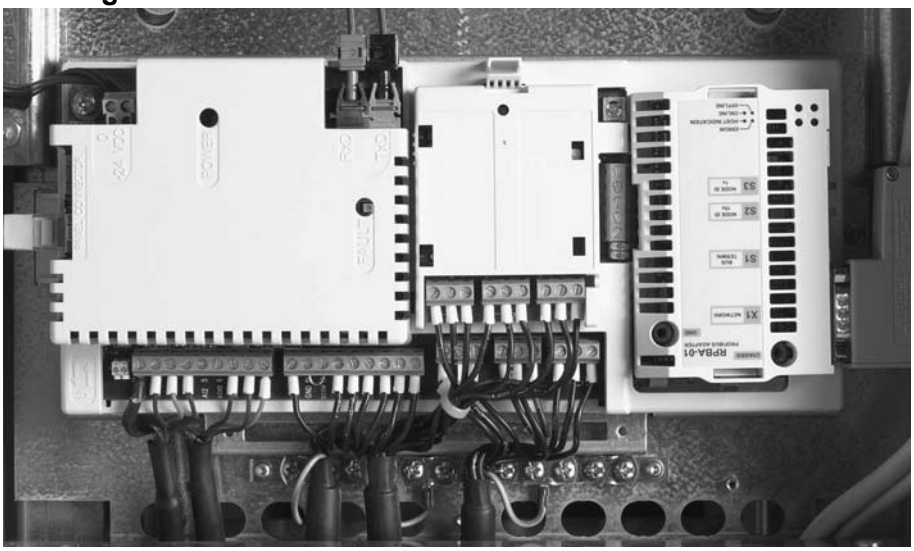
Secure the cables with cable ties to these holes



Connecting the Control Cables

Connect the control cables as described below. Connect the conductors to the appropriate detachable terminals of the OMIO board. Tighten the screws to secure the connection.

Connecting the Shield Wires at OMIO Board



Single shielded cables: Twist the grounding wires of the outer shield and connect them through the shortest possible route to the nearest grounding clamp. Double shielded cables: Connect each pair cable shield (twisted grounding wires) with other pair cable shields of the same cable and the grounding wires of the outer shield to the nearest grounding clamp.

Do not connect shields of different cables to the same grounding clamp.

Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency, high-voltage capacitor (e.g. 3.3 nF / 3000 V). The shield can also be grounded directly at both ends if they are *in the same ground line* with no significant voltage drop between the end points.

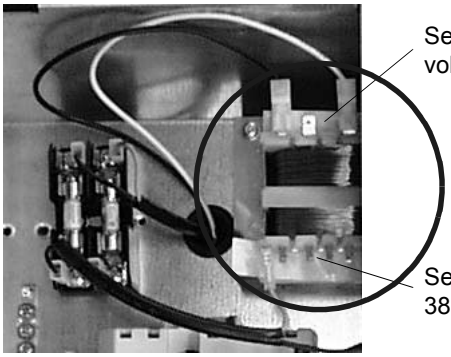
Keep the signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

Securing the Control Cables Mechanically

Fasten the control cables together and to the drive frame with cable ties as shown in section *Routing the Control/Signal Cables Inside the Cubicle* on page 34.

Settings of the Cooling Fan Transformer

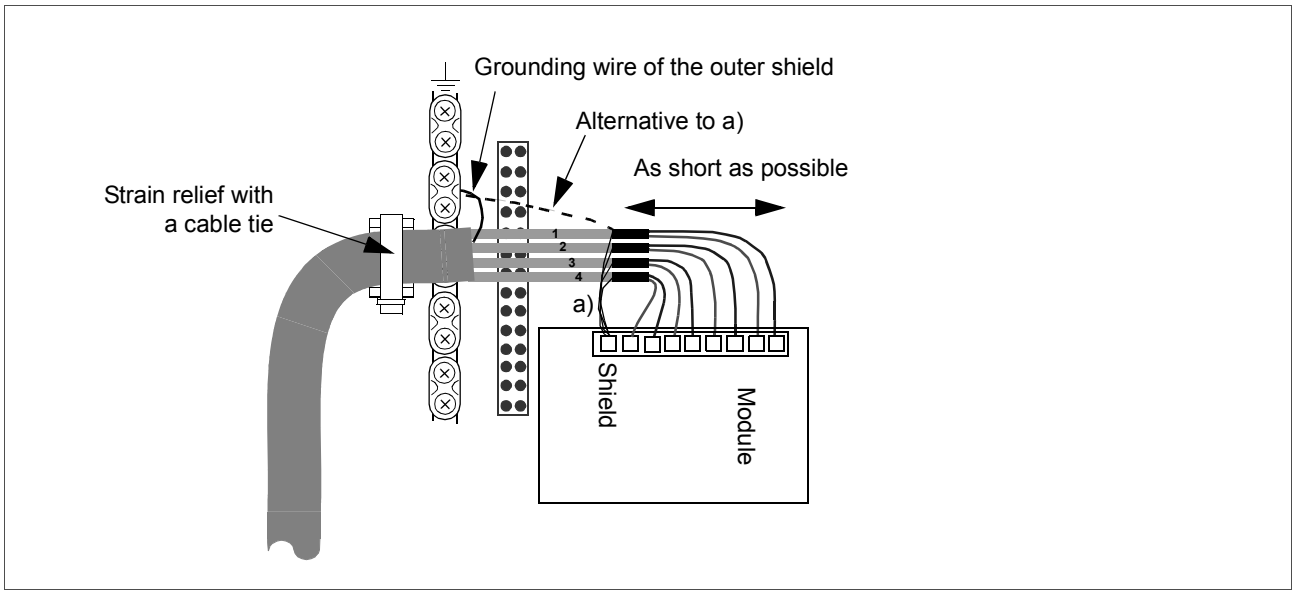
The voltage transformer of the cooling fan is located at the top right-hand corner of the drive.



Installation of Optional Modules

The optional module (fieldbus adapter, relay output extension module) is inserted in the optional module slot of the OMIO board. See the appropriate optional module manual for cable connections.

Cabling of I/O and fieldbus modules



Installation Checklist

Check the mechanical and electrical installation of the drive before start-up. Go through the checklist below together with another person. Read the *Safety* on the first pages of this manual before you work on the unit.

Check	
MECHANICAL INSTALLATION	
The ambient operating conditions are allowed. See *Installation, Technical Data: Ratings on page 180, Ambient Conditions* on page *185*.	☐
The unit is fixed properly on floor and a vertical non-flammable wall. See *Installation.*	☐
The cooling air will flow freely.	☐
ELECTRICAL INSTALLATION See *Installation.*	
The motor and the driven equipment are ready for start. See *Installation: Checking the Compatibility of the Motor* on page *6, Technical Data: Motor Connection* on page *183*.	☐
EMC filter capacitors are disconnected if the drive is connected to an IT (ungrounded) system.	☐
The drive is grounded properly.	☐
The mains (input power) voltage matches the drive nominal input voltage.	☐
The mains (input power) connections at U1, V1 and W1 and their tightening torques are OK.	☐
Appropriate mains (input power) fuses and disconnector are installed.	☐
The motor connections at U2, V2 and W2 and their tightening torques are OK.	☐
The motor cable is routed away from other cables.	☐
Setting of the fan voltage transformer	☐
Setting of the auxiliary voltage transformer.	☐
There are no power factor compensation capacitors in the motor cable.	☐
The external control connections inside the drive are OK.	☐
There are no tools, foreign objects or dust from drilling inside the drive.	☐
Mains (input power) voltage cannot be applied to the output of the drive (especially with bypass connection).	☐
Drive, motor connection box and other covers are in place.	☐

Start-Up

Start-up configures the drive. This process sets parameters that define how the drive operates and communicates. Depending on the control and communication requirements, the start-up process may require any or all of the following:

- The Start-up Assistant (requires the Assistant Control Panel) steps you through the default configuration. The Start-up Assistant runs automatically at the first power up, or can be accessed at any time using the main menu.
- Application macros can be selected to define common, alternate system configurations, using the default settings. See *Application Macros* on page *52*.
- Additional refinements can be made using the control panel to manually select and set individual parameters. See *Complete Parameter Descriptions* on page *72*.

Control Panels

Use a control panel to control the ACS550, to read status data, and to adjust parameters. The ACS 550 works with either of two different control panel types:

- Assistant Control Panel – This panel (described below) includes pre-programmed assistants to automate the most common parameter setups.
- Basic control panel – This panel (described in a later section) provides basic tools for manual entry of parameter values.

Assistant Control Panel

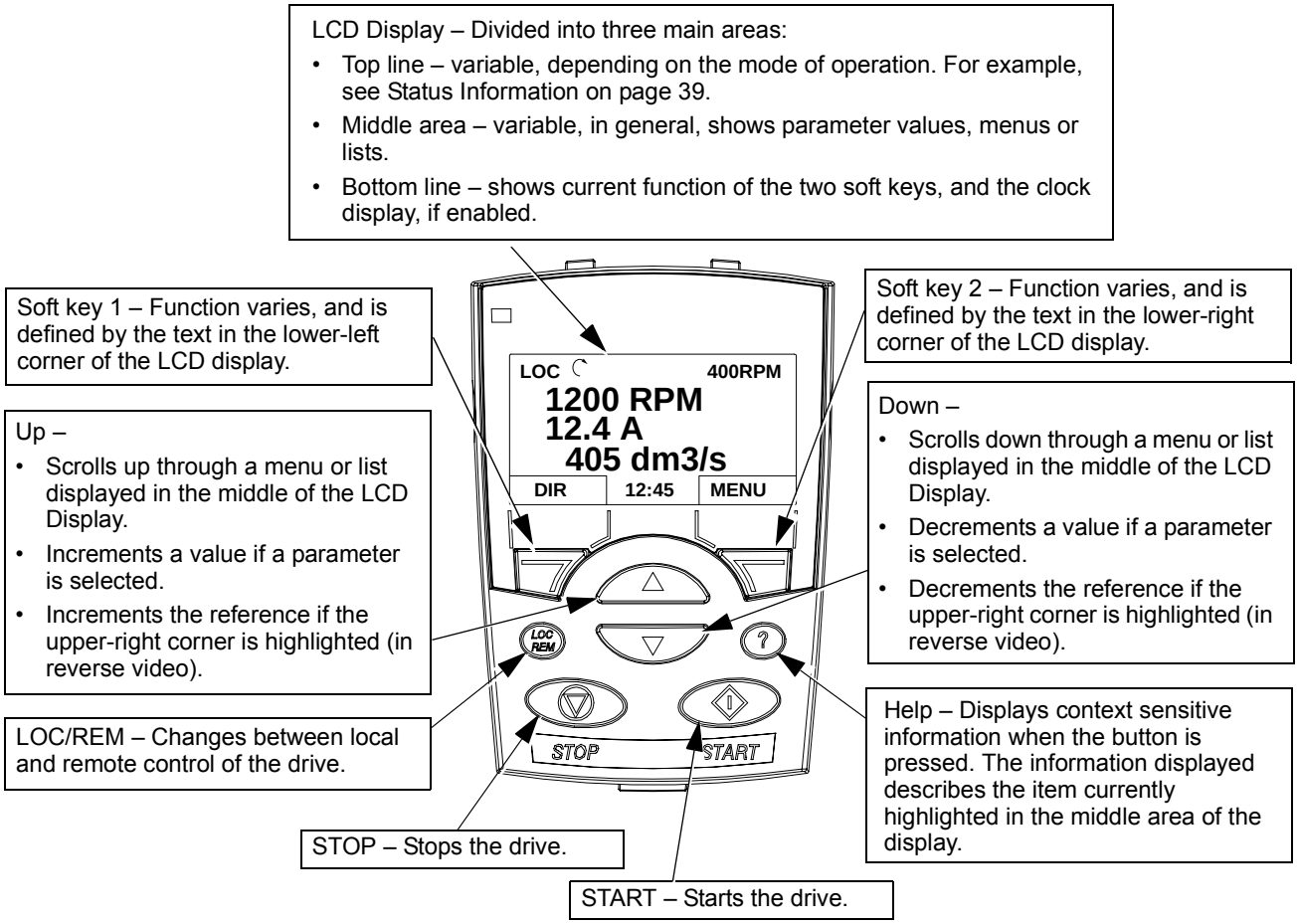
Features

The ACS550 Assistant Control Panel features:

- Alphanumeric control panel with a LCD display
- Language selection for the display
- Drive connection that can be made or detached at any time
- Start-up Assistant to ease drive commissioning
- Copy function – Parameters can be copied to the Control Panel memory for later transfer to other drives, or for backup of a particular system.
- Context sensitive help

Controls/Display Overview

The following table summarizes the button functions and displays on the Assistant Control Panel.



Output Mode

Use the Output mode to read information on the drive's status and to operate the drive. To reach the Output mode, press EXIT until the LCD display shows status information as described below.

Status Information

Top. The top line of the LCD display shows the basic status information of the drive.

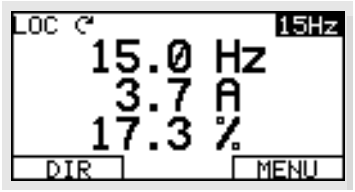
- LOC – indicates that the drive control is local, that is, from the control panel.
- REM – indicates that the drive control is remote, such as the basic I/O (X1) or fieldbus.
- ↻ – indicates the drive and motor rotation status as follows:

Control Panel Display	Significance
Rotating arrow (clockwise or counter clockwise)	• Drive is running and at setpoint • Shaft direction is forward ↻ or reverse ↺

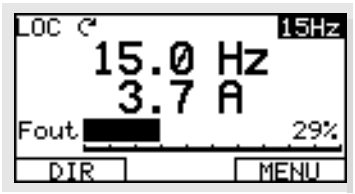
Control Panel Display	Significance
Rotating arrow blinking	Drive is running but not at setpoint.
Stationary arrow	Drive is stopped.

- Upper right – shows the active reference.

Middle. Using parameter Group 34, the middle of the LCD display can be configured to display:



- Up to three parameter values
  - By default, the displays shows three parameters. The particular parameters depend on the value of parameter 9904 MOTOR CTRL MODE. For example, if 9904 = 1, the display shows parameters 0102 (SPEED), 0104 (CURRENT), 0105 (TORQUE).
  - Use parameters 3401, 3408, and 3415 to select the parameters (from Group 01) to display. Entering “parameter” 0100 results in no parameter displayed. For example, if 3401 = 0100 and 3415 = 0100, then only the parameter specified by 3408 appears in the Control Panel display.
  - You can also scale each parameter in the display. For example, use parameters 3402…3405 to scale the parameter specified by 3401. For example, to convert motor speed to a display of conveyor speed.
- A bar graph rather than any of the parameter values.
  - Enter a negative value in the units parameter (3405, 3412, or 3418) to change the parameter display to a bar graph.



Bottom. The bottom of the LCD display shows:

- Lower corners – show the functions currently assigned to the two soft keys.
- Lower middle – displays the current time (if configured to show the time).

Operating the Drive

LOC/REM – The very first time the drive is powered up, it is in the remote control (REM) mode, and is controlled from the Control Terminal Block X1.

To switch to local control (LOC) and control the drive using the control panel, press and hold the LOC/REM button until first, LOCAL CONTROL, or later, LOCAL, KEEP RUN, is displayed:

- Release the button while LOCAL CONTROL is displayed to set the panel reference to the current external reference. The drive stops.
- Release the button when LOCAL, KEEP RUN is displayed, to copy the current run/stop status and the reference from the user I/O.

To switch back to remote control (REM) press and hold the LOC/REM button until REMOTE CONTROL is displayed.

Start/Stop – To start and stop the drive press the START and STOP buttons.

Shaft direction – To change the shaft direction press DIR (parameter 1003 must be set to 3 (REQUEST)).

Reference – To modify the reference (only possible if the display in the upper right corner is in reverse video) press the UP or DOWN buttons (the reference changes immediately).

The reference can be modified when in local control (LOC), and can be parameterized (using Group 11: Reference Select) to also allow modification when remote control (REM).

Other Modes

Besides the Output mode, the Assistant Control Panel has:

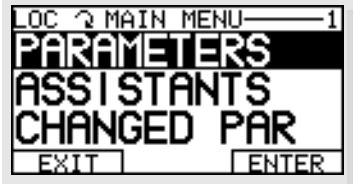
- Other operating modes that are available through the main menu.
- A fault mode that is triggered by faults. The fault mode includes a diagnostic assistant mode.

Access to Main Menu and the Other Modes

To reach the main menu:

1. Press EXIT, as necessary, to step back through the menus or lists associated with a particular mode. Continue until you are back to the Output mode.
2. Press MENU from the Output mode.

   At this point, the middle of the display is a listing of the other modes, and the top-right text says “Main menu”



3. Press UP/DOWN to scroll to the desired mode.
4. Press ENTER to enter the mode that is highlighted (reverse video).

   The following sections describe each of the other modes.

Parameters Mode

Use the Parameters mode to view and edit parameter values:

1. Select PARAMETERS in the Main Menu.

2. Press UP/DOWN to highlight the appropriate parameter group, then press SEL.

3. Press UP/DOWN to highlight the appropriate parameter in a group.

NOTE! The current parameter value appears below the highlighted parameter.

4. Press EDIT.
5. Press UP/DOWN to step to the desired parameter value.

Note! To view the parameter default value: In the set mode, press UP/DOWN simultaneously.

- Press SAVE to store the modified value or press CANCEL to leave the set mode. Any modifications not saved are cancelled.
- Press EXIT to return to the listing of parameter groups, and again to return to the main menu.

Start-up Assistant Mode

When the drive is first powered up, the Start-up Assistant guides you through the setup of a few basic parameters. For example, at the first start, the drive automatically suggests entering the first task, Language Select.

The Start-up Assistant is divided into tasks. You may activate the tasks one after the other, as the Start-up Assistant suggests, or independently. (You are not required to use the assistant, you may use instead, the parameter mode to set the drive parameters.)

The order of the tasks presented by the Start-up Assistant depends on your entries. The task list in the following table is typical.

Task name	Description
Language Select	Selects the language used in control panel displays
Motor Set-up	Enters motor data and motor identification
Application	Selects an application macro
Option Modules	Activates optional modules, if any, mounted on the drive.
Speed Control EXT1	• Selects the source for the speed reference • Sets the reference limits • Sets the speed (or frequency) limits • Sets acceleration and deceleration times • Sets up the brake chopper if activated
Speed Control EXT2	• Sets the source for the speed reference • Sets the reference limits
Torque Control	• Selects the source for the torque reference • Sets the reference limits • Sets the torque ramp up and ramp down times

PID Control	• Selects the source for the process reference • Sets the reference limits • Sets the speed (reference) limits • Sets the source and limits for the process actual value
Start/Stop Control	• Selects either EXT1 or EXT2 • Defines the direction control • Defines the start and stop modes • Selects the use of Run Enable signal
Protections	Sets the torque and current limits
Output Signals	Selects the signals indicated through the relay outputs RO1, RO2, RO3 and optional relay output's (if installed). Selects the signals indicated through the analog outputs AO1 and AO2. Sets the minimum, maximum, scaling and inversion values.

1. Select ASSISTANTS in the Main Menu.
2. Press UP/DOWN to select START-UP ASSISTANT.

Note! Rather than the Start-up Assistant, you can select Assistants for individual tasks, such as Output Signals.

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3. Make entries or selections as appropriate.
4. Press SAVE to save settings, or EXIT to reset settings to original values.

Changed Parameters Mode

Use the Changed Parameters mode to view (and edit) a listing of all parameters that have been changed from default values.

Procedure:

1. Select CHANGED PAR in the Main Menu.
   The display lists all changed parameters.
2. Press ENTER.
3. Press UP/DOWN to select a changed parameter.
   As each parameter is highlighted, the parameter value appears.
4. Press EDIT to edit the parameter value.
5. Press UP/DOWN to select a new value / edit the parameter value. (Pressing both keys at the same time sets a parameter to its default value.)
6. Press SAVE to save the new parameter value. (If the new value is the default value, the parameter will no longer appear on the Changed Parameters listing.)

Par Backup Mode

The Assistant Control Panel can store a full set of drive parameters. If two sets of parameters are defined, both are copied and transferred when using this feature.

The Par Backup mode has three functions:

- Upload to Panel – Copies all parameters from the drive to the Control Panel. This includes a second set of parameters (if defined) and internal parameters such as those created by the Motor Id Run. The Control Panel memory is non-volatile and does not depend on the panel's battery.
- Restore All (Download To Drive All) – Restores the full parameter set(s) from the Control Panel to the drive. Use this option to restore a drive, or to configure identical drives.

Note! The Restore All function writes all parameters to the drive, including motor parameters. Only use this function to *restore* a drive, or to transfer parameters to systems that are *identical* to the original system.

- Download Application – Copies partial parameter set(s) from the Control Panel to a drive. The partial set does not include internal motor parameters, parameters 9905…9909, 1605, 1607, 5201, nor any Group 51 parameters. Use this option to transfer parameters to systems that use similar configurations – the drive and motor sizes do not need to be the same.

1. Select COPY in the Main Menu.
2. Press UP/DOWN to step to the desired option.
3. Press SAVE.

   The parameter set is transferred as directed. During the transfer, the display shows the transfer status as a percent of completion.
4. Press EXIT to step back to the Output mode.

Clock Set Mode

Use the Clock Set mode to:

- Enable/disable the clock function.
- Set date and time.
- Select display format.

1. Select CLOCK SET in the Main Menu.
2. Press UP/DOWN to step to the desired option.
3. Press EDIT.
4. Press UP/DOWN to select the desired setting.
5. Press SAVE to save setting.

I/O Settings Mode

Use the I/O Setting mode to check (and edit) the setting at any I/O terminal.

1. Select I/O SETTINGS in the Main Menu.
2. Press UP/DOWN to step to the desired I/O group, for example, digital inputs.
3. Press ENTER.

4. Press UP/DOWN to step to a particular item, for example DI1.
   After a brief pause, the displays shows the current setting for the selection.
5. Press EDIT.
6. Press UP/DOWN to select a new setting.
7. Press SAVE to save.

Basic Control Panel

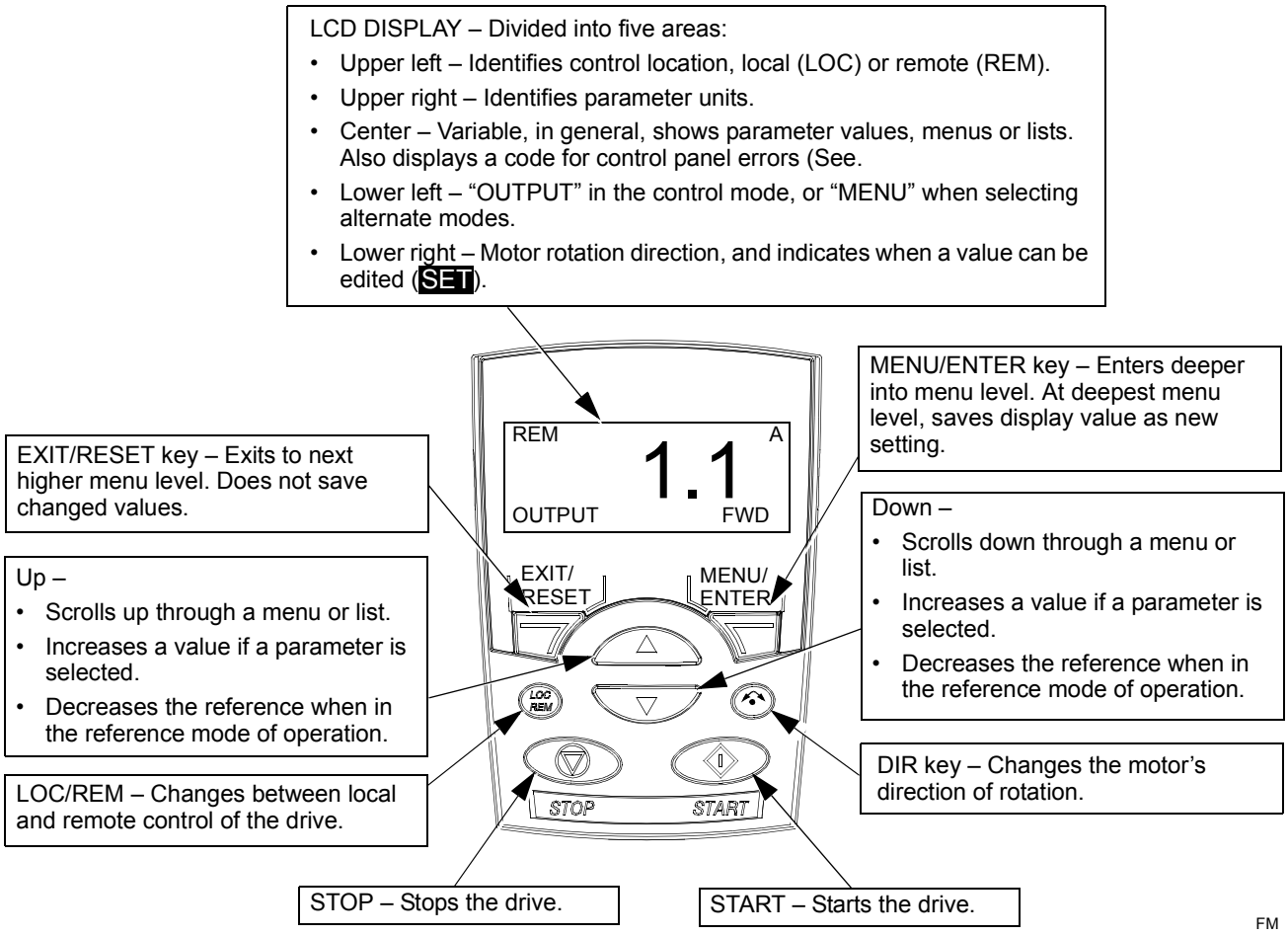
Features

The Basic Control Panel features:

- Numeric control panel with a LCD display.
- Drive connection that can be made or detached at any time
- Copy function – Parameters can be copied to the Control Panel memory for later transfer to other drives, or for backup of a particular system.

Controls/Display Overview

The following table summarizes the button functions and displays on the Basic Control Panel.



Output Mode

Use the Output mode to read information on the drive's status and to operate the drive. To reach the Output mode, press EXIT/RESET until the display shows status information as described below.

Status Information

When the Basic Control Panel is in the Output mode, the display:

- Top-left shows the control location:
  - LOC – indicates that the drive control is local, that is, from the control panel.
  - REM – indicates that the drive control is remote, such as the basic I/O (X1) or fieldbus.
- The center of the display is a Group 01 parameter value. Up to three parameter values may be available (press UP or DOWN to step through available parameters).
  - By default, the displays holds three parameters. The particular parameters depend on the value of parameter 9904 MOTOR CTRL MODE. For example, if 9904 = 1, the display shows parameters 0102 (SPEED), 0104 (CURRENT), 0105 (TORQUE).
  - Use parameters 3401, 3408, and 3415 to select the parameters (from Group 01) to display. Entering “parameter” 0100 results in no parameter displayed. For example, if 3401 = 0100 and 3415 = 0100, then only the parameter specified by 3408 appears in the Control Panel display.
  - You can also scale each parameter in the display. For example, use parameters 3402…3405 to scale the parameter specified by 3401. For example, to convert motor speed to a display of conveyor speed.
- Top-right shows the units for the parameter value.
- Bottom-left shows OUTPUT.
- Bottom-right shows the motor direction of rotation. Text display (FWD or REV) is:
  - Steady when the motor is up to speed
  - Flashing slowly when the motor is stopped.
  - Flashing quickly when the motor is accelerating.

Operating the Drive

LOC/REM – The very first time the drive is powered up, it is in the remote control (REM) mode, and is controlled from the Control Terminal Block X1.

To switch to local control (LOC) and control the drive using the control panel, press (LOC REM) . If you:

- Press and release (the display flashes “LoC”), then: the drive stops. Use the Reference Mode to set the local control reference.
- Press and hold for about 2 seconds (release when the display changes from “LoC” to “LoC r”), then the drive continues as before. The drive copies the current remote values for run/stop status and the reference, and uses them as the initial local control commands.

To switch back to remote control (REM) press (LOC REM) .

Start/Stop – To start and stop the drive press the START and STOP buttons.

Shaft direction – To change the shaft direction press DIR (parameter 1003 must be set to 3 (REQUEST)).

Reference – See Reference Mode below.

Reference Mode

Use the Reference Mode to set the speed or frequency reference. Normally this reference control is only possible when the drive is under Local (LOC) control. However, the drive can be set up (using Group 11: Reference Select) to also allow reference modification when the drive is under remote (REM) control.

1. Starting from the Output mode, press MENU/ENTER.

   The display shows one of the following alternate modes:

   - reF (Reference)
   - PAr (Parameter)
   - CoPY (Copy)
2. Use UP or DOWN arrow key to step through to the “reF” (Reference Mode).
3. Press MENU/ENTER.

   The display shows the current reference value with SET under the value.

Note! Normally, reference adjustment is only possible here when under LOC control, but settings in Group 11, do allow reference adjustments under REM control. The SET display indicates when reference adjustment is possible at the control panel.

---

4. Use UP or DOWN arrow key to step to the desired parameter value.
5. Press EXIT/RESET to step back to the Output mode.

Parameters Mode

Use the Parameter Mode to set parameter values.

1. Starting from the Output mode, press MENU/ENTER.

   The display shows one of the following alternate modes:

   - reF (Reference)
   - PAr (Parameter)
   - CoPY (Copy)
2. Use UP or DOWN arrow key to step through to the “PAr” (Parameter Mode).
3. Press MENU/ENTER.

   The display shows one of the parameter groups:

   - “01”
   - …
   - “99”

4. Use UP or DOWN arrow key to step through to the desired group, for example “03”.
5. Press MENU/ENTER.

   The display shows one of the parameters in the selected parameter group. For example, “0301”.
6. Use UP or DOWN arrow key to step through to the desired parameter.
7. Press MENU/ENTER, either:
   - Press and hold for about 2 seconds or
   - Press the key twice in quick succession

   The display shows the value of the selected parameter with SET under the value.

Note! Briefly pressing the MENU/ENTER key displays the parameter’s current value for about 2 seconds. During this display, pressing the MENU/ENTER key again also enables SET.

---

8. Use UP or DOWN arrow key to step to the desired parameter value.

Note! In SET, pressing the UP and DOWN arrow keys simultaneously displays the default parameter value.

---

9. In SET, press MENU/ENTER to save the parameter value being displayed.

Note! If, instead, you press EXIT/RESET the original, or last saved, parameter value is the active value.

---

10. Press EXIT/RESET to step back to the Output mode.

Par Backup Mode

The Basic Control Panel can store a full set of drive parameters. If two sets of parameters are defined, both are copied and transferred when using this feature.

The Par Backup mode has three functions:

- uL (Upload) – Copies all parameters from the drive to the Control Panel. This includes a second set of parameters (if defined) and internal parameters such as those created by the Motor Id Run. The Control Panel memory is non-volatile.
- rE A (Restore All) – Restores the full parameter set(s) from the Control Panel to the drive. Use this option to restore a drive, or to configure identical drives.

Note! The Restore All function writes all parameters to the drive, including motor parameters. Only use this function to restore a drive, or to transfer parameters to systems that are identical to the original system.

- dL P (Download Partial) – Copies a partial parameter set from the Control Panel to a drive. The partial set does not include internal motor parameters, parameters 9905…9909, 1605, 1607, 5201, nor any Group 51 parameters. Use this option to transfer parameters to systems that use similar configurations – the drive and motor sizes do not need to be the same.

1. Starting from the Output mode, press MENU/ENTER.

   The display shows one of the following alternate modes:

   - reF (Reference)
   - PAr (Parameter)
   - CoPY (Copy)

2. Use UP or DOWN arrow key to step through to the “CoPY” (Copy) Mode.
3. Press MENU/ENTER.

   The display shows one of the following copy options:

   - uL (Upload)
   - rE A (Restore All)
   - dL P (Download Partial)

4. Use UP or DOWN arrow key to step to the desired option.
5. Press MENU/ENTER.

   The parameter set is transferred as directed. During the transfer, the display shows the transfer status as a percent of completion.

6. Press EXIT/RESET to step back to the Output mode.

Alarm Codes (Basic Control Panel)

The Basic Control Panel indicates Control Panel alarms with a code, A3xxx. The following table lists the alarm codes and descriptions.

Note! Fault/Alarm codes not specific to the Basic Control Panel are defined in the *Diagnostics* section starting on page *164*.

Code	Description
3001	Communication fault.
3002	Control Panel to Drive interface error. Call local ABB sales representative and report the error code number.
3003	Control Panel and drive are not both in the ACS550 family.
3010	Parameter backup CRC failure.
3011	Drive is controlled from another source.
3012	Rotation direction is locked.
3013	Key is disabled, start is inhibited.
3014	Key is disabled, due to drive fault. Correct fault.

Code	Description
3015	Local mode lock is on.
3016	Write protected because drive is started. Stop drive before making this change.
3017	Write protected, read only.
3018	Parameter error.
3019	Writing of not zero value is not allowed.
3020	Group or parameter does not exist.
3021	Group or parameter is not available.
3022	Group or parameter is write protected.
3023	Modification not allowed when running. Stop drive before making this change.
3024	Operation not allowed due to parameter lock.
3025	Parameter error.
3026	Parameter value error.
3027	
3028	
3029	Access to non-volatile memory was ‘not ready’.
3030	Parameter value error.
3031	Invalid request.
3032	Parameter error.
3033	Drive is not ready for download.
3040	Backup buffer empty.
3041	Backup file too large.
3042	Backup not found.
3043	No start inhibit granted.
3050	Upload aborted.
3051	Upload error.
3052	Unknown upload error.
3060	Download aborted.
3061	Drive not ready to download.
3062	Unknown download error.
3070	Write error to Control Panel memory.
3071	Read error to Control Panel memory.

Application Macros

Macros change a group of parameters to new, predefined values. Use macros to minimize the need for manual editing of parameters. Selecting a macro sets all other parameters to their default values, except:

- Group 99: Start-up Data parameters
- the PARAMETER LOCK 1602
- the PARAM SAVE 1607
- Groups 50…52 serial communication parameters

After selecting a macro, additional parameter changes can be made manually using the control panel.

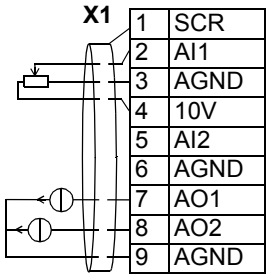
Application macros are predefined parameter sets enabled by setting the value for parameter 9902 APPLIC MACRO. By default, 1, ABB Standard, is the enabled macro.

The following sections describe each of the application macros and provide a connection example for each macro.

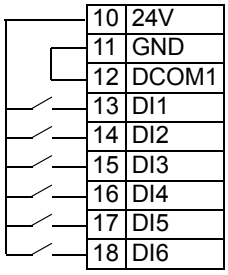
Application Macro: ABB Standard (Default)

This macro provides a general purpose, 2-wire I/O configuration, with three (3) constant speeds. This is the default macro. Parameter values are the default values defined in the *Complete Parameter List for ACS550* on page *61*.

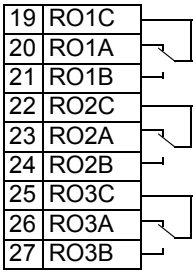
Connection example:



Signal cable shield (screen)
External frequency reference 1: 0…10 V
Analog input circuit common
Reference voltage 10 VDC
Not used
Analog input circuit common
Output frequency: 0…20 mA
Output current: 0…20 mA
Analog output circuit common



Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
Start/Stop: Activate to start
Fwd/Rev: Activate to reverse rotation direction
Constant speed selection[2]
Constant speed selection[2]
Ramp pair selection: Activate to select 2nd acc/dec ramp pair.
Not used



Relay output 1, programmable
Default operation:
Ready =>19 connected to 21
Relay output 2, programmable
Default operation:
Running =>22 connected to 24
Relay output 3, programmable
Default operation:
Fault (-1) =>25 connected to 27
(Fault => 25 connected to 26)

Note 1. The external reference is used as a speed reference, if a vector mode is selected,

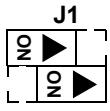
Note 2. Code:
0 = open, 1 = connected

DI3	DI4	Output
0	0	Reference through AI1
1	0	CONSTANT SPEED 1 (1202)
0	1	CONSTANT SPEED 2 (1203)
1	1	CONSTANT SPEED 3 (1204)

Input signals
- Analog reference (AI1)
- Start, stop and direction (DI1,2)
- Constant speed selection (DI3,4)
- Ramp pair (1 of 2) selection (DI5)

Output signals
- Analog output AO1: Frequency
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper Setting



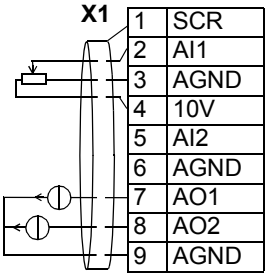
AI1: 0…10 V
AI2: 0(4)…20 mA

Application Macro: 3-wire

This macro is used when the drive is controlled using momentary push-buttons, and provides three (3) constant speeds. To enable, set the value of parameter 9902 to 2 (3-WIRE).

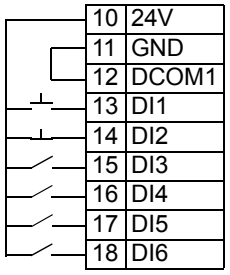
Note! When the stop input (DI2) is deactivated (no input), the control panel start/stop buttons are disabled.

Connection example:



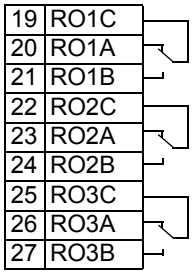
X1	1	SCR
	2	AI1
	3	AGND
	4	10V
	5	AI2
	6	AGND
	7	AO1
	8	AO2
	9	AGND

Signal cable shield (screen)
External speed reference 1: 0…10 V
Analog input circuit common
Reference voltage 10 VDC
Not used
Analog input circuit common
Motor output speed: 0…20 mA
Output current: 0…20 mA
Analog output circuit common



	10	24V
	11	GND
	12	DCOM1
	13	DI1
	14	DI2
	15	DI3
	16	DI4
	17	DI5
	18	DI6

Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
Start: Momentary activation with DI2 activated starts the drive.
Stop: Momentary deactivation stops the drive.
Fwd/Rev: Activation reverses rotation direction.
Constant speed selection[1]
Constant speed selection[1]
Not used



	19	RO1C
	20	RO1A
	21	RO1B
	22	RO2C
	23	RO2A
	24	RO2B
	25	RO3C
	26	RO3A
	27	RO3B

Relay output 1, programmable
Default operation:
Ready =>19 connected to 21
Relay output 2, programmable
Default operation:
Running =>22 connected to 24
Relay output 3, programmable
Default operation:
Fault (-1) =>25 connected to 26
(Fault => 25 connected to 26)

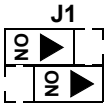
Note 1. Code:
0 = open, 1 = connected

DI4	DI5	Output
0	0	Reference through AI1
1	0	CONSTANT SPEED 1 (1202)
0	1	CONSTANT SPEED 2 (1203)
1	1	CONSTANT SPEED 3 (1204)

Input signals
- Analog reference (AI1)
- Start, stop and direction (DI1,2,3)
- Constant speed selection (DI4,5)

Output signals
- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper Setting

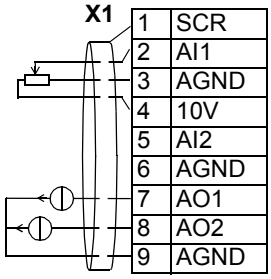


AI1: 0…10 V
AI2: 0(4)…20 mA

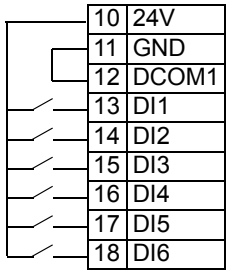
Application Macro: Alternate

This macro provides an I/O configuration adopted to a sequence of DI control signals used when alternating the rotation direction of the drive.To enable, set the value of parameter 9902 to 3 (ALTERNATE).

Connection example:



1	SCR	Signal cable shield (screen)
2	AI1	**External speed reference 1:** 0…10 V
3	AGND	Analog input circuit common
4	10V	Reference voltage 10 VDC
5	AI2	Not used
6	AGND	Analog input circuit common
7	AO1	**Motor output speed:** 0…20 mA
8	AO2	**Output current:** 0…20 mA
9	AGND	Analog output circuit common



10	24V	Auxiliary voltage output +24 VDC
11	GND	Common for DI return signals.
12	DCOM1	Digital input common for all
13	DI1	**Start fwd:** If DI1 state is the same as DI2, drive **stops**
14	DI2	**Start reverse**
15	DI3	**Constant speed selection**[1]
16	DI4	**Constant speed selection**[1]
17	DI5	**Ramp pair selection:** Activation selects 2nd acc/dec ramp pair.
18	DI6	**Run enable:** Deactivation always stops the drive

19	RO1C	Relay output 1, programmable Default operation: **Ready** =>19 connected to 21
20	RO1A	
21	RO1B	
22	RO2C	Relay output 2, programmable Default operation: **Running** =>22 connected to 24
23	RO2A	
24	RO2B	
25	RO3C	Relay output 3, programmable Default operation: **Fault (-1)** =>25 connected to 27 (Fault => 25 connected to 26)
26	RO3A	
27	RO3B	

Note 1. Code:
0 = open, 1 = connected

DI4	DI5	Output
0	0	Reference through AI1
1	0	CONSTANT SPEED 1 (1202)
0	1	CONSTANT SPEED 2 (1203)
1	1	CONSTANT SPEED 3 (1204)

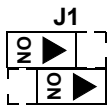
Input signals

- Analog reference (AI1)
- Start, stop and direction (DI1,2)
- Constant speed selection (DI3,4)
- Ramp pair 1/2 selection (DI5)
- Run enable (DI6)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper Setting

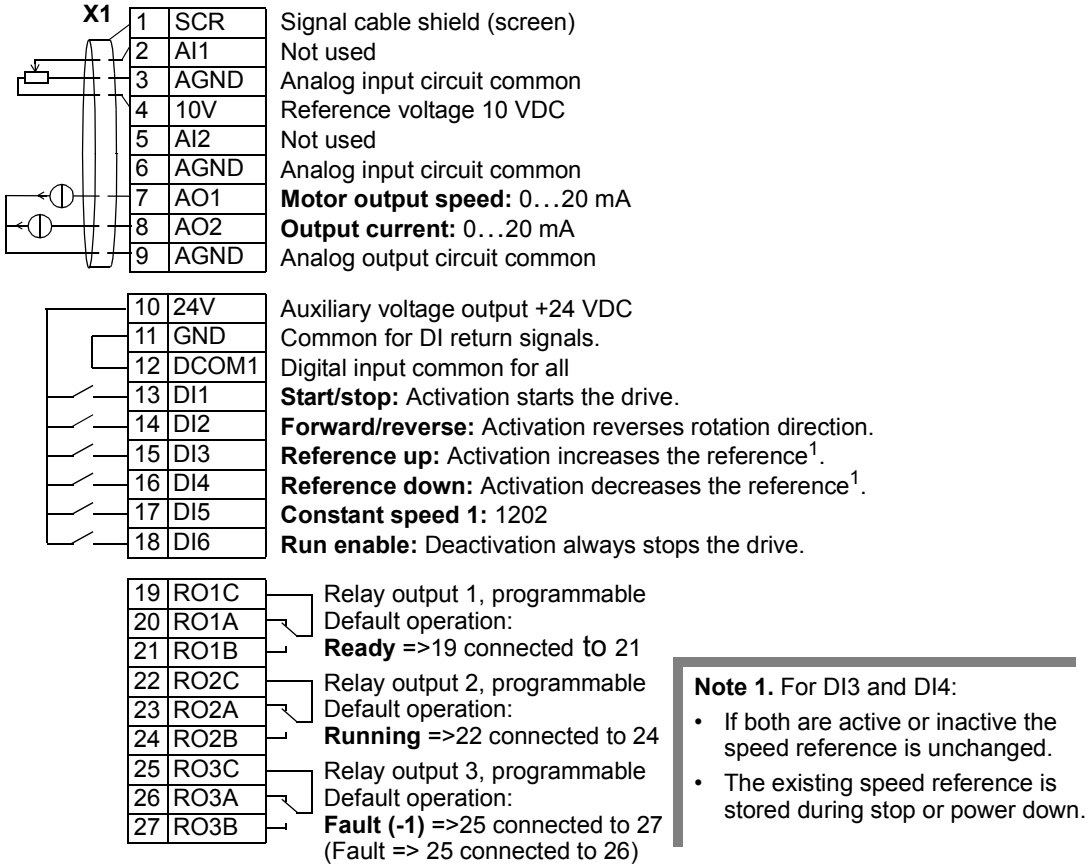


AI1: 0…10 V
AI2: 0(4)…20 mA

Application Macro: Motor Potentiometer

This macro provides a cost-effective interface for PLCs that vary the speed of the drive using only digital signals. To enable, set the value of parameter 9902 to 4 (MOTOR POT).

Connection example:



Note 1. For DI3 and DI4:

- If both are active or inactive the speed reference is unchanged.
- The existing speed reference is stored during stop or power down.

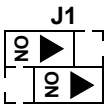
Input signals

- Start, stop and direction (DI1,2)
- Reference up/down (DI3,4)
- Constant speed selection (DI5)
- Run enable (DI6)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper Setting



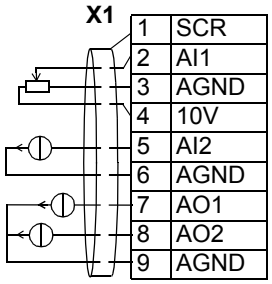
AI1: 0…10 V
AI2: 0(4)…20 mA

Application macro: Hand-Auto

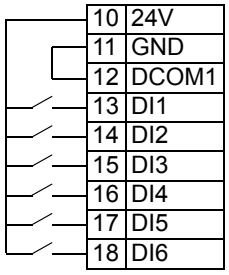
This macro provides an I/O configuration that is typically used in HVAC applications. To enable, set the value of parameter 9902 to 5 (HAND/AUTO).

Note! Parameter 2108 START INHIBIT must remain in the default setting, 0 (OFF).

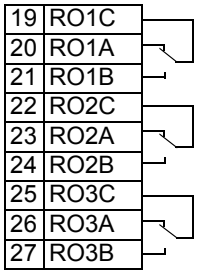
Connection example:



Signal cable shield (screen)
External reference 1: 0…10 V **(Hand Control)**
Analog input circuit common
Reference voltage 10 VDC
External reference 2: 0…20 mA **(Auto Control)**
Analog input circuit common
Motor output speed: 0…20 mA
Output current: 0…20 mA
Analog output circuit common



Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
Start/Stop (Hand): Activation starts the drive.
Forward/Reverse (Hand): Activation reverses rotation direction.
EXT1/EXT2 Selection: Activation selects auto control
Run enable: Deactivation always stops the drive
Forward/Reverse (Auto): Activation reverses rotation direction.
Start/Stop (Auto): Activation starts the drive.



Relay output 1, programmable
Default operation:
Ready =>19 connected to 21
Relay output 2, programmable
Default operation:
Running =>22 connected to 24
Relay output 3, programmable
Default operation:
Fault (-1) =>25 connected to 27
(Fault => 25 connected to 26)

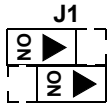
Input signals

- Two analog references (AI1, 2)
- Start/stop – hand/auto (DI1, 6)
- Direction – hand/auto (DI2, 5)
- Control location selection (DI3)
- Run enable (DI4)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper Setting



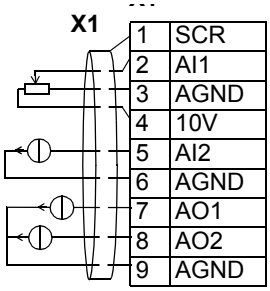
AI1: 0…10 V
AI2: 0(4)…20 mA

Application Macro: PID Control

This macro provides parameter settings for closed-loop control systems such as pressure control, flow control, etc. To enable, set the value of parameter 9902 to 6 (PID CTRL).

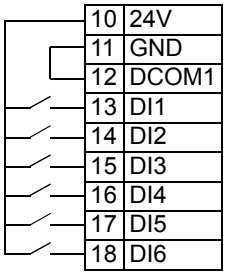
Note! Parameter 2108 START INHIBIT must remain in the default setting, 0 (OFF).

Connection example:

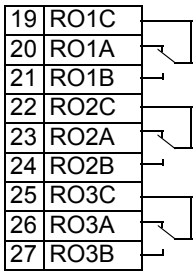


Signal cable shield (screen)
External ref. 1 (Manual) or Ext ref. 2 (PID): 0…10 V[1]
Analog input circuit common
Reference voltage 10 VDC
Actual signal (PID): 0…20 mA
Analog input circuit common
Motor output speed: 0…20 mA
Output current: 0…20 mA
Analog output circuit common

Note 1.
Manual: 0…10V => speed reference
PID: 0…10V => 0…100% PID setpoint



Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
Start/Stop (Hand): Activation starts the drive.
EXT1/EXT2 selection: Activation selects PID control.
Constant speed selection 1: (Not used in PID control)[2]
Constant speed selection 2: (Not used in PID control)[2]
Run enable: Deactivation always stops the drive
Start/Stop (PID): Activation starts the drive.



Relay output 1, programmable
Default operation:
Ready =>19 connected to 21
Relay output 2, programmable
Default operation:
Running =>22 connected to 24
Relay output 3, programmable
Default operation:
Fault (-1) =>25 connected to 27
(Fault => 25 connected to 26)

Note 2. Code:
0 = open, 1 = connected

DI3	DI4	Output
0	0	Reference through AI1
1	0	CONSTANT SPEED 1 (1202)
0	1	CONSTANT SPEED 2 (1203)
1	1	CONSTANT SPEED 3 (1204)

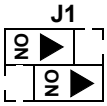
Input signals

- Analog reference (AI1)
- Actual value (AI2)
- Start/stop – hand/PID (DI1, 6)
- EXT1/EXT2 selection (DI2)
- Constant speed selection (DI3, 4)
- Run enable (DI5)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper Setting



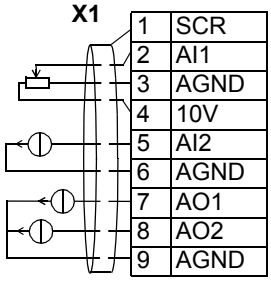
AI1: 0…10 V
AI2: 0(4)…20 mA

Application Macro: PFC

This macro provides parameter settings for pump and fan control (PFC) applications. To enable, set the value of parameter 9902 to 7 (PFC CONTROL).

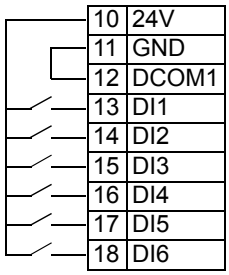
Note! Parameter 2108 START INHIBIT must remain in the default setting, 0 (OFF).

Connection example:

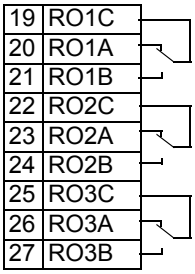


Signal cable shield (screen)
External ref. 1 (Manual) or Ext ref. 2 (PID/PFC): 0…10 V[1]
Analog input circuit common
Reference voltage 10 VDC
Actual signal (PID): 4…20 mA
Analog input circuit common
Output frequency: 0…20 mA
Actual 1 (PI controller actual value): 0(4)…20 mA
Analog output circuit common

Note 1.
Manual: 0…10V => 0…50 Hz
PID/PFC: 0…10V => 0…100%
PID setpoint



Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
Start/Stop (Manual): Activation starts the drive.
Run enable: Deactivation always stops the drive
EXT1/EXT2 selection: Activation selects PID control.
Interlock: Deactivation always stops the drive.
Interlock: Deactivation stops constant speed motor.
Start/Stop (PFC): Activation starts the drive.



Relay output 1, programmable
Default operation:
Running =>19 connected to 21

Relay output 2, programmable
Default operation:
Fault (-1) =>22 connected to 24 (Fault => 22 connected to 23)

Relay output 3, programmable
Default operation:
Auxiliary motor switched on=>25 connected to 27

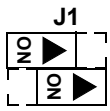
Input signals

- Analog ref. and actual (AI1, 2)
- Start/stop – manual/PFC (DI1, 6)
- Run enable (DI2)
- EXT1/EXT2 selection (DI3)
- Interlock (DI4, 5)

Output signals

- Analog output AO1: Frequency
- Analog output AO2: Actual 1
- Relay output 1: Running
- Relay output 2: Fault (-1)
- Relay output 3: Aux. motor ON

Jumper Setting

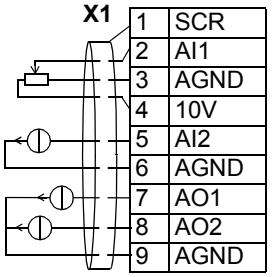


AI1: 0…10 V
AI2: 0(4)…20 mA

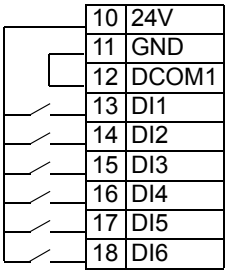
Application Macro: Torque Control

This macro provides parameter settings for applications that require torque control of the motor. Control can also be switched to speed control. To enable, set the value of parameter 9902 to 8 (TORQUE CONTROL).

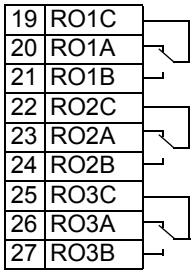
Connection example:



1 Signal cable shield (screen)
External speed reference 1: 0…10 V
3 Analog input circuit common
4 Reference voltage 10 VDC
External torque reference: 4…20 mA
6 Analog input circuit common
Motor output speed: 0…20 mA
Output current: 0…20 mA
9 Analog output circuit common



10 Auxiliary voltage output +24 VDC
11 Common for DI return signals.
12 Digital input common for all
Start/stop: Activation starts the drive.
Forward/reverse: Activation reverses direction.[1]
Speed/torque control: Activation selects torque control.
Constant speed 1: 1202
Ramp pair selection: Activate to select 2nd acc/dec ramp pair.
Run enable: Deactivation always stops the drive.



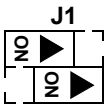
Relay output 1, programmable
Default operation:
Ready =>19 connected to 21
Relay output 2, programmable
Default operation:
Running =>22 connected to 24
Relay output 3, programmable
Default operation:
Fault (-1) =>25 connected to 27
(Fault => 25 connected to 26)

Note 1.
- Reverses rotation direction in speed control.
- Reverses torque direction in torque control.

Input signals
- Two analog references (AI1, 2)
- Start/stop and direction (DI1, 2)
- Speed/torque control (DI3)
- Constant speed selection (DI4)
- Ramp pair 1/2 selection (DI5)
- Run enable (DI6)

Output signals
- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper Setting



AI1: 0…10 V
AI2: 0(4)…20 mA

Complete Parameter List for ACS550

The following table lists all parameters. Table header abbreviations are:

- S = Parameters can be modified only when the drive is stopped.
- User = Space to enter desired parameter values.

Code	Name	Range	Resolution	Default	User	S
Group 99: Start-Up Data						
9901	LANGUAGE	0…10	1	0		
9902	APPLIC MACRO	-3…8	1	1		✓
9904	MOTOR CTRL MODE	1=VECTOR: SPEED, 2=VECTOR: TORQUE, 3=SCALAR: SPEED	1	3		✓
9905	MOTOR NOM VOLT	115…345 V	1 V	230 V		✓
		200…600 V / US: 230…690 V	1 V	400 V / US: 460 V		✓
9906	MOTOR NOM CURR	$0.2*I_{2hd}$…$2.0*I_{2hd}$	0.1 A	$1.0*I_{2hd}$		✓
9907	MOTOR NOM FREQ	10.0…500 Hz	0.1 Hz	50 Hz / US: 60 Hz		✓
9908	MOTOR NOM SPEED	50…18000 rpm	1 rpm	1440 rpm / US: 1750 rpm		✓
9909	MOTOR NOM POWER	$0.2…2.0*P_{hd}$	0.1 kW / US: 0.1 HP	$1.0 * P_{hd}$		✓
9910	MOTOR ID RUN	0 = OFF, 1= ON	1	0		✓
Group 01: Operating Data						
0102	SPEED	0…30000 rpm	1 rpm	-		
0103	OUTPUT FREQ	0.0…500.0 Hz	0.1 Hz	-		
0104	CURRENT	$0…2.0*I_{2hd}$	0.1 A	-		
0105	TORQUE	-200…200%	0.1%	-		
0106	POWER	$-2.0…2.0*P_{hd}$	0.1 kW	-		
0107	DC BUS VOLTAGE	$0…2.5*V_{dN}$	1 V	-		
0109	OUTPUT VOLTAGE	$0…2.0*V_{dN}$	1 V	-		
0110	DRIVE TEMP	0…150 °C	0.1 °C	-		
0111	EXTERNAL REF 1	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	-		
0112	EXTERNAL REF 2	0…100% (0…600% for torque)	0.1%	-		
0113	CTRL LOCATION	0 = local, 1 = ext1, 2 = ext2	1	-		
0114	RUN TIME (R)	0…9999 h	1 h	0 h		
0115	KWH COUNTER (R)	0…9999 kWh	1 kWh	-		
0116	APPL BLK OUTPUT	0…100% (0…600% for torque)	0.1%	-		
0118	DI 1-3 STATUS	000…111 (0…7 decimal)	1	-		
0119	DI 4-6 STATUS	000…111 (0…7 decimal)	1	-		
0120	AI1	0…100%	0.1%	-		
0121	AI2	0…100%	0.1%	-		
0122	RO 1-3 STATUS	000…111 (0…7 decimal)	1	-		
0123	RO 4-6 STATUS	000…111 (0…7 decimal)	1	-		
0124	AO1	0…20 mA	0.1 mA	-		
0125	AO2	0…20 mA	0.1 mA	-		
0126	PID 1 OUTPUT	-1000…1000%	0.1%	-		

Code	Name	Range	Resolution	Default	User	S
0127	PID 2 OUTPUT	-100…100%	0.1%	-		
0128	PID 1 SETPNT	Unit and scale defined by par. 4006/ 4106 and 4007/4107	-	-		
0129	PID 2 SETPNT	Unit and scale defined by par. 4206 and 4207				
0130	PID 1 FBK	Unit and scale defined by par. 4006/ 4106 and 4007/4107	-	-		
0131	PID 2 FBK	Unit and scale defined by par. 4206 and 4207	-	-		
0132	PID 1 DEVIATION	Unit and scale defined by par. 4006/ 4106 and 4007/4107	-	-		
0133	PID 2 DEVIATION	Unit and scale defined by par. 4206 and 4207	-	-		
0134	COMM RO WORD	0…65535	1	0		
0135	COMM VALUE 1	-32768…+32767	1	0		
0136	COMM VALUE 2	-32768…+32767	1	0		
0137	PROCESS VAR 1	-	1			
0138	PROCESS VAR 2	-	1			
0139	PROCESS VAR 3	-	1			
0140	RUN TIME	0…499.99 kh	0.01 kh	0 kh		
0141	MWH COUNTER	0…9999 MWh	1 MWh	-		
0142	REVOLUTION CNTR	0…65535	1	0		
0143	DRIVE ON TIME (HI)	Days	1 day	0		
0144	DRIVE ON TIME (LO)	hh.mm.ss	1 = 2s	0		
0145	MOTOR TEMP	-10...200 °C/ 0...5000 Ohm / 0…1	1	0		
Group 03: FB Actual Signals						
0301	FB CMD WORD 1	-	-	-		
0302	FB CMD WORD 2	-	-	-		
0303	FB STS WORD 1	-	-	-		
0304	FB STS WORD 2	-	1	0		
0305	FAULT WORD 1	-	1	0		
0306	FAULT WORD 2	-	1	0		
0307	FAULT WORD 3	-	1	0		
0308	ALARM WORD 1	-	1	0		
0309	ALARM WORD 2	-	1	0		
Group 04: Fault History						
0401	LAST FAULT	Fault codes (panel displays as text)	1	0		
0402	FAULT TIME 1	Date dd.mm.yy / power-on time in days	1	0		
0403	FAULT TIME 2	Time hh.mm.ss	2 s	0		
0404	SPEED AT FLT	-	1 rpm	0		
0405	FREQ AT FLT	-	0.1 Hz	0		
0406	VOLTAGE AT FLT	-	0.1 V	0		
0407	CURRENT AT FLT	-	0.1 A	0		
0408	TORQUE AT FLT	-	0.1%	0		
0409	STATUS AT FLT	-	1	0		
0410	DI1-3 AT FLT	000…111 (0…7 decimal)	1	0		
0411	DI4-6 AT FLT	000…111 (0…7 decimal)	1	0		

Code	Name	Range	Resolution	Default	User	S
0412	PREVIOUS FAULT 1	as Par. 0401	1	0		
0413	PREVIOUS FAULT 2	as Par. 0401	1	0		
Group 10: Start/Stop/Dir						
1001	EXT1 COMMANDS	0…14	1	2		✓
1002	EXT2 COMMANDS	0…14	1	0		✓
1003	DIRECTION	1…3	1	3		✓
Group 11: Reference Select						
1101	KEYPAD REF SEL	1…2	1	1		
1102	EXT1/EXT2 SEL	-6…12	1	0		✓
1103	REF1 SELECT	0…17	1	1		✓
1104	REF1 MIN	0…500 Hz / 0…30000 rpm	0.1 Hz / 1 rpm	0 Hz / 0 rpm		
1105	REF1 MAX	0…500 Hz / 0…30000 rpm	0.1 Hz / 1 rpm	50 Hz / 1500 rpm US: 60 Hz / 1800 rpm		
1106	REF2 SELECT	0…19	1	2		✓
1107	REF2 MIN	0…100% (0…600% for torque)	0.1%	0%		
1108	REF2 MAX	0…100% (0…600% for torque)	0.1%	100%		
Group 12: Constant Speeds						
1201	CONST SPEED SEL	-14 …18	1	9		✓
1202	CONST SPEED 1	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	300 rpm / 5 Hz US: 360 rpm / 6 Hz		
1203	CONST SPEED 2	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	600 rpm / 10 Hz US: 720 rpm / 12 Hz		
1204	CONST SPEED 3	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	900 rpm / 15 Hz US: 1080 rpm / 18 Hz		
1205	CONST SPEED 4	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	1200 rpm /20 Hz US: 1440 rpm / 24 Hz		
1206	CONST SPEED 5	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	1500 rpm / 25 Hz US: 1800 rpm / 30 Hz		
1207	CONST SPEED 6	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	2400 rpm / 40 Hz US: 2880 rpm / 48 Hz		
1208	CONST SPEED 7	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	3000 rpm / 50 Hz US: 3600 rpm / 60 Hz		
1209	TIMED MODE SEL	1…2	1	2		✓
Group 13: Analogue Inputs						
1301	MINIMUM AI1	0…100%	0.1%	0%		
1302	MAXIMUM AI1	0…100%	0.1%	100%		
1303	FILTER AI1	0…10 s	0.1 s	0.1 s		
1304	MINIMUM AI2	0…100%	0.1%	0%		
1305	MAXIMUM AI2	0…100%	0.1%	100%		
1306	FILTER AI2	0…10 s	0.1 s	0.1 s		
Group 14: Relay Outputs						
1401	RELAY OUTPUT 1	0…40	1	1		
1402	RELAY OUTPUT 2	0…40	1	2		
1403	RELAY OUTPUT 3	0…40	1	3		
1404	RO 1 ON DELAY	0…3600 s	0.1 s	0 s		
1405	RO 1 OFF DELAY	0…3600 s	0.1 s	0 s		

Code	Name	Range	Resolution	Default	User	S
1406	RO 2 ON DELAY	0…3600 s	0.1 s	0 s		
1407	RO 2 OFF DELAY	0…3600 s	0.1 s	0 s		
1408	RO 3 ON DELAY	0…3600 s	0.1 s	0 s		
1409	RO 3 OFF DELAY	0…3600 s	0.1 s	0 s		
1410	RELAY OUTPUT 4	0…40	1	0		
1411	RELAY OUTPUT 5	0…40	1	0		
1412	RELAY OUTPUT 6	0…40	1	0		
1413	RO 4 ON DELAY	0…3600 s	0.1 s	0 s		
1414	RO 4 OFF DELAY	0…3600 s	0.1 s	0 s		
1415	RO 5 ON DELAY	0…3600 s	0.1 s	0 s		
1416	RO 5 OFF DELAY	0…3600 s	0.1 s	0 s		
1417	RO 6 ON DELAY	0…3600 s	0.1 s	0 s		
1418	RO 6 OFF DELAY	0…3600 s	0.1 s	0 s		
Group 15: Analogue Outputs						
1501	AO1 CONTENT	99...199	1	103		
1502	AO1 CONTENT MIN	-	-	Defined by par. 0103		
1503	AO1 CONTENT MAX	-	-	Defined by par. 0103		
1504	MINIMUM AO1	0.0…20.0 mA	0.1 mA	0 mA		
1505	MAXIMUM AO1	0.0…20.0 mA	0.1 mA	20.0 mA		
1506	FILTER AO1	0…10 s	0.1 s	0.1 s		
1507	AO2 CONTENT	99…199	1	104		
1508	AO2 CONTENT MIN	-	-	Defined by par. 0104		
1509	AO2 CONTENT MAX	-	-	Defined by par. 0104		
1510	MINIMUM AO2	0.0…20.0 mA	0.1 mA	0 mA		
1511	MAXIMUM AO2	0.0…20.0 mA	0.1 mA	20.0 mA		
1512	FILTER AO2	0…10 s	0.1 s	0.1 s		
Group 16: System Controls						
1601	RUN ENABLE	0…7, -1…-6	1	0		✓
1602	PARAMETER LOCK	0…2	1	1		
1603	PASS CODE	0…65535	1	0		
1604	FAULT RESET SEL	0…8, -1…-6	1	0		
1605	USER PAR SET CHG	0…6, -1…-6	1	0		
1606	LOCAL LOCK	0…8, -1…-6	1	0		
1607	PARAM SAVE	0 = Done, 1 = Save	1	0		
Group 20: Limits						
2001	MINIMUM SPEED	-30000…30000 rpm	1 rpm	0 rpm		✓
2002	MAXIMUM SPEED	0…30000 rpm	1 rpm	1500 rpm / US: 1800 rpm		✓
2003	MAX CURRENT	0… 1.8 * I_{2hd}	0.1 A	1.8 * I_{2hd}		✓
2005	OVERVOLT CTRL	0 = Disable, 1 = Enable	1	1		
2006	UNDERVOLT CTRL	0 = Disable, 1 = Enable	1	1		
2007	MINIMUM FREQ	-500…500 Hz	0.1 Hz	0 Hz		✓
2008	MAXIMUM FREQ	0…500 Hz	0.1 Hz	50 Hz / US: 60 Hz		✓
2013	MIN TORQUE SEL	0…7, -1…-6	1	0		
2014	MAX TORQUE SEL	0…7, -1…-6	1	0		

Code	Name	Range	Resolution	Default	User	S
2015	MIN TORQUE 1	-600.0%…0%	0.1%	-300.0%		
2016	MIN TORQUE 2	-600.0%…0%	0.1%	-300.0%		
2017	MAX TORQUE 1	0%…600.0%	0.1%	300.0%		
2018	MAX TORQUE 2	0%…600.0%	0.1%	300.0%		
Group 21: Start/Stop						
2101	START FUNCTION	1…5	1	1		✓
2102	STOP FUNCTION	1 = coast, 2 = ramp	1	1		
2103	DC MAGN TIME	0…10 s	0.01 s	0.3 s		
2104	DC CURR CTL	0, 2	-	0		✓
2105	DC HOLD SPEED	0…3000 rpm	1 rpm	5 rpm		
2106	DC CURR REF	0%…100%	1%	30%		
2107	DC BRAKE TIME	0…250 s	0.1 s	0 s		
2108	START INHIBIT	0 = off, 1 = on	1	0		✓
2109	EM STOP SEL	0…6, -1…-6	1	0		
2110	TORQ BOOST CURR	0…300%	1	100%		
Group 22: Accel/Decel						
2201	ACC/DEC 1/2 SEL	0…6, -1…-6	1	5		
2202	ACCELER TIME 1	0.0…1800 s	0.1 s	5 s		
2203	DECELER TIME 1	0.0…1800 s	0.1 s	5 s		
2204	RAMP SHAPE 1	0=linear; 0.1...1000.0 s	0.1 s	0.0 s		
2205	ACCELER TIME 2	0.0…1800 s	0.1 s	60 s		
2206	DECELER TIME 2	0.0…1800 s	0.1 s	60 s		
2207	RAMP SHAPE 2	0=linear; 0.1...1000.0 s	0.1 s	0.0 s		
2208	EM DEC TIME	0.0…1800 s	0.1 s	1.0 s		
2209	RAMP INPUT 0	0…6, -1…-6	1	0		
Group 23: Speed Control						
2301	PROP GAIN	0.00…200.0	0.01	10		
2302	INTEGRATION TIME	0…600.00 s	0.01 s	2.5		
2303	DERIVATION TIME	0…10000 ms	1 ms	0		
2304	ACC COMPENSATION	0…600.00 s	0.01 s	0		
2305	**AUTOTUNE RUN**	0…1	1	0 (OFF)		
Group 24: Torque Control						
2401	TORQ RAMP UP	0.00…120.00 s	0.01 s	0		
2402	TORQ RAMP DOWN	0.00…120.00 s	0.01 s	0		
Group 25: Critical Speeds						
2501	CRIT SPEED SEL	0 = OFF, 1 = ON	1	0		
2502	CRIT SPEED 1 LO	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	0 rpm / 0 Hz		
2503	CRIT SPEED 1 HI	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	0 rpm / 0 Hz		
2504	CRIT SPEED 2 LO	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	0 rpm / 0 Hz		
2505	CRIT SPEED 2 HI	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	0 rpm / 0 Hz		
2506	CRIT SPEED 3 LO	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	0 rpm / 0 Hz		
2507	CRIT SPEED 3 HI	0…30000 rpm / 0…500 Hz	1 rpm / 0.1 Hz	0 rpm / 0 Hz		
Group 26: Motor Control						
2601	FLUX OPTIMIZATION	0…1	1	0		
2602	FLUX BRAKING	0…1	1	1 (ON)		

Code	Name	Range	Resolution	Default	User	S
2603	IR COMP VOLT	0…100 V	1	50		
2604	IR COMP FREQ	0…100%	1	50		
2605	U/F RATIO	1 = linear, 2 = squared	1	1		
2606	SWITCHING FREQ	1,4,8 kHz	-	4 kHz		
2607	SW FREQ CTRL	0 = OFF, 1 = ON	-	1		
2608	SLIP COMP RATIO	0…200%	1	0		
Group 29: Maintenance Trig						
2901	**COOLING FAN TRIG**	0.0…6553.5 kh	0.1 kh	0.0 (NOT SEL)		
2902	**COOLING FAN ACT**	0.0…6553.5 kh	0.1 kh	0.0 kh		
2903	**REVOLUTION TRIG**	0…65535 MRev	1 MRev	0 (NOT SEL)		
2904	**REVOLUTION ACT**	0…65535 MRev	1 MRev	0 MRev		
2905	**RUN TIME TRIG**	0.0…6553.5 kh	0.1 kh	0.0 (NOT SEL)		
2906	**RUN TIME ACT**	0.0…6553.5 kh	0.1 kh	0.0 kh		
2907	**USER MWH TRIG**	0.0…6553.5 MWh	0.1 MWh	0.0 (NOT SEL)		
2901	**USER MWH ACT**	0.0…6553.5 MWh	0.1 MWh	0.0 MWh		
Group 30: Fault Functions						
3001	AI<MIN FUNCTION	0…3	1	0		
3002	PANEL COMM ERR	1…3	1	1		
3003	EXTERNAL FAULT 1	0…6, -1…-6	1	0		
3004	EXTERNAL FAULT 2	0…6, -1…-6	1	0		
3005	MOT THERM PROT	0 = NOT SEL, 1 = FAULT, 2 = WARNING	1	1 (FAULT)		
3006	MOT THERM TIME	256…9999 s	1	500 s		
3007	MOT LOAD CURVE	50…150%	1	100%		
3008	ZERO SPEED LOAD	25…150%	1	70%		
3009	BREAK POINT FREQ	1…250 Hz	1	35 Hz		
3010	STALL FUNCTION	0…2	1	0 (NOT SEL)		
3011	STALL FREQUENCY	0.5…50 Hz	0.1 Hz	20 Hz		
3012	STALL TIME	10…400 s	1 s	20 s		
3013	UNDERLOAD FUNC	0 = NOT SEL, 1 = FAULT, 2 = WARNING	-	0 (NOT SEL)		
3014	UNDERLOAD TIME	10…400 s	1 s	20 s		
3015	UNDERLOAD CURVE	1…5	1	1		
3017	**EARTH FAULT**	0…1	1	1		
3018	COMM FAULT FUNC	0…3	1	0		
3019	COMM FAULT TIME	0…60.0 s	0.1 s	3.0 s		
3021	AI1 FAULT LIMIT	0…100%	0.1%	0%		
3022	AI2 FAULT LIMIT	0…100%	0.1%	0%		
Group 31: Automatic Reset						
3101	NR OF TRIALS	0…5	1	0		
3102	TRIAL TIME	1.0…600.0 s	0.1 s	30 s		
3103	DELAY TIME	0.0…120.0 s	0.1 s	0 s		
3104	AR OVERCURRENT	0=disable, 1=enable	1	0		
3105	AR OVERVOLTAGE	0=disable, 1=enable	1	0		
3106	AR UNDERVOLTAGE	0=disable, 1=enable	1	0		
3107	AR AI<MIN	0=disable, 1=enable	1	0		
3108	AR EXTERNAL FLT	0=disable, 1=enable	1	0		

Code	Name	Range	Resolution	Default	User	S
Group 32: Supervision						
3201	SUPERV 1 PARAM	101…199	1	103		
3202	SUPERV 1 LIM LO	-	-	0		
3203	SUPERV 1 LIM HI	-	-	0		
3204	SUPERV 2 PARAM	101…199	1	103		
3205	SUPERV 2 LIM LO	-	-	0		
3206	SUPERV 2 LIM HI	-	-	0		
3207	SUPERV 3 PARAM	101…199	1	103		
3208	SUPERV 3 LIM LO	-	-	0		
3209	SUPERV 3 LIM HI	-	-	0		
Group 33: Information						
3301	FW VERSION	0000...FFFF hex	1	Firmware version		
3302	LP VERSION	0000...FFFF hex	1	0		
3303	TEST DATE	yy.ww	1	0		
3304	DRIVE RATING	-	-	-		
Group 34: Panel Display / Process Variables						
3401	SIGNAL 1 PARAM	100...199	1	103		
3402	SIGNAL 1 MIN	-	1	-		
3403	SIGNAL 1 MAX	-	1	-		
3404	OUTPUT 1 DSP FORM	0…7	1	-		
3405	OUTPUT 1 UNIT	-128...127	1	.		
3406	OUTPUT 1 MIN	-	1	-		
3407	OUTPUT 1 MAX	-	1	-		
3408	SIGNAL 2 PARAM	100...199	1	104		
3409	SIGNAL 2 MIN	-	1	-		
3410	SIGNAL 2 MAX	-	1	-		
3411	OUTPUT 2 DSP FORM	0…7	1	-		
3412	OUTPUT 2 UNIT	-128...127	1	.		
3413	OUTPUT 2 MIN	-	1	-		
3414	OUTPUT 2 MAX	-	1	-		
3415	SIGNAL 3 PARAM	100...199	1	105		
3416	SIGNAL 3 MIN	-	1	-		
3417	SIGNAL 3 MAX	-	1	-		
3418	OUTPUT 3 DSP FORM	0…7	1	-		
3419	OUTPUT 3 UNIT	-128…127	1	.		
3420	OUTPUT 3 MIN	-	1	-		
3421	OUTPUT 3 MAX	-	1	-		
Group 35: Motor Temp Meas						
3501	SENSOR TYPE	0…6	1	0		
3502	INPUT SELECTION	1…8	1	1		
3503	ALARM LIMIT	-10...200 °C / 0...5000 Ohm / 0…1	1	110 °C / 1500 Ohm / 0		
3504	FAULT LIMIT	-10...200 °C / 0...5000 Ohm / 0…1	1	130 °C / 4000 Ohm / 0		
Group 36: Timer Functions						
3601	TIMERS ENABLE	-6…7	1	0		
3602	START TIME 1	00:00:00…23:59:58	2 s	00:00:00		

Code	Name	Range	Resolution	Default	User	S
3603	STOP TIME 1	00:00:00…23:59:58	2 s	00:00:00		
3604	START DAY 1	1…7	1	1		
3605	STOP DAY 1	1…7	1	1		
3606	START TIME 2	00:00:00…23:59:58	2 s	00:00:00		
3607	STOP TIME 2	00:00:00…23:59:58	2 s	00:00:00		
3608	START DAY 2	1…7	1	1		
3609	STOP DAY 2	1…7	1	1		
3610	START TIME 3	00:00:00…23:59:58	2 s	00:00:00		
3611	STOP TIME 3	00:00:00…23:59:58	2 s	00:00:00		
3612	START DAY 3	1…7	1	1		
3613	STOP DAY 3	1…7	1	1		
3614	START TIME 4	00:00:00…23:59:58	2 s	00:00:00		
3615	STOP TIME 4	00:00:00…23:59:58	2 s	00:00:00		
3616	START DAY 4	1…7	1	1		
3617	STOP DAY 4	1…7	1	1		
3622	BOOSTER SEL	-6…6	1	0		
3623	BOOSTER TIME	00:00:00…23:59:58	2 s	00:00:00		
3624 … 3628	TMR FUNC1…4 SRC	0…31	1	0		
Group 40: Process PID Set 1						
4001	GAIN	0.1…100	0.1	1.0		
4002	INTEGRATION TIME	0.0s = NOT SEL, 0.1…600 s	0.1 s	60 s		
4003	DERIVATION TIME	0…10 s	0.1 s	0 s		
4004	PID DERIV FILTER	0…10 s	0.1 s	1 s		
4005	ERROR VALUE INV	0 = no, 1 = yes	-	0		
4006	UNIT	0…31	-	4		
4007	DSP FORMAT	0…4	1	1		
4008	0% VALUE	Unit and scale defined by par. 4006 and 4007	1	0.0%		
4009	100% VALUE	Unit and scale defined by par. 4006 and 4007	1	100%		
4010	SET POINT SEL	0…19	1	1		✓
4011	INTERNAL SETPNT	Unit and scale defined by par. 4006 and 4007	1	40.0%		
4012	SETPOINT MIN	-500.0%…500.0%	0.1%	0%		
4013	SETPOINT MAX	-500.0%…500.0%	0.1%	100%		
4014	FBK SEL	1…9	-	1		
4015	FBK MULTIPLIER	-32.768…32.767 (0 = not used)	0.001	0		
4016	ACT1 INPUT	1…2	-	2		✓
4017	ACT2 INPUT	1…2	-	2		✓
4018	ACT1 MINIMUM	-1000…1000%	1%	0%		
4019	ACT1 MAXIMUM	-1000…1000%	1%	100%		
4020	ACT2 MINIMUM	-1000…1000%	1%	0%		
4021	ACT2 MAXIMUM	-1000…1000%	1%	100%		
4022	SLEEP SELECTION	0…7, -1…-6	-	0		

Code	Name	Range	Resolution	Default	User	S
4023	PID SLEEP LEVEL	0…7200 rpm / 0.0…120 Hz	1 rpm / 0.1 Hz	0 Hz		
4024	PID SLEEP DELAY	0.0…3600 s	0.1 s	60 s		
4025	WAKE-UP DEV	Unit and scale defined by par. 4006 and 4007	1	-		
4026	WAKE-UP DELAY	0…60 s	0.01 s	0.50 s		
4027	PID 1 PARAM SET	-6…11	1	0		
Group 41: Process PID Set 2						
4101	GAIN	0.1…100	0.1	1.0		
4102	INTEGRATION TIME	0.0s = NOT SEL, 0.1…600 s	0.1 s	60 s		
4103	DERIVATION TIME	0…10 s	0.1 s	0 s		
4104	PID DERIV FILTER	0…10 s	0.1 s	1 s		
4105	ERROR VALUE INV	0 = no, 1 = yes	-	0		
4106	UNIT	0…31	-	4		
4107	DSP FORMAT	0…4	1	1		
4108	0% VALUE	Unit and scale defined by par. 4106 and 4107	1	0.0%		
4109	100% VALUE	Unit and scale defined by par. 4106 and 4107	1	100%		
4110	SET POINT SEL	0…19	1	1		✓
4111	INTERNAL SETPNT	Unit and scale defined by par. 4106 and 4107	1	40.0%		
4112	SETPOINT MIN	-500.0%…500.0%	0.1%	0%		
4113	SETPOINT MAX	-500.0%…500.0%	0.1%	100%		
4114	FBK SEL	1…9	-	1		
4115	FBK MULTIPLIER	-32.768…32.767 (0 = not used)	0.001	0		
4116	ACT1 INPUT	1…5	-	2		✓
4117	ACT2 INPUT	1…5	-	2		✓
4118	ACT1 MINIMUM	-1000…1000%	1%	0%		
4119	ACT1 MAXIMUM	-1000…1000%	1%	100%		
4120	ACT2 MINIMUM	-1000…1000%	1%	0%		
4121	ACT2 MAXIMUM	-1000…1000%	1%	100%		
4122	SLEEP SELECTION	0…7, -1…-6	-	0		
4123	PID SLEEP LEVEL	0…7200 rpm / 0.0…120 Hz	1 rpm / 0.1 Hz	0 Hz		
4124	PID SLEEP DELAY	0.0…3600 s	0.1 s	60 s		
4125	WAKE-UP DEV	Unit and scale defined by par. 4106 and 4107	-	-		
4126	WAKE-UP DELAY	0…60 s	0.01 s	0.50 s		
Group 42: External / Trimming PID						
4201	GAIN	0.1…100	0.1	1.0		
4202	INTEGRATION TIME	0.0s = NOT SEL, 0.1…600 s	0.1 s	60 s		
4203	DERIVATION TIME	0…10 s	0.1 s	0 s		
4204	PID DERIV FILTER	0…10 s	0.1 s	1 s		
4205	ERROR VALUE INV	0 = no, 1 = yes	-	0		
4206	UNIT	0…31	-	4		
4207	DSP FORMAT	0…4	1	1		
4208	0% VALUE	Unit and scale defined by par. 4206 and 4207	1	0%		

Code	Name	Range	Resolution	Default	User	S
4209	100% VALUE	Unit and scale defined by par. 4206 and 4207	1	100%		
4210	SET POINT SEL	0…19	1	1		✓
4211	INTERNAL SETPNT	Unit and scale defined by par. 4206 and 4207	1	40.0%		
4212	SETPOINT MIN	-500.0%…500.0%	0.1%	0%		
4213	SETPOINT MAX	-500.0%…500.0%	0.1%	100%		
4214	FBK SEL	1…9	-	1		
4215	FBK MULTIPLIER	-32.768…32.767 (0 = not used)	0.001	0		
4216	ACT1 INPUT	1…5	-	2		✓
4217	ACT2 INPUT	1…5	-	2		✓
4218	ACT1 MINIMUM	-1000…1000%	1%	0%		
4219	ACT1 MAXIMUM	-1000…1000%	1%	100%		
4220	ACT2 MINIMUM	-1000…1000%	1%	0%		
4221	ACT2 MAXIMUM	-1000…1000%	1%	100%		
4228	ACTIVATE	-6…12	-	0		
4229	OFFSET	0.0…100.0%	0.1%	0		
4230	TRIM MODE	0…2	1	0		
4231	TRIM SCALE	-100.0%…100.0%	0.1%	100.0%		
4232	CORRECTION SRC	1…2	1	1 (PID2 REF)		
Group 51: Ext Comm Module						
5101	FBA TYPE	-	1	0		
5102…5126	FBA PAR 2…26	0...65535	1	0		
5127	FBA PAR REFRESH	0 = done, 1 = refresh	1	0		
5128	FILE CPI FW REV	0...0xFFFF	1	0		
5129	FILE CONFIG ID	0...0xFFFF	1	0		
5130	FILE CONFIG REV	0...0xFFFF	1	0		
5131	FBA STATUS	0…6	1	0		
5132	FBA CPI FW REV	0...0xFFFF	1	0		
5133	FBA APPL FW REV	0...0xFFFF	1	0		
Group 52: Panel Communication						
5201	STATION ID	1…247	1	1		
5202	BAUD RATE	9.6, 19.2, 38.4, 57.6, 115.2 kbits/s	-	9.6 kbits/s		
5203	PARITY	0…3	1	0		
5204	OK MESSAGES	0…65535	1	-		
5205	PARITY ERRORS	0…65535	1	-		
5206	FRAME ERRORS	0…65535	1	-		
5207	BUFFER OVERRUNS	0…65535	1	-		
5208	CRC ERRORS	0…65535	1	-		
Group 53: EFB Protocol						
5301	EFB PROTOCOL ID	0...0xFFFF	1	0		
5302	EFB STATION ID	0…65535	1	1		✓
5303	EFB BAUD RATE	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6 kbits/s	-	9.6 kbits/s		
5304	EFB PARITY	0...3		0		

Code	Name	Range	Resolution	Default	User	S
5305	EFB CTRL PROFILE	0 = ABB drives, 1 = ACS550 drives	1	0		
5306	EFB OK MESSAGES	0…65535	1	0		
5307	EFB CRC ERRORS	0…65535	1	0		
5308	EFB UART ERRORS	0…65535	1	0		
5309	EFB STATUS	0…65535	1	0		
5310	EFB PAR 10	0…65535	1	0 (NOT SEL)		
5311	EFB PAR 11	0…65535	1	0 (NOT SEL)		
5312	EFB PAR 12	0…65535	1	0 (NOT SEL)		
5313	EFB PAR 13	0…65535	1	0 (NOT SEL)		
5314	EFB PAR 14	0…65535	1	0 (NOT SEL)		
5315	EFB PAR 15	0…65535	1	0 (NOT SEL)		
5316	EFB PAR 16	0…65535	1	0 (NOT SEL)		
5317	EFB PAR 17	0…65535	1	0 (NOT SEL)		
5318 ... 5320	EFB PAR 10 - 20	0…65535	1	0		
Group 81: PFC Control						
8103	REFERENCE STEP 1	0.0…100%	0.1%	0%		
8104	REFERENCE STEP 2	0.0…100%	0.1%	0%		
8105	REFERENCE STEP 3	0.0…100%	0.1%	0%		
8109	START FREQ 1	0.0…500 Hz	0.1 Hz	50Hz / US:60 Hz		
8110	START FREQ 2	0.0…500 Hz	0.1 Hz	50 Hz/ US:60 Hz		
8111	START FREQ 3	0.0…500 Hz	0.1 Hz	50 Hz/ US:60 Hz		
8112	LOW FREQ 1	0.0…500 Hz	0.1 Hz	25 Hz/ US:30 Hz		
8113	LOW FREQ 2	0.0…500 Hz	0.1 Hz	25 Hz/ US:30 Hz		
8114	LOW FREQ 3	0.0…500 Hz	0.1 Hz	25 Hz/ US:30 Hz		
8115	AUX MOT START D	0.0…3600 s	0.1 s; 1 s	5 s		
8116	AUX MOT STOP D.	0.0…3600 s	0.1 s; 1 s	3 s		
8117	NR OF AUX MOT	0…3	1	1		✓
8118	AUTOCHNG INTERV	0.0…336 h	0.1 h	0.0 h (NOT SEL)		✓
8119	AUTOCHNG LEVEL	0.0…100.0%	0.1%	50%		
8120	INTERLOCKS	0…6	1	4		✓
8121	REG BYPASS CTRL	0…1	1	0 (NO)		
8122	PFC START DELAY	0…10 s	0.01 s	0.5 s		
8123	PFC ENABLE	0…1	-	0		✓
8124	ACC IN AUX STOP	0.0...1800 s	0.1 s	0.0 s (NOT SEL)		
8125	DEC IN AUX START	0.0...1800 s	0.1 s	0.0 s (NOT SEL)		
8126	TMED AUTOCHNG	0…4	1	0		
Group 98: Options						
9802	COMM PROT SEL	0, 1, 4	1	0		✓

Complete Parameter Descriptions

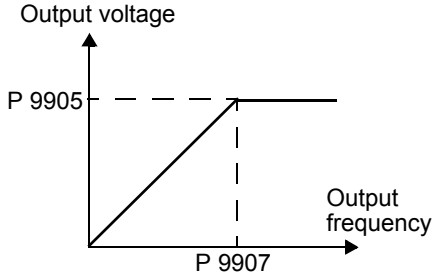
This section describes the actual signals and parameters for ACS550.

Group 99: Start-up Data

This group defines special Start-up data required to:

- Set up the drive.
- Enter motor information.

Code	Description
9901	**LANGUAGE** Selects the display language. 0 = ENGLISH 1 = ENGLISH (AM) 2 = DEUTSCH 3 = ITALIANO 4 = ESPAÑOL 5 = PORTUGUES 6 = NEDERLANDS 7 = FRANCAIS 8 = DANSK 9 = SUOMI 10 = SVENSKA
9902	**APPLIC MACRO** Selects an application macro. Application macros automatically edit parameters to configure the ACS550 for a particular application. 1 = ABB STANDARD 2 = 3-WIRE 3 = ALTERNATE 4 = MOTOR POT 5 = HAND/AUTO 6 = PID CONTROL 7 = PFC CONTROL 8 = TORQUE CTRL 0 = USER S1 LOAD -1 = USER S1 SAVE -2 = USER S2 LOAD -3 = USER S2 SAVE
9904	**MOTOR CTRL MODE** Selects the motor control mode. 1 = VECTOR: SPEED – sensorless vector control mode. • Reference 1 is speed reference in rpm. • Reference 2 is speed reference in % (100% is absolute maximum speed, equal to the value of parameter 2002 MAXIMUM SPEED, or 2001 MINIMUM SPEED if the absolute value of the minimum speed is greater than the maximum speed). 2 = VECTOR: TORQ. • Reference 1 is speed reference in rpm. • Reference 2 is torque reference in % (100% is nominal torque.) 3 = SCALAR: SPEED – scalar control mode. • Reference 1 is frequency reference in Hz. • Reference 2 is frequency reference in % (100% is absolute maximum frequency, equal to the value of parameter 2008 MAXIMUM FREQUENCY, or 2007 MINIMUM FREQUENCY if the absolute value of the minimum speed is greater than the maximum speed).
9905	**MOTOR NOM VOLT** Defines the nominal motor voltage. • Must equal the value on the motor rating plate. • The ACS550 cannot supply the motor with a voltage greater than the mains voltage.
9906	**MOTOR NOM CURR** Defines the nominal motor current. • Must equal the value on the motor rating plate. • Range allowed: (0.2…2.0) · I_{2hd} (where I_{2hd} is drive current).
9907	**MOTOR NOM FREQ** Defines the nominal motor frequency. • Range: 10…500 Hz (typically 50 or 60 Hz) • Sets the frequency at which output voltage equals the MOTOR NOM VOLT. • Field weakening point = Nom Freq * Supply Volt / Mot Nom Volt

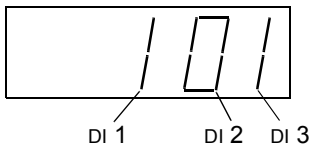


9908	**MOTOR NOM SPEED** Defines the nominal motor speed. • Must equal the value on the motor rating plate.	
9909	**MOTOR NOM POWER** Defines the nominal motor power. • Must equal the value on the motor rating plate.	
9910	**MOTOR ID RUN** This parameter controls a self-calibration process called the Motor Id Run. During this process, the drive operates the motor in order to identify it's characteristics, and then optimizes control by creating a motor model. This motor model is especially effective when: • Operation point is near zero speed. • Operation requires a torque range above the motor nominal torque, over a wide speed range, and without any measured speed feedback (i.e. without a pulse encoder). If no Motor Id Run is performed, the drive uses a less detailed motor model created when the drive is first run. This "First Start" model is updated automatically* after any motor parameter is changed. To update the model, the drive magnetizes the motor for 10 to 15 seconds at zero speed. *Creating the "First Start model does require that either 9904 = 1 (VECTOR: SPEED), or 9904 = 3 (SCALAR: SPEED) and 2101 = 3 (SCALAR FLYSTART) or 5 (FLYSTART + TORQ BOOST). **Note:** Motor models work with internal parameters and user-defined motor parameters. In creating a model the drive does not change any user-defined parameters. 0 = NO ID RUN – Disables the Motor Id Run creation process. (Does not disable the operation of a motor model.) 1 = STANDARD – Enables a Motor Id Run at the next start command. After run completion, this value automatically changes to 0.	To perform a Motor Id Run: 1. De-couple load from motor (or otherwise reduce load to near zero). 2. Verify that motor operation is safe: • The run automatically operates the motor in the forward direction – confirm that forward rotation is safe. • The run automatically operates the motor at 50…80% of nominal speed – confirm that operation at these speeds is safe. 3. Check following parameters (if changed from factory settings): • 2001 MINIMUM SPEED $\leq$ 0 • 2002 MAXIMUM SPEED > 80% of motor rated speed. • 2003 MAX CURRENT $\geq$ 100% of I_{2hd} value. • The maximum torque (parameters 2014, 2017 and/or 2018) > 50%. 4. At the Control Panel, select: • Select Parameters • Select Group 99 • Select Parameter 9910 • Set value to 1 and press Enter – The display shows a warning. • Press START – The display shows the progress of the run. Note! Pressing STOP, or removing the run enable signal stops the ID run. In this case you'll need to repeat the Motor Id Run to create the motor model.

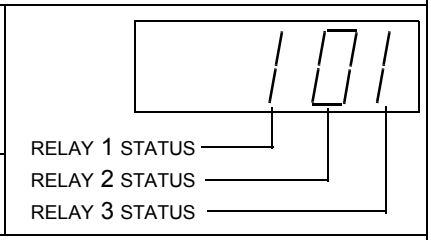
Group 01: Operating Data

This group contains drive operating data, including actual signals. The drive sets the values for actual signals, based on measurements or calculations. You cannot set these values.

Code	Description
0102	**SPEED** The calculated speed of the motor (rpm).
0103	**OUTPUT FREQ** The frequency (Hz) applied to the motor. (Also shown by default in OUTPUT display.)
0104	**CURRENT** The motor current, as measured by the ACS550. (Also shown by default in OUTPUT display.)
0105	**TORQUE** Output torque. Calculated value of torque on motor shaft in % of motor nominal torque.
0106	**POWER** The measured motor power in kW.
0107	**DC BUS VOLTAGE** The DC bus voltage in VDC, as measured by the ACS550.
0109	**OUTPUT VOLTAGE** The voltage applied to the motor.
0110	**DRIVE TEMP** The temperature of the drive heatsink in Centigrade.
0111	**EXTERNAL REF 1** External reference, REF1, in rpm or Hz – units determined by parameter 9904.
0112	**EXTERNAL REF 2** External reference, REF2, in %.
0113	**CTRL LOCATION** Active control location. Alternatives are: 0 = LOCAL 1 = EXT1 2 = EXT2
0114	**RUN TIME (R)** The drive's accumulated running time in hours (h). • Can be **reset** by pressing UP and DOWN buttons simultaneously when in parameter set mode.
0115	**KWH COUNTER (R)** The drive's accumulated power consumption in kilowatt hours. • Can be **reset** by pressing UP and DOWN buttons simultaneously when in parameter set mode.
0116	**APPL BLK OUTPUT** Application block output signal. Value is from either: • PFC control, if PFC Control is active, or • Parameter 0112 EXTERNAL REF 2.
0118	**DI1-3 STATUS** Status of the three digital inputs. • Status is displayed as a binary number. • 1 indicates that the input is activated. • 0 indicates that the input is deactivated.
0119	**DI4-6 STATUS** Status of the three digital inputs. • See parameter 0118 DI1-3 STATUS.
0120	**AI1** Relative value of analog input 1 in %.



Code	Description
0121	**AI2** The relative value of analog input 2 in %.
0122	**RO1-3 STATUS** Status of the three relay outputs. • 1 indicates that the relay is energized. • 0 indicates that the relay is de-energized.
0123	**RO4-6 STATUS** Status of the three relay outputs. See parameter 0122.
0124	**AO1** The analog output 1 value in milliamperes.
0125	**AO2** The analog output 2 value in milliamperes.
0126	**PID 1 OUTPUT** The PID Controller 1 output value in %.
0127	**PID 2 OUTPUT** The PID Controller 2 output value in %.
0128	**PID 1 SETPNT** The PID 1 controller setpoint signal. • Units and scale defined by PID parameters.
0129	**PID 2 SETPNT** The PID 2 controller setpoint signal. • Units and scale defined by PID parameters.
0130	**PID 1 FBK** The PID 1 controller feedback signal. • Units and scale defined by PID parameters.
0131	**PID 2 FBK** The PID 2 controller feedback signal. • Units and scale defined by PID parameters.
0132	**PID 1 DEVIATION** The difference between the PID 1 controller reference value and actual value. • Units and scale defined by PID parameters.
0133	**PID 2 DEVIATION** The difference between the PID 2 controller reference value and actual value. • Units and scale defined by PID parameters.
0134	**COMM RO WORD** Free data location that can be written from serial link. • Used for relay output control. • See parameter 1401.
0135	**COMM VALUE 1** Free data location that can be written from serial link.
0136	**COMM VALUE 2** Free data location that can be written from serial link.
0137	**PROCESS VAR 1** Process variable 1 • Defined by parameters in Group 34: Panel Display / Process Variables.
0138	**PROCESS VAR 2** Process variable 2 • Defined by parameters in Group 34: Panel Display / Process Variables.



Code	Description
0139	**PROCESS VAR 3** Process variable 3 • Defined by parameters in Group 34: Panel Display / Process Variables.
0140	**RUN TIME** The drive's accumulated running time in thousands of hours (kh).
0141	**MWH COUNTER** The drive's accumulated power consumption in megawatt hours. Can not be reset.
0142	**REVOLUTION CNTR** The motor's accumulated revolutions in millions of revolutions.
0143	**DRIVE ON TIME (HI)** The drive's accumulated power on time in days.
0144	**DRIVE ON TIME (LO)** The drive's accumulated power on time in 2 second ticks (30 ticks = 60 seconds).
0145	**MOTOR TEMP** Motor temperature in degrees centigrade / PTC resistance in Ohms. • Applies only if motor temperature sensor is set up. See parameter 3501.

Group 03: FB Actual Signals

This group monitors fieldbus communications.

Code	Description
0301	**FB CMD WORD 1** Read-only copy of the Fieldbus Command Word 1. • The fieldbus command is the principal means for controlling the drive from a fieldbus controller. The command consists of two Command Words. Bit-coded instructions in the Command Words switch the drive between states. • To control the drive, using the Command Words, an external location (EXT1 or EXT2) must be active and set to COMM. (See parameters 1001 and 1002.) • The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in BIt 15 displays as 8000.
0302	**FB CMD WORD 2** Read-only copy of the Fieldbus Command Word 2. • See parameter 0301.

Bit #	0301, FB CMD WORD 1	0302, FB CMD WORD 2
0	STOP	Reserved
1	START	Reserved
2	REVERSE	Reserved
3	LOCAL	Reserved
4	RESET	Reserved
5	EXT2	Reserved
6	RUN_DISABLE	Reserved
7	STPMODE_R	Reserved
8	STPMODE_EM	Reserved
9	STPMODE_C	Reserved
10	RAMP_2	Reserved
11	RAMP_OUT_0	REF_CONST
12	RAMP_HOLD	REF_AVE
13	RAMP_IN_0	LINK_ON
14	RREQ_LOCALLOC	REQ_STARTINH
15	TORQLIM2	OFF_INTERLOCK

Code	Description
0303	**FB STS WORD 1** Read-only copy of the Status Word 1. • The drive sends status information to the fieldbus controller. The status consists of two Status Words. • The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in BIt 15 displays as 8000.
0304	**FB STS WORD 2** Read-only copy of the Status Word 2. • See parameter 0303.

Bit #	0303, STS CMD WORD 1	0304, FB STS WORD 2
0	READY	ALARM
1	ENABLED	REQ_MAINT
2	STARTED	DIRLOCK
3	RUNNING	LOCALLOCK
4	ZERO_SPEED	CTL_MODE
5	ACCELERATE	Reserved
6	DECELERATE	Reserved
7	AT_SETPOINT	Reserved
8	LIMIT	Reserved
9	SUPERVISION	Reserved
10	REV_REF	REQ_CTL
11	REV_ACT	REQ_REF1
12	PANEL_LOCAL	REQ_REF2
13	FIELDBUS_LOCAL	REQ_REF2EXT
14	EXT2_ACT	ACK_STARTINH
15	FAULT	ACK_OFF_ILCK

0305 **FAULT WORD 1**

Read-only copy of the Fault Word 1.

- When a fault is active, the corresponding bit for the active fault is set in the Fault Words.
- Each fault has a dedicated bit allocated within Fault Words.
- See *Fault Listing* on page *165* for a description of the faults.
- The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in BIt 15 displays as 8000.

0306 **FAULT WORD 2**

Read-only copy of the Fault Word 2.

- See parameter 0305.

0307 **FAULT WORD 3**

Read-only copy of the Fault Word 3.

- See parameter 0305.

Bit #	0305, FAULT WORD 1	0306, FAULT WORD 2	0307, FAULT WORD 3
0	OVERCURRENT	UNDERLOAD	EFB 1
1	DC OVERVOLT	THERM FAIL	EFB 2
2	DEV OVERTEMP	OPEX LINK	EFB 3
3	SHORT CIRC	OPEX PWR	Reserved
4	OVERLOAD	CURR MEAS	Reserved
5	DC UNDERVOLT	SUPPLY PHASE	Reserved
6	AI1 LOSS	Reserved	Reserved
7	AI2 LOSS	OVERSPEED	Reserved
8	MOT OVERTEMP	DC HIGH RUSH	Reserved
9	PANEL LOSS	DRIVE ID	Reserved
10	ID RUN FAIL	CONFIG FILE	Reserved
11	MOTOR STALL	SERIAL 1 ERR	System Error
12	Reserved	EFB CON FILE	System Error
13	EXT FLT 1	FORCE TRIP	System Error
14	EXT FLT 2	MOTOR PHASE	Hardware Error
15	EARTH FAULT	OUTPUT WIRING	Param. Setting Fault

0308 **ALARM WORD 1**

- When an alarm is active, the corresponding bit for the active alarm is set in the Alarm Words.
- Each alarm has a dedicated bit allocated within Alarm Words.
- Bits remain set until the whole alarm word is reset. (Reset by writing zero to the word.)
- The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in BIt 15 displays as 8000.

0309 **ALARM WORD 2**

See parameter 0308.

Bit #	0308, ALARM WORD 1	0309, ALARM WORD 2
0	Reserved	Reserved / OFFBUTTON 0*
1		PID SLEEP
2		ID RUN
3	DIR LOCK	Reserved
4	I/O COMM	
5	AI1 LOSS	
6	AI2 LOSS	
7	PANEL LOSS	
8	Reserved	
9	MOT OVERTEMP	
10	UNDERLOAD	
11	MOTOR STALL	
12	AUTORESET	
13	AUTOCHANGE	
14	PFC INTERLOCK	
15	reserved BP LOSS	

* Applies only to HVAC drives.

Group 04: Fault History

This group stores a recent history of the faults reported by the drive.

Code	Description
0401	**LAST FAULT** 0 = Clear the fault history (on panel = NO RECORD). n = Fault code of the last recorded fault.
0402	**FAULT TIME 1** The day on which the last fault occurred. Either as: • A date – if real time clock is operating. • The number of days after power on – if real time clock is not used, or was not set.
0403	**FAULT TIME 2** The time at which the last fault occurred. Either as: • Real time, in format hh:mm:ss – if real time clock is operating. • The time since power on (less the whole days reported in 0402), in format hh:mm:ss – if real time clock is not used, or was not set.
0404	**SPEED AT FLT** The motor speed (rpm) at the time the last fault occurred.
0405	**FREQ AT FLT** The frequency (Hz) at the time the last fault occurred.
0406	**VOLTAGE AT FLT** The DC bus voltage (V) at the time the last fault occurred.
0407	**CURRENT AT FLT** The motor current (A) at the time the last fault occurred.
0408	**TORQUE AT FLT** The motor torque (%) at the time the last fault occurred.
0409	**STATUS AT FLT** The drive status (hex code word) at the time the last fault occurred.
0410	**DI1-3 AT FLT** The status of digital inputs 1…3 at the time the last fault occurred.
0411	**DI4-6 AT FLT** The status of digital inputs 4…6 at the time the last fault occurred.
0412	**PREVIOUS FAULT 1** Fault code of the second last fault. Read-only.
0413	**PREVIOUS FAULT 2** Fault code of the third last fault. Read-only.

Group 10: Start/Stop/Dir

This group:

- Defines external sources (EXT1, and EXT2) for commands that enable start, stop and direction changes.
- Locks direction or enables direction control.

To select between the two external locations use the next group (parameter 1102).

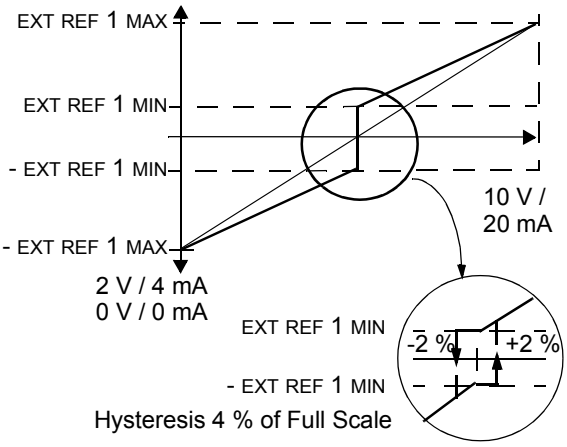
Code	Description
1001	**EXT1 COMMANDS** Defines external control location 1 (EXT1) – the configuration of start, stop and direction commands. 0 = NOT SEL – No external start, stop and direction command source. 1 = DI1 – Two-wire Start/Stop. • Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop). • Parameter 1003 defines the direction. Selecting 1003 = 3 (request) is the same as 1003 = 1 (fwd). 2 = DI1, 2 – Two-wire Start/Stop, Direction. • Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop). • Direction control (requires parameter 1003 = 3 (request)) is through digital input DI2 (DI2 activated = Reverse; de-activated = Forward). 3 = DI1P, 2P – Three-wire Start/Stop. • Start/Stop commands are through momentary push-buttons (the P stands for “pulse”). • Start is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI2 must be activated prior to the pulse in DI1. • Connect multiple Start push-buttons in parallel. • Stop is through a normally closed push-button connected to digital input DI2. • Connect multiple Stop push-buttons in series. • Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FWD). 4 = DI1P, 2P, 3 – Three-wire Start/Stop, Direction. • Start/Stop commands are through momentary push-buttons, as described for DI1P, 2P. • Direction control (requires parameter 1003 = 3 (REQUEST)) is through digital input DI3 (DI3 activated = Reverse; de-activated = Forward). 5 = DI1P, 2P, 3P – Start Forward, Start Reverse, and Stop. • Start and Direction commands are given simultaneously with two separate momentary push-buttons (the P stands for “pulse”). • Start Forward command is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI3 must be activated prior to the pulse in DI1. • Start Reverse command is through a normally open push-button connected to digital input DI2. In order to start the drive, the digital input DI3 must be activated during the pulse in DI2. • Connect multiple Start push-buttons in parallel. • Stop is through a normally closed push-button connected to digital input DI3. • Connect multiple Stop push-buttons in series. • Requires parameter 1003 = 3 (REQUEST). 6 = DI6 – Two-wire Start/Stop. • Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop). • Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FWD). 7 = DI6, 5 – Two-wire Start/Stop/Direction. • Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop). • Direction control (requires parameter 1003 = 3 (REQUEST)) is through digital input DI5. (DI5 activated = Reverse; de-activated = Forward). 8 = KEYPAD – Control Panel. • Start/Stop and Direction commands are through the control panel when EXT1 is active. • Direction control requires parameter 1003 = 3 (REQUEST). 9 = DI1F, 2R – Start/Stop/Direction commands through DI1 and DI2 combinations. • Start forward = DI1 activated and DI2 de-activated. • Start reverse = DI1 de-activated and DI2 activated. • Stop = both DI1 and DI2 activated, or both de-activated. • Requires parameter 1003 = 3 (REQUEST). 10 = COMM – Assigns the fieldbus Command Word as the source for the start/stop and direction commands. • Bits 0,1, 2 of Command Word 1 (parameter 0301) activates the start/stop and direction commands. • See Fieldbus user’s manual for detailed instructions.

Code	Description
	11 = TIMER FUNCTION 1. – Assigns Start/Stop control to Timer Function 1 (Timer Function activated = START; Timer Function de-activated = STOP). See Group 36, Timer Functions. 12…14 = TIMER FUNCTION 2... 4 – Assigns Start/Stop control to Timer Function 2…4. See Timer Function 1 above.
1002	**EXT2 COMMANDS** Defines external control location 2 (EXT2) – the configuration of start, stop and direction commands. • See parameter 1001 EXT1 COMMANDS above.
1003	**DIRECTION** Defines the control of motor rotation direction. 1 = FORWARD – Rotation is fixed in the forward direction. 2 = REVERSE – Rotation is fixed in the reverse direction. 3 = REQUEST – Rotation direction can be changed on command.

Group 11: Reference Select

This group defines:

- How the drive selects between command sources.
- Characteristics and sources for REF1 and REF2.

Code	Description
1101	**KEYPAD REF SEL** Selects the reference controlled in local control mode. 1 = REF1 (Hz/rpm) – Reference type depends on parameter 9904 MOTOR CTRL MODE. • Speed reference (rpm) if 9904 = 1 (VECTOR: SPEED) or 2 (VECTOR: TORQ). • Frequency reference (Hz) if 9904 = 3 (SCALAR: SPEED). 2 = REF2 (%)
1102	**EXT1/EXT2 SEL** Defines the source for selecting between the two external control locations EXT1 or EXT2. Thus, defines the source for Start/Stop/Direction commands and reference signals. 0 = EXT1 – Selects external control location 1 (EXT1). • See parameter 1001 EXT1 COMMANDS for EXT1's Start/Stop/Dir definitions. • See parameter 1103 REF1 SELECT for EXT1's reference definitions. 1 = DI1 – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT2; DI1 de-activated = EXT1). 2...6 = DI2...DI6 – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1 above. 7 = EXT2 – Selects external control location 2 (EXT2). • See parameter 1002 EXT2 COMMANDS for EXT2's Start/Stop/Dir definitions. • See parameter 1106 REF2 SELECT for EXT2's reference definitions. 8 = COMM – Assigns control of the drive via external control location EXT1 or EXT2 based on the fieldbus control word. • Bit 5 of the Command Word 1 (parameter 0301) defines the active external control location (EXT1 or EXT2). • See Fieldbus user's manual for detailed instructions. 9 = TIMER FUNCTION 1 – Assigns control to EXT1 or EXT2 based on the state of the Timer Function (Timer Function activated = EXT2; Timer Function de-activated = EXT1). See Group 36, Timer Functions. 10…12 = TIMER FUNCTION 2... 4 – Assigns control to EXT1 or EXT2 based on the state of the Timer Function. See Timer Function 1 above. -1 = DI1(INV) – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT1; DI1 de-activated = EXT2). -2...-6 = DI2(INV)...DI6(INV) – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1(INV) above.
1103	**REF1 SELECT** Selects the signal source for external reference REF1. 0 = KEYPAD – Defines the control panel as the reference source. 1 = AI1 – Defines analog input 1 (AI1) as the reference source. 2 = AI2 – Defines analog input 2 (AI2) as the reference source. 3 = AI1/JOYST – Defines analog input 1 (AI1), configured for joystick operation, as the reference source. • The minimum input signal runs the drive at the maximum reference in the reverse direction. Define the minimum using parameter 1104. • The maximum input signal runs the drive at maximum reference in the forward direction. Define the maximum using parameter 1105. • Requires parameter 1003=3 (request).  **Warning! Because the low end of the reference range commands full reverse operation, do not use 0 V as the lower end of the reference range. Doing so means that if the control signal is lost (which is a 0 V input) the result is full reverse operation. Instead, use the following set-up so that loss of the analog input triggers a fault, stopping the drive:** • Set parameter 1301 MINIMUM AI1 (1304 MINIMUM AI2) at 20% (2 V or 4 mA). • Set parameter 3021 AI1 FAULT LIMIT to a value 5% or higher. • Set parameter 3001 AI<MIN FUNCTION to 1 (FAULT). 4 = AI2/JOYST – Defines analog input 2 (AI2), configured for joystick operation, as the reference source. • See above (AI2/JOYST) description.

5 = DI3U,4D(R) – Defines digital inputs as the speed reference source (motor potentiometer control).
- Digital input DI3 increases the speed (the U stands for “up”).
- Digital input DI4 decreases the speed (the D stands for “down”).
- A Stop command resets the reference to zero (the R stands for “reset”).
- Parameter 2205 ACCELER TIME 2 controls the reference signal’s rate of change.

6 = DI3U,4D – Same as above (DI3U,4D(R)), except:
- A Stop command does not reset the reference to zero. The reference is stored.
- When the drive restarts, the motor ramps up (at the selected acceleration rate) to the stored reference.

7 = DI5U,6D – Same as above (DI3U,4D), except that DI5 and DI6 are the digital inputs used.
8 = COMM – Defines the fieldbus as the reference source.
9 = COMM+AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.
10 = COMM*AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.
11 = DI3U, 4D(RNC) – Same as DI3U,4D(R) above, except that:
- Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.

12 = DI3U,4D(NC) – Same as DI3U,4D above, except that:
- Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.

13 = DI5U,6D(NC) – Same as DI5U,6D above, except that:
- Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.

14 = AI1+AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
15 = AI1*AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
16 = AI1-AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
17 = AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.

Analog Input Reference Correction

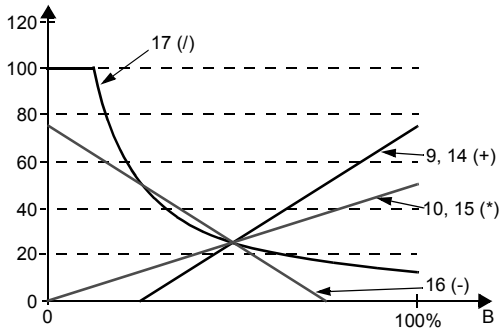
Parameter values 9, 10, and 14…17 use the formula in the following table.

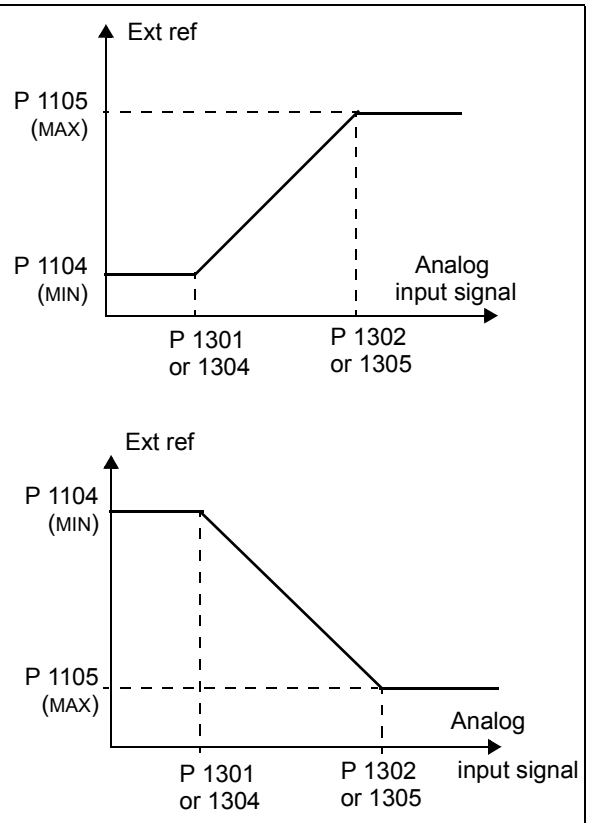
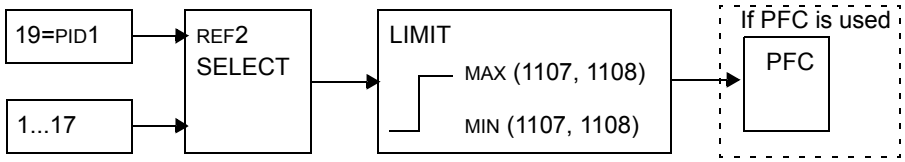
Value Setting	AI reference is calculated as following:
C + B	C value + (B value - 50% of reference value)
C * B	C value * (B value / 50% of reference value)
C - B	(C value + 50% of reference value) - B value
C / B	(C value * 50% of reference value) / B value

Where:
- C = Main Reference value
  (= COMM for values 9, 10 and
  = AI1 for values 14…17).
- B = Correcting reference
  (= AI1 for values 9, 10 and
  = AI2 for values 14…17).

Example:

The figure shows the reference source curves for value settings 9, 10, and 14…17, where:
- C = 25%.
- P 4012 SETPOINT MIN = 0.
- P 4013 SETPOINT MAX = 0.
- B varies along the horizontal axis.



1104	**REF1 MIN** Sets the minimum for external reference 1. • The minimum analog input signal (as a percent of the full signal in volts or amps) corresponds to REF1 MIN in Hz/rpm. • Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal. • These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference.	
1105	**REF1 MAX** Sets the maximum for external reference 1. • The maximum analog input signal (as a percent of full the signal in volts or amps) corresponds to REF1 MAX in Hz/rpm. • Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal.	
1106	**REF2 SELECT** Selects the signal source for external reference REF2. 0...17 – Same as for parameter 1103 REF1 SELECT. 19 = PID1OUT – The reference is taken from the PID1 output. See Groups 40 and 41. 	
1107	**REF2 MIN** Sets the minimum for external reference 2. • The minimum analog input signal (in volts or amps) corresponds to REF2 MIN in %. • Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal. • This parameter sets the minimum frequency reference. • The value is a percentage of the: - maximum frequency or speed. - maximum process reference - nominal torque	
1108	**REF2 MAX** Sets the maximum for external reference 2. • The maximum analog input signal (in volts or amps) corresponds to REF2 MAX in Hz. • Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal. • This parameter sets the maximum frequency reference. • The value is a percentage of the: - maximum frequency or speed - maximum process reference - nominal torque	

Group 12: Constant Speeds

This group defines a set of constant speeds. In general:

- You can program up to 7 constant speeds, ranging from 0...500 Hz or 0...30000 rpm.
- Values must be positive (No negative speed values for constant speeds).
- Constant speed selections are ignored if:
  - the torque control is active, or
  - the process PID reference is followed, or
  - the drive is in local control mode, or
  - PFC (Pump-Fan Control) is active.

Note! Parameter 1208 CONST SPEED 7 acts also as a so-called fault speed which may be activated if the control signal is lost. Refer to parameter 3001 AI<MIN FUNCTION and parameter 3002 PANEL COMM ERROR.

Code	Description
1201	**CONST SPEED SEL** Defines the digital inputs used to select Constant Speeds. See general comments in introduction. 0 = NOT SEL – Disables the constant speed function. 1 = DI1 – Selects Constant Speed 1 with digital input DI1. • Digital input activated = Constant Speed 1 activated. 2...6 = DI2...DI6 – Selects Constant Speed 1 with digital input DI2…DI6. See above. 7 = DI1,2 – Selects one of three Constant Speeds (1…3) using DI1 and DI2. • Uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):

DI1	DI2	Function
0	0	No constant speed
1	0	Constant speed 1 (1202)
0	1	Constant speed 2 (1203)
1	1	Constant speed 3 (1204)

• Can be set up as a so-called fault speed, which is activated if the control signal is lost. Refer to parameter 3001 AI<MIN function and parameter 3002 PANEL COMM ERR.

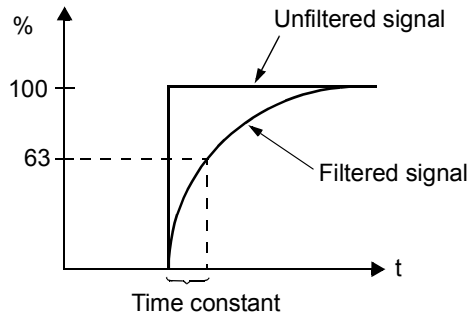
8 = DI2,3 – Selects one of three Constant Speeds (1…3) using DI2 and DI3.
• See above (DI1,2) for code.
9 = DI3,4 – Selects one of three Constant Speeds (1…3) using DI3 and DI4.
• See above (DI1,2) for code.
10 = DI4,5 – Selects one of three Constant Speeds (1…3) using DI4 and DI5.
• See above (DI1,2) for code.
11 = DI5,6 – Selects one of three Constant Speeds (1…3) using DI5 and DI6.
• See above (DI1,2) for code.
12 = DI1,2,3 – Selects one of seven Constant Speeds (1…7) using DI1, DI2 and DI3.
• Uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):

DI1	DI2	DI3	Function
0	0	0	No constant speed
1	0	0	Constant speed 1 (1202)
0	1	0	Constant speed 2 (1203)
1	1	0	Constant speed 3 (1204)
0	0	1	Constant speed 4 (1205)
1	0	1	Constant speed 5 (1206)
0	1	1	Constant speed 6 (1207)
1	1	1	Constant speed 7 (1208)

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>
13 = DI3,4,5 – Selects one of seven Constant Speeds (1…7) using DI3, DI4 and DI5.
• See above (DI1,2,3) for code.
14 = DI4,5,6 – Selects one of seven Constant Speeds (1…7) using DI5, DI6 and DI7.
• See above (DI1,2,3) for code.
15…18 = TIMER FUNCTION 1…4 – Selects Constant speed 1 when Timer Function is active. See Group 36, Timer Functions.
-1 = DI1(INV) – Selects Constant Speed 1 with digital input DI1.
• Inverse operation: Digital input de-activated = Constant Speed 1 activated.
-2...- 6 = DI2(INV)...DI6(INV) – Selects Constant Speed 1 with digital input. See above.
-7 = DI1,2(INV) – Selects one of three Constant Speeds (1…3) using DI1 and DI2.
• Inverse operation uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):
<table>
<tr><th>DI1</th><th>DI2</th><th>Function</th></tr>
<tr><td>1</td><td>1</td><td>No constant speed</td></tr>
<tr><td>0</td><td>1</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>1</td><td>0</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>0</td><td>0</td><td>Constant speed 3 (1204)</td></tr>
</table>
-8 = DI2,3(INV) – Selects one of three Constant Speeds (1…3) using DI2 and DI2.
• See above (DI1,2(INV)) for code.
-9 = DI3,4(INV) – Selects one of three Constant Speeds (1…3) using DI3 and DI4.
• See above (DI1,2(INV)) for code.
-10 = DI4,5(INV) – Selects one of three Constant Speeds (1…3) using DI4 and DI5.
• See above (DI1,2(INV)) for code.
-11 = DI5,6(INV) – Selects one of three Constant Speeds (1…3) using DI5 and DI6.
• See above (DI1,2(INV)) for code.
-12 = DI1,2,3(INV) – Selects one of seven Constant Speeds (1…7) using DI1, DI2 and DI3.
• Inverse operation uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):
<table>
<tr><th>DI1</th><th>DI2</th><th>DI3</th><th>Function</th></tr>
<tr><td>1</td><td>1</td><td>1</td><td>No constant speed</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Constant speed 3 (1204)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Constant speed 4 (1205)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Constant speed 5 (1206)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Constant speed 6 (1207)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Constant speed 7 (1208)</td></tr>
</table>
-13 = DI3,4,5(INV) – Selects one of seven Constant Speeds (1…7) using DI3, DI4 and DI5.
• See above (DI1,2,3(INV)) for code.
-14 = DI4,5,6(INV) – Selects one of seven Constant Speeds (1…7) using DI4, DI5 and DI6.
• See above (DI1,2,3(INV)) for code.
</td></tr>
<tr><td>1202</td><td>
CONST SPEED 1
Sets value for Constant Speed 1.
• The range and units depend on parameter 9904 MOTOR CTRL MODE.
• Range: 0…30000 rpm when 9904 = 1 (VECTOR: SPEED) or 2 (VECTOR: TORQ).
• Range: 0…500 Hz when 9904 = 3 (SCALAR: SPEED).
</td></tr>
<tr><td>1203
…
1208</td><td>
CONST SPEED 2…CONST SPEED 7
Each sets a value for a Constant Speed. See CONST SPEED 1 above.
</td></tr>
<tr><td>1209</td><td>
TIMED MODE SEL
Defines timer activated, constant speed mode. Timer can be used to activate constant speed 1 or to change between 2 selectable speeds: constant speed 1 and 2.
</td></tr>
</table>

Group 13: Analog Inputs

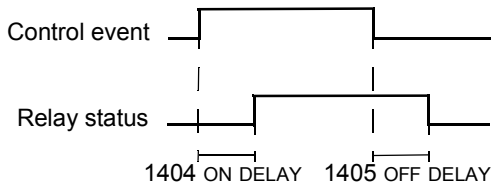
This group defines the limits and the filtering for analog inputs.

Code	Description
1301	**MINIMUM AI1** Defines the minimum value of the analog input. • Define value as a percent of the full analog signal range. See example below. • The minimum analog input signal corresponds to 1104 REF1 MIN or 1107 REF2 MIN. • MINIMUM AI cannot be greater than MAXIMUM AI. • These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference. • See figure at parameter 1104. **Example.** To set the minimum analog input value to 4 mA: • Configure the analog input for 0…20 mA current signal. • Calculate the minimum (4 mA) as a percent of full range (20 mA) = 4 mA / 20 mA * 100% = 20%
1302	**MAXIMUM AI1** Defines the maximum value of the analog input. • Define value as a percent of the full analog signal range. • The maximum analog input signal corresponds to 1105 REF1 MAX or 1108 REF2 MAX. • See figure at parameter 1104.
1303	**FILTER AI1** Defines the filter time constant for analog input 1 (AI1). • The filtered signal reaches 63% of a step change within the time specified. 
1304	**MINIMUM AI2** Defines the minimum value of the analog input. • See MINIMUM AI1 above.
1305	**MAXIMUM AI2** Defines the maximum value of the analog input. • See MAXIMUM AI1 above.
1306	**FILTER AI2** Defines the filter time constant for analog input 2 (AI2). • See FILTER AI1 above.

Group 14: Relay Outputs

This group defines the condition that activates each of the relay outputs.

Code	Description
1401	**RELAY OUTPUT 1** Defines the event or condition that activates relay 1 – what relay output 1 means. 0 = NOT SEL – Relay is not used and is de-energized. 1 = READY – Energize relay when drive is ready to function. Requires: • Run enable signal present. • No faults exist. • Supply voltage is within range. • Emergency Stop command is not on. 2 = RUN – Energize relay when the drive is running. 3 = FAULT (-1) – Energize relay when power is applied. De-energizes when a fault occurs. 4 = FAULT – Energize relay when a fault is active. 5 = ALARM – Energize relay when an alarm is active. 6 = REVERSED – Energize relay when motor rotates in reverse direction. 7 = STARTED – Energize relay when drive receives a start command (even if Run Enable signal is not present). De-energized relay when drive receives a stop command or a fault occurs. 8= SUPRV1 OVER – Energize relay when first supervised parameter (3201) exceeds the limit (3203). • See *Group 32: Supervision* starting on page *112*. 9 = SUPRV1 UNDER – Energize relay when first supervised parameter (3201) drops below the limit (3202). • See *Group 32: Supervision* starting on page *112*. 10 = SUPRV2 OVER – Energize relay when second supervised parameter (3204) exceeds the limit (3206). • See Group 32: Supervision starting on page *112*. 11 = SUPRV2 UNDER – Energize relay when second supervised parameter (3204) drops below the limit (3205). • See *Group 32: Supervision* starting on page *112*. 12 = SUPRV3 OVER – Energize relay when second supervised parameter (3207) exceeds the limit (3209). • See *Group 32: Supervision* starting on page *112*. 13 = SUPRV3 UNDER – Energize relay when second supervised parameter (3207) drops below the limit (3208). • See *Group 32: Supervision* starting on page *112*. 14 = AT SET POINT – Energize relay when the output frequency is equal to the reference frequency. 15 = FAULT (RST) – Energize relay when the drive is in a fault condition and will reset after the programmed auto-reset delay. • See parameter 3103 delay time. 16 = FLT/ALARM – Energize relay when fault or alarm occurs. 17 = EXT CTRL – Energize relay when external control is selected. 18 = REF 2 SEL – Energize relay when EXT2 is selected. 19 = CONST FREQ – Energize relay when a constant speed is selected. 20 = REF LOSS – Energize relay when reference or active control place is lost. 21 = OVERCURRENT – Energize relay when an overcurrent alarm or fault occurs. 22 = OVERVOLTAGE – Energize relay when an overvoltage alarm or fault occurs. 23 = DRIVE TEMP – Energize relay when a drive overtemperature alarm or fault occurs. 24 = UNDERVOLTAGE – Energize relay when an undervoltage alarm or fault occurs. 25 = AI1 LOSS – Energize relay when AI1 signal is lost. 26 = AI2 LOSS – Energize relay when AI2 signal is lost. 27 = MOTOR TEMP – Energize relay when a motor overtemperature alarm or fault occurs. 28 = STALL – Energize relay when a stall alarm or fault exists. 29 = UNDERLOAD – Energize relay when an underload alarm or fault occurs. 30 = PID SLEEP – Energize relay when the PID sleep function is active. 31 = PFC – Use relay to start/stop motor in PFC control (See Group 81: PFC Control). • Use this option only when PFC control is used. • Selection activated / deactivated when drive is not running. 32 = AUTOCHANGE – Energize relay when PFC autochange operation is performed. • Use this option only when PFC control is used. 33 = FLUX READY – Energize relay when the motor is magnetized and able to supply nominal torque (motor has reached nominal magnetizing). 34 = USER S2 – Energize relay when User Parameter Set 2 is active.

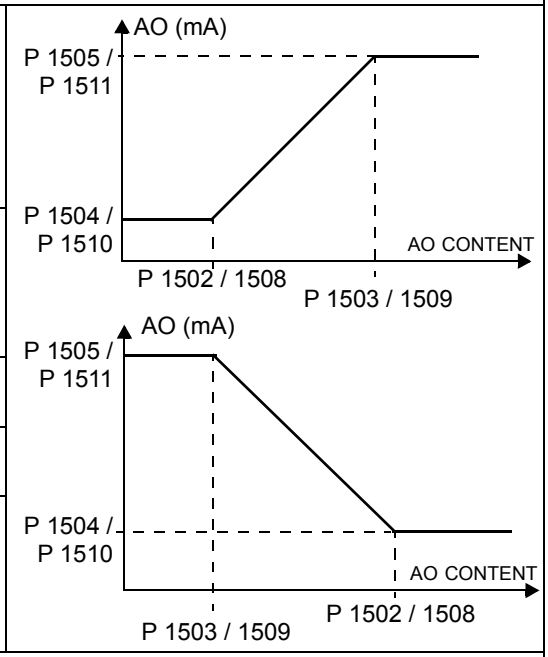
<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>35 = COMM – Energize relay based on input from fieldbus communication.
• Fieldbus writes binary code in parameter 0134 that can energizes relay 1…relay 6 according to the following:
<table>
<tr><th>Par. 0134</th><th>Binary</th><th>RO6</th><th>RO5</th><th>RO4</th><th>RO3</th><th>RO2</th><th>RO1</th></tr>
<tr><td>0</td><td>000000</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>000001</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>000010</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>3</td><td>000011</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>4</td><td>000100</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>5...62</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td>63</td><td>111111</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
• 0 = De-energize relay, 1 = Energize relay.
36 = COMM(-1) – Energize relay based on input from fieldbus communication.
• Fieldbus writes binary code in parameter 0134 that can energizes relay 1…relay 6 according to the following:
<table>
<tr><th>Par. 0134</th><th>Binary</th><th>RO6</th><th>RO5</th><th>RO4</th><th>RO3</th><th>RO2</th><th>RO1</th></tr>
<tr><td>0</td><td>000000</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>000001</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>2</td><td>000010</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>3</td><td>000011</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>000100</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>5...62</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr>
<tr><td>63</td><td>111111</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
• 0 = De-energize relay, 1 = Energize relay.
37 = TIMER FUNCTION 1 – Energize relay when Timer Function 1 is active. See Group 36, Timer Functions.
38…40 = TIMER FUNCTION 2…4 – Energize relay when Timer Function 2…4 is active. See Timer Function 1 above.</td></tr>
<tr><td>1402</td><td>RELAY OUTPUT 2
Defines the event or condition that activates relay 2 – what relay output 2 means.
• See 1401 RELAY OUTPUT 1.</td></tr>
<tr><td>1403</td><td>RELAY OUTPUT 3
Defines the event or condition that activates relay 3 – what relay output 3 means.
• See 1401 RELAY OUTPUT 1.</td></tr>
<tr><td>1404</td><td>RO 1 ON DELAY
Defines the switch-on delay for relay 1.
• On / off delays are ignored when relay output 1401 is set to PFC.</td><td rowspan="2"> 
</td></tr>
<tr><td>1405</td><td>RO 1 OFF DELAY
Defines the switch-off delay for relay 1.
• On / off delays are ignored when relay output 1401 is set to PFC.</td></tr>
<tr><td>1406</td><td>RO 2 ON DELAY
Defines the switch-on delay for relay 2.
• See RO 1 ON DELAY.</td></tr>
<tr><td>1407</td><td>RO 2 OFF DELAY
Defines the switch-off delay for relay 2.
• See RO 1 OFF DELAY.</td></tr>
<tr><td>1408</td><td>RO 3 ON DELAY
Defines the switch-on delay for relay 3.
• See RO 1 ON DELAY.</td></tr>
<tr><td>1409</td><td>RO 3 OFF DELAY
Switch-off delay for relay 3.
• See RO 1 OFF DELAY.</td></tr>
<tr><td>1410
…
1412</td><td>RELAY OUTPUT 4…6
Defines the event or condition that activates relay 4…6 – what relay output 4…6 means.
• See 1401 RELAY OUTPUT 1.</td></tr>
</table>

Code	Description
1413	**RO 4 ON DELAY** Defines the switch-on delay for relay 4. • See RO 1 ON DELAY.
1414	**RO 4 OFF DELAY** Defines the switch-off delay for relay 4. • See RO 1 OFF DELAY.
1415	**RO 5 ON DELAY** Defines the switch-on delay for relay 5. • See RO 1 ON DELAY.
1416	**RO 5 OFF DELAY** Defines the switch-off delay for relay 5. • See RO 1 OFF DELAY.
1417	**RO 6 ON DELAY** Defines the switch-on delay for relay 6. • See RO 1 ON DELAY.
1418	**RO 6 OFF DELAY** Defines the switch-off delay for relay 6. • See RO 1 OFF DELAY.

Group 15: Analog Outputs

This group defines the drive's analog (current signal) outputs. The drive's analog outputs can be:

- Any parameter of the Operating Data group (Group 01).
- Limited to programmable minimum and maximum values of output current.
- Scaled (and/or inverted) by defining the minimum and maximum values of the source parameter (or content). Defining an maximum value (parameter 1503 or 1509) that is less than the content minimum value (parameter 1502 or 1508) results in an inverted output.
- Filtered.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>1501</td><td colspan="2">AO1 CONTENT
Defines the content for analog output AO1.
99 = EXCITE PTC – Provides a current source for sensor type PTC. Output = 1.6 mA. See Group 35.
100 = EXCITE PT100 – Provides a current source for sensor type Pt100. Output = 9.1 mA. See Group 35.
101...145 – Output corresponds to a parameter in the Operating Data group (Group 01).
• Parameter defined by value (value 102 = parameter 0102)</td></tr>
<tr><td>1502</td><td>AO1 CONTENT MIN
Sets the minimum content value.
• Content is the parameter selected by parameter 1501.
• Minimum value refers to the minimum content value that will be converted to an analog output.
• These parameters (content and current min. and max. settings) provide scale and offset adjustment for the output. See figure.</td><td rowspan="5"> 
</td></tr>
<tr><td>1503</td><td>AO1 CONTENT MAX
Sets the maximum content value
• Content is the parameter selected by parameter 1501.
• Maximum value refers to the maximum content value that will be converted to an analog output.</td></tr>
<tr><td>1504</td><td>MINIMUM AO1
Sets the minimum output current.</td></tr>
<tr><td>1505</td><td>MAXIMUM AO1
Sets the maximum output current.</td></tr>
<tr><td>1506</td><td>FILTER AO1
Defines the filter time constant for AO1.
• The filtered signal reaches 63% of a step change within the time specified.
• See figure in parameter 1303.</td></tr>
<tr><td>1507</td><td colspan="2">AO2 CONTENT
Defines the content for analog output AO2. See AO1 CONTENT above.</td></tr>
<tr><td>1508</td><td colspan="2">AO2 CONTENT MIN
Sets the minimum content value. See AO1 CONTENT MIN above.</td></tr>
<tr><td>1509</td><td colspan="2">AO2 CONTENT MAX
Sets the maximum content value. See AO1 CONTENT MAX above.</td></tr>
<tr><td>1510</td><td colspan="2">MINIMUM AO2
Sets the minimum output current. See MINIMUM AO1 above.</td></tr>
<tr><td>1511</td><td colspan="2">MAXIMUM AO2
Sets the maximum output current. See MAXIMUM AO1 above.</td></tr>
<tr><td>1512</td><td colspan="2">FILTER AO2
Defines the filter time constant for AO2. See FILTER AO1 above.</td></tr>
</table>

Group 16: System Controls

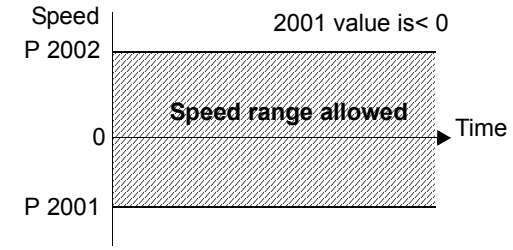
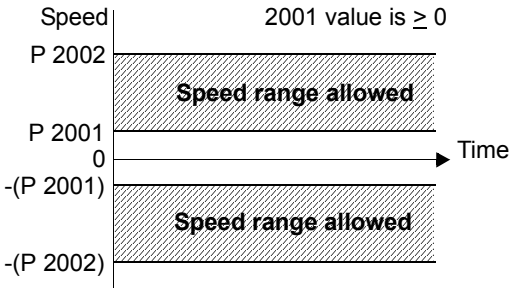
This group defines a variety of system level locks, resets and enables.

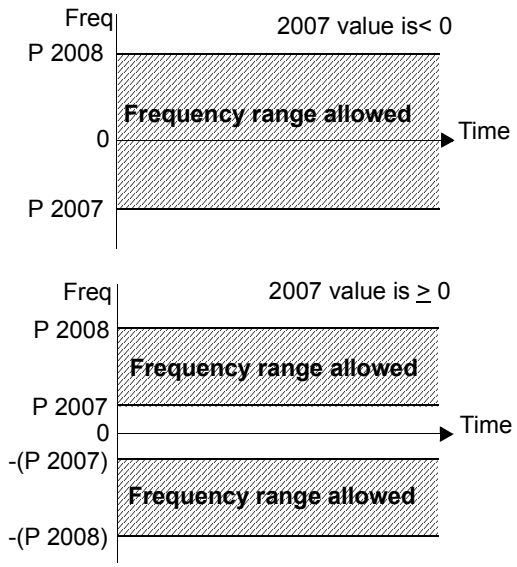
Code	Description
1601	**RUN ENABLE** Selects the source of the run enable signal. 0 = NOT SEL – Allows the drive to start without an external run enable signal. 1 = DI1 – Defines digital input DI1 as the run enable signal. • This digital input must be activated for run enable. • If the voltage drops and de-activates this digital input, the drive will coast to stop and not start until the run enable signal resumes. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the run enable signal. • See DI1 above. 7 = COMM – Assigns the fieldbus Command Word as the source for the run enable signal. • Bit 6 of the Command Word 1 (parameter 0301) activates the run disable signal. • See fieldbus user's manual for detailed instructions. -1 = DI1(INV) – Defines an inverted digital input DI1 as the run enable signal. • This digital input must be de-activated for run enable. • If this digital input activates, the drive will coast to stop and not start until the run enable signal resumes. -2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the run enable signal. • See DI1(INV) above.
1602	**PARAMETER LOCK** Determines if the control panel can change parameter values. • This lock does not limit parameter changes made by macros. • This lock does not limit parameter changes written by fieldbus inputs. 0 = LOCKED – You cannot use the control panel to change parameter values. • The lock can be opened by entering the valid pass code to parameter 1603. 1 = OPEN – You can use the control panel to change parameter values. 2 = NOT SAVED – You can use the control panel to change parameter values, but they are not stored in permanent memory. • Set parameter 1607 PARAM SAVE to 1 (SAVE) to store changed parameter values to memory.
1603	**PASS CODE** Entering the correct pass code unlocks the parameter lock. • See parameter 1602 above. • The code 358 opens the lock. • This entry reverts back to 0 automatically.
1604	**FAULT RESET SEL** Selects the source for the fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 0 = KEYPAD – Defines the control panel as the only fault reset source. • Fault reset is always possible with control panel. 1 = DI1 – Defines digital input DI1 as a fault reset source. • Activating the digital input resets the drive. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as a fault reset source. • See DI1 above. 7 = START/STOP – Defines the Stop command as a fault reset source. • Do not use this option when fielbus communication provides the start, stop and direction commands. 8 = COMM – Defines the fieldbus as a fault reset source. • The Command Word is supplied through fieldbus communication. • The bit 4 of the Command Word 1 (parameter 0301) resets the drive. -1 = DI1(INV) – Defines an inverted digital input DI1 as a fault reset source. • De-activating the digital input resets the drive. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as a fault reset source. • See DI1(INV) above.

Code	Description
1605	**USER PAR SET CHG** Defines control for changing the user parameter set. • See parameter 9902 (APPLIC MACRO). • The drive must be stopped to change User Parameter Sets. • During a change, the drive will not start. **Note:** Always save the User Parameter Set after changing any parameter settings, or performing a motor identification. • Whenever the power is cycled, or parameter 9902 (APPLIC MACRO) is changed, the drive loads the last settings saved. Any unsaved changes to a user parameter set are lost. **Note:** The value of this parameter (1605) is not included in the User Parameter Sets, and does not change if User Parameter Sets change. **Note:** You can use a relay output to supervise the selection of User Parameter Set 2. • See parameter 1401. 0 = NOT SEL – Defines the control panel (using parameter 9902) as the only control for changing User Parameter Sets. 1 = DI1 – Defines digital input DI1 as a control for changing User Parameter Sets. • The drive loads User Parameter Set 1 on the falling edge of the digital input. • The drive loads User Parameter Set 2 on the rising edge of the digital input. • The User Parameter Set changes only when the drive is stopped. 2…6 = DI2…DI6 – Defines digital input DI2…DI6 as a control for changing User Parameter Sets. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as a control for changing User Parameter Sets. • The drive loads User Parameter Set 1 on the rising edge of the digital input. • The drive loads User Parameter Set 2 on the falling edge of the digital input. • The User Parameter Set changes only when the drive is stopped. -2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as a control for changing User Parameter Sets. • See DI1(INV) above.
1606	**LOCAL LOCK** Defines control for the use of the LOC mode. The LOC mode allows drive control from the control panel. • When LOCAL LOCK is active, the control panel cannot change to LOC mode. 0 = NOT SEL – Disables the lock. The control panel can select LOC and control the drive. 1 = DI1 – Defines digital input DI1 as the control for setting the local lock. • Activating the digital input locks out local control. • De-activating the digital input enable the LOC selection. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for setting the local lock. • See DI1 above. 7 = ON – Sets the lock. The control panel cannot select LOC, and cannot control the drive. 8 = COMM – Defines bit 14 of the Command Word 1 as the control for setting the local lock. • The Command Word is supplied through fieldbus communication. • The Command Word is 0301. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for setting the local lock. • De-activating the digital input locks out local control. • Activating the digital input enable the LOC selection. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for setting the local lock. • See DI1(INV) above.
1607	**PARAM. SAVE** Saves all altered parameters to permanent memory. • Parameters altered through a fieldbus are not automatically saved to permanent memory. To save, you must use this parameter. • If 1602 PARAMETER LOCK = 2 (NOT SAVED), parameters altered from the control panel are not saved. To save, you must use this parameter. • If 1602 PARAMETER LOCK = 1 (OPEN), parameters altered from the control panel are stored immediately to permanent memory. 0 = DONE – Value changes automatically when all parameters are saved. 1 = SAVE – Saves altered parameters to permanent memory.

Group 20: Limits

This group defines minimum and maximum limits to follow in driving the motor – speed, frequency, current, torque, etc.

Code	Description
2001	**MINIMUM SPEED** Defines the minimum speed (rpm) allowed. • A positive (or zero) minimum speed value defines two ranges, one positive and one negative. • A negative minimum speed value defines one speed range. • See figure. 
2002	**MAXIMUM SPEED** Defines the maximum speed (rpm) allowed. 
2003	**MAX CURRENT** Defines the maximum output current (A) supplied by the drive to the motor.
2005	**OVERVOLT CTRL** Sets the DC overvoltage controller on or off. • Fast braking of a high inertia load causes the DC bus voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the trip limit, the overvoltage controller automatically decreases the braking torque by increasing output frequency. 0 = DISABLE – Disables controller. 1 = ENABLE – Enables controller **Warning! If a braking chopper or a braking resistor is connected to the drive, this parameter value must be set to 0 to ensure proper operation of the chopper.**
2006	**UNDERVOLT CTRL** Sets the DC undervoltage controller on or off. When on: • If the DC bus voltage drops due to loss of input power, the undervoltage controller decreases the motor speed in order to keep the DC bus voltage above the lower limit. • When the motor speed decreases, the inertia of the load causes regeneration back into the drive, keeping the DC bus charged, and preventing an undervoltage trip. • The DC undervoltage controller increases power loss ride-through on systems with a high inertia, such as a centrifuge or a fan. 0 = DISABLE – Disables controller. 1 = ENABLE – Enables controller without a maximum time limit for operation.

Code	Description
2007	**MINIMUM FREQ** Defines the minimum limit for the drive output frequency. • A positive or zero minimum speed value defines two ranges, one positive and one negative. • A negative minimum speed value defines one speed range. See figure. **Note!** Keep MINIMUM FREQ ≤ MAXIMUM FREQ.
2008	**MAXIMUM FREQ** Defines the maximum limit for the drive output frequency.
	
2013	**MIN TORQUE SEL** Defines control of the selection between two minimum torque limits (2015 MIN TORQUE 1 and 2016 MIN TORQUE 2). 0 = MIN TORQUE 1 – Selects 2015 MIN TORQUE 1 as the minimum limit used. 1 = DI1 – Defines digital input DI1 as the control for selecting the minimum limit used. • Activating the digital input selects MIN TORQUE 2 value. • De-activating the digital input selects MIN TORQUE 1 value. 2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for selecting the minimum limit used. • See DI1 above. 7 = COMM – Defines bit 15 of the Command Word 1 as the control for selecting the minimum limit used. • The Command Word is supplied through fieldbus communication. • The Command Word is parameter 0301. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for selecting the minimum limit used. • Activating the digital input selects MIN TORQUE 1 value. • De-activating the digital input selects MIN TORQUE 2 value. -2…-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for selecting the minimum limit used. • See DI1(INV) above.
2014	**MAX TORQUE SEL** Defines control of the selection between two maximum torque limits (2017 MAX TORQUE 1 and 2018 MAX TORQUE 2). 0 = MAX TORQUE 1 – Selects 2017 MAX TORQUE 1 as the maximum limit used. 1 = DI1 – Defines digital input DI1 as the control for selecting the maximum limit used. • Activating the digital input selects MAX TORQUE 2 value. • De-activating the digital input selects MAX TORQUE 1 value. 2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for selecting the maximum limit used. • See DI1 above. 7 = COMM – Defines bit 15 of the Command Word 1 as the control for selecting the maximum limit used. • The Command Word is supplied through fieldbus communication. • The Command Word is parameter 0301. -1 = DI1(INV) – Defines an inverted digital input di1 as the control for selecting the maximum limit used. • Activating the digital input selects MAX TORQUE 1 value. • De-activating the digital input selects MAX TORQUE 2 value. -2…-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for selecting the maximum limit used. • See DI1(INV) above.
2015	**MIN TORQUE 1** Sets the first minimum limit for torque (%). Value is a percent of the motor nominal torque.
2016	**MIN TORQUE 2** Sets the second minimum limit for torque (%). Value is a percent of the motor nominal torque.

Code	Description
2017	**MAX TORQUE 1** Sets the first maximum limit for torque (%). Value is a percent of the motor nominal torque.
2018	**MAX TORQUE 2** Sets the second maximum limit for torque (%). Value is a percent of the motor nominal torque.

Group 21: Start/Stop

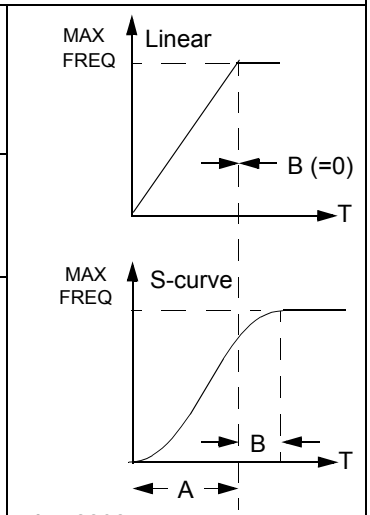
This group defines how the motor starts and stops. The ACS550 supports several start and stop modes.

Code	Description
2101	**START FUNCTION** Selects the motor start method. 1 = AUTO – Selects the automatic start mode. • Vector control modes: Optimal start in most cases. Flying start function to a rotating axis and start at zero speed. • SCALAR: SPEED mode: Immediate start from zero frequency. 2 = DC MAGN – Selects the DC Magnetizing start mode. **Note!** Mode cannot start a rotating motor. **Note!** The drive starts when the set pre-magnetizing time (param. 2103) has passed, even if motor magnetization is not complete. • Vector control modes: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time. This selection guarantees the highest possible break-away torque. • SCALAR: SPEED mode: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time. 3 = SCALAR FLYSTART – Selects the flying start mode. • Vector control modes: Not applicable. • SCALAR: SPEED mode: The drive will automatically selects the correct output frequency to start a rotating motor. Useful if the motor is already rotating and the drive will start smoothly at the current frequency. 4 = TORQ BOOST – Selects the automatic torque boost mode (SCALAR: SPEED mode only). • May be necessary in drives with high starting torque. • Torque boost is only applied at start, ending when output frequency exceeds 20 Hz or when output frequency is equal to reference. • In the beginning the motor magnetizes within the time determined by the parameter 2103 DC MAGN TIME using DC current. • See parameter 2110 TORQ BOOST CURR. 5 = FLYSTART + TORQ BOOST – Selects both the flying start and the torque boost mode (SCALAR: SPEED mode only). • Flying start routine is performed first and the motor is magnetized. If the speed is found to be zero, the torque boost is done.
2102	**STOP FUNCTION** Selects the motor stop method. 1 = COAST – Selects cutting off the motor power as the stop method. The motor coasts to stop. 2 = RAMP – Selects using a deceleration ramp • Deceleration ramp is defined by 2203 DECELER TIME 1 or 2206 DECELER TIME 2 (whichever is active).
2103	**DC MAGN TIME** Defines the pre-magnetizing time for the DC Magnetizing start mode. • Use parameter 2101 to select the start mode. • After the start command, the drive pre-magnetizes the motor for the time defined here, and then starts the motor. • Set the pre-magnetizing time just long enough to allow full motor magnetization. Too long a time heats the motor excessively.
2104	**DC CURR CTL** Selects whether DC current is used for braking. 0 = NOT SEL – Disables the DC current operation. 2 = DC BRAKING – Enables the DC Injection Braking after modulation has stopped. • If parameter 2102 STOP FUNCTION is 1 (COAST), braking is applied after start is removed. • If parameter 2102 STOP FUNCTION IS 2 (RAMP), braking is applied after ramp.
2106	**DC CURR REF** Defines the DC current control reference as a percentage of parameter 9906 (MOTOR NOM CURR).
2107	**DC BRAKE TIME** Defines the DC brake time after modulation has stopped, if parameter 2104 is 2 (DC BRAKING).

Code	Description
2108	**START INHIBIT** Sets the Start inhibit function on or off. The Start inhibit function ignores a pending start command in any of the following situations (a new start command is required): • A fault is reset. • Run Enable (parameter 1601) activates while start command is active. • Mode changes from local to remote. • Mode changes from remote to local. • Control switches from EXT1 to EXT2. • Control switches from EXT2 to EXT1. 0 = OFF – Disables the Start inhibit function. 1 = ON – Enables the Start inhibit function.
2109	**EM STOP SEL** Defines control of the Emergency stop command. When activated: • Emergency stop decelerates the motor using the emergency stop ramp (parameter 2208 EM DEC TIME). • Requires an external stop command and removal of the emergency stop command before drive can restart. 0 = NOT SEL – Disables the Emergency stop function through digital inputs. 1 = DI1 – Defines digital input DI1 as the control for Emergency stop command. • Activating the digital input issues an Emergency stop command. • De-activating the digital input removes the Emergency stop command. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for Emergency stop command. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for Emergency stop command. • De-activating the digital input issues an Emergency stop command. • Activating the digital input removes the Emergency stop command. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for Emergency stop command. • See DI1(INV) above.
2110	**TORQ BOOST CURR** Sets the maximum supplied current during torque boost. • See parameter 2101 START FUNCTION.

Group 22: Accel/Decel

This group defines ramps that control the rate of acceleration and deceleration. You define these ramps as a pair, one for acceleration and one for deceleration. You can define two pairs of ramps and use a digital input to select one or the other pair.

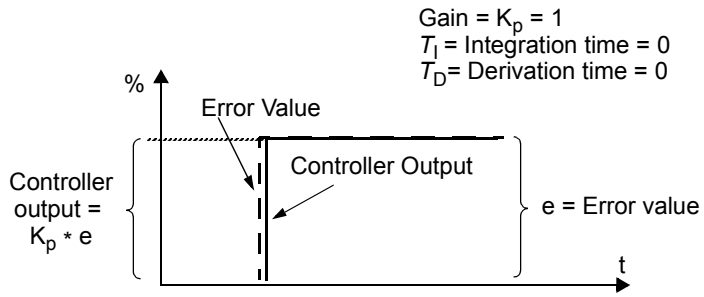
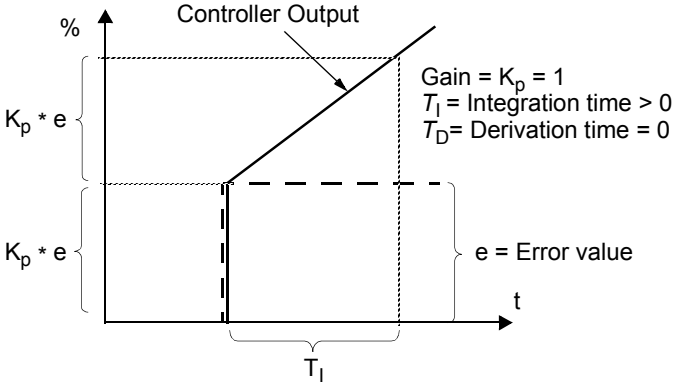
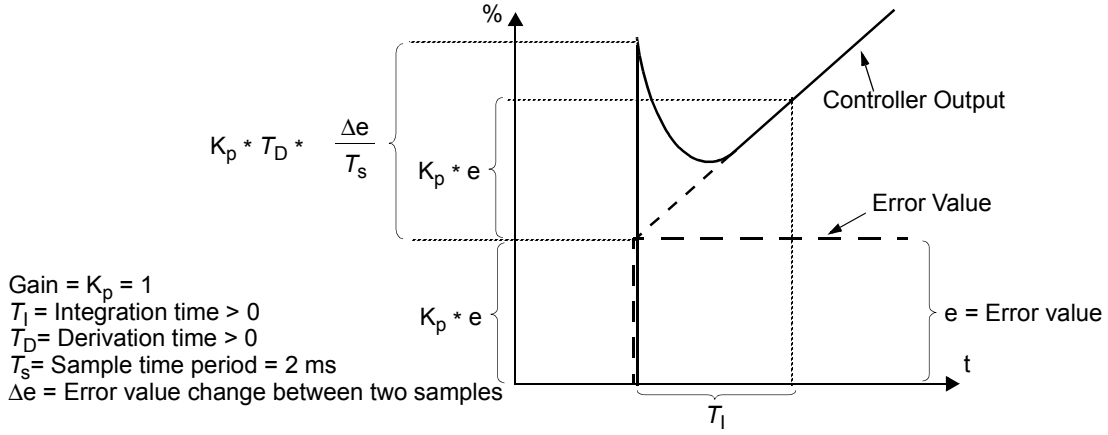
<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>2201</td><td>ACC/DEC 1/2 SEL
Defines control for selection of acceleration/deceleration ramps.
• Ramps are defined in pairs, one each for acceleration and deceleration.
• See below for the ramp definition parameters.
0 = NOT SEL – Disables selection, the first ramp pair is used.
1 = DI1 – Defines digital input DI1 as the control for ramp pair selection.
• Activating the digital input selects ramp pair 2.
• De-activating the digital input selects ramp pair 1.
2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for ramp pair selection.
• See DI1 above.
-1 = DI1(INV) – Defines an inverted digital input DI1 as the control for ramp pair selection.
• De-activating the digital input selects ramp pair 2
• Activating the digital input selects ramp pair 1.
-2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for ramp pair selection.
• See DI1(INV) above.</td></tr>
<tr><td>2202</td><td>ACCELER TIME 1
Sets the acceleration time for zero to maximum frequency for ramp pair 1. See A in figure.
• Actual acceleration time also depends on 2204 RAMP SHAPE.
• See 2008 MAXIMUM FREQUENCY.</td></tr>
<tr><td>2203</td><td>DECELER TIME 1
Sets the deceleration time for maximum frequency to zero for ramp pair 1.
• Actual deceleration time also depends on 2204 RAMP SHAPE.
• See 2008 MAXIMUM FREQUENCY.</td></tr>
<tr><td>2204</td><td>RAMP SHAPE 1
Selects the shape of the acceleration/deceleration ramp for ramp pair 1. See B in figure.
• Shape is defined as a ramp, unless additional time is specified here to reach the maximum frequency. A longer time provides a softer transition at each end of the slope. The shape becomes an s-curve.
• Rule of thumb: 1/5 is a suitable relation between the ramp shape time and the acceleration ramp time.
0.0 = LINEAR – Specifies linear acceleration/deceleration ramps for ramp pair 1.
0.1...1000.0 = S-CURVE – Specifies s-curve acceleration/deceleration ramps for ramp pair 1.</td></tr>
<tr><td colspan="2"> 

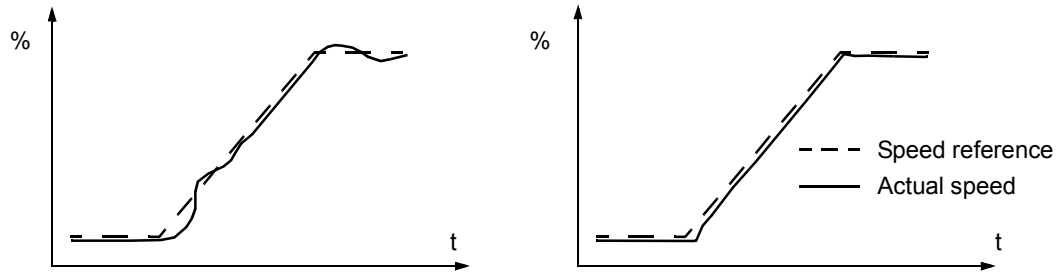
A = 2202 ACCELERATION TIME
B = 2204 RAMP SHAPE</td></tr>
<tr><td>2205</td><td>ACCELER TIME 2
Sets the acceleration time (s) for zero to maximum frequency for ramp pair 2. See 2002 ACCELER TIME 1.</td></tr>
<tr><td>2206</td><td>DECELER TIME 2
Sets the deceleration time for maximum frequency to zero for ramp pair 2. See 2003 DECELER TIME 1.</td></tr>
<tr><td>2207</td><td>RAMP SHAPE 2
Selects the shape of the acceleration/deceleration ramp for ramp pair 2. See 2004 RAMP SHAPE 1.</td></tr>
<tr><td>2208</td><td>EM DEC TIME
Sets the deceleration time for maximum frequency to zero for an emergency.
• See parameter 2109 EM STOP SEL.
• Ramp is linear.</td></tr>
</table>

Code	Description
2209	**RAMP INPUT 0** Defines control for forcing the ramp input to 0. 0 = NOT SEL – 1 = DI1 – Defines digital input DI1 as the control for forcing the ramp input to 0. • Activating the digital input forces ramp input to 0. Ramp output will ramp to 0 according to the currently used ramp time, after which it will stay at 0. • De-activating the digital input: ramp resumes normal operation. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for forcing the ramp input to 0. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for forcing the ramp input to 0. • De-activating the digital input forces ramp input to 0. • Activating the digital input: ramp resumes normal operation. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for forcing the ramp function generator input to 0. • See DI1(INV) above.

Group 23: Speed Control

This group defines variables used for speed control operation.

Code	Description
2301	**PROP GAIN** Sets the relative gain for the speed controller. • Larger values may cause speed oscillation. • The figure shows the speed controller output after an error step (error remains constant). Note! You can use parameter 2305, **AUTOTUNE RUN**, to automatically set proportional gain. 
2302	**INTEGRATION TIME** Sets the integration time for the speed controller. • The integration time defines the rate at which the controller output changes for a constant error value. • Shorter integration times correct continuous errors faster. • Control becomes unstable if the integration time is too short. • The figure shows the speed controller output after an error step (error remains constant). Note! You can use parameter 2305, **AUTOTUNE RUN**, to automatically set integration time. 
2303	**DERIVATION TIME** Sets the derivation time for the speed controller. • Derivative action makes the control more responsive to error value changes. • The longer the derivation time, the more the speed controller output is boosted during the change. • If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The figure below shows the speed controller output after an error step when the error remains constant. 

Code	Description
2304	**ACC COMPENSATION** Sets the derivation time for acceleration compensation. • Adding a derivative of the reference to the output of the speed controller compensates for inertia during acceleration. • 2303 DERIVATION TIME describes the principle of derivative action. • Rule of thumb: Set this parameter between 50 and 100% of the sum of the mechanical time constants for the motor and the driven machine. • The figure shows the speed responses when a high inertia load is accelerated along a ramp. **No Acceleration Compensation** **Acceleration Compensation** 
2305	**AUTOTUNE RUN** Starts automatic tuning of the speed controller. 0 = OFF– Disables the Autotune creation process. (Does not disable the operation of Autotune settings.) 1 = ON – Activates speed controller autotuning. Automatically reverts to OFF. Procedure: **Note!** The motor load must be connected. • Run the motor at a constant speed of 20 to 40% of the rated speed. • Change the autotuning parameter 2305 to ON. The drive: • Accelerates the motor. • Calculates values for proportional gain and integration time. • Changes parameters 2301 and 2302 to these values. • Resets 2305 to OFF.

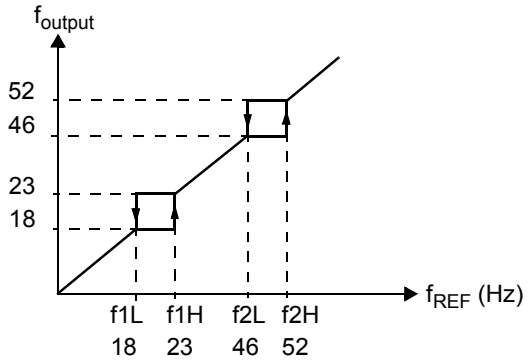
Group 24: Torque Control

This group defines variables used for torque control operation.

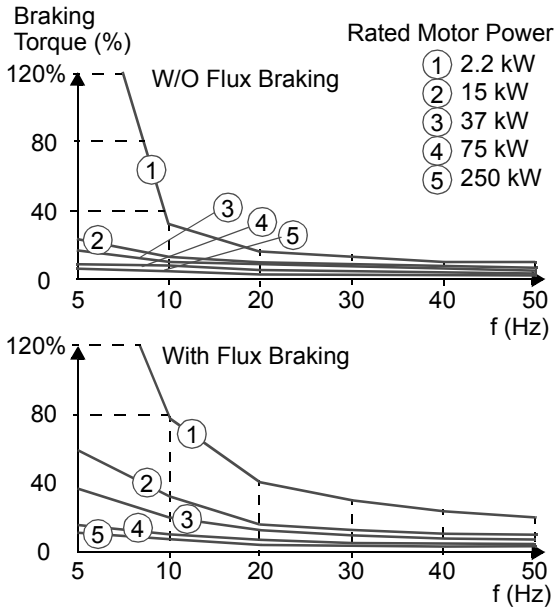
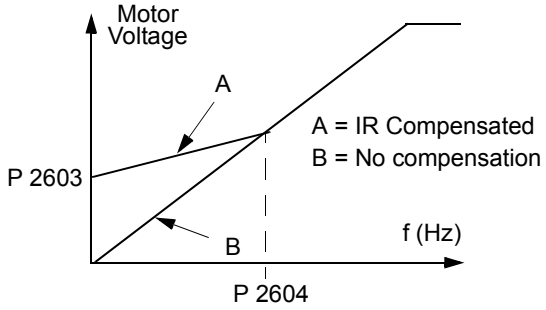
Code	Description
2401	**TORQ RAMP UP** Defines the torque reference ramp up time – The minimum time for the reference to increase from zero to the nominal motor torque.
2402	**TORQ RAMP DOWN** Defines the torque reference ramp down time – The minimum time for the reference to decrease from the nominal motor torque to zero.

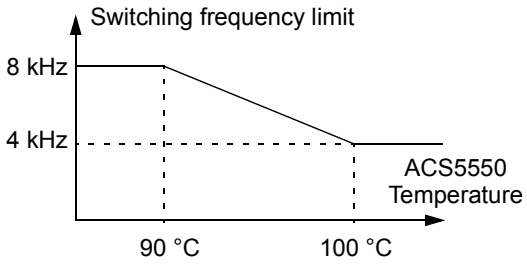
Group 25: Critical Speeds

This group defines up to three critical speeds or ranges of speeds that are to be avoided due, for example, to mechanical resonance problems at certain speeds.

Code	Description
2501	**CRIT SPEED SEL** Sets the critical speeds function on or off. The critical speed function avoids specific speed ranges. 0 = OFF – Disables the critical speeds function. 1 = ON – Enables the critical speeds function. **Example**: To avoid speeds at which a fan system vibrates badly: • Determine problem speed ranges. Assume they are found to be: 18…23 Hz and 46…52 Hz. • Set 2501 CRIT SPEED SEL = 1. • Set 2502 CRIT SPEED 1 LO = 18 Hz. • Set 2503 CRIT SPEED 1 HI = 23 Hz. • Set 2504 CRIT SPEED 2 LO = 46 Hz. • Set 2505 CRIT SPEED 2 HI = 52 Hz. 
2502	**CRIT SPEED 1 LO** Sets the minimum limit for critical speed range 1. • The value must be less than or equal to 2503 CRIT SPEED 1 HI. • Units are rpm, unless 9904 MOTOR CTRL MODE = 3 (SCALAR: SPEED), then units are Hz.
2503	**CRIT SPEED 1 HI** Sets the maximum limit for critical speed range 1. • The value must be greater than or equal to 2502 CRIT SPEED 1 LO. • Units are rpm, unless 9904 MOTOR CTRL MODE = 3 (SCALAR: SPEED), then units are Hz.
2504	**CRIT SPEED 2 LO** Sets the minimum limit for critical speed range 2. • See parameter 2502.
2505	**CRIT SPEED 2 HI** Sets the maximum limit for critical speed range 2. • See parameter 2503.
2506	**CRIT SPEED 3 LO** Sets the minimum limit for critical speed range 3. • See parameter 2502.
2507	**CRIT SPEED 3 HI** Sets the maximum limit for critical speed range 3. • See parameter 2503.

Group 26: Motor Control

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>2601</td><td colspan="2">FLUX OPTIMIZATION
Changes the magnitude of the flux depending on the actual load. Flux Optimization can reduce the total energy consumption and noise, and should be enabled for drives that usually operate below nominal load.
0 = Disables the feature.
1 = Enables the feature.</td></tr>
<tr><td>2602</td><td>FLUX BRAKING
Provides faster deceleration by raising the level of magnetization in the motor when needed, instead of limiting the deceleration ramp. By increasing the flux in the motor, the energy of the mechanical system is changed to thermal energy in the motor.
0 = Disables the feature.
1 = Enables the feature.</td><td> 
</td></tr>
<tr><td>2603</td><td>IR COMP VOLT
Sets the IR compensation voltage used for 0 Hz.
• Requires parameter 9904 MOTOR CTRL MODE = 3 (SCALAR: SPEED).
• Keep IR compensation as low as possible to prevent overheating.
• Typical IR compensation values are:
<table><tr><td colspan="6">380…480 V Units</td></tr><tr><td>P_N (kW)</td><td>3</td><td>7.5</td><td>15</td><td>37</td><td>132</td></tr><tr><td>IR comp (V)</td><td>21</td><td>18</td><td>15</td><td>10</td><td>4</td></tr></table></td><td rowspan="2">IR Compensation
• When enabled, IR Compensation provides an extra voltage boost to the motor at low speeds. Use IR Compensation, for example, in applications that require a high breakaway torque.
 
</td></tr>
<tr><td>2604</td><td>IR COMP FREQ
Sets the frequency at which IR compensation is 0 V (in % of motor frequency).</td></tr>
<tr><td>2605</td><td colspan="2">U/f RATIO
Selects the form for the U/f (voltage to frequency) ratio below field weakening point.
1 = LINEAR – Preferred for constant torque applications.
2 = SQUARE – Preferred for centrifugal pump and fan applications. (Square is more silent for most operating frequencies.)</td></tr>
<tr><td>2606</td><td colspan="2">SWITCHING FREQ
Sets the switching frequency for the drive.
• Higher switching frequencies mean less noise.</td></tr>
</table>

Code	Description
2607	**SW FREQ CTRL** The switching frequency may be reduced if the ACS550 internal temperature rises above 90 °C. See Figure. This function allows the highest possible switching frequency to be used based on operating conditions. Higher switching frequency results in lower acoustic noise. 0 = OFF – The function is disabled. 1 = ON – The switching frequency is limited according to the figure. 
2608	**SLIP COMP RATIO** Sets gain for slip compensation (in %). • A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip. • Requires parameter 9904 MOTOR CTRL MODE = 3 (SCALAR: SPEED). 0 = No slip compensation. 1…200 = Increasing slip compensation. 100% means full slip compensation.

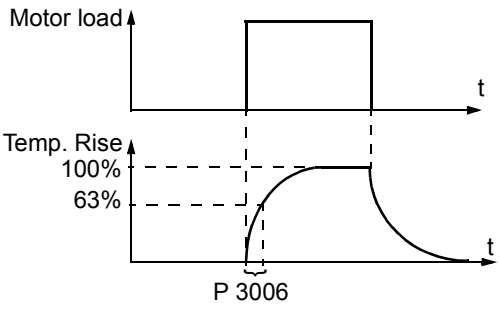
Group 29: Maintenance Trig

This group contains usage levels and trigger points. When usage reaches the set trigger point, a notice displayed on the control panel signals that maintenance is due.

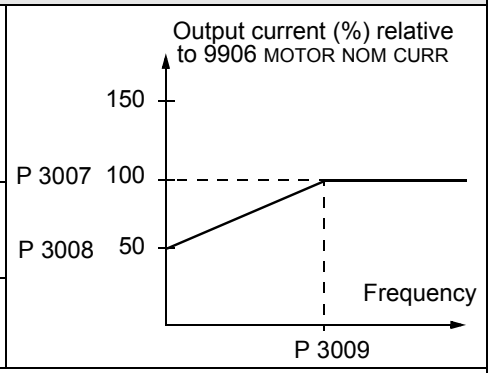
Code	Description
2901	**COOLING FAN TRIG** Sets the trigger point for the drive's cooling fan counter. • 0.0 = NO SEL
2902	**COOLING FAN ACT** Defines the actual value of the drive's cooling fan counter. • The parameter is reset by writing 0.0 to it.
2903	**REVOLUTION TRIG** Sets the trigger point for the motor's accumulated revolutions counter. • 0 = NO SEL
2904	**REVOLUTION ACT** Defines the actual value of the motor's accumulated revolutions counter. • The parameter is reset by writing 0 to it.
2905	**RUN TIME TRIG** Sets the trigger point for the drive's run time counter. • 0.0 = NO SEL
2906	**RUN TIME ACT** Defines the actual value of the drive's run time counter. • The parameter is reset by writing 0.0 to it.
2907	**USER MWh TRIG** Sets the trigger point for the drive's accumulated power consumption (in megawatt hours) counter. • 0.0 = NO SEL
2908	**USER MWh ACT** Defines the actual value of the drive's accumulated power consumption (in megawatt hours) counter. • The parameter is reset by writing 0.0 to it.

Group 30: Fault Functions

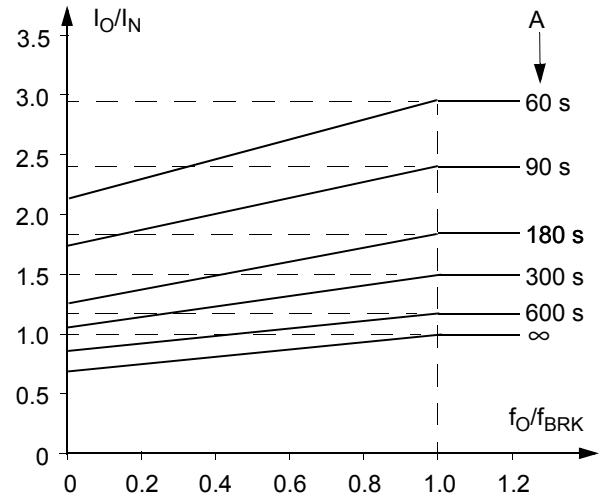
This group defines situations that the drive should recognize as potential faults and defines how the drive should respond if the fault is detected.

Code	Description
3001	**AI<MIN FUNCTION** Defines the drive response if the analog input (AI) signal drops below the fault limits and AI is used in reference chain). • 3021 AI1 FAULT LIMIT and 3022 AI2 FAULT LIMIT set the minimum limits 0 = NOT SEL – No response. 1 = FAULT – Displays a fault (7, AI1 LOSS or 8, AI2 LOSS) and the drive coasts to stop. 2 = CONST SP 7 – Displays a warning (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using 1208 CONST SPEED 7. 3 = LAST SPEED – Displays a warning (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. **Warning! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the analog input signal is lost.**
3002	**PANEL COMM ERR** Defines the drive response to a control panel communication error. 1 = FAULT – Displays a fault (10, PANEL LOSS) and the drive coasts to stop. 2 = CONST SP 7 – Displays a warning (2008, PANEL LOSS) and sets speed using 1208 CONST SPEED 7. 3 = LAST SPEED – Displays a warning (2008, PANEL LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. **Warning! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the control panel communication is lost.**
3003	**EXTERNAL FAULT 1** Defines the External Fault 1 signal input and the drive response to an external fault. 0 = NOT SEL – External fault signal is not used. 1 = DI1 – Defines digital input DI1 as the external fault input. • Activating the digital input indicates a fault. The drive displays a fault (14, EXT FAULT 1) and the drive coasts to stop. 2...6 = DI2…DI6 – Defines digital input DI2…DI6 as the external fault input. • See DI1 above. -1 = DI1(INV) – Defines an inverted digital input DI1 as the external fault input. • De-activating the digital input indicates a fault. The drive displays a fault (14, EXT FAULT 1) and the drive coasts to stop. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2…DI6 as the external fault input. • See DI1(INV) above.
3004	**EXTERNAL FAULT 2** Defines the External Fault 2 signal input and the drive response to an external fault. • See parameter 3003 above.
3005	**MOT THERM PROT** Defines the drive response to motor overheating. 0 = NOT SEL – No response and/or motor thermal protection not set up. 1 = FAULT – When the calculated motor temperature exceeds 90 C, displays a warning (2010, MOT OVERTEMP). When the calculated motor temperature exceeds 110 C, displays a fault (9, MOT OVERTEMP) and the drive coasts to stop. 2 = WARNING – When the calculated motor temperature exceeds 90 C, displays a warning (2010, MOT OVERTEMP).
3006	**MOT THERM TIME** Sets the motor thermal time constant for the motor temperature model. • This is the time required for the motor to reach 63% of the final temperature with steady load. • For thermal protection according to UL requirements for NEMA class motors, use the rule of thumb: MOTOR THERM TIME equals 35 times t6, where t6 (in seconds) is specified by the motor manufacturer as the time that the motor can safely operate at six times its rated current. • The thermal time for a Class 10 trip curve is 350 s, for a Class 20 trip curve 700 s, and for a Class 30 trip curve 1050 s. 

Code	Description
3007	**MOT LOAD CURVE** Sets the maximum allowable operating load of the motor. • When set to 100%, the maximum allowable load is equal to the value of Start-up Data parameter 9906 MOTOR NOM CURRENT. • Adjust the load curve level if the ambient temperature differs from nominal.
3008	**ZERO SPEED LOAD** Sets the maximum allowable current at zero speed. • Value is relative to 9906 MOTOR NOM CURR.
3009	**BREAK POINT FREQ** Sets the break point frequency for the motor load curve.

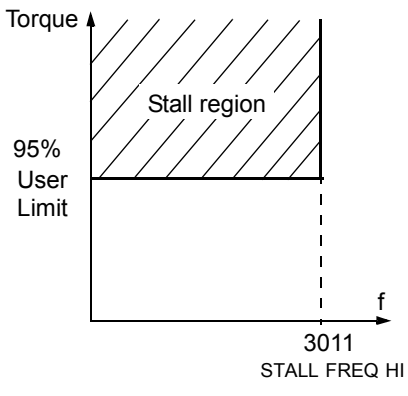


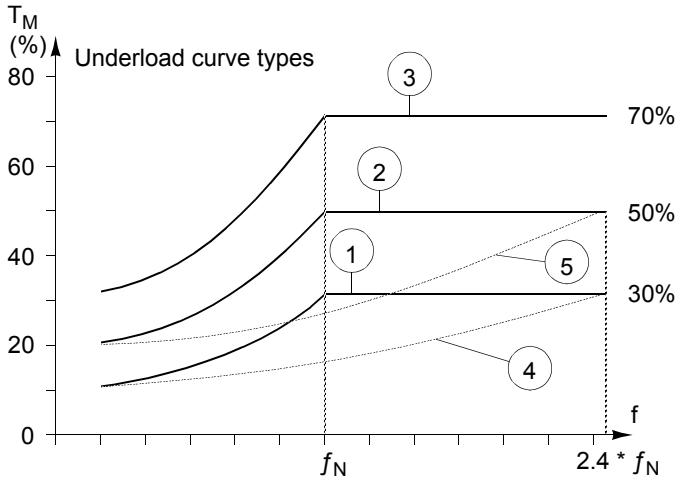
Example: Thermal protection trip times when parameters 3005 MOT THERM TIME, 3006 MOT LOAD CURVE and 3007 ZERO SPEED LOAD have default values.



I_O = Output current
I_N = Nominal motor current
f_O = Output frequency
f_{BRK} = Break point frequency
A = Trip time

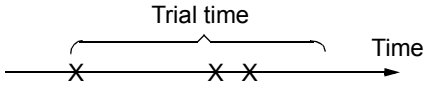
Code	Description
3010	**STALL FUNCTION** This parameter defines the operation of the Stall function. This protection is active if the drive operates in the stall region (see figure) for the time defined by 3012 STALL TIME. The “User Limit” is defined in Group 20 by 2017 MAX TORQUE 1, 2018 MAX TORQUE 2, or the limit on the COMM input. 0 = NOT SEL – Stall protection is not used. 1 = FAULT – When the drive operates in the stall region for the time set by 3012 STALL TIME: • The drive coasts to stop. • A fault indication is displayed. 2 = WARNING – When the drive operates in the stall region for the time set by 3012 STALL TIME: • A warning indication is displayed. • The warning disappears when the drive is out of the stall region for half the time set by parameter 3012 STALL TIME.
3011	**STALL FREQUENCY** This parameter sets the frequency value for the Stall function. Refer to Figure.
3012	**STALL TIME** This parameter sets the time value for the Stall function.



Code	Description
3013	**UNDERLOAD FUNCTION** Removal of motor load may indicate a process malfunction. The protection is activated if: • The motor torque drops below the load curve selected by parameter 3015 UNDERLOAD CURVE. • This condition has lasted longer than the time set by parameter 3014 UNDERLOAD TIME. • Output frequency is higher than 10% of the nominal frequency. 0 = NOT SEL – Underload protection is not used. 1 = FAULT – When the protection is activated the drive coasts to stop. A fault indication is displayed. 2 = WARNING – A warning indication is displayed.
3014	**UNDERLOAD TIME** Time limit for underload protection.
3015	**UNDERLOAD CURVE** This parameter provides five selectable curves shown in the figure. • If the load drops below the set curve for longer than the time set by parameter 3014, the underload protection is activated. • Curves 1...3 reach maximum at the motor rated frequency set by parameter 9907 MOTOR NOM FREQ. • T_M = nominal torque of the motor. • f_N = nominal frequency of the motor. 
3017	**EARTH FALULT** Defines the drive response if the drive detects a ground fault in the motor or motor cables. 0 = NO – No response. 1 = FAULT – Displays a fault (16, EARTH FAULT) and the drive coasts to stop.
3018	**COMM FAULT FUNC** Defines the drive response if the fieldbus communication is lost. 0 = NOT SEL – No response. 1 = FAULT – Displays a fault (28, SERIAL 1 ERR) and the drive coasts to stop. 2 = CONST SP7 – Displays a warning (2005, I/O COMM) and sets speed using 1208 CONST SPEED 7. This “alarm speed” remains active until the fieldbus writes a new reference value. 3 = LAST SPEED – Displays a warning (2005, I/O COMM) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. This “alarm speed” remains active until the fieldbus writes a new reference value. **Caution**: If you select CONST SPEED 7, or LAST SPEED, make sure that continued operation is safe when fieldbus communication is lost.
3019	**COMM FAULT TIME** Sets the communication fault time used with 3018 COMM FAULT FUNC. • Brief interruptions in the fieldbus communication are not treated as faults if they are less than the COMM FAULT TIME value.
3021	**AI1 FAULT LIMIT** Sets a fault level for analog input 1. See 3001 AI<MIN FUNCTION.
3022	**AI2 FAULT LIMIT** Sets a fault level for analog input 2. See 3001 AI<MIN FUNCTION.

Group 31: Automatic Reset

This group defines conditions for automatic resets. An automatic reset occurs after a particular fault is detected. The drive holds for a set delay time, then automatically restarts. You can limit the number of resets in a specified time period, and you can set up automatic resets for a variety of faults.

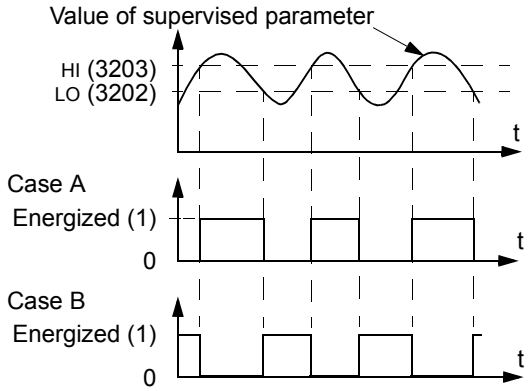
Code	Description	
3101	**NR OF TRIALS** Sets the number of allowed automatic resets within a trial period defined by 3102 TRIAL TIME. • If the number of automatic resets exceeds this limit (within the trial time), the drive prevents additional automatic resets and remains stopped. • Starting then requires a successful reset performed from the control panel or from a source selected by 1604 FAULT RESET SEL.	**Example:** Three faults have occurred in the trial time. The last is reset only if the value for 3101 NR OF TRIALS is 3 or more.  x = Automatic reset
3102	**TRIAL TIME** Sets the time period used for counting and limiting the number of resets. • See 3101 NR OF TRIALS.	
3103	**DELAY TIME** Sets the delay time between a fault detection and attempted drive restart. • If DELAY TIME = zero, the drive resets immediately.	
3104	**AR OVERCURRENT** Sets the automatic reset for the overcurrent function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (OVERCURRENT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.	
3105	**AR OVERVOLTAGE** Sets the automatic reset for the overvoltage function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (DC OVERVOLT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.	
3106	**AR UNDERVOLTAGE** Sets the automatic reset for the undervoltage function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (DC UNDERVOLTAGE) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.	
3107	**AR AI<MIN** Sets the automatic reset for the analog input less than minimum value function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (AI<MIN) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation. **Warning! When the analog input signal is restored, the drive may restart, even after a long stop. Make sure that automatic, long delayed starts will not cause physical injury and/or damage equipment.**	
3108	**AR EXTERNAL FAULT** Sets the automatic reset for external faults function on or off. 0 = DISABLE – Disables automatic reset. 1 = ENABLE – Enables automatic reset. • Automatically resets the fault (EXTERNAL FAULT 1 or EXTERNAL FAULT 2) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.	

Group 32: Supervision

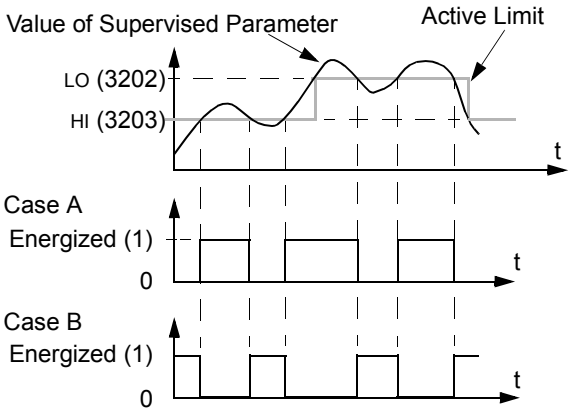
This group defines supervision for up to three signals from Group 01, Operating Data. Supervision monitors a specified parameter and energizes a relay output if the parameter passes a defined limit. Use Group 14, Relay Outputs, to define the relay and whether the relay activates when the signal is too low or too high.

Code	Description
3201	**SUPERV 1 PARAM** Selects the first supervised parameter. • Must be a parameter number from Group 01 Operating Data. • If the supervised parameter passes a limit, a relay output is energized. • The supervision limits are defined in this group. • The relay outputs are defined in Group 14 Relay Outputs (definition also specifies which supervision limit is monitored). **LO ≤ HI** Operating data supervision using relay outputs, when LO≤HI. • Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV 2 OVER. Use for monitoring when/if the supervised signal exceeds a given limit. The relay remains active until the supervised value drops below the low limit. • Case B = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV 1 UNDER or SUPRV 2 UNDER. Use for monitoring when/if the supervised signal falls below a given limit. The relay remains active until the supervised value rises above the high limit. **LO > HI** Operating data supervision using relay outputs, when LO>HI. The lowest limit (HI 3203) is active initially, and remains active until the supervised parameter goes above the highest limit (LO 3202), making that limit the active limit. That limit remains active until the supervised parameter goes below the lowest limit (HI 3203), making that limit active. • Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV2 OVER. Initially the relay is de-energized. It is energized whenever the supervised parameter goes above the active limit. • Case B = Parameter 1402 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 UNDER or SUPRV2 UNDER. Initially the relay is energized. It is de-energized whenever the supervised parameter goes below the active limit.
3202	**SUPERV 1 LIM LO** Sets the low limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above.
3203	**SUPERV 1 LIM HI** Sets the high limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above.
3204	**SUPERV 2 PARAM** Selects the second supervised parameter. See 3201 SUPERV 1 PARAM above.
3205	**SUPERV 2 LIM LO** Sets the low limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above.
3206	**SUPERV 2 LIM HI** Sets the high limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above.
3207	**SUPERV 3 PARAM** Selects the third supervised parameter. See 3201 SUPERV 1 PARAM above.

LO ≤ HI
Note! Case LO ≤ HI represents a normal hysteresis.



LO > HI
Note! Case LO>HI represents a special hysteresis with two separate supervision limits.



Code	Description
3208	**SUPERV 3 LIM LO** Sets the low limit for the third supervised parameter. See 3207 SUPERV 3 PARAM above.
3209	**SUPERV 3 LIM HI** Sets the high limit for the third supervised parameter. See 3207 SUPERV 3 PARAM above.

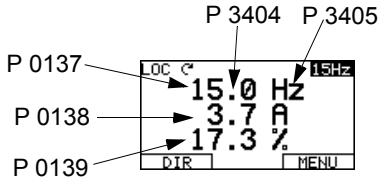
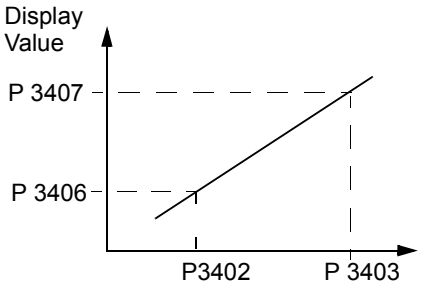
Group 33: Information

This group provides access to information about the drive's current programs: versions and test date.

Code	Description
3301	**FW VERSION** Contains the version of the drive's firmware.
3302	**LP VERSION** Contains the version of the loading package.
3303	**TEST DATE** Contains the test date (yy.ww).
3304	**DRIVE RATING** Indicates the drive's current and voltage rating. The format is XXXY, where: • XXX =The nominal current rating of the drive in amps. If present, an "A" indicates a decimal point in the rating for the current. For example XXX = 8A8 indicates a nominal current rating of 8.8 Amps. • Y = The voltage rating of the drive, where Y = 2 indicates a 208…240 Volt rating, and Y = 4 indicates a 380…480 Volt rating.

Group 34: Panel Display Process Variables

This group defines the content for control panel display (middle area), when the control panel is in the control mode.

Code	Description
3401	**SIGNAL1 PARAM** Selects the first parameter (by number) displayed on the control panel. • Definitions in this group define display content when the control panel is in the control mode. • Any Group 01 parameter number can be selected. • Using the following parameters, the display value can be scaled, converted to convenient units, and/or displayed as a bar graph. • The figure identifies selections made by parameters in this group.  100 = not selected – First parameter not displayed. 101…199 = Displays parameter 0101…0199. If parameter does not exist, the display shows “n.a.”
3402	**SIGNAL1 MIN** Defines the minimum expected value for the first display parameter. Use parameters 3402, 3403, 3406, and 3407, for example to convert a Group 01 parameter, such as 0102 SPEED (in rpm) to the speed of a conveyor driven by the motor (in ft/min). For such a conversion, the source values in the figure are the min. and max. motor speed, and the display values are the corresponding min. and max. conveyor speed. Use parameter 3405 to select the proper units for the display. Note! Selecting units does not convert values.
3403	**SIGNAL1 MAX** Defines the maximum expected value for the first display parameter.
	
3404	**OUTPUT1 DSP FORM** Defines the decimal point location for the first display parameter. • Enter the number of digits desired to the right of the decimal point. • See table for example using pi (3.14159).

3404 Value	Display	Range
0	± 3	-32768…+32767 (Signed)
1	± 3.1	
2	± 3.14	
3	± 3.142	
4	3	0…65535 (Unsigned)
5	3.1	
6	3.14	
7	3.142	

3405	**OUTPUT1 DSP UNIT** Selects the units used with the first display parameter. • Enter positive values in parameter 3405 for a numeric display. • Enter negative values in parameter 3405 for a bar-graph display.

0 = NOT SEL	8 = kh	16 = °F	24 = GPM	32 = kHz	40 = m^3/m	48 = gal/m	56 = FPS
1 = A	9 = °C	17 = hp	25 = PSI	33 = Ohm	41 = kg/s	49 = gal/h	57 = ft/s
2 = V	10 = lb ft	18 = MWh	26 = CFM	34 = ppm	42 = kg/m	50 = ft^3/s	58 = inH_2O
3 = Hz	11 = mA	19 = m/s	27 = ft	35 = pps	43 = kg/h	51 = ft^3/m	59 = in wg
4 = %	12 = mV	20 = m^3/h	28 = MGD	36 = l/s	44 = mbar	52 = ft^3/h	60 = ft wg
5 = s	13 = kW	21 = dm^3/s	29 = inHg	37 = l/min	45 = Pa	53 = lb/s	61 = lbsi
6 = h	14 = W	22 = bar	30 = FPM	38 = l/h	46 = GPS	54 = lb/m	62 = ms
7 = rpm	15 = kWh	23 = kPa	31 = kb/s	39 = m^3/s	47 = gal/s	55 = lb/h	63 = Mrev

122...127 = Cst

Additional bar display units

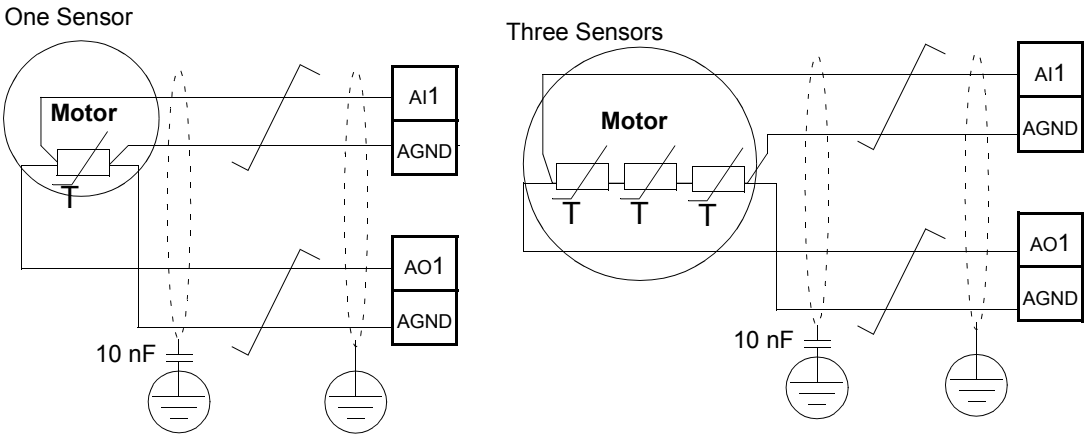
-123 =Iout -124 = Vout -125 = Fout -126 = Tout -127 = Vdc

3406	**OUTPUT1 MIN** Sets the minimum value displayed for the first display parameter.

Code	Description
3407	**OUTPUT1 MAX** Sets the maximum value displayed for the first display parameter.
3408	**SIGNAL 2 PARAM** Selects the second parameter (by number) displayed on the control panel. See parameter 3401.
3409	**SIGNAL 2 MIN** Defines the minimum expected value for the second display parameter. See parameter 3402.
3410	**SIGNAL 2 MAX** Defines the maximum expected value for the second display parameter. See parameter 3403.
3411	**OUTPUT 2 DSP FORM** Defines the decimal point location for the second display parameter. See parameter 3404.
3412	**OUTPUT 2 DSP UNIT** Selects the units used with the second display parameter. See parameter 3405.
3413	**OUTPUT 2 MIN** Sets the minimum value displayed for the second display parameter. See parameter 3406.
3414	**OUTPUT 2 MAX** Sets the maximum value displayed for the second display parameter. See parameter 3407.
3415	**SIGNAL 3 PARAM** Selects the third parameter (by number) displayed on the control panel. See parameter 3401.
3416	**SIGNAL 3 MIN** Defines the minimum expected value for the third display parameter. See parameter 3402.
3417	**SIGNAL 3 MAX** Defines the maximum expected value for the third display parameter. See parameter 3403.
3418	**OUTPUT 3 DSP FORM** Defines the decimal point location for the third display parameter. See parameter 3404.
3418	**OUTPUT 3 DSP UNIT** Selects the units used with the third display parameter. See parameter 3405.
3420	**OUTPUT 3 MIN** Sets the minimum value displayed for the third display parameter. See parameter 3406.
3421	**OUTPUT 3 MAX** Sets the maximum value displayed for the third display parameter. See parameter 3407.

Group 35: Motor Temp Meas

This group defines the detection and reporting for a particular potential fault – motor overheating, as detected by a temperature sensor. Typical connections are defined below.



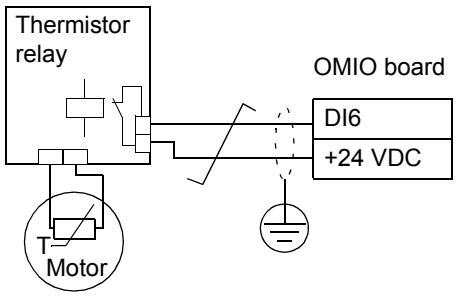
Warning! IEC 60664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

To fulfil this requirement, connect a thermistor (and other similar components) to the drive's control terminals using any of these alternatives:

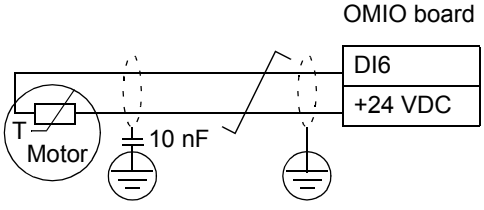
- **Separate the thermistor from live parts of the motor with double reinforced insulation.**
- **Protect all circuits connected to the drive's digital and analog inputs. Protect against contact, and insulate from other low voltage circuits with basic insulation (rated for the same voltage level as the drive's main circuit).**
- **Use an external thermistor relay. The relay insulation must be rated for the same voltage level as the drive's main circuit.**

The figure below shows alternate thermistor connections. At the motor end the cable shield should be earthed through a 10 nF capacitor. If this is not possible, leave the shield unconnected.

Thermistor Relay: Thermistor (0) or (1)



Thermistor (0)

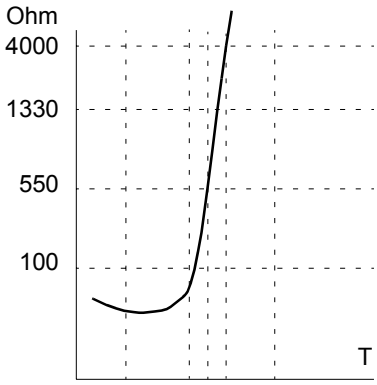


For other faults, or for anticipating motor overheating using a model, see Group 30: Fault Functions.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>3501</td><td>SENSOR TYPE
Identifies the type of motor temperature sensor used, PT100 (°C) or PTC (ohms).
See parameters 1501 and 1507.
0 = NONE
1 = 1 x PT100 – Sensor configuration uses one PT 100 sensor.
• Analog output AO1 or AO2 feeds constant current through the sensor.
• The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor.
• The temperature measurement function reads the voltage through analog input AI1 or AI2 and converts it to degrees centigrade.
2 = 2 x PT100 – Sensor configuration uses two PT 100 sensors.
• Operation is the same as for above 1 x PT100.

3 = 3 x PT100 – Sensor configuration uses three PT 100 sensors.
• Operation is the same as for above 1 x PT100.

4 = PTC – Sensor configuration uses PTC.
• The analog output feeds a constant current through the sensor.
• The resistance of the sensor increases sharply as the motor temperature rises over the PTC reference temperature (T_{ref}), as does the voltage over the resistor. The temperature measurement function reads the voltage through analog input AI1 and converts it into ohms.
• The figure shows typical PTC sensor resistance values as a function of the motor operating temperature.

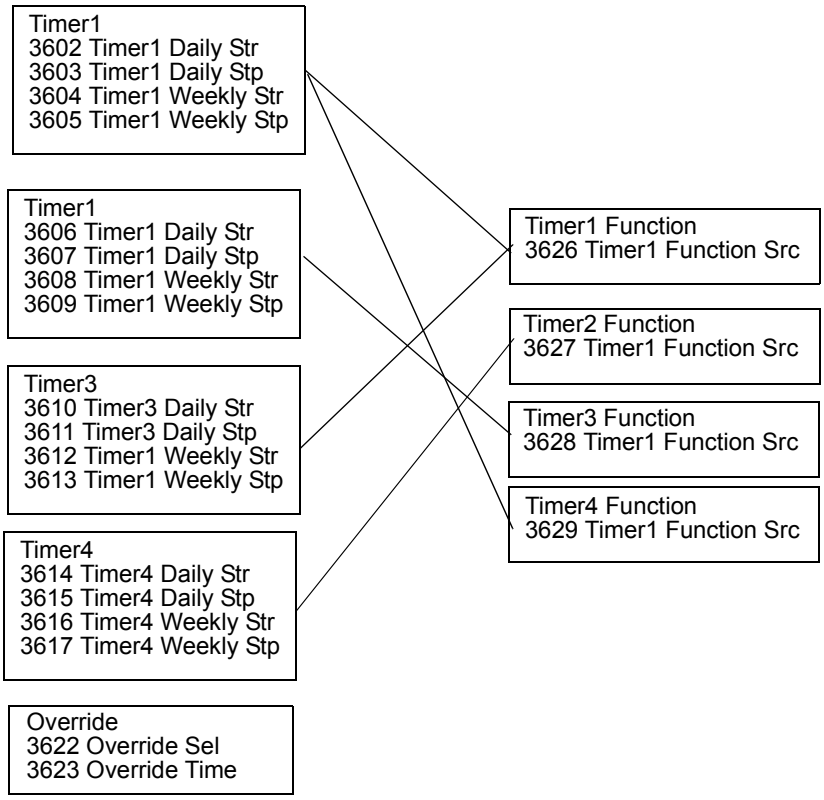
<table>
<tr><th>Temperature</th><th>Resistance</th></tr>
<tr><td>Normal</td><td>0 … 1.5 kohm</td></tr>
<tr><td>Excessive</td><td>≥ 4 kohm</td></tr>
</table>
5 = THERMISTOR (0) – Sensor configuration uses a thermistor.
• Motor thermal protection is activated through a digital input. Connect either a PTC sensor or a normally closed thermistor relay to a digital input. The drive reads the digital input states as shown in the above table.
• When the digital input is ‘0’ the motor is overheated.
• See the figures in the introduction to this Group.
6 = THERMISTOR (1) – Sensor configuration uses a thermistor.
• Motor thermal protection is activated through a digital input. Connect a normally open thermistor relay to a digital input. The drive reads the digital input states as shown in the above table.
• When the digital input is ‘1’ the motor is overheated.
• See the figures in the introduction to this Group.</td></tr>
<tr><td>3502</td><td>INPUT SELECTION
Defines the input used for the temperature sensor.
1 = AI1 – PT100 and PTC.
2 = AI2 – PT100 and PTC.
3…8 = DI1…DI6 – Thermistor</td></tr>
<tr><td>3503</td><td>ALARM LIMIT
Defines the alarm limit for motor temperature measurement.
• At motor temperatures above this limit, the drive displays an alarm (2010, MOTOR OVERTEMP)
For thermistors:
0 = de-activated
1 = activated</td></tr>
<tr><td>3504</td><td>FAULT LIMIT
Defines the fault limit for motor temperature measurement.
• At motor temperatures above this limit, the drive displays a fault (9, MOTOR OVERTEMP) and stops the drive.
For thermistors:
0 = de-activated
1 = activated</td></tr>
</table>

Group 36: Timer Functions

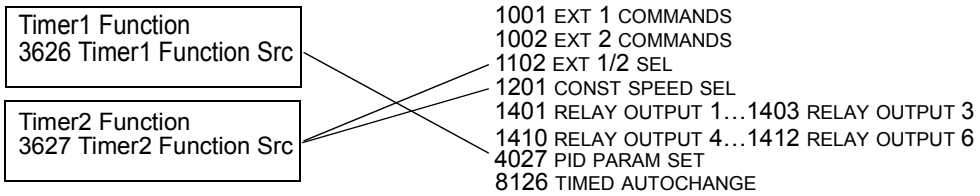
This group defines the timer functions. The timer functions include:

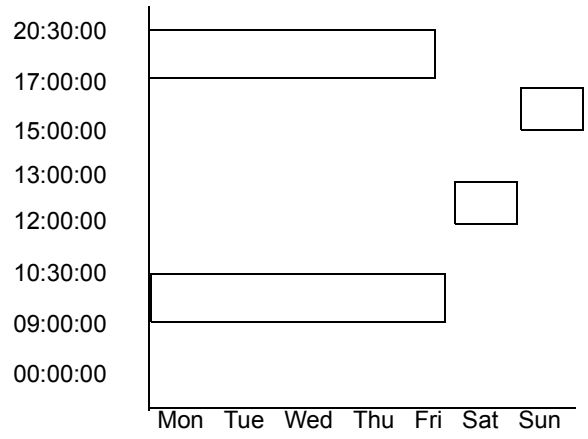
- Four daily starts/stops
- Four weekly starts/stops, overrides
- Four timed functions for collecting selected timers together.

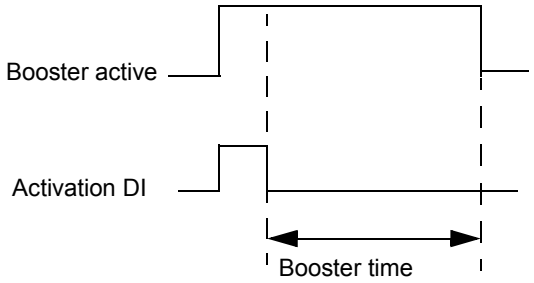
A timer function can be connected to multiple timers and a timer can be in multiple timer functions.



A parameter can be connected to only one timer function.



Code	Description
3601	**TIMERS ENABLE** Selects the source for the timer enable signal. 0 = NOT SEL – Timed functions are disabled. 1 = DI1– Defines digital input DI1 as the timed function enable signal. • The digital input must be activated to enable the timed function. 2...6 = DI2...DI6 – Defines digital input DI2...DI6 as the timed function enable signal. 7 = ENABLED – Timed functions are enabled. -1 = DI1(INV) – Defines an inverted digital input DI1 as the timed function enable signal. • This digital input must be de-activated to enable the timed function. • -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the timed function enable signal.
3602	**START TIME 1** Defines the daily start time. • The time can be changed in steps of 2 seconds. • If parameter value is 07:00:00, then the timer is activated at 7 a.m. • The figure shows multiple timers on different weekdays. 
3603	**STOP TIME 1** Defines the daily stop time. • The time can be in steps of 2 seconds. • If the parameter value is 09:00:00, then the timer is deactivated at 9 a.m.
3604	**START DAY 1** Defines the weekly start day. 1 = Monday ... 7 = Sunday. • If parameter value is 1, then timer 1 weekly is active from Monday midnight (00:00:00).
3605	**STOP DAY 1** Defines weekly stop day. 1 = Monday ... 7 = Sunday. • If parameter value is 5, then timer 1 weekly is deactivated on Friday midnight (23:59:58).
3606	**START TIME 2** Defines timer2 daily start time. • See parameter 3602
3607	**STOP TIME 2** Defines timer2 daily stop time. • See parameter 3603
3608	**START DAY 2** Defines timer 2 weekly start day. • See parameter 3604
3609	**STOP DAY 2** Defines timer 2 weekly stop day. • See parameter 3605
3610	**START TIME 3** Defines timer 3 daily start time. • See parameter 3602

Code	Description
3611	**STOP TIME 3** Defines timer 3 daily stop time. • See parameter 3603
3612	**START DAY 3** Defines timer 3 weekly start day. • See parameter 3604
3613	**STOP DAY 3** Defines timer 3 weekly stop day. • See parameter 3605
3614	**START TIME 4** Defines timer 4 daily start time. • See parameter 3602
3615	**STOP TIME 4** Defines timer 4 daily start time. • See parameter 3603
3616	**START DAY 4** Defines timer 4 weekly start day. • See parameter 3604
3617	**STOP DAY 4** Defines timer 4 weekly stop day. • See parameter 3605
3622	**BOOSTER SEL** Selects the source for the booster signal. 0 = NOT SEL – Override signal is disabled. 1 = DI1 – Defines DI1 as the booster signal. 2...6 = DI2...DI6 – Defines DI2...DI6 as the booster signal. -1 = DI1(INV) – Defines an inverted digital input DI1 as the booster signal. -2...-6 = DI2(INV)...DI6(INV) – Defines an inverted digital input DI2...DI6 as the booster signal.
3623	**BOOSTER TIME** Defines the booster ON time. Time is started when booster sel signal is released. If parameter range is 01:30:00, then booster is active for 1 hour and 30 minutes after activation DI is released. 

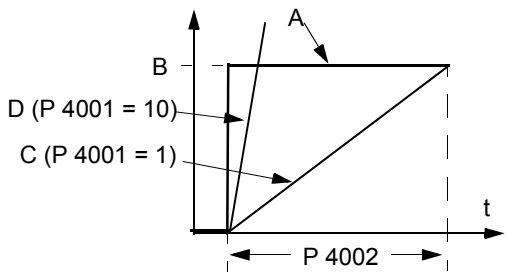
Code	Description
3626	**TIMER FUNC1 SRC** Collects all wanted timers to a timer function. 0 = NOT SEL – No timers have been selected. 1 = T1 – Timer 1 selected in the timer function. 2 = T2 – Timer 2 selected in the timer function. 3 = T2 + T1 – Timers 1 and 2 selected in the timer function. 4 = T3 – Timer 3 selected in the timer function. 5 = T3 + T1 – Timers 1 and 3 selected in the timer function. 6 = T3 + T2 – Timers 2 and 3 selected in the timer function. 7 = T3 + T2 + T1 – Timers 1, 2 and 3 selected in the timer function. 8 = T4 – Timer 4 selected in the timer function. 9 = T4+ T1 – Timers 4 and 1 selected in the timer function. 10 = T4 + T2 – Timers 4 and 2 selected in the timer function. 11 = T4 + T2 + T1 – Timers 4,2 and 1 selected in the timer function. 12 = T4 + T3 – Timers 4 and 3 selected in the timer function. 13 = T4 + T3 + T1 – Timers 4,3 and 1 selected in the timer function. 14 = T4 + T3 + T2 – Timers 4,3 and 2 selected in the timer function. 15 = T4 + T3 + T2 + T1 – Timers 4,3,2 and 1 selected in the timer function. 16 = BOOSTER (B) – Booster selected in the timer function. 17 = B + T1 – Booster and timer 1 selected in the timer function. 18 = B+ T2 – Booster and timer 2 selected in the timer function. 19 = B+ T2 + T1 – Booster and timers 1 and 2 selected in the timer function. 20 = B + T3 – Booster and Timer 3 selected in the timer function. 21 = B + T3 + T1 – Booster and Timers 3 and 1 selected in the timer function. 22 = B + T3 + T2 – Booster and Timers 3 and 2 selected in the timer function. 23 = B + T3 + T2 + T1 – Booster and Timers 3, 2 and 1 selected in the timer function. 24 = B + T4 – Booster and Timer 4 selected in the timer function. 25 = B + T4 + T1 – Booster and Timer 4 and Timer 1 selected in the timer function. 26 = B + T4 + T2 – Booster and Timers 4 and 2 selected in the timer function. 27 = B + T4 + T2 + T1 – Booster and Timers 4, 2 and 1 selected in the timer function. 28 = B + T4 + T3 – Booster and Timers 4, 3 29 = B + T4 + T3 +T1 – Booster and Timers 4, 3 and 1 selected in the timer function. 30 = B + T4 + T3 + T2 – Override and timers 4, 3 and 2 selected. 31 = B + T4 + T3 + T2 + T1 – Override and timers 4, 3, 2 and 1 selected.
3627	**TIMER FUNC2 SRC** • See parameter 3626.
3628	**TIMER FUNC3 SRC** • See parameter 3626.
3629	**TIMER FUNC4 SRC** • See parameter 3626.

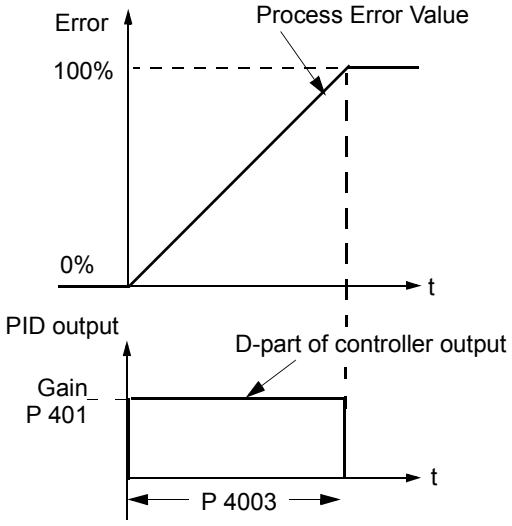
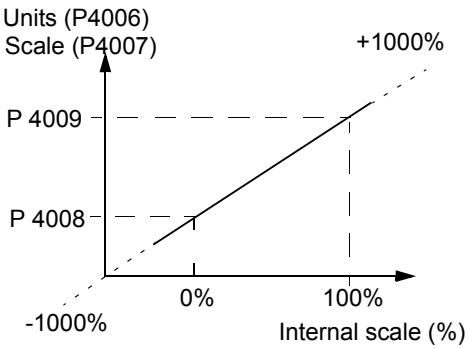
Group 40: Process PID Set 1

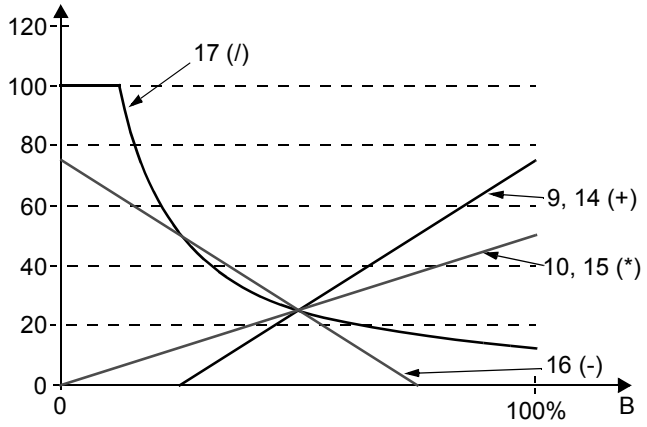
This group defines a process PID control operation mode for the drive. In PID control mode, the drive compares a reference signal (setpoint) to an actual signal (feedback), and automatically adjusts the speed of the drive to match the two signals. The difference between the two signals is the error value.

Three groups of parameters define PID control:

- Group 40 Process PID Set 1 defines process PID Set 1. Normally, this parameter set is used.
- Group 41 Process PID Set 2 defines process PID Set 2.
  Both Group 40 and 41 have the same parameters, except for the parameter used to select the PID set (4027).
- Group 42 External / Trimming PID defines:
  - an external PID control parameters or
  - trimming input parameters for speed /frequency reference.

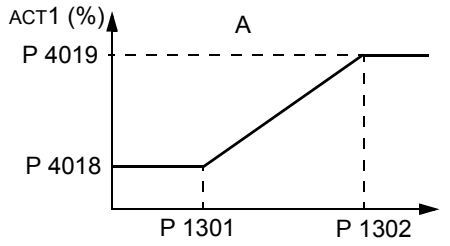
Code	Description
4001	**GAIN** Defines the PID Controller's gain. • The setting range is 0.1... 100. • At 0.1, the PID Controller output changes one-tenth as much as the error value. • At 100, the PID Controller output changes one hundred times as much as the error value. Use the proportional gain and integration time values to adjust the responsiveness of the system. • A low value for proportional gain and a high value for integral time ensures stable operation, but provides sluggish response. If the proportional gain value is too large or the integral time too short, the system can become unstable. Procedure: • Initially, set: • 4001 GAIN = 0.0. • 4002 INTEGRATION TIME = 20 seconds. • Start the system and see if it reaches the set point quickly while maintaining stable operation. If not, increase GAIN (4001) until the actual signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation. • Reduce GAIN (4001) until the oscillation stops. • Set GAIN (4001) to 0.4 to 0.6 times the above value. • Decrease the INTEGRATION TIME (4002) until the feedback signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation. • Increase INTEGRATION TIME (4002) until the oscillation stops. • Set INTEGRATION TIME (4002) to 1.15 to 1.5 times the above value. • If the feedback signal contains high frequency noise, increase the value of Parameter 1303 FILTER AI1 or 1306 FILTER AI2 until the noise is filtered from the signal.
4002	**INTEGRATION TIME** Defines the PID Controller's integration time. Integration time is, by definition, is the time required to increase the output by the error value: • Error value is constant and 100%. • Gain = 1. • Integration time of 1 second denotes that a 100% change is achieved in 1 second. 0.0 = NOT SEL – Disables integration (I-part of controller). 0.1…600.0 = Integration time (seconds). See 4001 for adjustment procedure.  A = Error B = Error value step C = Controller output with Gain = 1 D = Controller output with Gain = 10

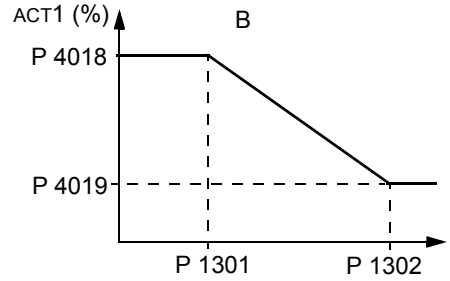
<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>4003</td><td>DERIVATION TIME
Defines the PID Controller’s derivation time.
• You can add the derivative of the error to the PID controller output. The derivative is the error value’s rate of change. For example, if the process error value changes linearly, the derivative is a constant added to the PID controller output.
• The error-derivative is filtered with a 1-pole filter. The time constant of the filter is defined by parameter 4004 PID DERIV FILTER.
0.0 = NOT SEL – Disables the error-derivative part of the PID controller output
0.1…10.0 = Derivation time (seconds)
 
</td></tr>
<tr><td>4004</td><td>PID DERIV FILTER
Defines the filter time constant for the error-derivative part of the PID controller output.
• Before being added to the PID controller output, the error-derivative is filtered with a 1-pole filter.
• Increasing the filter time smooths the error-derivative, reducing noise.
0.0 = NOT SEL – Disables the error-derivative filter.
0.1…10.0 = Filter time constant (seconds).</td></tr>
<tr><td>4005</td><td>ERROR VALUE INV
Selects either a normal or inverted relationship between the feedback signal and the drive speed.
0 = NO – Normal, a decrease in feedback signal increases drive speed. Error = Ref - Fbk
1 = YES – Inverted, a decrease in feedback signal decreases drive speed. Error = Fbk - Ref</td></tr>
<tr><td>4006</td><td>UNIT
Selects the unit for the PID controller actual values. (PID1 parameters 0128, 0130, and 0132).
• See parameter 3405 for list of available units.</td></tr>
<tr><td>4007</td><td>DSP FORMAT
Defines the decimal point location in PID controller actual values.
• Enter the decimal point location counting in from the right of the entry.
• See table for example using pi (3.14159).
<table><tr><th>4007 Value</th><th>Entry</th><th>Display</th></tr><tr><td>0</td><td>0003</td><td>3</td></tr><tr><td>1</td><td>0031</td><td>3.1</td></tr><tr><td>2</td><td>0314</td><td>3.14</td></tr><tr><td>3</td><td>3142</td><td>3.142</td></tr></table></td></tr>
<tr><td>4008</td><td>0 % VALUE
Defines (together with the next parameter) the scaling applied to the PID controller’s actual values (PID1 parameters 0128, 0130, and 0132).
• Units and scale are defined by parameters 4006 and 4007.</td></tr>
<tr><td>4009</td><td>100 % VALUE
Defines (together with the previous parameter) the scaling applied to the PID controller’s actual values.
• Units and scale are defined by parameters 4006 and 4007.
 
</td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>4010</td><td>SET POINT SEL
Defines the reference signal source for the PID controller.
• Parameter has no significance when the PID regulator is by-passed (see 8121 REG BYPASS CTRL).
0 = keypad – Control panel provides reference.
1 = AI1 – Analog input 1 provides reference.
2 = AI2 – Analog input 2 provides reference.
8 = comm – Fieldbus provides reference.
9 = COMM + AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.
10 = COMM * AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.
11 = DI3U, 4D(RNC) – Digital inputs, acting as a motor potentiometer control, provide reference.
• DI3 increases the speed (the U stands for “up”)
• DI4 decreases the reference (the D stands for “down”).
• Parameter 2205 ACCELER TIME 2 controls the reference signal’s rate of change.
• R = Stop command resets the reference to zero.
• NC = Reference value is not copied.
12 = DI3U, 4D(NC) – Same as DI3U, 4D(RNC) above, except:
• Stop command does not reset reference to zero. At restart the motor ramps up, at the selected acceleration rate, to the stored reference.
13 = DI5U, 6D(NC) – Same as DI3U, 4D(NC) above, except:
• Uses digital inputs DI5 and DI6.
14 = AI1 + AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
15 = AI1 * AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
16 = AI1 - AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
17 = AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
19 = INTERNAL – A constant value set using parameter 4011 provides reference.</td></tr>
<tr><td></td><td>Analog Input Reference Correction
Parameter values 9, 10, and 14…17 use the formula in the following table.
<table><tr><th>Value Setting</th><th>AI reference is calculated as following:</th></tr><tr><td>C + B</td><td>C value + (B value - 50% of reference value)</td></tr><tr><td>C * B</td><td>C value * (B value / 50% of reference value)</td></tr><tr><td>C - B</td><td>(C value + 50% of reference value) - B value</td></tr><tr><td>C / B</td><td>(C value * 50% of reference value) / B value</td></tr></table>Where:
• C = Main Reference value
(= COMM for values 9, 10 and
= AI1 for values 14…17).
• B = Correcting reference
(= AI1 for values 9, 10 and
= AI2 for values 14…17).
Example:
The figure shows the reference source curves for value settings 9, 10, and 14…17, where:
• C = 25%.
• P 4012 SETPOINT MIN = 0.
• P 4013 SETPOINT MAX = 0.
• B varies along the horizontal axis.
 
</td></tr>
<tr><td>4011</td><td>INTERNAL SETPNT
Sets a constant value used for the process reference.
• Units and scale are defined by parameters 4006 and 4007.</td></tr>
</table>

Code	Description
4012	**SETPOINT MIN** Sets the minimum value for the reference signal source. See parameter 4010.
4013	**SETPOINT MAX** Sets the maximum value for the reference signal source. See parameter 4010.
4014	**FBK SEL** Defines the PID controller feedback (actual signal). • You can define a combination of two actual values (ACT1 and ACT2) as the feedback signal. • Use parameter 4016 to define the source for actual value 1 (ACT1). • Use parameter 4017 to define the source for actual value 2 (ACT2). 1 = ACT1 – Actual value 1 (ACT1) provides the feedback signal. 2 = ACT1-ACT2 – ACT1 minus ACT2 provides the feedback signal. 3 = ACT1+ACT2 – ACT1 plus ACT2 provides the feedback signal. 4 = ACT1*ACT2 – ACT1 times ACT2 provides the feedback signal. 5 = ACT1/ACT2 – ACT1 divided by ACT2 provides the feedback signal. 6 = MIN (A1, A2) – The smaller of ACT1 or ACT2 provides the feedback signal. 7 = MAX (A1, A2) – The greater of ACT1 or ACT2 provides the feedback signal. 8 = SQRT (A1-A2) – Square root of the value for ACT1 minus ACT2 provides the feedback signal. 9 = SQA1 + SQA2 – Square root of ACT1 plus the square root of ACT2 provides the feedback signal.
4015	**FBK MULTIPLIER** Defines an extra multiplier for the PID FBK value defined by parameter 4014. • Used mainly in applications where the flow is calculated from the pressure difference. 0 = NOT USED. -32.768…32.767 = Multiplier applied to the signal defined by parameter 4014 FBK SEL. **Example:** $FBK = Multiplier \times \sqrt{A1 - A2}$
4016	**ACT1 INPUT** Defines the source for actual value 1 (ACT1). 0 = AI 1 – Uses analog input 1 for ACT1. 1 = AI 2 – Uses analog input 2 for ACT1. 2 = Current – Uses current for ACT1, scaled so: • Min ACT1 = 0 current • Max ACT1 = 2 x nominal current 3 = Torque – Uses torque for ACT1, scaled so: • Min ACT1 = -2 x nominal torque • Max ACT1 = 2 x nominal torque 4 = Power – Uses power for ACT1, scaled so: • Min ACT1 = -2 x nominal power • Max ACT1 = 2 x nominal power
4017	**ACT2 INPUT** Defines the source for actual value 2 (ACT2). 0 = AI 1 – Uses analog input 1 for ACT2. 1 = AI 2 – Uses analog input 2 for ACT2. 2 = Current – Uses current for ACT2, scaled so: • Min ACT2 = 0 current • Max ACT2 = 2 x nominal current 3 = Torque – Uses torque for ACT2, scaled so: • Min ACT2 = -2 x nominal torque • Max ACT2 = 2 x nominal torque 4 = Power – Uses power for ACT2, scaled so: • Min ACT2 = -2 x nominal power • Max ACT2 = 2 x nominal power

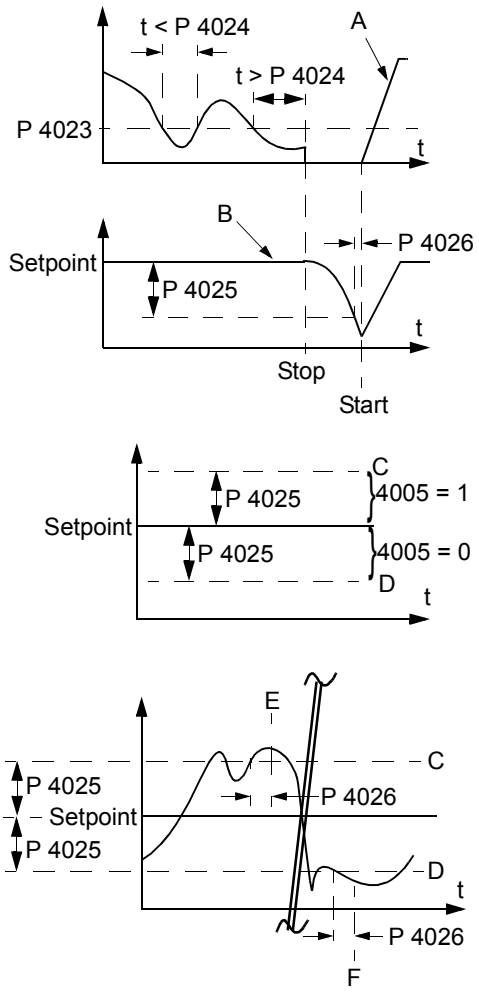
Code	Description
4018	**ACT1 MINIMUM** Sets the minimum value for ACT1. • Used with analog input min/max settings (e.g. 1301 MINIMUM AI1, 1302 MAXIMUM AI1). • Scales analog inputs used as actual values. • See figure: A= Normal; B = Inversion (ACT1 MINIMUM > ACT1 MAXIMUM)
4019	**ACT1 MAXIMUM** Sets the maximum value for ACT1. • See 4018 ACT1 MINIMUM.
4020	**ACT2 MINIMUM** Sets the minimum value for ACT2. • See 4018 ACT1 MINIMUM.
4021	**ACT2 MAXIMUM** Sets the maximum value for ACT2. • See 4018 ACT1 MINIMUM.





4022	**SLEEP SELECTION** Defines the control for the PID sleep function. 0 = NOT SEL– Disables the PID sleep control function. 1 = DI1 – Defines digital input DI1 as the control for the PID sleep function. • Activating the digital input activates the sleep function. • De-activating the digital input restores PID control. 2...6 = DI2...DI6 – Defines digital input DI2…DI6 as the control for the PID sleep function. • See DI1 above. 7 = INTERNAL – Defines the output rpm/frequency, process reference, and process actual value as the control for the PID sleep function. Refer to parameters 4025 WAKE-UP DEV and 4023 PID SLEEP LEVEL. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for the PID sleep function. • De-activating the digital input activates the sleep function. • Activating the digital input restores PID control. -2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for the PID sleep function. • See DI1(INV) above.

Code	Description
4023	**PID SLEEP LEVEL** Sets the motor speed / frequency that enables the PID sleep function – a motor speed / frequency below this level, for at least the time period 4024 PID SLEEP DELAY enables the PID sleep function (stopping the drive). • Requires 4022 = 7 INTERNAL. • See figure: A = PID output level; B = PID process feedback.
4024	**PID SLEEP DELAY** Sets the time delay for the PID sleep function – a motor speed / frequency below 4023 PID SLEEP LEVEL for at least this time period enables the PID sleep function (stopping the drive). • See 4023 PID SLEEP LEVEL above.
4025	**WAKE-UP DEVIATION** Defines the wake-up deviation – a deviation from the setpoint greater than this value, for at least the time period 4026 WAKE-UP DELAY, re-starts the PID controller. • Parameters 4006 and 4007 define the units and scale. • Parameter 4005 = 0, Wake-up level = Setpoint - Wake-up deviation. • Parameter 4005 = 1, Wake-up level = Setpoint + Wake-up deviation. • Wake-up level can be above or below setpoint. See figures: • C = Wake-up level when parameter 4005 = 1 • D = Wake-up level when parameter 4005 = 0 • E = Feedback is above wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up. • F = Feedback is below wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up.
4026	**WAKE-UP DELAY** Defines the wake-up delay – a deviation from the setpoint greater than 4025 WAKE-UP DEVIATION, for at least this time period, re-starts the PID controller.



4027	**PID 1 PARAM SET** Defines how selections are made between PID Set 1 and PID Set 2. PID parameter set selection. When set 1 is selected, parameters 4001…4026 are used. When set 2 is selected, parameters 4101…4126 are used. 0 = SET 1 – PID Set 1 (parameters 4001…4026) is active. 1 = DI1 – Defines digital input DI1 as the control for PID Set selection. • Activating the digital input selects PID Set 2. • De-activating the digital input selects PID Set 1. 2...6 = DI2...DI6 – Defines digital input DI2…DI6 as the control for PID Set selection. • See DI1 above. 7 = SET 2 – PID Set 2 (parameters 4101…4126) is active. 8...11 = TIMER FUNCTION 1...4 – Defines the Timer function as the control for the PID Set selection (Timer function de-activated = PID Set 1; Timer function activated = PID Set 2) • See parameter Group 36: Timer Functions. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for PID Set selection. • Activating the digital input selects PID Set 1. • De-activating the digital input selects PID Set 2. -2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for PID Set selection. • See DI1(INV) above.

Group 41: Process PID Set 2

Parameters of this group belong to PID parameter set 2. The operation of parameters 4101…4126 is analogous with set 1 parameters 4001…4026.

PID parameter set 2 can be selected by parameter 4027 PID 1 PARAM SET.

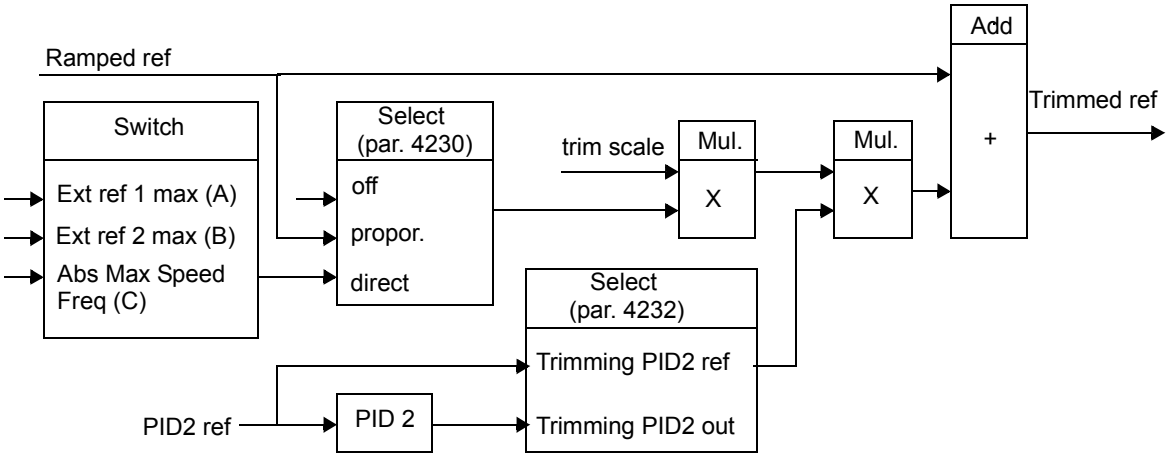
Group 42: External / Trimming PID

This group defines the parameters used for the External / Trimming PID.

The operation of parameters 4201...4221 is analogous with set 1 (and set 2) parameters 4001...4021 (4011...4021). The parameter groups 40 and 41 define the parameters for a process PID.

Code	Description
4228	**ACTIVATE** Defines the source for enabling the external PID function. • Requires 4230 TRIM MODE = 0 NOT SEL. 0 = NOT SEL – Disables external PID control. 1 = DI1 – Defines digital input DI1 as the control for enabling external PID control. • Activating the digital input enables external PID control. • De-activating the digital input disables external PID control. 2...6 = DI2...DI6 – Defines digital input DI2…DI6 as the control for enabling external PID control. • See DI1 above. 7 = DRIVE RUN – Defines the start command as the control for enabling external PID control. • Activating the start command (drive is running) enables external PID control. 8 = ON – Defines the power-on as the control for enabling external PID control. • Activating power to the drive enables external PID control. 9...12 = TIMER FUNCTION 1...4 – Defines the Timer function as the control for enabling external PID control (Timer function active enables external PID control). • See parameter Group 36: Timer Functions. -1 = DI1(INV) – Defines an inverted digital input DI1 as the control for enabling external PID control. • Activating the digital input disables external PID control. • De-activating the digital input enables external PID control. -2...-6 = DI2(INV)...DI6(INV) – Defines digital input DI2…DI6 as the control for enabling external PID control. • See DI1(INV) above.
4229	**OFFSET** Defines the offset for the PID output. • When PID is activated, output starts from this value. • When PID is deactivated, output resets to this value. • Parameter is not active when 4230 TRIM MODE not = 0 (trim mode is active).
4230	**TRIM MODE** Selects the type of trim, if any. Using the trim it is possible to combine a corrective factor to the drive reference. 0 = NOT SEL – Disables the trim function. 1 = PROPORTIONAL – Adds a trim factor that is proportional to the rpm/Hz reference. 2 = DIRECT – Adds a trim factor based on the control loop’s maximum limit.
4231	**TRIM SCALE** Defines the multiplier (as a percent, plus or minus) used in the trim mode.

Code	Description
4232	**CORRECTION SRC** Defines the trimming reference for the correction source. 1 = PID2 REF – Uses appropriate REF MAX (SWITCH A OR B): • 1105 REF 1 MAX when REF1 is active (A). • 1108 REF 2 MAX when REF2 is active (B). 2 = PID2 OUTPUT – Uses the absolute maximum speed or frequency (Switch C): • 2002 MAXIMUM SPEED if 9904 MOTOR CONTROL MODE = 1 SPEED or 2 TORQUE. • 2008 MAXIMUM FREQUENCY IF 9904 MOTOR CONTROL MODE = 3 SCALAR.



Group 51: Ext Comm Module

This group defines set-up variables for an external fieldbus communication module. Refer to communication module documentation for more information on these parameters.

Code	Description
5101	**FBA TYPE** Displays the type of the connected fieldbus adapter module. 0 = Module not found or not connected. Check the fieldbus User's Manual chapter "Mechanical Installation" and check that parameter 9802 is set to 4 = EXT FBA. 1 = PROFIBUS-DP – 16 = INTERBUS – 21 = LONWORKS – 32 = CANOPEN – 37 = DEVICENET – 64 = MODBUS PLUS – 101 = CONTROLNET – 128 = ETHERNET –
5102 … 5126	**FB PAR 2…FB PAR 26** Refer to communication module documentation for more information on these parameters.
5127	**FBA PAR REFRESH** Validates any changed fieldbus parameter settings. • After refreshing, the value reverts automatically to DONE.
5128	**FILE CPI FW REV** Displays the CPI firmware revision of the drive's fieldbus adapter configuration file. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number **Example:** 107 = revision 1.07
5129	**FILE CONFIG ID** Displays the revision of the drive's fieldbus adapter module's configuration file identification. • File configuration information is drive application program-dependent.
5130	**FILE CONFIG REV** Contains the revision of the drive's fieldbus adapter module configuration file. **Example:** 1 = revision 1
5131	**FBA STATUS** Contains the status of the adapter module. 0 = IDLE – Adapter not configured. 1 = EXEC. INIT – Adapter is initializing. 2 = TIME OUT – A timeout has occurred in the communication between the adapter and the drive. 3 = CONFIG ERROR – Adapter configuration error. • The major or minor revision code of the adapter's CPI firmware revision differs from that stated in the drive's configuration file. 4 = OFF-LINE – Adapter is off-line. 5 = ON-LINE – Adapter is on-line. 6 = RESET – Adapter is performing a hardware reset.
5132	**FBA CPI FW REV** Contains the revision of the module's CPI program. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number **Example:** 107 = revision 1.07

Code	Description
5133	**FBA APPL FW REV** Contains the revision of the module's application program Format is xyz where: • x = major revision number • y = minor revision number • z = correction number **Example:** 107 = revision 1.07

Group 52: Panel Communication

This group defines the communication settings for the control panel port on the drive. Normally, when using the supplied control panel, there is no need to change settings in this group.

In this group, parameter modifications take effect on the next power-up.

Code	Description
5201	**STATION ID** Defines the address of the drive. • Two units with the same address are not allowed on-line. • Range: 1…247
5202	**BAUDRATE** Defines the communication speed of the drive in kbits per second (kbits/s). 9.6 19.2 38.4 57.6 115.2
5203	**PARITY** Sets the character format to be used with the panel communication. 0 = 8N1 – No parity, one stop bit. 1 = 8N2 – No parity, two stop bits. 2 = 8E1 – Even parity, one stop bit. 3 = 8O1 – Odd parity, one stop bit.
5204	**OK MESSAGES** Contains a count of valid Modbus messages received by the drive. • During normal operation, this counter is increasing constantly.
5205	**PARITY ERRORS** Contains a count of the characters with a parity error that is received from the bus. For high counts, check: • Parity settings of devices connected on the bus – they must not differ. • Ambient electro-magnetic noise levels – high noise levels generate errors.
5206	**FRAME ERRORS** Contains a count of the characters with a framing error that the bus receives. For high counts, check: • Communication speed settings of devices connected on the bus – they must not differ. • Ambient electro-magnetic noise levels – high noise levels generate errors.
5207	**BUFFER OVERRUNS** Contains a count of the characters received that cannot be placed in the buffer. • Longest possible message length for the drive is 128 bytes. • Received messages exceeding 128 bytes overflow the buffer. The excess characters are counted.
5208	**CRC ERRORS** Contains a count of the messages with a CRC error that the drive receives. For high counts, check: • Ambient electro-magnetic noise levels – high noise levels generate errors. • CRC calculations for possible errors.

Group 53: EFB Protocol

This group defines set-up variables used for an embedded fieldbus (EFB) communication protocol. The standard EFB protocol in the ACS550 is Modbus. See *Standard Serial Communication* starting on page *150*.

Code	Description
5301	**EFB PROTOCOL ID** Contains the identification and program revision of the protocol. • Format: XXYY, where xx = protocol ID, and YY = program revision.
5302	**EFB STATION ID** Defines the node address of the RS485 link. • The node address on each unit must be unique.
5303	**EFB BAUD RATE** Defines the communication speed of the RS485 link in kbits per second (kbits/s). 1.2 kbits/s 2.4 kbits/s 4.8 kbits/s 9.6 kbits/s 19.2 kbits/s 38.4 kbits/s 57.6 kbits/s
5304	**EFB PARITY** Defines the data length parity and stop bits to be used with the RS485 link communication. • The same settings must be used in all on-line stations. 0 = 8N1 – 8 data bits, No parity, one stop bit. 1 = 8N2 – 8 data bits, No parity, two stop bits. 2 = 8E1 – 8 data bits, Even parity, one stop bit. 3 = 8O1 – 8 data bits, Odd parity, one stop bit.
5305	**EFB CTRL PROFILE** Selects the communication profile used by the EFB protocol. 0 = ABB DRIVES – Operation of Control Word and Status Word conforms to ABB Drives Profile. 1 = ACS550 – Alternate 32 bit profile (Advanced users only).
5306	**EFB OK MESSAGES** Contains a count of valid messages received by the drive. • During normal operation, this counter is increasing constantly.
5307	**EFB CRC ERRORS** Contains a count of the messages with a CRC error received by the drive. For high counts, check: • Ambient electro-magnetic noise levels – high noise levels generate errors. • CRC calculations for possible errors.
5308	**EFB UART ERRORS** Contains a count of the messages with a character error received by the drive.
5309	**EFB STATUS** Contains the status of the EFB protocol. 0 = IDLE – EFB protocol is configured, but not receiving any messages. 1 = EXEC. INIT – EFB protocol is initializing. 2 = TIME OUT – A timeout has occurred in the communication between the network master and the EFB protocol. 3 = CONFIG ERROR – EFB protocol has a configuration error. 4 = OFF-LINE – EFB protocol is receiving messages that are NOT addressed to this drive. 5 = ON-LINE – EFB protocol is receiving messages that are addressed to this drive. 6 = RESET – EFB protocol is performing a hardware reset. 7 = LISTEN ONLY – EFB protocol is in listen-only mode.
5310	**EFB PAR 10** Specifies the parameter mapped to Modbus Register 40005.
5311	**EFB PAR 11** Specifies the parameter mapped to Modbus Register 40006.

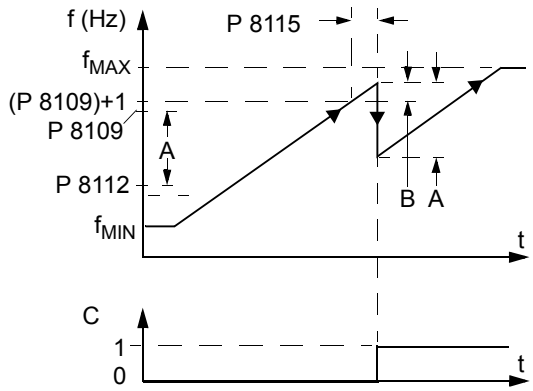
Code	Description
5312	**EFB PAR 12** Specifies the parameter mapped to Modbus Register 40007.
5313	**EFB PAR 13** Specifies the parameter mapped to Modbus Register 40008.
5314	**EFB PAR 14** Specifies the parameter mapped to Modbus Register 40009.
5315	**EFB PAR 15** Specifies the parameter mapped to Modbus Register 40010.
5316	**EFB PAR 16** Specifies the parameter mapped to Modbus Register 40011.
5317	**EFB PAR 17** Specifies the parameter mapped to Modbus Register 40012.
5318 … 5320	**EFB PAR 18…EFB PAR 20** Reserved.

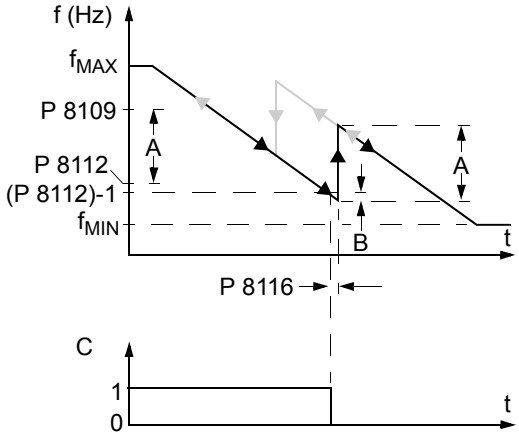
Group 81: PFC Control

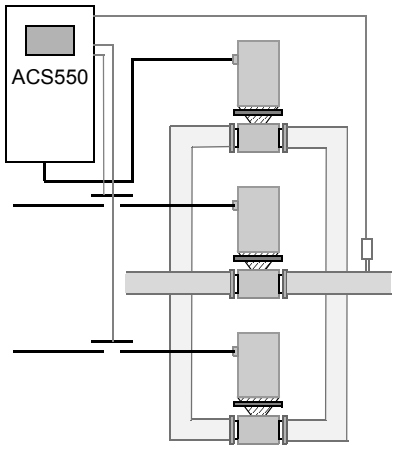
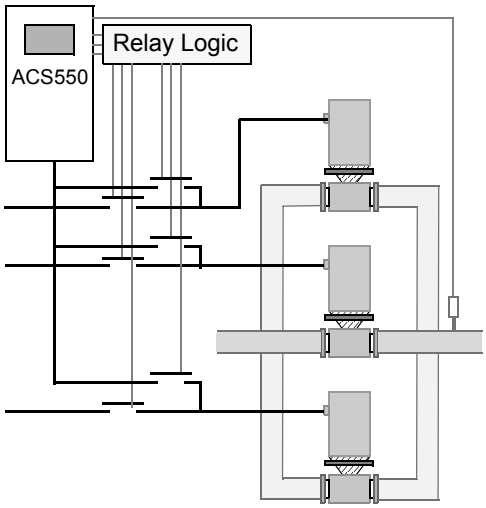
This group defines a Pump-Fan Control (PFC) mode of operation. The major features of PFC control are:

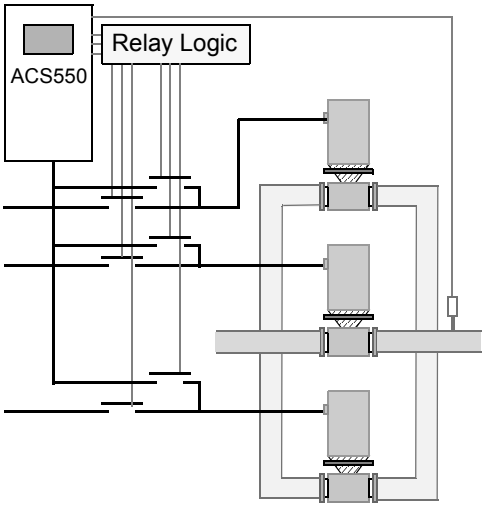
- The ACS550 controls the motor of pump no. 1, varying the motor speed to control the pump capacity. This motor is the speed regulated motor.
- Direct line connections power the motor of pump no. 2 and pump no.3, etc. The ACS550 switches pump no. 2 (and then pump no. 3, etc.) on and off as needed. These motors are auxiliary motors.
- The ACS550 PID control uses two signals: a process reference and an actual value feedback. The PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference.
- When demand (defined by the process reference) exceeds the first motor's capacity (user defined as a frequency limit), the PFC control automatically starts an auxiliary pump. The PFC also reduces the speed of the first pump to account for the auxiliary pump's addition to total output. Then, as before, the PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference. If demand continues to increase, PFC adds additional auxiliary pumps, using the same process.
- When demand drops, such that the first pump speed falls below a minimum limit (user defined by a frequency limit), the PFC control automatically stops an auxiliary pump. The PFC also increases the speed of the first pump to account for the auxiliary pump's missing output.
- An Interlock function (when enabled) identifies off-line (out of service) motors, and the PFC control skips to the next available motor in the sequence.
- An Autochange function (when enabled and with the appropriate switchgear) equalizes duty time between the pump motors. Autochange periodically increments the position of each motor in the rotation – the speed regulated motor becomes the last auxiliary motor, the first auxiliary motor becomes the speed regulated motor, etc.

Code	Description
8103	**REFERENCE STEP 1** Sets a percentage value that is added to the process reference. • Applies only when at least one auxiliary (constant speed) motor is running. • Default value is 0%. **Example:** An ACS550 operates three parallel pumps that maintain water pressure in a pipe. • 4011 INTERNAL SETPNT sets a constant pressure reference that controls the pressure in the pipe. • The speed regulated pump operates alone at low water consumption levels. • As water consumption increases, first one constant speed pump operates, then, the second. • As flow increases, the pressure at the output end of the pipe drops relative to the pressure measured at the input end. As auxiliary motors step in to increase the flow, the adjustments below correct the reference to more closely match the output pressure. • When the first auxiliary pump operates, increase the reference with parameter 8103 REFERENCE STEP 1. • When both auxiliary pumps operate, increase the reference with parameter 8103 reference step 1 + parameter 8104 reference step 2. • When three auxiliary pumps operate, increase the reference with parameter 8103 REFERENCE STEP 1 + parameter 8104 REFERENCE STEP 2 + parameter 8105 REFERENCE STEP 3.

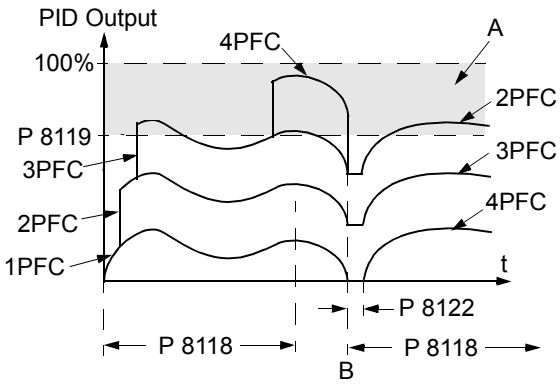
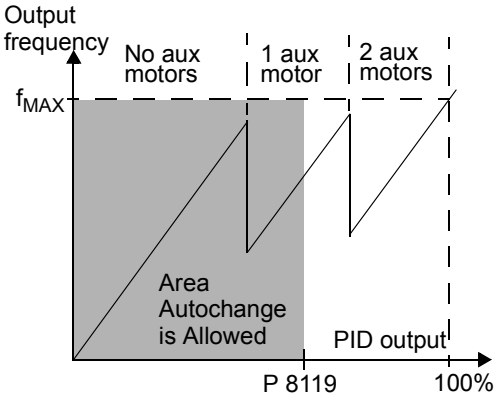
Code	Description
8104	**REFERENCE STEP 2** Sets a percentage value that is added to the process reference. • Applies only when at least two auxiliary (constant speed) motors are running. • See parameter 8103 REFERENCE STEP1.
8105	**REFERENCE STEP 3** Sets a percentage value that is added to the process reference. • Applies only when at least three auxiliary (constant speed) motors are running. • See parameter 8103 REFERENCE STEP1.
8109	**START FREQ 1** Sets the frequency limit used to start the first auxiliary motor. The first auxiliary motor starts if: • No auxiliary motors are running. • ACS550 output frequency exceeds the limit: 8109 + 1 Hz. • Output frequency stays above a relaxed limit (8109 - 1 Hz) for at least the time: 8115 AUX MOT START D. After the first auxiliary motor starts: • Output frequency decreases by the value = (8109 START FREQ 1) - (8112 LOW FREQ 1). • In effect, the output of the speed regulated motor drops to compensate for the input from the auxiliary motor. See figure, where: • A = (8109 START FREQ 1) - (8112 LOW FREQ 1) • B = Output frequency increase during the start delay. • C = Diagram showing auxiliary motor's run status as frequency increases (1 = On). **Note!** 8109 START FREQ 1 value must be between: • 8112 LOW FREQ 1 • (2008 MAXIMUM FREQ) -1. 
8110	**START FREQ 2** Sets the frequency limit used to start the second auxiliary motor. • See 8109 START FREQ 1 for a complete description of the operation. The second auxiliary motor starts if: • One auxiliary motor is running. • ACS550 output frequency exceeds the limit: 8110 + 1. • Output frequency stays above the relaxed limit (8110 - 1 Hz) for at least the time: 8115 AUX MOT START D.
8111	**START FREQ 3** Sets the frequency limit used to start the third auxiliary motor. • See 8109 START FREQ 1 for a complete description of the operation. The third auxiliary motor starts if: • Two auxiliary motors are running. • ACS550 output frequency exceeds the limit: 8111 + 1 Hz. • Output frequency stays above the relaxed limit (8111 - 1 Hz) for at least the time: 8115 AUX MOT START D.

Code	Description
8112	**LOW FREQ 1** Sets the frequency limit used to stop the first auxiliary motor. The first auxiliary motor stops if: • The first auxiliary motor is running alone. • ACS550 output frequency drops below the limit: 8112 - 1. • Output frequency stays below the relaxed limit (8112 + 1 Hz) for at least the time: 8116 AUX MOT STOP D. After the first auxiliary motor stops: • Output frequency increases by the value = (8109 START FREQ 1) - (8112 LOW FREQ 1). • In effect, the output of the speed regulated motor increases to compensate for the loss of the auxiliary motor. See figure, where: • A = (8109 START FREQ 1) - (8112 LOW FREQ 1) • B = Output frequency decrease during the stop delay. • C = Diagram showing auxiliary motor's run status as frequency decreases (1 = On). • Grey path = Shows hysteresis – if time is reversed, the path backwards is not the same. For details on the path for starting, see the diagram at 8109 START FREQ 1. **Note!** Low Frequency 1 value must be between: • (2007 MINIMUM FREQ) +1. • 8109 START FREQ 1 
8113	**LOW FREQ 2** Sets the frequency limit used to stop the second auxiliary motor. • See 8112 LOW FREQ 1 for a complete description of the operation. The second auxiliary motor stops if: • Two auxiliary motors are running. • ACS550 output frequency drops below the limit: 8113 - 1. • Output frequency stays below the relaxed limit (8113 + 1 Hz) for at least the time: 8116 AUX MOT STOP D.
8114	**LOW FREQ 3** Sets the frequency limit used to stop the third auxiliary motor. • See 8112 LOW FREQ 1 for a complete description of the operation. The third auxiliary motor stops if: • Three auxiliary motors are running. • ACS550 output frequency drops below the limit: 8114 - 1. • Output frequency stays below the relaxed limit (8114 + 1 Hz) for at least the time: 8116 AUX MOT STOP D.
8115	**AUX MOT START D** Sets the Start Delay for the auxiliary motors. • The output frequency must remain above the start frequency limit (parameter 8109, 8110, or 8111) for this time period before the auxiliary motor starts. • See 8109 START FREQ 1 for a complete description of the operation.
8116	**AUX MOT STOP D.** Sets the Stop Delay for the auxiliary motors. • The output frequency must remain below the low frequency limit (parameter 8112, 8113, or 8114) for this time period before the auxiliary motor stops. • See 8112 LOW FREQ 1 for a complete description of the operation.

Code	Description
8117	**NR OF AUX MOT** Sets the number of auxiliary motors. • Each auxiliary motor requires a relay output, which the drive uses to send start/stop signals. • The Autochange function, if used, requires an additional relay output for the speed regulated motor. • The following describes the set-up of the required relay outputs. **Relay Outputs** As noted above, each auxiliary motor requires a relay output, which the drive uses to send start/stop signals. The following describes how the drive keeps track of motors and relays. • The ACS550 provides relay outputs RO1…RO3. • An external digital output module can be added to provide relay outputs RO4…RO6. • Parameters 1401…1403 and 1410…1412 define, respectively, how relays RO1…RO6 are used – the parameter value 31 PFC defines the relay as used for PFC. • The ACS550 assigns auxiliary motors to relays in ascending order. If the Autochange function is disabled, the first auxiliary motor is the one connected to the first relay with a parameter setting = 31 PFC, and so on. If the Autochange function is used, the assignments rotate. Initially, the speed regulated motor is the one connected to the first relay with a parameter setting = 31 PFC, the first auxiliary motor is the one connected to the second relay with a parameter setting = 31 PFC, and so on.  Standard PFC mode  PFC with Autochange mode

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>
• The table below shows the ACS550 PFC motor assignments for some typical settings in the Relay Output parameters (1401…1403 and 1410…1412), where the settings are either =31 (PFC), or =X (anything but 31), and where the Autochange function is disabled (8118 AUTOCHNG INTERV = 0).
<table>
<tr><th colspan="7">Parameter Setting</th><th colspan="6">ACS550 Relay Assignment</th></tr>
<tr><th rowspan="2">1401</th><th rowspan="2">1402</th><th rowspan="2">1403</th><th rowspan="2">1410</th><th rowspan="2">1411</th><th rowspan="2">1412</th><th rowspan="2">8117</th><th colspan="6">Autochange Disabled</th></tr>
<tr><th>RO1</th><th>RO2</th><th>RO3</th><th>RO4</th><th>RO5</th><th>RO6</th></tr>
<tr><td>31</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>1</td><td>Aux.</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>31</td><td>31</td><td>X</td><td>X</td><td>X</td><td>X</td><td>2</td><td>Aux.</td><td>Aux.</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>31</td><td>31</td><td>31</td><td>X</td><td>X</td><td>X</td><td>3</td><td>Aux.</td><td>Aux.</td><td>Aux.</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>X</td><td>31</td><td>31</td><td>X</td><td>X</td><td>X</td><td>2</td><td>X</td><td>Aux.</td><td>Aux.</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>31</td><td>X</td><td>31</td><td>2</td><td>X</td><td>X</td><td>X</td><td>Aux.</td><td>X</td><td>Aux.</td></tr>
<tr><td>31</td><td>31</td><td>X</td><td>X</td><td>X</td><td>X</td><td>1*</td><td>Aux.</td><td>Aux.</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
*= One additional relay output for the PFC that is in use. One motor is in “sleep” when the other is rotating.
• The table below shows the ACS550 PFC motor assignments for some typical settings in the Relay Output parameters (1401…1403 and 1410…1412), where the settings are either =31 (PFC), or =X (anything but 31), and where the Autochange function is enabled (8118 AUTOCHNG INTERV = value > 0).
<table>
<tr><th colspan="7">Parameter Setting</th><th colspan="6">ACS550 Relay Assignment</th></tr>
<tr><th rowspan="2">1401</th><th rowspan="2">1402</th><th rowspan="2">1403</th><th rowspan="2">1410</th><th rowspan="2">1411</th><th rowspan="2">1412</th><th rowspan="2">8117</th><th colspan="6">Autochange Disabled</th></tr>
<tr><th>RO1</th><th>RO2</th><th>RO3</th><th>RO4</th><th>RO5</th><th>RO6</th></tr>
<tr><td>31</td><td>31</td><td>X</td><td>X</td><td>X</td><td>X</td><td>1</td><td>PFC</td><td>PFC</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>31</td><td>31</td><td>31</td><td>X</td><td>X</td><td>X</td><td>2</td><td>PFC</td><td>PFC</td><td>PFC</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>x</td><td>31</td><td>31</td><td>X</td><td>X</td><td>X</td><td>1</td><td>X</td><td>PFC</td><td>PFC</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>31</td><td>X</td><td>31</td><td>1</td><td>X</td><td>X</td><td>X</td><td>PFC</td><td>X</td><td>PFC</td></tr>
<tr><td>31</td><td>31</td><td>X</td><td>X</td><td>X</td><td>X</td><td>0**</td><td>PFC</td><td>PFC</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
• ** = No auxiliary motors, but the autochange function is in use. Working as a standard PID-control.
</td></tr>
<tr><td>8118</td><td>
AUTOCHNG INTERV
Controls operation of the Autochange function and sets the interval between changes.
• The Autochange time interval only applies to the time when the speed regulated motor is running.
• See parameter 8119 AUTOCHNG LEVEL for an overview of the Autochange function.
• The drive always coasts to a stop when autochange is performed.
• Autochange enabled requires parameter 8120 INTERLOCKS = value > 0.
0.0 = NOT SEL – Disables the Autochange function.
0.1…336 = The operating time interval (the time when the start signal is on) between automatic motor changes.
Warning! When enabled, the Autochange function requires the interlocks (8120 interlocks = value > 0) enabled. During autochange the interlocks interrupt the drive’s power output, preventing damage to the contacts.


PFC with Autochange mode
</td></tr>
</table>

Code	Description
8119	**AUTOCHNG LEVEL** Sets an upper limit, as a percent of output capacity, for the autochange logic. When the output from the PID/PFC control block exceeds this limit, autochange is prevented. For example, use this parameter to deny autochange when the Pump-Fan system is operating near maximum capacity. **Autochange Overview** The purpose of the autochange operation is to equalize duty time between multiple motors used in a system. At each autochange operation: • A different motor takes a turn connected to the ACS550 output – the speed regulated motor. • The starting order of the other motors rotates. The Autochange function requires: • External switchgear for changing the drive's output power connections. • Parameter 8120 INTERLOCKS = value > 0. Autochange is performed when: • The running time since the previous autochange reaches the time set by 8118 AUTOCHNG INTERV • The PFC input is below the level set by this parameter, 8119 AUTOCHNG LEVEL. **Note!** The ACS550 always coasts to stop when autochange is performed. In an autochange, the Autochange function does all of the following (see figure): • Initiates a change when the running time, since the last autochange, reaches 8118 AUTOCHNG INTERV, and PFC input is below limit 8119 AUTOCHNG LEVEL. • Stops the speed regulated motor. • Switches off the contactor of the speed regulated motor. • Increments the starting order counter, to change the starting order for the motors. • Identifies the next motor in line to be the speed regulated motor. • Switches off the above motor's contactor, if the motor was running. Any other running motors are not interrupted. • Switches on the contactor of the new speed regulated motor. The autochange switchgear connects this motor to the ACS550 power output. • Delays motor start for the time 8122 PFC START DELAY. • Starts the speed regulated motor. • Identifies the next constant speed motor in the rotation. • Switches the above motor on, but only if the new speed regulated motor had been running (as a constant speed motor) – This step keeps an equal number of motors running before and after autochange. • Continues with normal PFC operation.  A = Area above 8119 AUTOCHNG LEVEL – autochange not allowed. B = Autochange occurs. 1PFC, etc. = PID output associated with each motor. **Starting Order Counter** The operation of the starting-order counter: • The relay output parameter definitions (1401…1403 and 1410…1412)) establish the initial motor sequence. (The lowest parameter number with a value 31 (PFC) identifies the relay connected to 1PFC, the first motor, and so on.) • Initially, 1PFC = speed regulated motor, 2PFC = 1st auxiliary motor, etc. • The first autochange shifts the sequence to: 2PFC = speed regulated motor, 3PFC = 1st auxiliary motor, …, 1PFC = last auxiliary motor. • The next autochange shifts the sequence again, and so on. • If the autochange cannot start a needed motor because all inactive motors are interlocked, the drive displays an alarm (2015, PFC INTERLOCK).  • When ACS550 power supply is switched off, the counter preserves the current Autochange rotation positions in permanent memory. When power is restored, the Autochange rotation starts at the position stored in memory. • If the PFC relay configuration is changed (or if the PFC enable value is changed), the rotation is reset. (See the first bullet above.)

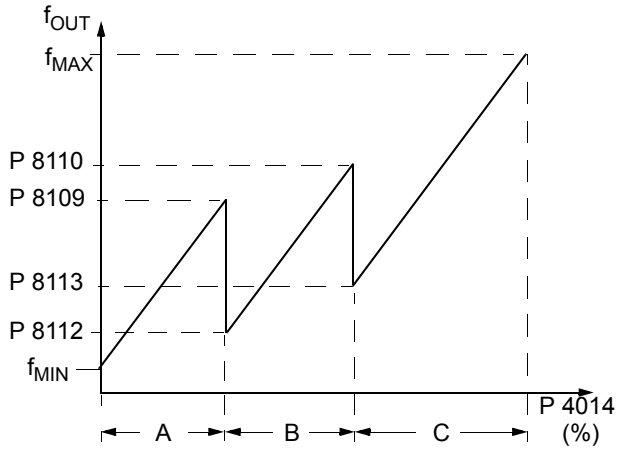
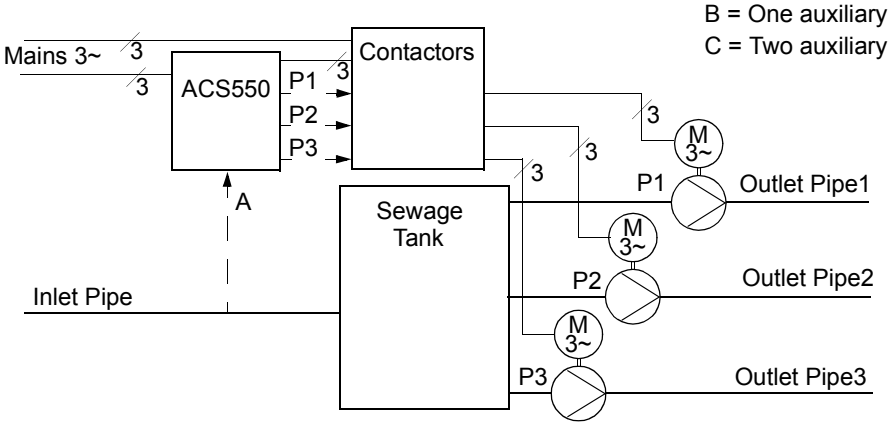
<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>8120</td><td>
INTERLOCKS
Defines operation of the Interlock function. When the Interlock function is enabled:
• An interlock is active when its command signal is absent.
• An interlock is inactive when its command signal is present.
• The ACS550 will not start if a start command occurs when the speed regulated motor’s interlock is active – the control panel displays an alarm (2015, PFC INTERLOCK).
Wire each Interlock circuit as follows:
• Wire a contact of the motor’s On/Off switch to the Interlock circuit – the drive’s PFC logic can then recognize that the motor is switched off, and start the next available motor.
• Wire a contact of the motor thermal relay (or other protective device in the motor circuit) to the Interlock input – the drive’s PFC logic can then recognize that a motor fault is activated and stop the motor.
0 = NOT SEL – Disables the Interlock function. All digital inputs are available for other purposes.
• Requires 8118 AUTOCHNG INTERV = 0 (The Autochange function must be disabled if Interlock function is disabled.)
1 = DI1 – Enables the Interlock function, and assigns a digital input (starting with DI1) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on:
• The number of PFC relays (number of parameters 1401…1403 and 1410…1412) and with value = 31 PFC)
• The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).
<table>
<tr><th>No. PFC Relays</th><th>Autochange Disabled (P 8118)</th><th>Autochange Enabled (P 8118)</th></tr>
<tr><td>0</td><td>DI1: Speed Reg Motor
DI2…DI6: Free</td><td>Not allowed</td></tr>
<tr><td>1</td><td>DI1: Speed Reg Motor
DI2: First PFC Relay
DI3…DI6: Free</td><td>DI1: First PFC Relay
DI2…DI6: Free</td></tr>
<tr><td>2</td><td>DI1: Speed Reg Motor
DI2: First PFC Relay
DI3: Second PFC Relay
DI4…DI6: Free</td><td>DI1: First PFC Relay
DI2: Second PFC Relay
DI3…DI6: Free</td></tr>
<tr><td>3</td><td>DI1: Speed Reg Motor
DI2: First PFC Relay
DI3: Second PFC Relay
DI4: Third PFC Relay
DI5…DI6: Free</td><td>DI1: First PFC Relay
DI2: Second PFC Relay
DI3: Third PFC Relay
DI4…DI6: Free</td></tr>
<tr><td>4</td><td>DI1: Speed Reg Motor
DI2: First PFC Relay
DI3: Second PFC Relay
DI4: Third PFC Relay
DI5: Fourth PFC Relay
DI6: Free</td><td>DI1: First PFC Relay
DI2: Second PFC Relay
DI3: Third PFC Relay
DI4: Fourth PFC Relay
DI5…DI6: Free</td></tr>
<tr><td>5</td><td>DI1: Speed Reg Motor
DI2: First PFC Relay
DI3: Second PFC Relay
DI4: Third PFC Relay
DI5: Fourth PFC Relay
DI6: Fifth PFC Relay</td><td>DI1: First PFC Relay
DI2: Second PFC Relay
DI3: Third PFC Relay
DI4: Fourth PFC Relay
DI5: Fifth PFC Relay
DI6: Free</td></tr>
<tr><td>6</td><td>Not allowed</td><td>DI1: First PFC Relay
DI2: Second PFC Relay
DI3: Third PFC Relay
DI4: Fourth PFC Relay
DI5: Fifth PFC Relay
DI6: Sixth PFC Relay</td></tr>
</table>
</td></tr>
</table>

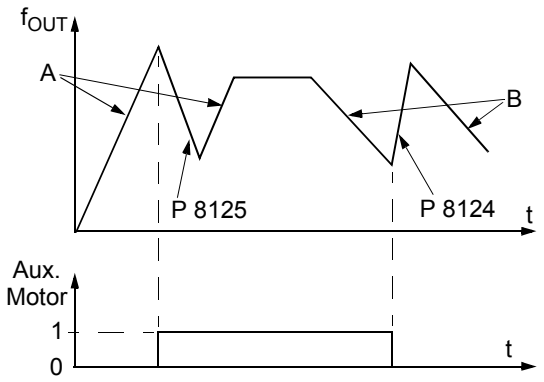
<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>2 = DI2 – Enables the Interlock function, and assigns a digital input (starting with DI2) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on:
• The number of PFC relays (number of parameters 1401…1403 and 1410…1412) with value = 31 PFC)
• The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).

<table>
<tr><th>No. PFC Relays</th><th>Autochange Disabled (P 8118)</th><th>Autochange Enabled (P 8118)</th></tr>
<tr><td>0</td><td>DI1: Free
DI2: Speed Reg Motor
DI3…DI6: Free</td><td>Not allowed</td></tr>
<tr><td>1</td><td>DI1: Free
DI2: Speed Reg Motor
DI3: First PFC Relay
DI4…DI6: Free</td><td>DI1: Free
DI2: First PFC Relay
DI3…DI6: Free</td></tr>
<tr><td>2</td><td>DI1: Free
DI2: Speed Reg Motor
DI3: First PFC Relay
DI4: Second PFC Relay
DI5…DI6: Free</td><td>DI1: Free
DI2: First PFC Relay
DI3: Second PFC Relay
DI4…DI6: Free</td></tr>
<tr><td>3</td><td>DI1: Free
DI2: Speed Reg Motor
DI3: First PFC Relay
DI4: Second PFC Relay
DI5: Third PFC Relay
DI6: Free</td><td>DI1: Free
DI2: First PFC Relay
DI3: Second PFC Relay
DI4: Third PFC Relay
DI5…DI6: Free</td></tr>
<tr><td>4</td><td>DI1: Free
DI2: Speed Reg Motor
DI3: First PFC Relay
DI4: Second PFC Relay
DI5: Third PFC Relay
DI6: Fourth PFC Relay</td><td>DI1: Free
DI2: First PFC Relay
DI3: Second PFC Relay
DI4: Third PFC Relay
DI5: Fourth PFC Relay
DI6: Free</td></tr>
<tr><td>5</td><td>Not allowed</td><td>DI1: Free
DI2: First PFC Relay
DI3: Second PFC Relay
DI4: Third PFC Relay
DI5: Fourth PFC Relay
DI6: Fifth PFC Relay</td></tr>
<tr><td>6</td><td>Not allowed</td><td>Not allowed</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>
3 = DI3 – Enables the Interlocks function, and assigns a digital input (starting with DI3) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on:
• The number of PFC relays (number of parameters 1401…1403 and 1410…1412) with value = 31 PFC)
• The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).
<table>
<tr><th>No. PFC Relays</th><th>Autochange Disabled (P 8118)</th><th>Autochange Enabled (P 8118)</th></tr>
<tr><td>0</td><td>DI1…DI2: Free
DI3: Speed Reg Motor
DI4…DI6: Free</td><td>Not allowed</td></tr>
<tr><td>1</td><td>DI1…DI2: Free
DI3: Speed Reg Motor
DI4: First PFC Relay
DI5…DI6: Free</td><td>DI1…DI2: Free
DI3: First PFC Relay
DI4…DI6: Free</td></tr>
<tr><td>2</td><td>DI1…DI2: Free
DI3: Speed Reg Motor
DI4: First PFC Relay
DI5: Second PFC Relay
DI6: Free</td><td>DI1…DI2: Free
DI3: First PFC Relay
DI4: Second PFC Relay
DI5…DI6: Free</td></tr>
<tr><td>3</td><td>DI1…DI2: Free
DI3: Speed Reg Motor
DI4: First PFC Relay
DI5: Second PFC Relay
DI6: Third PFC Relay</td><td>DI1…DI2: Free
DI3: First PFC Relay
DI4: Second PFC Relay
DI5: Third PFC Relay
DI6: Free</td></tr>
<tr><td>4</td><td>Not allowed</td><td>DI1…DI2: Free
DI3: First PFC Relay
DI4: Second PFC Relay
DI5: Third PFC Relay
DI6: Fourth PFC Relay</td></tr>
<tr><td>5…6</td><td>Not allowed</td><td>Not allowed</td></tr>
</table>
4 = DI4 – Enables the Interlock function, and assigns a digital input (starting with DI4) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on:
• The number of PFC relays (number of parameters 1401…1403 and 1410…1412) with value = 31 PFC)
• The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).
<table>
<tr><th>No. PFC Relays</th><th>Autochange Disabled (P 8118)</th><th>Autochange Enabled (P 8118)</th></tr>
<tr><td>0</td><td>DI1…DI3: Free
DI4: Speed Reg Motor
DI5…DI6: Free</td><td>Not allowed</td></tr>
<tr><td>1</td><td>DI1…DI3: Free
DI4: Speed Reg Motor
DI5: First PFC Relay
DI6: Free</td><td>DI1…DI3: Free
DI4: First PFC Relay
DI5…DI6: Free</td></tr>
<tr><td>2</td><td>DI1…DI3: Free
DI4: Speed Reg Motor
DI5: First PFC Relay
DI6: Second PFC Relay</td><td>DI1…DI3: Free
DI4: First PFC Relay
DI5: Second PFC Relay
DI6: Free</td></tr>
<tr><td>3</td><td>Not allowed</td><td>DI1…DI3: Free
DI4: First PFC Relay
DI5: Second PFC Relay
DI6: Third PFC Relay</td></tr>
<tr><td>4…6</td><td>Not allowed</td><td>Not allowed</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td></td><td>
5 = DI5 – Enables the Interlock function, and assigns a digital input (starting with DI5) to the interlock signal for each PFC relay. These assignments are defined in the following table and depend on:
• The number of PFC relays (number of parameters 1401…1403 and 1410…1412) with value = 31 PFC)
• The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).
<table>
<tr><th>No. PFC Relays</th><th>Autochange Disabled (P 8118)</th><th>Autochange Enabled (P 8118)</th></tr>
<tr><td>0</td><td>DI1…DI4: Free
DI5: Speed Reg Motor
DI6: Free</td><td>Not allowed</td></tr>
<tr><td>1</td><td>DI1…DI4: Free
DI5: Speed Reg Motor
DI6: First PFC Relay</td><td>DI1…DI4: Free
DI5: First PFC Relay
DI6: Free</td></tr>
<tr><td>2</td><td>Not allowed</td><td>DI1…DI4: Free
DI5: First PFC Relay
DI6: Second PFC Relay</td></tr>
<tr><td>3…6</td><td>Not allowed</td><td>Not allowed</td></tr>
</table>
6 = DI6 – Enables the Interlock function, and assigns digital input DI6 to the interlock signal for the speed regulated motor.
• Requires 8118 AUTOCHNG INTERV = 0.
<table>
<tr><th>No. PFC Relays</th><th>Autochange Disabled</th><th>Autochange Enabled</th></tr>
<tr><td>0</td><td>DI1…DI5: Free
DI6: Speed Reg Motor</td><td>Not allowed</td></tr>
<tr><td>1</td><td>Not allowed</td><td>DI1…DI5: Free
DI6: First PFC Relay</td></tr>
<tr><td>2...6</td><td>Not allowed</td><td>Not allowed</td></tr>
</table>
</td></tr>
</table>

Code	Description
8121	**REG BYPASS CTRL** Selects Regulator by-pass control. When enabled, Regulator by-pass control provides a simple control mechanism without a PID regulator. • Use Regulator by-pass control only in special applications. 0 = NO – Disables Regulator by-pass control. The drive uses the normal PFC reference: 1106 REF2 SELECT. 1 = YES – Enables Regulator by-pass control. • The process PID regulator is bypassed. Actual value of PID is used as the PFC reference (input). Normally EXT REF2 is used as the PFC reference. • The drive uses the feedback signal defined by 4014 FBK SEL (or 4114) for the PFC frequency reference. • The figure shows the relation between the control signal 4014 FBK SEL (OR 4114) and the speed regulated motor's frequency in a three-motor system. Example: In the diagram below, the pumping station's outlet flow is controlled by the measured inlet flow (A).  A = No auxiliary motors running B = One auxiliary motor running C = Two auxiliary motors running 
8122	**PFC START DELAY** Sets the start delay for speed regulated motors in the system. Using the delay, the drive works as follows: • Switches on the contactor of the speed regulated motor – connecting the motor to the ACS550 power output. • Delays motor start for the time 8122 PFC START DELAY. • Starts the speed regulated motor. • Starts auxiliary motors. See parameter 8115 for delay. **Warning! Motors equipped with star-delta starters require a PFC Start Delay.** • After the ACS550 relay output switches a motor On, the star-delta starter must switch to the star-connection and then back to the delta-connection before the drive applies power. • So, the PFC Start Delay must be longer than the time setting of the star-delta starter.
8123	**PFC ENABLE** Selects PFC control. When enabled, PFC control: • Switches in, or out, auxiliary constant speed motors as output demand increases or decreases. Parameters 8109 START FREQ 1 to 8114 LOW FREQ 3 define the switch points in terms of the drive output frequency. • Adjusts the speed regulated motor output down, as auxiliary motors are added, and adjusts the speed regulated motor output up, as auxiliary motors are taken off line. • Provides Interlock functions, if enabled. • Requires 9904 MOTOR CTRL MODE = 3 SCALAR. 0 = NOT SEL – Disables PFC control. 1 = ACTIVE – Enables PFC control.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>8124</td><td>ACC IN AUX STOP
Sets the PFC acceleration time for a zero-to-maximum frequency ramp. This PFC acceleration ramp:
• Applies to the speed regulated motor, when an auxiliary motor is switched off.
• Replaces the acceleration ramp defined in Group 22: Accel / Decel.
• Applies only until the output of the regulated motor increases by an amount equal to the output of the switched off auxiliary motor. Then the acceleration ramp defined in Group 22: Accel / Decel applies.
0 = NOT SEL.
0.1…1800 = Activates this function using the value entered as the acceleration time.</td><td rowspan="2"> 

• A = speed regulated motor accelerating using Group 22 parameters (2202 or 2205).
• B = speed regulated motor decelerating using Group 22 parameters (2203 or 2206).
• At aux. motor start, speed regulated motor decelerates using 8125 DEC IN AUX START.
• At aux. motor stop, speed regulated motor accelerates using 8124 ACC IN AUX STOP.</td></tr>
<tr><td>8125</td><td>DEC IN AUX START
Sets the PFC deceleration time for a maximum-to-zero frequency ramp. This PFC deceleration ramp:
• Applies to the speed regulated motor, when an auxiliary motor is switched on.
• Replaces the deceleration ramp defined in Group 22 ACCEL / DECEL.
• Applies only until the output of the regulated motor decreases by an amount equal to the output of the auxiliary motor. Then the deceleration ramp defined in Group 22 ACCEL / DECEL applies.
0 = NOT SEL.
0.1…1800 = Activates this function using the value entered as the deceleration time.</td></tr>
<tr><td>8126</td><td colspan="2">TIMED AUTOCHNG
Sets the autochange using the Timer function. See parameter 8119 AUTOCHANGE LEVEL.
0 = NOT SEL.
1 = Timer function 1 – Enables autochange when Timer function 1 is active.
2…4 = Timer function 2…4 – Enables autochange when Timer function 2…4 is active.</td></tr>
</table>

Group 98: Options

This group configures for options, in particular, enabling serial communication with the drive.

Code	Description
9802	**COMM PROT SEL** Selects the communication protocol. 0 = NOT SEL – No communication protocol selected. 1 = STD MODBUS – The drive communicates via a Modbus controller via the RS485 serial link (X1-communications, terminal). • See also parameter Group 53 EFB PROTOCOL. 4 = EXT FBA – The drive communicates via a fieldbus adapter module in option slot 2 of the drive. • See also parameter Group 51 EXT COMM MODULE.

Standard Serial Communication

This section describes ACS550 serial communication.

- The ACS550 includes, as standard, Modbus® communication on the RS485 port (terminals 28…32).
- You can connect other fieldbus types using a special fieldbus adapter module connection to option slot 2. For more information on fieldbus options, contact your supplier.

When using serial communication, the ACS550 can either:

- Receive all of its control information from the fieldbus, or
- Be controlled from some combination of fieldbus control and other available control locations, such as digital or analog inputs, and the control panel.

Introduction to Modbus

The Modbus protocol was introduced by Modicon, Inc. for use in control environments featuring Modicon programmable controllers. Due to its ease of use and implementation, this common PLC language was quickly adopted as a de-facto standard for integration of a wide variety of master controllers and slave devices.

Modbus is a serial, asynchronous protocol. Transactions are half-duplex, featuring a single Master controlling one or more Slaves. While RS232 can be used for point-to-point communication between a single Master and a single Slave, a more common implementation features a multi-drop RS485 network with a single Master controlling multiple Slaves. The ACS550 features RS485 for its Modbus physical interface.

Modbus specification defines two distinct transmission modes: ASCII and RTU. The ACS550 supports RTU only.

The remainder of this chapter assumes that you have a basic understanding of the Modbus Protocol and its application in a control environment. If you need additional information regarding Modbus, contact your ABB supplier for a copy of the Modbus Protocol Reference Guide.

Activating Modbus Protocol

Per the default factory setting, fieldbus control is not operational. To activate standard Modbus, set parameter 9802 COMM PROT SEL = 1 (STD MODBUS). After this single modification, the ACS550 is ready to communicate via the RS485 port using the default communication settings. At this point, you can read and write drive parameters using serial communication.

Communication Settings

Communication settings define the station number, communication speed, parity checking, and number of stop bits. These settings are defined using parameters in Group 53: EFB Protocol. The default settings are defined in the following table.

	Channel 1 Communication Settings				
	Station Number	**Communication Speed**	**Parity Bit**	**Stop Bits**	**Number Of Data Bits**
Parameter	5302	5303	5304		None
Default Setting	1	9600 bps	None	2	8

For more information on these parameters, see *Group 53: EFB Protocol* on page *135*.

Note! After any changes to the communication settings, protocol must be reactivated by either cycling the drive power, or by clearing and then restoring the station Id (5302).

Loss of Communication

Use Group 30: Fault Functions to configure ACS550 behavior if communication is lost. The default settings are defined in the following table:

Parameter	Default Setting
3018 COMM FAULT FUNC	= 0 (NOT SEL) – No response to loss of serial communication.
3019 COMM FAULT TIME	= 3 – Loss of serial communication must be at least 3 seconds before specified response (if any).

For more information on these parameters, see *Group 30: Fault Functions* on page *108*.

Diagnostic Counters

The ACS550 includes three parameters (5306, 5307, 5308) that act as diagnostic counters for use in debugging the Modbus system. These counters:

- Count to 65535, then roll over to 0.
- Store their values in permanent memory when power is disconnected.
- Can be reset from either the control panel or serial communication by writing a zero to the parameter.

Control Locations

The ACS550 can receive control information from multiple sources, including digital I/O, analog I/O, the control panel, and serial communication. To control the ACS550 via the RS485 port, you must:

- Set parameters to accept serial communication control commands (see *The CONTROL WORD and the STATUS WORD – Standard Profile (ABB DRIVES)* section below) and/or frequency references (see *References* section below).

- Using the drive control panel, set the ACS550 to remote control.

Controlling Relays

You can use serial communication to control relays as described below.

- Use parameters in Group 14, Relay Outputs to configure a relay output to respond to serial communication.
- Control the selected relay(s) by writing to parameter 0134 (Modbus holding register 40134) or to the appropriate Modbus coil (Modbus coils 33…38).

For example: To control relays 1 and 2 using serial communication:
Set parameters 1401 RELAY OUTPUT 1 and 1402 RELAY OUTPUT 1 = 35 (COMM).

Then:

- To turn Relay 1 On, either:
  - Write “1” to Modbus holding register 40134, or
  - Force Modbus coil 33 to On.
- To turn Relay 2 On, either:
  - Write “2” to Modbus holding register 40134, or
  - Force Modbus coil 34 to On.
- To turn both Relay 1 and 2 On, either:
  - Write “3” to Modbus holding register 40134, or
  - Force Modbus coils 33 and 34 to On.

ACS550 Mapping to Modbus Reference Space

Communication Profiles

When communicating by Modbus, the ACS550 supports multiple profiles for control and status information. Parameter 5305 (EFB CTRL PROFILE) selects the profile used.

- ABB DRIVES (Standard) – The primary (and default) profile is the ABB Drives Profile, which standardizes the control interface among ABB drives. This profile is based on the PROFIBUS interface, and is discussed in detail in the following sections.
- ACS550 (Alternate) – An alternate profile is called the ACS550 Profile. It extends the control and status interface to 32 bits, and is the internal interface between the main drive application and the embedded fieldbus environment. This profile is intended for advanced users only. This manual does not cover the ACS550 Profile in detail. Contact your ABB supplier if you need more information on this profile.

Modbus Addressing

With Modbus, each function code implies access to a specific Modbus reference set. Thus, the leading digit is not included in the address field of a Modbus message.

Note: The ACS550 supports the zero-based addressing of the Modbus specification. Holding register 40002 is addressed as 0001 in a Modbus message. Similarly, coil 33 is addressed as 0032 in a Modbus message.

ACS550 parameters and I/O “map” to the Modbus reference space as defined in the following table.

ACS550	Modbus Reference Set	Supported Function Codes
• Control bits • Relay outputs	Coils (0xxxx)	• 01 – Read coil status • 05 – Force single coil • 15 – Force multiple coils (0x0F Hex)
• Status bits • Discrete inputs	Discrete inputs (1xxxx)	• 02 – Read input status
• Analog inputs	Input registers (3xxxx)	• 04 – Read input registers
• CONTROL WORD • STATUS WORD • References • Parameters	Holding registers (4xxxx)	• 03 – Read 4xxxx registers • 06 – Preset single 4xxxx register • 16 – Preset multiple 4xxxx registers (0x10 Hex) • 23 – Read/write 4xxxx registers (0x17 Hex)

The following sections describe, in detail, the mapping to each Modbus reference set.

0xxxx Mapping – Modbus Coils

The drive maps the following information to the 0xxxx Modbus set called Modbus Coils:

- Bit-wise map of the CONTROL WORD (selected using parameter 5305 EFB CTRL PROFILE). The first 32 coils are reserved for this purpose.
- Relay output states, numbered sequentially beginning with coil 00033.

The following table summarizes the 0xxxx reference set:

Modbus Ref.	ACS550		
	Internal Location (All Profiles)	Standard Profile (ABB DRIVES) 5305 EFB CTRL PROFILE = 0	Alternate Profile (ACS550) 5305 EFB CTRL PROFILE = 1
00001	CONTROL WORD - Bit 0	OFF1*	STOP
00002	CONTROL WORD - Bit 1	OFF2*	START
00003	CONTROL WORD - Bit 2	OFF3*	REVERSE
00004	CONTROL WORD - Bit 3	START	LOCAL
00005	CONTROL WORD - Bit 4	N/A	RESET
00006	CONTROL WORD - Bit 5	RAMP_HOLD*	EXT2
00007	CONTROL WORD - Bit 6	RAMP_IN_ZERO*	RUN_DISABLE
00008	CONTROL WORD - Bit 7	RESET	STPMODE_R
00009	CONTROL WORD - Bit 8	N/A	STPMODE_EM
00010	CONTROL WORD - Bit 9	N/A	STPMODE_C
00011	CONTROL WORD - Bit 10	N/A	RAMP_2

Modbus Ref.	ACS550		
	Internal Location (All Profiles)	Standard Profile (ABB DRIVES) 5305 EFB CTRL PROFILE = 0	Alternate Profile (ACS550) 5305 EFB CTRL PROFILE = 1
00012	CONTROL WORD - Bit 11	EXT2	RAMP_OUT_0
00013	CONTROL WORD - Bit 12	N/A	RAMP_HOLD
00014	CONTROL WORD - Bit 13	N/A	RAMP_IN_0
00015	CONTROL WORD - Bit 14	N/A	REQ_LOCALLOCK
00016	CONTROL WORD - Bit 15	N/A	TORQLIM2
00017… **0**0032	Reserved	Reserved	Reserved
00033	Relay Output 1	Relay Output 1	Relay Output 1
00034	Relay Output 2	Relay Output 2	Relay Output 2
00035	Relay Output 3	Relay Output 3	Relay Output 3
00036	Relay Output 4	Relay Output 4	Relay Output 4
00037	Relay Output 5	Relay Output 5	Relay Output 5
00038	Relay Output 6	Relay Output 6	Relay Output 6

Note: * = Active low

For the 0xxxx registers:

- Status is always readable.
- Forcing is allowed by user configuration of the drive for fieldbus control.
- Additional relay outputs are added sequentially.

The ACS550 supports the following Modbus function codes for coils:

Function Code	Description
01	Read coil status
05	Force single coil
15 (0x0F Hex)	Force multiple coils

1xxxx Mapping – Modbus Discrete Inputs

The drive maps the following information to the 1xxxx Modbus set called Modbus Discrete Inputs:

- Bit-wise map of the STATUS WORD (selected using parameter 5305 EFB CTRL PROFILE). The first 32 inputs are reserved for this purpose.
- Discrete hardware inputs, numbered sequentially beginning with input 33.

The following table summarizes the 1xxxx reference set:

Modbus Ref.	ACS550		
	Internal Location (All Profiles)	Standard Profile (ABB DRIVES) 5305 EFB CTRL PROFILE = 0	Alternate Profile (ACS550) 5305 EFB CTRL PROFILE = 1
10001	STATUS WORD - Bit 0	RDY_ON	READY
10002	STATUS WORD - Bit 1	RDY_RUN	ENABLED

Modbus Ref.	ACS550		
	Internal Location (All Profiles)	Standard Profile (ABB DRIVES) 5305 EFB CTRL PROFILE = 0	Alternate Profile (ACS550) 5305 EFB CTRL PROFILE = 1
10003	STATUS WORD - Bit 2	RDY_REF	STARTED
10004	STATUS WORD - Bit 3	TRIPPED	RUNNING
10005	STATUS WORD - Bit 4	OFF_2_STA*	ZERO_SPEED
10006	STATUS WORD - Bit 5	OFF_3_STA*	ACCELERATE
10007	STATUS WORD - Bit 6	SWC_ON_INHIB	DECELERATE
10008	STATUS WORD - Bit 7	ALARM	AT_SETPOINT
10009	STATUS WORD - Bit 8	AT_SETPOINT	LIMIT
10010	STATUS WORD - Bit 9	REMOTE	SUPERVISION
10011	STATUS WORD - Bit 10	ABOVE_LIMIT	REV_REF
10012	STATUS WORD - Bit 11	EXT2	REV_ACT
10013	STATUS WORD - Bit 12	RUN_ENABLE	PANEL_LOCAL
10014	STATUS WORD - Bit 13	N/A	FIELDBUS_LOCAL
10015	STATUS WORD - Bit 14	N/A	EXT2_ACT
10016	STATUS WORD - Bit 15	N/A	FAULT
10017	STATUS WORD - Bit 16	Reserved	ALARM
10018	STATUS WORD - Bit 17	Reserved	REQ_MAINT
10019	STATUS WORD - Bit 18	Reserved	DIRLOCK
10020	STATUS WORD - Bit 19	Reserved	LOCALLOCK
10021	STATUS WORD - Bit 20	Reserved	CTL_MODE
10022	STATUS WORD - Bit 21	Reserved	Reserved
10023	STATUS WORD - Bit 22	Reserved	Reserved
10024	STATUS WORD - Bit 23	Reserved	Reserved
10025	STATUS WORD - Bit 24	Reserved	Reserved
10026	STATUS WORD - Bit 25	Reserved	Reserved
10027	STATUS WORD - Bit 26	Reserved	REQ_CTL
10028	STATUS WORD - Bit 27	Reserved	REQ_REF1
10029	STATUS WORD - Bit 28	Reserved	REQ_REF2
10030	STATUS WORD - Bit 29	Reserved	REQ_REF2EXT
10031	STATUS WORD - Bit 30	Reserved	ACK_STARTINH
10032	STATUS WORD - Bit 31	Reserved	ACK_OFF_ILCK
10033	DI1	DI1	DI1
10034	DI2	DI2	DI2
10035	DI3	DI3	DI3
10036	DI4	DI4	DI4
10037	DI5	DI5	DI5
10038	DI6	DI6	DI6

Note: * = Active low

For the 1xxxx registers:

- Additional discrete inputs are added sequentially.

The ACS550 supports the following Modbus function codes for discrete inputs:

Function Code	Description
02	Read input status

3xxxx Mapping – Modbus Inputs

The drive maps the following information to the 3xxxx Modbus addresses called Modbus input registers:

- Any user defined analog inputs.

The following table summarizes the input registers:

Modbus Reference	ACS550 All Profiles	Remarks
30001	AI1	This register shall report the level of Analog Input 1 (0…100%).
30002	AI2	This register shall report the level of Analog Input 2 (0…100%).

The ACS550 supports the following Modbus function codes for 3xxxx registers:

Function Code	Description
04	Read 3xxxx input status

4xxxx Register Mapping

The drive maps its parameters and other data to the 4xxxx holding registers as follows:

- 40001…40099 map to drive control and actual values. These registers are described in the table below.
- 40101…49999 map to drive parameters 0101…9999. Register addresses that do not correspond to drive parameters are invalid. If there is an attempt to read or write outside the parameter addresses, the Modbus interface returns an exception code to the controller.

The following table summarizes the 4xxxx drive control registers 40001…40099 (for 4xxxx registers above 40099, see the drive parameter list, e.g. 40102 is parameter 0102):

Modbus Register	ACS550 Standard Profile (ABB DRIVES)	Access	Remarks
40001	CONTROL WORD	R/W	Supported only if the drive is configured to use the ABB Drives Profile (5305 = 0).
40002	Reference 1	R/W	Range = 0…+20000 (scaled to 0…1105 REF1 MAX), or -20000…0 (scaled to 1105 REF1 MAX…0).
40003	Reference 2	R/W	Range = 0…+10000 (scaled to 0…1108 REF2 MAX), or -10000…0 (scaled to 1108 REF2 MAX…0).
40004	ABB DRIVES PROFILE	R	This register is only supported if the drive is configured to use the ABB Drives Profile (5305 = 0).

Modbus Register	ACS550 Standard Profile (ABB DRIVES)	Access	Remarks
40005	Actual 1 (select using 5310)	R	By default, stores a copy of 0103 OUTPUT FREQ. Use parameter 5310 to select a different actual value for this register.
40006	Actual 2 (select using 5311)	R	By default, stores a copy of 0104 CURRENT. Use parameter 5311 to select a different actual value for this register.
40007	Actual 3 (select using 5312)	R	By default, stores nothing. Use parameter 5312 to select an actual value for this register.
40008	Actual 4 (select by 5313)	R	By default, stores nothing. Use parameter 5313 to select an actual value for this register.
40009	Actual 5 (select by 5314)	R	By default, stores nothing. Use parameter 5314 to select an actual value for this register.
40010	Actual 6 (select by 5315)	R	By default, stores nothing. Use parameter 5315 to select an actual value for this register.
40011	Actual 7 (select by 5316)	R	By default, stores nothing. Use parameter 5316 to select an actual value for this register.
40012	Actual 8 (select by 5317)	R	By default, stores nothing. Use parameter 5317 to select an actual value for this register.
40031	ACS550 CONTROL WORD LSW	R/W	Maps directly to the Least Significant Word of the ACS550 Drive Profile CONTROL WORD. See parameter 0301.
40032	ACS550 CONTROL WORD MSW	R	Maps directly to the Most Significant Word of the ACS550 Drive Profile CONTROL WORD. See parameter 0302.
40033	ACS550 STATUS WORD LSW	R	Maps directly to the Least Significant Word of the ACS550 Drive Profile STATUS WORD. See parameter 0303.
40034	ACS550 STATUS WORD MSW	R	Maps directly to the Most Significant Word of the ACS550 Drive Profile STATUS WORD. See parameter 0304.

Except where restricted by the drive, all parameters are available for both reading and writing. The parameter writes are verified for the correct value, and for a valid register addresses.

Note! Parameter writes through standard Modbus are always volatile i.e. modified values are not automatically stored to permanent memory. Use parameter 1607 PARAM. SAVE to save all altered values.

The ACS550 supports the following Modbus function codes for 4xxxx registers:

Function Code	Description
03	Read holding 4xxxx registers
06	Preset single 4xxxx register
16 (0x10 Hex)	Preset multiple 4xxxx registers
23 (0x17 Hex)	Read/write 4xxxx registers

The CONTROL WORD and the STATUS WORD – Standard Profile (ABB DRIVES)

CONTROL WORD. The contents of the register address 40001 (CONTROL WORD) is the principal means for controlling the drive from a fieldbus system. The fieldbus master station sends the CONTROL WORD to the drive. The drive switches between states according to the bit-coded instructions in the CONTROL WORD. Using the CONTROL WORD requires that:

- The drive is in remote (REM) control.
- The serial communication channel is defined as the source for controlling commands (set using parameters 1001 EXT1 COMMANDS, 1002 EXT2 COMMANDS and 1102 EXT1/EXT2 SEL).
- The serial communication channel used is configured for Standard Modbus: Parameter 9802 COMM PROT SEL = 1 (STD MODBUS).
- Parameter 5305 EFB CTRL PROFILE = 0 (ABB DRIVES)

The following table and the state diagram later in this sub-section describe the CONTROL WORD content.

40001 CONTROL WORD			
Bit	**Value**	**Commanded State**	**Comments**
0	1	READY TO OPERATE	
	0	EMERGENCY OFF	Drive ramps to stop according to parameter 2203 DECELER TIME 1. Normal command sequence: • OFF1 ACTIVE • READY TO SWITCH ON, unless other interlocks (OFF2, OFF3) are active.
1	1	OPERATING	OFF2 inactive
	0	EMERGENCY OFF	Drive coasts to stop. Normal command sequence: • OFF2 ACTIVE • SWITCHON INHIBITED
2	1	OPERATING	OFF3 inactive
	0	EMERGENCY STOP	Drive ramps to stop according to parameter 2205 DECELER TIME 2. Normal command sequence: • OFF3 ACTIVE • SWITCHON INHIBITED
3	1	OPERATION ENABLED	Enter ***OPERATION ENABLED*** (Note that also the Run enable signal must be present on a digital input – see parameter 1601 RUN ENABLE).
	0	***OPERATION INHIBITED***	Inhibit operation. Enter ***OPERATION INHIBITED***
4			Unused.
5	1	RFG OUT ENABLED	Normal operation. Enter ***RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED***
	0	RFG OUT HOLD	Halt ramping (Ramp Function Generator output held)

40001 CONTROL WORD			
Bit	**Value**	**Commanded State**	**Comments**
6	1	RFG INPUT ENABLED	Normal operation. Enter ***OPERATING***
	0	RFG INPUT ZERO	Force Ramp Function Generator input to zero.
7	0=>1	RESET	Fault reset (Enter ***SWITCH-ON INHIBITED***)
	0	OPERATING	(Continue normal operation)
8…10			Unused
11	1	EXT2 SELECT	Select external control location 2 (EXT2)
	0	EXT1 SELECT	Select external control location 1 (EXT1)
12…15			Unused

STATUS WORD. The contents of the register address 40004 (STATUS WORD) is status information, sent by the drive to the master station. The following table and the state diagram later in this sub-section describe the STATUS WORD content

40004 STATUS WORD		
Bit	**Value**	**Description (Correspond to states/boxes in the state diagram)**
0	1	ready to switch on
	0	not ready to switch on
1	1	ready to operate
	0	off1 active
2	1	operation enabled
	0	Not ready (*OPERATION INHIBITED*)
3	0…1	fault
	0	No fault
4	1	OFF2 inactive
	0	**OFF2 ACTIVE**
5	1	OFF3 inactive
	0	**OFF3 ACTIVE**
6	1	switch-on inhibited
	0	
7	1	Alarm is active. See *Alarm Listing* on page *170* for a list of relevant alarms.
	0	No alarm
8	1	***OPERATING.*** Actual value equals reference value (= is within tolerance limits).
	0	Actual value differs from reference value (= is outside tolerance limits)
9	1	Drive control location: REMOTE
	0	Drive control location: LOCAL
10	1	The value of first supervised parameter equals to or is greater than supervision limit. Refer to Group 32: Supervision.
	0	The value of first supervised parameter is below supervision limit
11	1	External control location 2 (EXT2) selected
	0	External control location 1 (EXT1) selected

40004 STATUS WORD		
Bit	**Value**	**Description (Correspond to states/boxes in the state diagram)**
12	1	Run Enable signal received
	0	No Run Enable signal received
13… 15		Unused

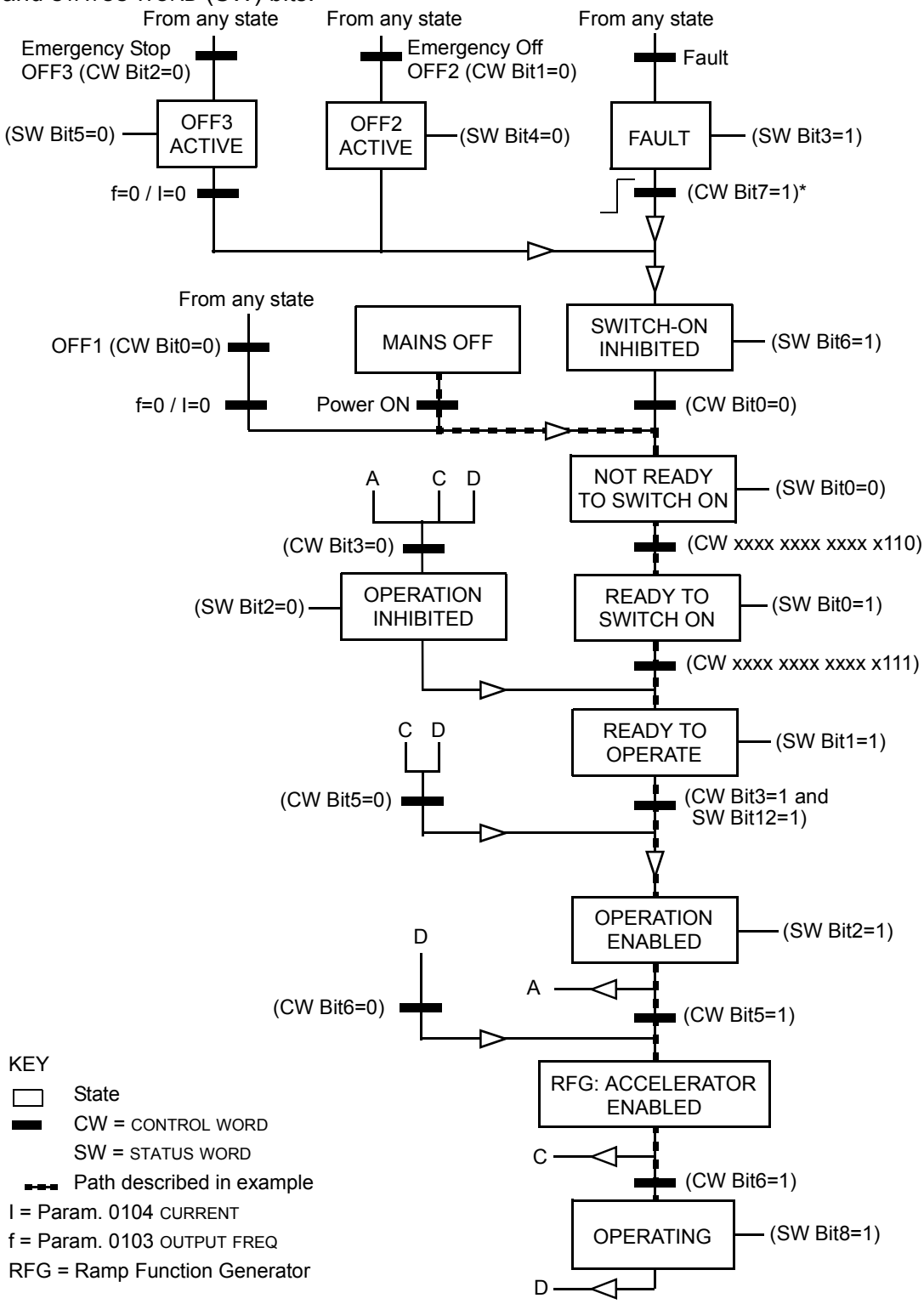
Note! Operation of CONTROL WORD and STATUS WORD conform to the ABB Drives Profile with one exception: CONTROL WORD bit 10 (REMOTE_CMD) is not used by the ACS550.

Example. Using the CONTROL WORD to start the drive:

- First, the requirements for using the CONTROL WORD must be met. See above.
- When the power is first connected, the state of the drive is not ready to switch on. See dotted lined path (▪▪▪) in the state diagram below.
- Use the CONTROL WORD to step through the state machine states until the OPERATING state is reached, meaning that the drive is running and follows the given reference. See table below.

Step	CONTROL WORD **Value**	**Description**
1	CW = 0000 0000 0000 0110 bit 15 bit 0	This CW value changes the drive state to READY TO SWITCH ON.
2		Wait at least 100 ms before proceeding.
3	CW = 0000 0000 0000 0111	This CW value changes the drive state to READY TO OPERATE.
4	CW = 0000 0000 0000 1111	This CW value changes the drive state to OPERATION ENABLED. The drive starts, but will not accelerate.
5	CW = 0000 0000 0010 1111	This CW value releases the ramp function generator (RFG) output, and changes the drive state to RFG: ACCELERATOR ENABLED.
6	CW = 0000 0000 0110 1111	This CW value releases the ramp function generator (RFG) output, and changes the drive state to OPERATING. The drive accelerates to the given reference and follows the reference.

The state diagram below describes the start-stop function of CONTROL WORD (CW) and STATUS WORD (SW) bits.



*This state transition also occurs if the fault is reset from any other source (e.g. digital input).

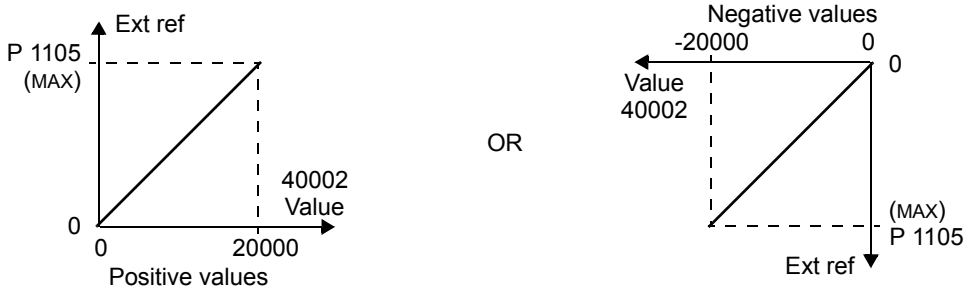
References

References are 16-bit words comprised of a sign bit and a 15-bit integer. A negative reference (indicating reversed rotation direction) is indicated by the two's complement of the corresponding positive reference value.

Reference 1. The contents of the register address 40002 REFERENCE 1 can be used as the frequency reference, REF1. The required parameter settings are:

- Use 1102 EXT1/EXT2 SEL to identify the control input that selects between EXT1 and EXT2. Then that control input must select EXT1.
- 1103 REF 1 SEL = 8 (COMM), 9 (COMM + AI1), or 10 (COMM * AI).

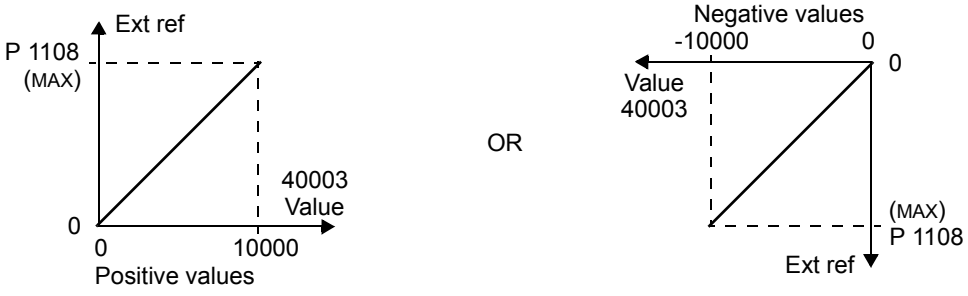
For scaling with positive values: +20000 in holding register 40002 equals the value of parameter 1105 REF1 MAX, and zero in holding register 40002 equals a zero value for ref 1. The diagrams below show both positive and negative value situations. 1104 REF1 Min is not used.



Reference 2. The contents of the register address 40003 REFERENCE 2 can be used as the frequency reference REF2. The required parameter settings are:

- Use 1102 EXT1/EXT2 SEL to identify the control input that selects between EXT1 and EXT2. Then that control input must select EXT2.
- 1106 REF 2 SEL = 8 (COMM), 9 (COMM + AI1), or 10 (COMM * AI).

For scaling with positive values: +10000 in holding register 40003 equals the value of parameter 1108 REF2 MAX, and zero in holding register 40003 equals a zero value for ref 2. The diagrams below show both positive and negative value situations. 1107 REF2 Min is not used.



Actual Values

The contents of the register addresses 40005…40012 are ACTUAL VALUES and are:

- Specified using parameters 5310…5317.

- Read-only values containing information on the operation of the drive.
- 16-bit words containing a sign bit and a 15-bit integer.
- When negative values, written as the two’s complement of the corresponding positive value.
- Scaled as defined for the selected parameter.

Exception Codes

Exception codes are serial communication responses from the drive. The ACS550 supports the standard Modbus exception codes defined below.

Exception Code	Name	Meaning
01	ILLEGAL FUNCTION	Unsupported Command
02	ILLEGAL DATA ADDRESS	The data address received in the query is not allowable. It is not a defined parameter/group.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for the ACS550, because it is one of the following: • Outside min. or max. limits. • Parameter is read-only. • Message is too long. • Parameter write not allowed when start is active. • Parameter write not allowed when factory macro is selected.

Diagnostics

Warning! Do not attempt any measurement, parts replacement or other service procedure not described in this manual. Such action will void the warranty, may endanger correct operation, and increase downtime and expense.

Warning! All electrical installation and maintenance work described in this chapter should only be undertaken by qualified service personnel. The Safety instructions on the first pages of this manual must be followed.

Diagnostic Displays

The drive detects error situations and reports them using:

- The green and red LED on the body of the drive
- The status LED on the control panel (if an Assistant control panel is attached to the drive)
- The control panel display (if a control panel is attached to the drive)
- The Fault Word and Alarm Word parameter bits (parameters 0305 to 0309). See *Group 03: FB Actual Signals* on page *77* for the bit definitions.

The form of the display depends on the severity of the error. You can specify the severity for many errors by directing the drive to:

- Ignore the error situation.
- Report the situation as an alarm.
- Report the situation as a fault.

Red – Faults

The drive signals that it has detected a severe error, or fault, by:

- Enabling the red LED on the drive (LED is either steady on or blinking).
- Setting an appropriate bit in a Fault Word parameter (0305 to 0307).
- Overriding the control panel display with the display of a fault code.
- Stopping the motor (if it was on).

The fault code on the control panel display is temporary. Pressing any of the following buttons removes the fault message: MENU, ENTER, UP button, or DOWN button. The message reappears after a few seconds if the control panel is not touched and the fault is still active.

Flashing Green – Alarms

For less severe errors, called alarms, the diagnostic display is advisory. For these situations, the drive is simply reporting that it had detected something “unusual.” In these situations, the drive:

- Flashes the green LED on the drive (does not apply to alarms that arise from control panel operation errors).
- Sets an appropriate bit in an Alarm Word parameter (0308 or 0309). See *Group 03: FB Actual Signals* on page *77* for the bit definitions.
- Overrides the control panel display with the display of an alarm code and/or name.

Alarm messages disappear from the control panel display after a few seconds. The message returns periodically as long as the alarm condition exists.

Correcting Faults

The recommended corrective action for faults is:

- Use the *Fault Listing* table below to find and address the root cause of the problem.
- Reset the drive. See *Fault Resetting* on page *169*.

Fault Listing

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
1	OVERCURRENT	Output current is excessive. Check for and correct: • Excessive motor load. • Insufficient acceleration time (parameters 2202 ACCELER TIME 1 and 2205 ACCELER TIME 2). • Faulty motor, motor cables or connections.
2	DC OVERVOLT	Intermediate circuit DC voltage is excessive. Check for and correct: • Static or transient overvoltages in the input power supply. • Insufficient deceleration time (parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2). • Undersized brake chopper (if present).
3	DEV OVERTEMP	Drive heatsink is overheated. Temperature is at or above 115 °C (239 °F). Check for and correct: • Fan failure. • Obstructions in the air flow. • Dirt or dust coating on the heat sink. • Excessive ambient temperature. • Excessive motor load.
4	SHORT CIRC	Fault current. Check for and correct: • A short-circuit in the motor cable(s) or motor. • Supply disturbances.

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
5	OVERLOAD	Inverter overload condition. The drive output current exceeds the ratings given in *Ratings* on page *180* of this manual.
6	DC UNDERVOLT	Intermediate circuit DC voltage is not sufficient. Check for and correct: • Missing phase in the input power supply. • Blown fuse. • Undervoltage on mains.
7	AI1 LOSS	Analog input 1 loss. Analog input value is less than AI1FLT LIMIT (3021). Check for and correct: • Source and connection for analog input. • Parameter settings for AI1FLT LIMIT (3021) and 3001 AI<MIN FUNCTION.
8	AI2 LOSS	Analog input 2 loss. Analog input value is less than AI2FLT LIMIT (3022). Check for and correct: • Source and connection for analog input. • Parameter settings for AI2FLT LIMIT (3022) and 3001 AI<MIN FUNCTION.
9	MOT OVERTEMP	Motor is too hot, based on either the drive's estimate or on temperature feedback. • Check for overloaded motor. • Adjust the parameters used for the estimate (3005…3009). • Check the temperature sensors and Group 35 parameters.
10	PANEL LOSS	Panel communication is lost and either: • Drive is in local control mode (the control panel displays LOC), or • Drive is in remote control mode (REM) and is parameterized to accept start/stop, direction or reference from the control panel. To correct check: • Communication lines and connections • Parameter 3002 PANEL COMM ERROR. • Parameters in Group 10: Command Inputs and Group 11: Reference Select (if drive operation is REM).
11	ID RUN FAIL	The motor ID run was not completed successfully. Check for and correct: • Motor connections
12	MOTOR STALL	Motor or process stall. Motor is operating in the stall region. Check for and correct: • Excessive load. • Insufficient motor power. • Parameters 3010…3012.
13	RESERVED	Not used.
14	EXT FAULT 1	Digital input defined to report first external fault is active. See parameter 3003 EXTERNAL FAULT 1.
15	EXT FAULT 2	Digital input defined to report second external fault is active. See parameter 3004 EXTERNAL FAULT 2.
16	EARTH FAULT	The load on the input power system is out of balance. • Check for/correct faults in the motor or motor cable. • Verify that motor cable does not exceed max. specified length.
17	UNDERLOAD	Motor load is lower than expected. Check for and correct: • Disconnected load. • Parameters 3013 UNDERLOAD FUNCTION…3015 UNDERLOAD CURVE.

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
18	THERM FAIL	Internal fault. The thermistor measuring the internal temperature of the drive is open or shorted. Contact your local ABB sales representative.
19	OPEX LINK	Internal fault. A communication-related problem has been detected on the fiber optic link between the OITF and OINT boards. Contact your local ABB sales representative.
20	OPEX PWR	Internal fault. Low voltage condition detected on OINT power supply. Contact your local ABB sales representative.
21	CURR MEAS	Internal fault. Current measurement is out of range. Contact your local ABB sales representative.
22	SUPPLY PHASE	Ripple voltage in the DC link is too high. Check for and correct: • Missing mains phase. • Blown fuse.
23	RESERVED	Not used.
24	OVERSPEED	Motor speed is greater than 120% of the larger (in magnitude) of 2001 MINIMUM SPEED or 2002 MAXIMUM SPEED. Check for and correct: • Parameter settings for 2001 and 2002. • Adequacy of motor braking torque. • Applicability of torque control. • Brake chopper and resistor.
25	RESERVED	Not used.
26	DRIVE ID	Internal fault. Configuration Block Drive ID is not valid. Contact your local ABB sales representative.
27	CONFIG FILE	Internal configuration file has an error. Contact your local ABB sales representative.
28	SERIAL 1 ERR	Fieldbus communication has timed out. Check for and correct: • Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). • Communication settings (Group 51 or 53 as appropriate). • Poor connections and/or noise on line.
29	EFB CON FILE	Error in reading the configuration file for the fieldbus adapter.
30	FORCE TRIP	Fault trip forced by the fieldbus. See the fieldbus User's Manual.
31	EFB 1	Fault code reserved for the EFB protocol application. The meaning is protocol dependent.
32	EFB 2	
33	EFB 3	
34	MOTOR PHASE	Fault in the motor circuit. One of the motor phases is lost. Check for and correct: • Motor fault. • Motor cable fault. • Thermal relay fault (if used). • Internal fault.
35	OUTPUT WIRING	Error in power wiring suspected. Check for and correct: • Input power wired to drive output. • Ground faults.

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
101	SERF CORRUPT	Error internal to the drive. Contact your local ABB sales representative and report the error number.
102	SERF IITFILE	
103	SERF MACRO	
104	SERF EFBPROT	
105	SERF BPFILE	
201	DSP T1 OVERLOAD	Error in the system. Contact your local ABB sales representative and report the error number.
202	DSP T2 OVERLOAD	
203	DSP T3 OVERLOAD	
204	DSP STACK ERROR	
205	DSP REV ERROR	
206	OMIO ID ERROR	

Faults that indicate conflicts in the parameter settings are listed below.

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
1000	PAR HZRPM	Parameter values are inconsistent. Check for any of the following: • 2001 MINIMUM SPEED > 2002 MAXIMUM SPEED. • 2007 MINIMUM FREQ > 2008 MAXIMUM FREQ. • 2001 MINIMUM SPEED / 9908 MOTOR NOM SPEED > 128 (or < -128) • 2002 MAXIMUM SPEED / 9908 MOTOR NOM SPEED > 128 (or < -128) • 2007 MINIMUM FREQ / 9907 MOTOR NOM FREQ > 128 (or < -128) • 2008 MAXIMUM FREQ / 9907 MOTOR NOM FREQ > 128 (or < -128)
1001	PAR PFCREFNG	Parameter values are inconsistent. Check for the following: • 2007 MINIMUM FREQ is negative, when 8123 PFC ENABLE is active.
1002	PAR PFCIOCNF	Parameter values are inconsistent. The number of programmed PFC relays does not match with Interlock configuration, when 8123 PFC ENABLE is active. Check consistency of: • RELAY OUTPUT parameters 1401…1403, and 1410…1412. • 8117 NR OF AUX MOTORS, 8118 AUTOCHANGE INTERV, and 8120 INTERLOCKS.
1003	PAR AI SCALE	Parameter values are inconsistent. Check for any of the following: • 1301 AI 1 MIN > 1302 AI 1 MAX. • 1304 AI 2 MIN > 1305 AI 2 MAX.
1004	PAR AO SCALE	Parameter values are inconsistent. Check for any of the following: • 1504 AO 1 MIN > 1505 AO 1 MAX. • 1510 AO 2 MIN > 1511 AO 2 MAX.

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
1005	PAR PCU 2	Parameter values for power control are inconsistent: Improper motor nominal kVA or motor nominal power. Check for the following: • 1.1 ≤ (9906 MOTOR NOM CURR * 9905 MOTOR NOM VOLT * 1.73 / P_N) ≤ 2.6 • Where: P_N = 1000 * 9909 MOTOR NOM POWER (if units are kW) or P_N = 746 * 9909 MOTOR NOM POWER (if units are HP, e.g. in US)
1006	PAR EXT RO	Parameter values are inconsistent. Check for the following: • Extension relay module not connected and • 1410…1412 RELAY OUTPUTS 4…6 have non-zero values.
1007	PAR FBUS	Parameter values are inconsistent. Check for and correct: • A parameter is set for fieldbus control (e.g. 1001 EXT1 COMMANDS = 10 (COMM)), but 9802 COMM PROT SEL = 0.
1008	PAR PFCMODE	Parameter values are inconsistent – 9904 MOTOR CTRL MODE must be = 3 (SCALAR: SPEED), when 8123 PFC ENABLE is activated.
1009	PAR PCU 1	Parameter values for power control are inconsistent: Improper motor nominal frequency or speed. Check for both of the following: • 1 ≤ (60 * 9907 MOTOR NOM FREQ / 9908 MOTOR NOM SPEED ≤ 16 • 0.8 ≤ 9908 MOTOR NOM SPEED / (120 * 9907 MOTOR NOM FREQ / Motor Poles) ≤ 0.992

Fault Resetting

The ACS550 can be configured to automatically reset certain faults. Refer to parameter Group 31: Automatic Reset.

Warning! If an external source for start command is selected and it is active, the ACS550 may start immediately after fault reset.

Flashing Red LED

To reset the drive for faults indicated by a flashing red LED:

- Turn the power off for 5 minutes.

Red LED

To reset the drive for faults indicated by a red LED (on, not flashing), correct the problem and do one of the following:

- From the control panel: Press RESET
- Turn the power off for 5 minutes.

Depending on the value of 1604, FAULT RESET SELECT, the following could also be used to reset the drive:

- Digital input
- Serial communication

When the fault has been removed, the motor can be started.

History

For reference, the last three fault codes are stored into parameters 0401, 0412, 0413. For the most recent fault (identified by parameter 0401), the drive stores additional data (in parameters 0402…0411) to aid in troubleshooting a problem. For example, parameter 0404 stores the motor speed at the time of the fault.

To clear the fault history (all of the Group 04, Fault History parameters):

1. Using the control panel in Parameters mode, select parameter 0401.
2. Press EDIT (or ENTER on the Basic control panel).
3. Press UP and Down at the same time.
4. Press SAVE.

Correcting Alarms

The recommended corrective action for alarms is:

- Determine if the Alarm requires any corrective action (action is not always required).
- Use *Alarm Listing* below to find and address the root cause of the problem.

Alarm Listing

The following table lists the alarms by code number and describes each.

Alarm Code	Display	Description
2001	Reserved	
2002		
2003		
2004	DIR LOCK	The change in direction being attempted is not allowed. Either: • Do not attempt to change the direction of motor rotation, or • Change parameter 1003 DIRECTION to allow direction change (if reverse operation is safe).
2005	I/O COMM	Fieldbus communication has timed out. Check for and correct: • Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). • Communication settings (Group 51 or 53 as appropriate). • Poor connections and/or noise on line.
2006	AI1 LOSS	Analog input 1 is lost, or value is less than the minimum setting. Check: • Input source and connections • Parameter that sets the minimum (3021) • Parameter that sets the Alarm/Fault operation (3001)
2007	AI2 LOSS	Analog input 2 is lost, or value is less than the minimum setting. Check: • Input source and connections • Parameter that sets the minimum (3022) • Parameter that sets the Alarm/Fault operation (3001)

Alarm Code	Display	Description
2008	PANEL LOSS	Panel communication is lost and either: • Drive is in local control mode (the control panel displays LOC), or • Drive is in remote control mode (REM) and is parameterized to accept start/stop, direction or reference from the control panel. To correct check: • Communication lines and connections • Parameter 3002 PANEL LOSS. • Parameters in groups 10 COMMAND INPUTS and 11 REFERENCE SELECT (if drive operation is REM).
2009	Reserved	
2010	MOT OVERTEMP	Motor is hot, based on either the drive's estimate or on temperature feedback. This alarm warns that a Motor Underload fault trip may be near. Check: • Check for overloaded motor. • Adjust the parameters used for the estimate (3005…3009). • Check the temperature sensors and Group 35 parameters.
2011	UNDERLOAD	Motor load is lower than expected. This alarm warns that a Motor Underload fault trip may be near. Check: • Motor and drive ratings match (motor is NOT undersized for the drive) • Settings on parameters 3013 to 3015
2012	MOTOR STALL	Motor is operating in the stall region. This alarm warns that a Motor Stall fault trip may be near.
2013 (note 1)	AUTORESET	This alarm warns that the drive is about to perform an automatic fault reset, which may start the motor. • To control automatic reset, use parameter group 31 AUTOMATIC RESET.
2014 (note 1)	AUTOCHANGE	This alarm warns that the PFC autochange function is active. • To control PFC, use parameter group 81 PFC CONTROL and *Application Macro: PFC* on page *59*.
2015	PFC INTERLOCK	This alarm warns that the PFC interlocks are active, which means that the drive cannot start the following: • Any motor (when Autochange is used), • The speed regulated motor (when Autochange is not used).
2016	Reserved	
2017		
2018 (note 1)	PID SLEEP	This alarm warns that the PID sleep function is active, which means that the motor could accelerate when the PID sleep function ends. • To control PID sleep, use parameters 4022…4026 or 4122…4126.

Note 1. Even when the relay output is configured to indicate alarm conditions (e.g. parameter 1401 RELAY OUTPUT 1 = 5 (ALARM) or 16 (FLT/ALARM)), this alarm is not indicated by a relay output.

Maintenance

Safety

WARNING! Read the *Safety* on the first pages of this manual before performing any maintenance on the equipment. Ignoring the safety instructions can cause injury or death. **Note:** There are parts carrying dangerous voltages near the OMIO board when the drive is powered.

Maintenance Intervals

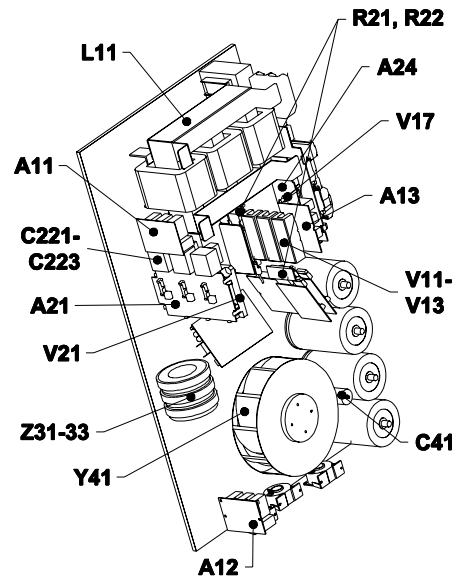
If installed in an appropriate environment, the drive requires very little maintenance. This table lists the routine maintenance intervals recommended by ABB.

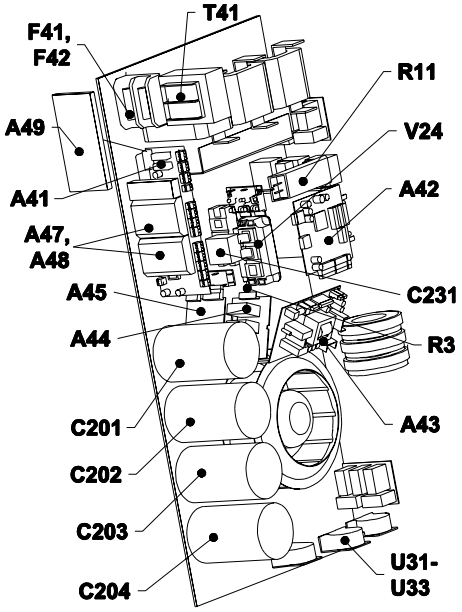
Interval	Maintenance	Instruction
Every year when stored	Capacitor reforming	See *Reforming* on page *177*.
Every 6 to 12 months (depending on the dustiness of the environment)	Heatsink temperature check and cleaning	See *Heatsink* on page*174.*
Every 7 years	Cooling fan change	See *Fan* on page *174.*
Every 10 years	Capacitor change	See *Capacitors* on page *177.*
Every 10 years	Replace Assistant Control Panel battery	See *Control Panel* on page *179*

Layout

The layout stickers of the drive are shown below. The stickers show all possible components concerning maintenance activities. Not all of them are present in each delivery.

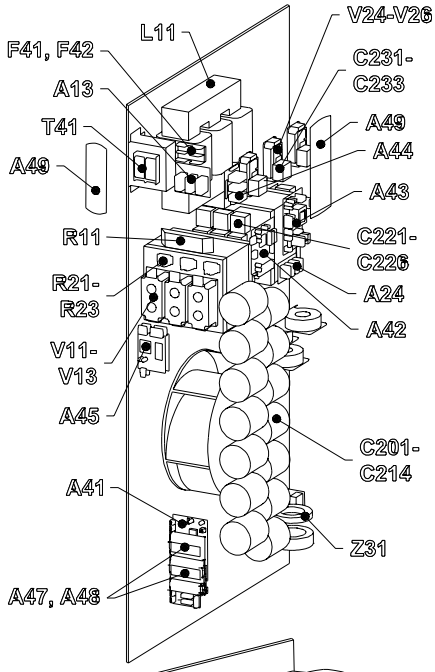
R7

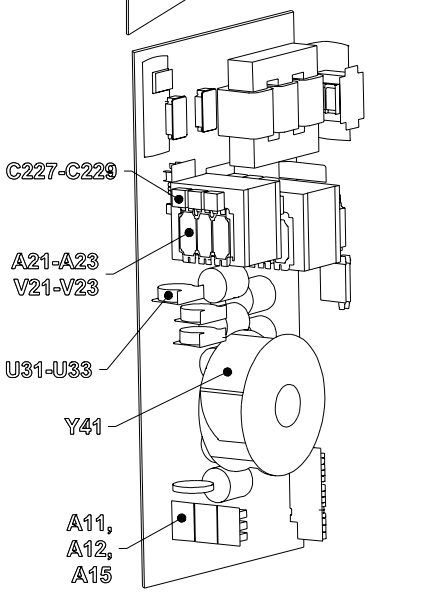




Code: 64572261

R8





Code: 64601423

Designation	Component
A49	Control panel
A41	Motor control and I/O board (OMIO)
Y41	Cooling fan
C_	Capacitors

Heatsink

The heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean. In a “normal” environment (not dusty, not clean) the heatsink should be checked annually, in a dusty environment more often.

Clean the heatsink as follows (when necessary):

1. Remove the cooling fan (see section *Fan*).
2. Blow dry clean compressed air from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust. **Note:** Prevent dust from entering adjoining equipment.
3. Replace the cooling fan.

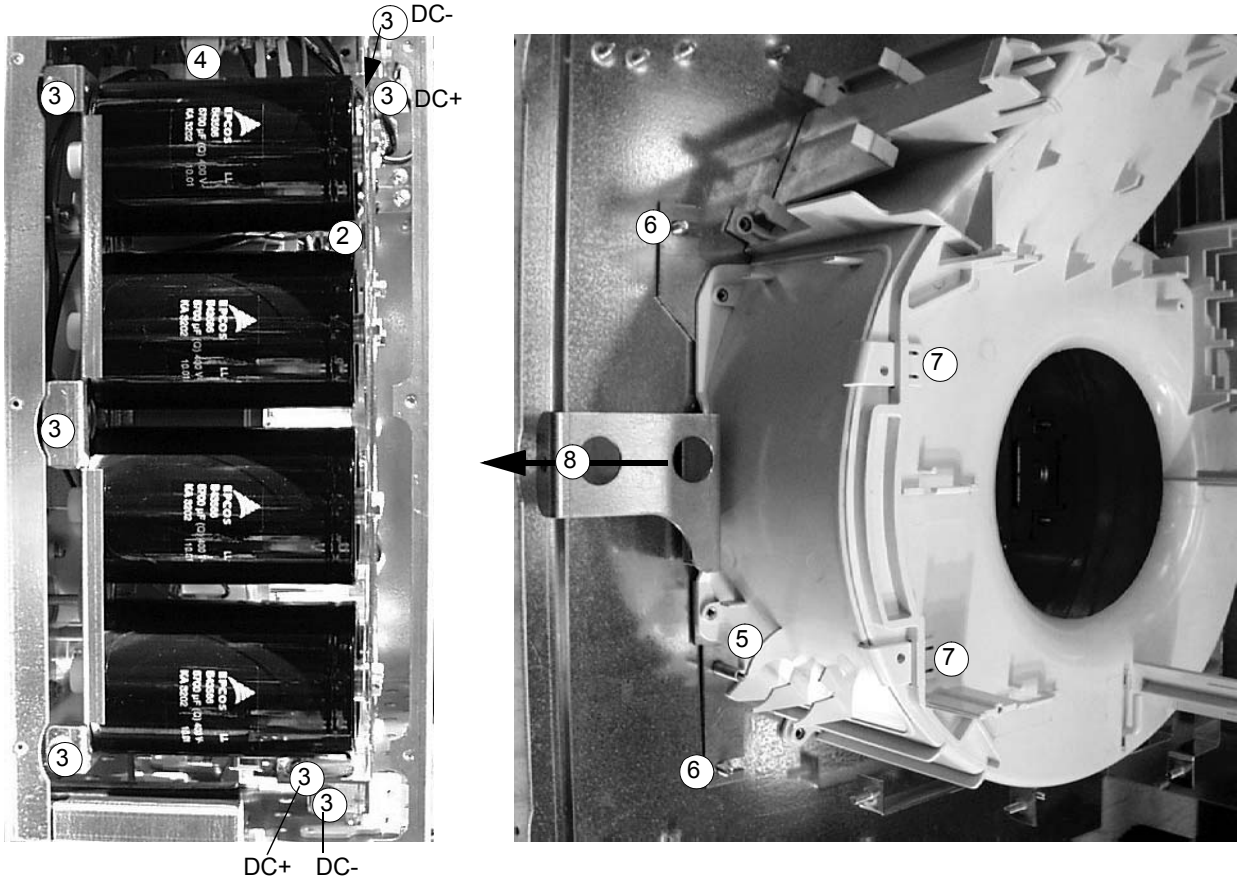
Fan

The life span of the cooling fan of the drive is about 50 000 (R7) and 60 000 (R8) hours. The actual life span depends on the running time of the fan, ambient temperature and dust concentration. See the appropriate ACS550 User Manual for the actual signal which indicates the running time of the cooling fan.

Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

Replacing the Fan (R7)

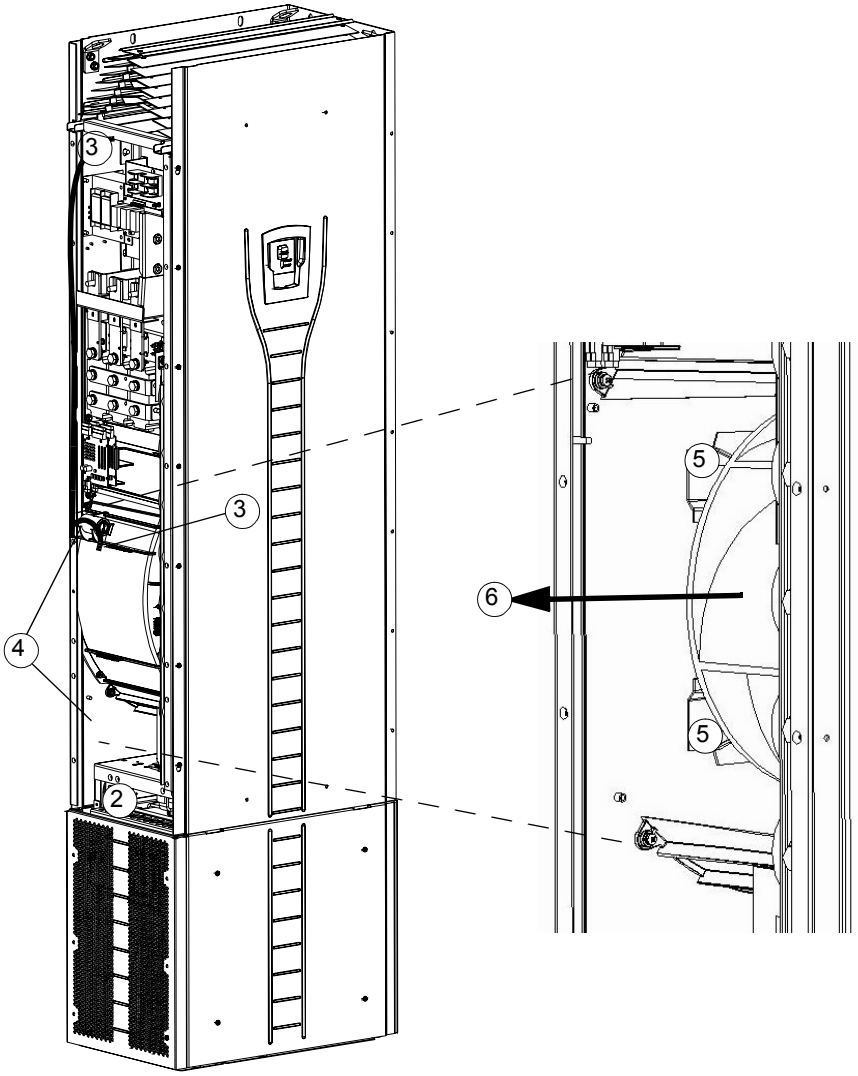
1. Remove the upper front cover and disconnect the control panel cables.
2. Disconnect the discharging resistor wire.
3. Remove the DC capacitor pack by undoing the black fixing screws.
4. Disconnect the fan supply wires (detachable terminal).
5. Disconnect the fan capacitor wires.
6. Undo the black fixing screws of the fan cassette.
7. Press the snap-on holders to release the side cover.
8. Lift from the handle and pull the fan cassette out.



Install the fan in reverse order to the above and replace the fan capacitor.

Replacing the Fan (R8)

1. Remove the upper front cover.
2. Remove the OMIO board as described in *Installation* / *Installation Procedure* / *Choose the mounting orientation (a, b, c or d)* on page *25.*
3. Disconnect the fan capacitor and power supply wires. Replace the starting capacitor.
4. Undo the black fastening screws of the plastic side cover of the fan and lift the cover off.
5. Undo the black fastening screws of the fan.
6. Lift the fan out of the cabinet.



Install the fan in reverse order to the above.

Capacitors

The drive intermediate circuit employs several electrolytic capacitors. Their life span is at least 90 000 hours depending on the operating time of the drive, loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. Capacitor failure is usually followed by damage to the unit and an input cable fuse failure, or a fault trip. Contact ABB if capacitor failure is suspected. Replacements are available from ABB. Do not use other than ABB specified spare parts.

Reforming

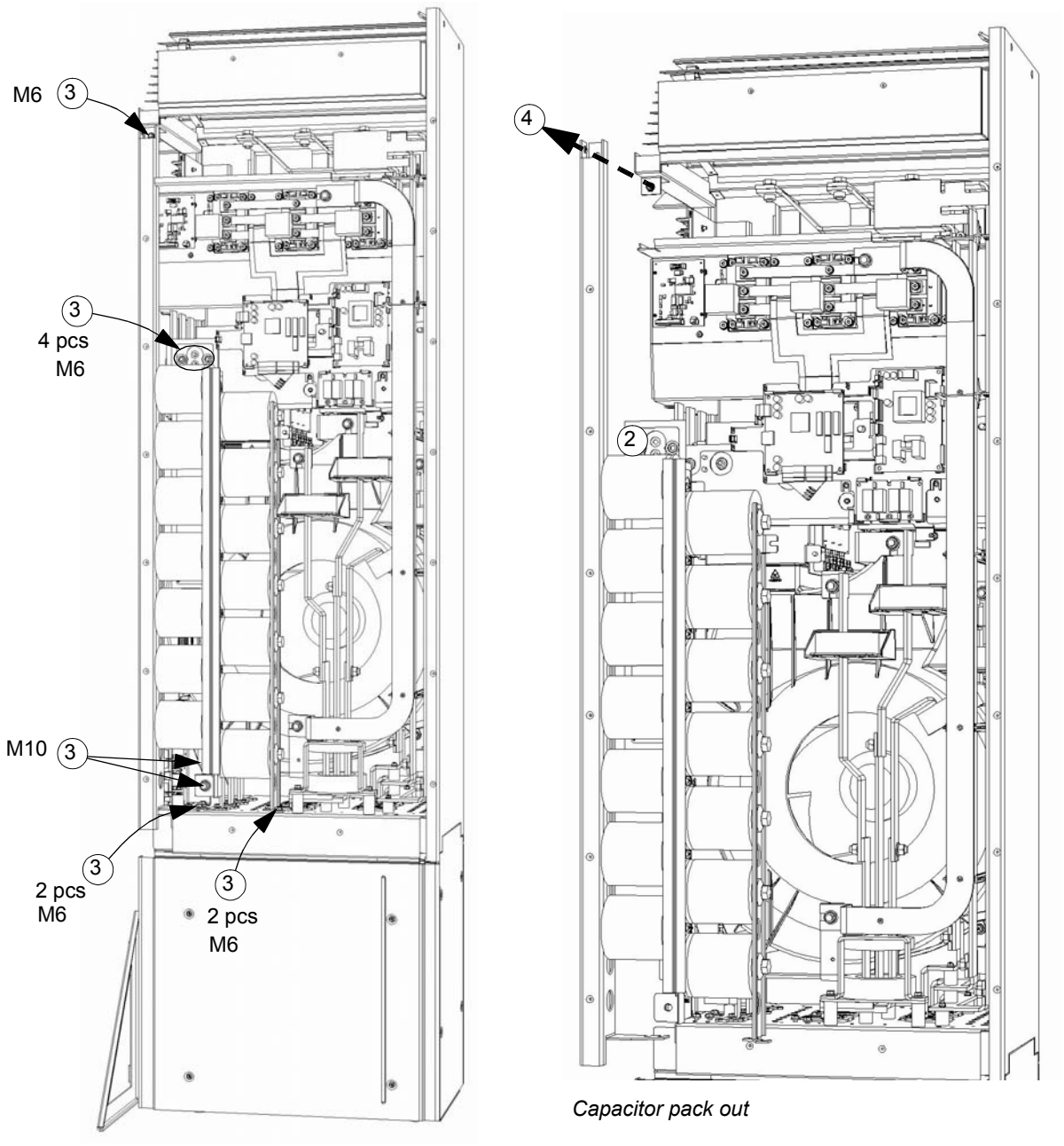
Reform (re-age) spare part capacitors once a year according to *ACS 600/800 Capacitor Reforming Guide* [code: 64059629 (English).

Replacing the Capacitor Pack (R7)

Replace the capacitor pack as described in section *Replacing the Fan (R7)* on page *175*.

Replacing the Capacitor Pack (R8)

1. Remove the upper front cover and the side plate equipped with control panel mounting slot.
2. Disconnect the discharging resistor wire.
3. Undo the fastening screws.
4. Lift the capacitor pack out.



Capacitor pack out

Install the capacitor pack in reverse order to the above.

LEDs

This table describes LEDs of the drive.

Where	LED	When the LED is lit
OMIO board	Red (blinking)	Drive in fault state
	Green	The power supply on the board is OK.
Control panel mounting platform	Red	Drive in fault state
	Green	The main + 24 V power supply for the control panel and the OMIO board is OK.
OITF board	V204 (green)	+5 V voltage of the board is OK.
	V309 (red)	Prevention of unexpected start is ON.
	V310 (green)	IGBT control signal transmission to the gate driver control boards is enabled.

Control Panel

Cleaning

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

Battery

A battery is only used in Assistant control panels that have the clock function available and enabled. The battery keeps the clock operating in memory during power interruptions.

The expected life for the battery is greater than ten years. To remove the battery, use a coin to rotate the battery holder on the back of the control panel. Replace the battery with type CR2032.

Technical Data

Ratings

By type code, the table below provides ratings for the ACS550 adjustable speed AC drive, including:

- IEC ratings
- NEMA ratings (shaded columns)
- Frame size
- Drive cabinet heat dissipation and air flow

IEC-ratings:

Type Code ACS550-02	Ratings (380 ... 480 VAC supply)						Frame Size
	Normal Use		Heavy-Duty Use		Heat Dissipation	Air Flow	
	I_{2N} A	P_N kW	I_{2hd} A	P_{hd} kW	W	m3/h	
-196A-4	196	110.0	162	90.0	3050	540	R7
-245A-4	245	132.0	192	110.0	3850	540	R7
-289A-4	289	160.0	224	132.0	4550	540	R7
-368A-4	368	200.0	302	160.0	6850	1220	R8
-486A-4	486	250.0	414	200.0	7850	1220	R8
-526A-4	526	280.0	477	250.0	7600	1220	R8
-602A-4	602	315.0	515	280.0	8100	1220	R8
-645A-4	645	355.0	590	315.0	9100	1220	R8

US-rating:

Type Code ACS550-U2 UL Type 1 (Nema 1)	Ratings (380 ... 480 VAC supply)						Frame Size
	Normal Use		Heavy-Duty Use		Heat Dissipation	Air Flow	
	I_{2N} A	P_N HP	I_{2hd} A	P_{hd} HP	W	m3/h	
-196A-4	196	150	162	125	3050	540	R7
-245A-4	245	200	192	150	3850	540	R7
-316A-4	316	250	240	200	6850	540	R7
-368A-4	368	300	302	250	6850	1220	R8
-414A-4	414	350	368	300	7850	1220	R8
-486A-4	486	400	414	350	7850	1220	R8
-526A-4	526	450	477	400	7600	1220	R8
-602A-4	602	500	515	450	8100	1220	R8
-645A-4	645	550	590	500	9100	1220	R8

Symbols

Typical ratings:

Normal use (10% overload capability)

I_{2N}	continuous rms current. 10% overload is allowed for one minute.
P_N	typical motor power. The power ratings apply to most IEC 34, or NEMA 4-pole motors at the nominal voltage, 400 V or 460 V.

Heavy-duty use (50% overload capability)

I_{2hd}	continuous rms current. 50% overload is allowed for one minute.
P_{hd}	typical motor power. The power ratings apply to most IEC 34, or NEMA 4-pole motors at the nominal voltage, 400 V or 460 V.

Sizing

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

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

Note 2: The ratings apply in ambient temperature of 40 °C (104 °F).

Derating

The load capacity (current and power) decreases if the installation site altitude exceeds 1000 meters (3300 ft), or if the ambient temperature exceeds 40 °C (104 °F) or if 8 kHz switching frequency (parameter 2606) is used.

Temperature Derating

In the temperature range +40 °C...50 °C (+104 °F...122 °F) the rated output current is decreased 1% for every 1 °C (1.8 °F) above +40 °C (+104 °F). The output current is calculated by multiplying the current given in the rating table by the derating factor.

Example If the ambient temperature is 50 °C (+122 °F) the derating factor is 100% - 1%/°C x 10 °C = 90% or 0.90.
The output current is then 0.90 x I_{2N} or 0.90 x I_{2hd}.

Altitude Derating

In altitudes from 1000...4000 m (3300...13,200 ft) above sea level, the derating is 1% for every 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.

Input Power Cables and Fuses

Branch circuit protection must be provided by the end-user, sized per national and local electric codes. Recommendations for fuses for short-circuit protection on the mains cable are below.

Type ACS550-02 ACS550-U2	Frame Size	Cable		Fuses				
		Cu (mm^2)	Al (mm^2)	A	V	Manufacturer	Type	IEC -size
-196A-4	R7	*3x185+195*	*3x240+95Cu*	*250*	*500*	*ABB Control*	*OFAF1H250*	*1*
-245A-4	R7	3x240+120	2x(3x120+50Cu)	250	500	*ABB Control*	*OFAF1H250*	1
-289A-4	R7	2x(3x95+50)	2x(3x150+50Cu)	315	500	*ABB Control*	*OFAF1H315*	2
-368A-4	R8	2x(3x150+95)	2x(3x240+95Cu)	400	500	*ABB Control*	*OFAF1H400*	2
-486A-4	R8	2x(3x240+120)	3x(3x150+50Cu)	500	500	*ABB Control*	*OFAF1H500*	3
-526A-4	R8	3x(3x150+95)	3x(3x240+95Cu)	630	500	*ABB Control*	*OFAF1H630*	3
-602A-4	R8	3x(3x185+95)	3x(3x240+95Cu)	630	500	*ABB Control*	*OFAF1H630*	3
-645A-4	R8	3x(3x185+95)	3x(3x240+95Cu)	800	500	*ABB Control*	*OFAF1H800*	3

Note 1: Mains cable sizing is based on a correction factor of 0.71 (maximum of 4 cables laid on a cable ladder side by side, ambient temperature 30 °C (86 °F), EN 60204-1 and IEC 364-5-523). For other conditions, dimension the cables according to local safety regulations, appropriate input voltage and the load current of the drive. In any case, the cable must be between the minimum limit defined in this table and the maximum limit defined by the terminal size (see *Cable Terminals* on page *182*).

Note 2: Fuse Type: IEC 269 gG, UL Class T.

Note 3: Fuses from other manufacturers can be used, if they meet the ratings.

Cable Terminals

Mains and motor cable maximum sizes (per phase) accepted a the cable terminals, and the tightening torques are listed below.

Frame Size	U1, V1, W1, U2, V2, W2						Earthing PE		
	Number of holes per phase	Cable diameter		Screw	Tightening Torque		Screw	Tightening torque	
		mm	*in*		*Nm*	*lb-ft*		*Nm*	*lb-ft*
R7	2	58	2.28	M12	50...75	35...55	M8	15...22	10...16
R8	3	58	2.28	M12	50...75	35...55	M8	15...22	10...16

Input Power (Mains) Connection

Input Power (Mains) Connection Specifications	
Voltage (U_1)	400/415/440/460/480 VAC 3-phase +10% -15% for 400 VAC units
Prospective short-circuit current (IEC 629)	Maximum allowed prospective short-circuit current in the supply is 65 kA in a second providing that the mains cable of the drive is protected with appropriate fuses. US: 65,000 AIC.
Frequency	48…63 Hz
Imbalance	Max. ± 3% of nominal phase to phase input voltage

Input Power (Mains) Connection Specifications	
Fundamental power factor (cos phi$_1$)	0.98 (at nominal load)
Cable Temperature Rating	70 °C (158 °F) rating minimum.

Motor Connection

Motor Connection Specifications		
Voltage (U_2)	0…U_1, 3-phase symmetrical, U_{max} at the field weakening point	
Frequency	0…500 Hz	
Frequency resolution	0.01 Hz	
Current	See section *Ratings.*	
Power limit	1.5 x P_{hd}	
Field weakening point	10…500 Hz	
Switching frequency	Selectable: 1, 4	
Cable Temperature Rating	70 °C (158 °F) rating minimum.	
Maximum motor cable length	**Frame Size**	**Max. motor cable length**
		f_{sw} = 1 or 4 kHz
	R7- R8	300 m

*** Warning! Using a motor cable longer than specified in the chart above may cause permanent damage to the drive.**

Control Connection

Control Connection Specifications	
Analog Inputs and Outputs	See table heading *Control Connections* on page *14*.
Digital Inputs	Digital input impedance 1.5 kΩ. Maximum voltage for digital inputs is 30 V.
Relays (Digital Outputs)	• Max. contact voltage: 30 V DC, 250 V AC • Max. contact current / power: 6 A, 30 V DC; 1500 VA, 250 V AC • Max. continuous current: 2 A rms (cos φ = 1), 1 A rms (cos φ = 0.4) • Minimum load: 500 mW (12 V, 10 mA) • Contact material: Silver-nickel (AgN) • Isolation between relay digital outputs, test voltage: 2.5 kV rms, 1 minute
Cable Specifications	See *Selecting the Control Cables* on page *14*.

Efficiency

Approximately 98% at nominal power level.

Cooling

Cooling Specifications	
Method	Internal fan, flow direction from bottom to top.
Free space around the unit	See table on page 25 for required free space around the unit.

Dimensions, Weights and Noise

The dimensions and mass for the ACS550 depend on the frame size and enclosure type, refer to *Dimension Drawings* on page *188* and *189*. A complete set of dimensional drawings for ACS550 drives is located in the ACS550 Technical Reference Manual.

Frame size	IP21						Weight		Noise
	H		W		D				
	mm	in	mm	in	mm	in	kg	lb	dB
R7	1507	59.33	250	9.84	520	20.47	195	420	71
R8	2024	79.68	347	13.66	617	24.29	375	827	72

Degrees of Protection

Available enclosures:

- IP 21 / UL type 1 enclosure. The site must be free of airborne dust, corrosive gases or liquids, and conductive contaminants such as condensation, carbon dust, and metallic particles.
- IP 54 / UL type 12 enclosure. This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.

Ambient Conditions

The following table lists the ACS550 environmental requirements.

Ambient Environment Requirements		
	Installation Site	**Storage and Transportation in the protective package**
Altitude	• 0…1000 m (0…3,300 ft) • 1000…2000 m (3,300…6,600 ft) if P_N and I_2 derated 1% every 100 m above 1000 m (300 ft above 3,300 ft)	
Ambient temperature	• -15…40 ºC (5…104 ºF) • Max. 50 ºC (122 ºF) if P_N and I_2 derated to 90%	-40…70 ºC (-40…158 ºF)
Relative humidity	< 95% (non-condensing)	
Contamination levels (IEC 721-3-3)	• No conductive dust allowed. • The ACS550 should be installed in clean air according to enclosure classification. • Cooling air must be clean, free from corrosive materials and free from electrically conductive dust. • Chemical gases: Class 3C2 • Solid particles: Class 3S2	Storage • No conductive dust allowed. • chemical gases: Class 1C2 • solid particles: Class 1S2 Transportation • No conductive dust allowed. • Chemical gases: Class 2C2 • Solid particles: Class 2S2
vibration (IEC 60068-2)	• Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal	Storage • Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal Transportation • 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), 11ms (36 fts)
Free fall	Not allowed	• 100 mm (4 in) for weight over 100 kg (220 lb)

Materials

Materials Specifications	
Drive enclosure	• PC/ABS 2.5 mm, color NCS 1502-Y (RAL 9002 / PMS 420 C and 425 C) • Hot-dip zinc coated steel sheet 1.5…2 mm, thickness of coating 100 micrometers
Package	Plywood box with expanded polystyrene pillows. Plastic covering of the package: PE-LD, bands PP or steel.
Disposal	The drive contains raw materials that should be recycled to preserve energy and natural resources. The 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. Most recyclable parts are marked with recycling marks. If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors contain electrolyte and the printed circuit boards contain lead, both of which will be classified as hazardous waste within the EU. They must be removed and handled according to local regulations. For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor.

Applicable Standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standards EN 50178 and EN 60204-1.

Applicable Standards	
EN 50178 (1997)	Electronic equipment for use in power installations
EN 60204-1 (1997)	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
EN 60529: 1991 (IEC 529), IEC 60664-1 (1992)	Degrees of protection provided by enclosures (IP code)
EN 61800-3 (1996) + Amendment A11 (2000)	EMC product standard including specific test methods
UL 508C	UL Standard for Safety, Power Conversion Equipment, second edition

CE / UL Markings / C-Tick

UL Markings status:

ACS550	CE	UL	C-UL	C-Tick
R7…R8	Approved	Approved	Approved	Pending

UL

The ACS550 is suitable for use on a circuit capable of delivering not more than 65,000 RMS symmetrical amperes, 480 V maximum. The ACS550 has an electronic motor protection feature that complies with the requirements of UL 508C. When this feature is selected and properly adjusted, additional overload protection is not

required unless more than one motor is connected to the drive or unless additional protection is required by applicable safety regulations. See parameters 3005 (MOT THERM PROT) and 3006 (MOT THERM RATE).

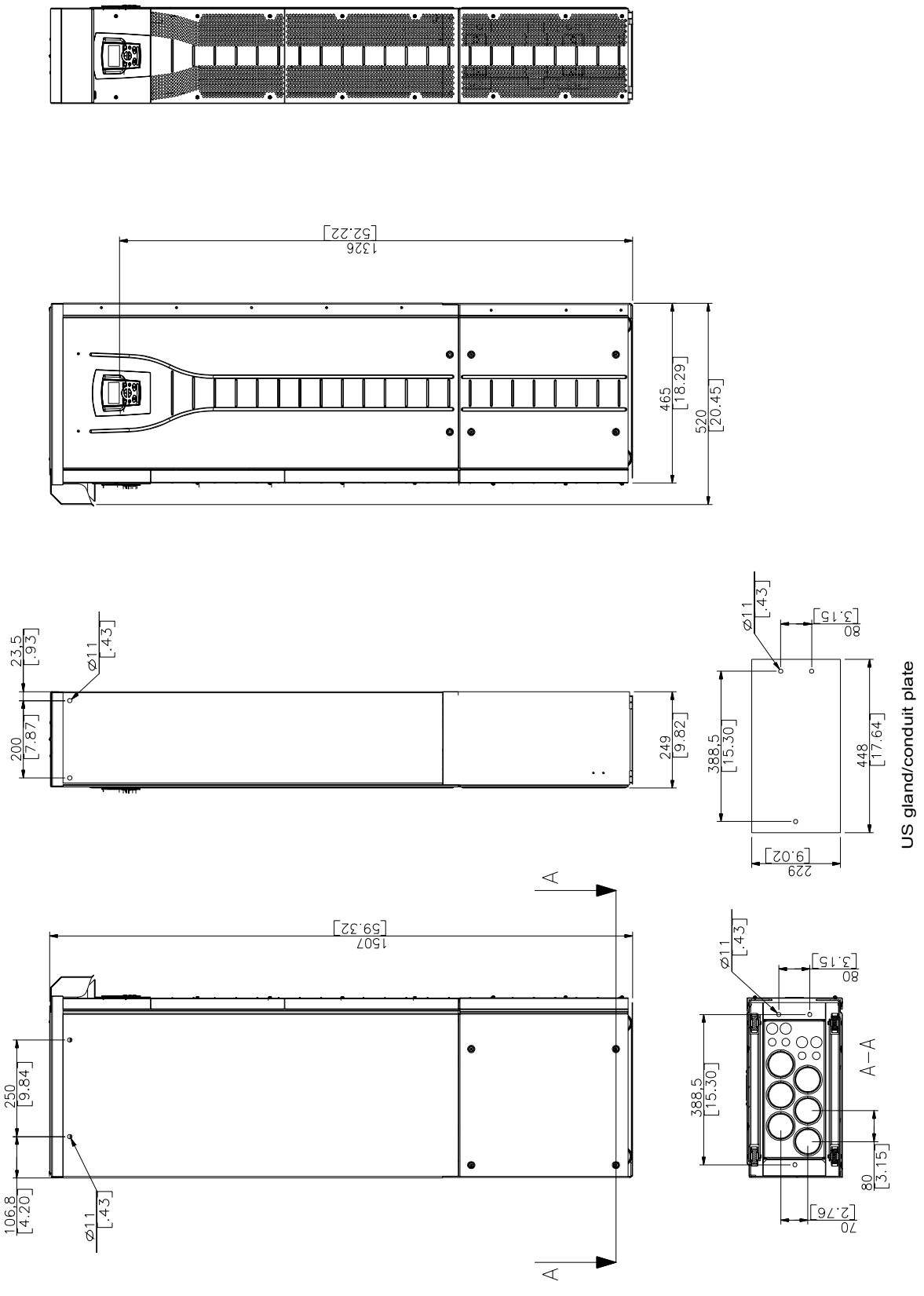
The drives are to be used in a controlled environment. See section *Ambient Conditions* on page *185* for specific limits.

Brake chopper - ABB has brake choppers that, when applied with appropriately sized brake resistors, will allow the drive to dissipate regenerative energy (normally associated with quickly decelerating a motor).

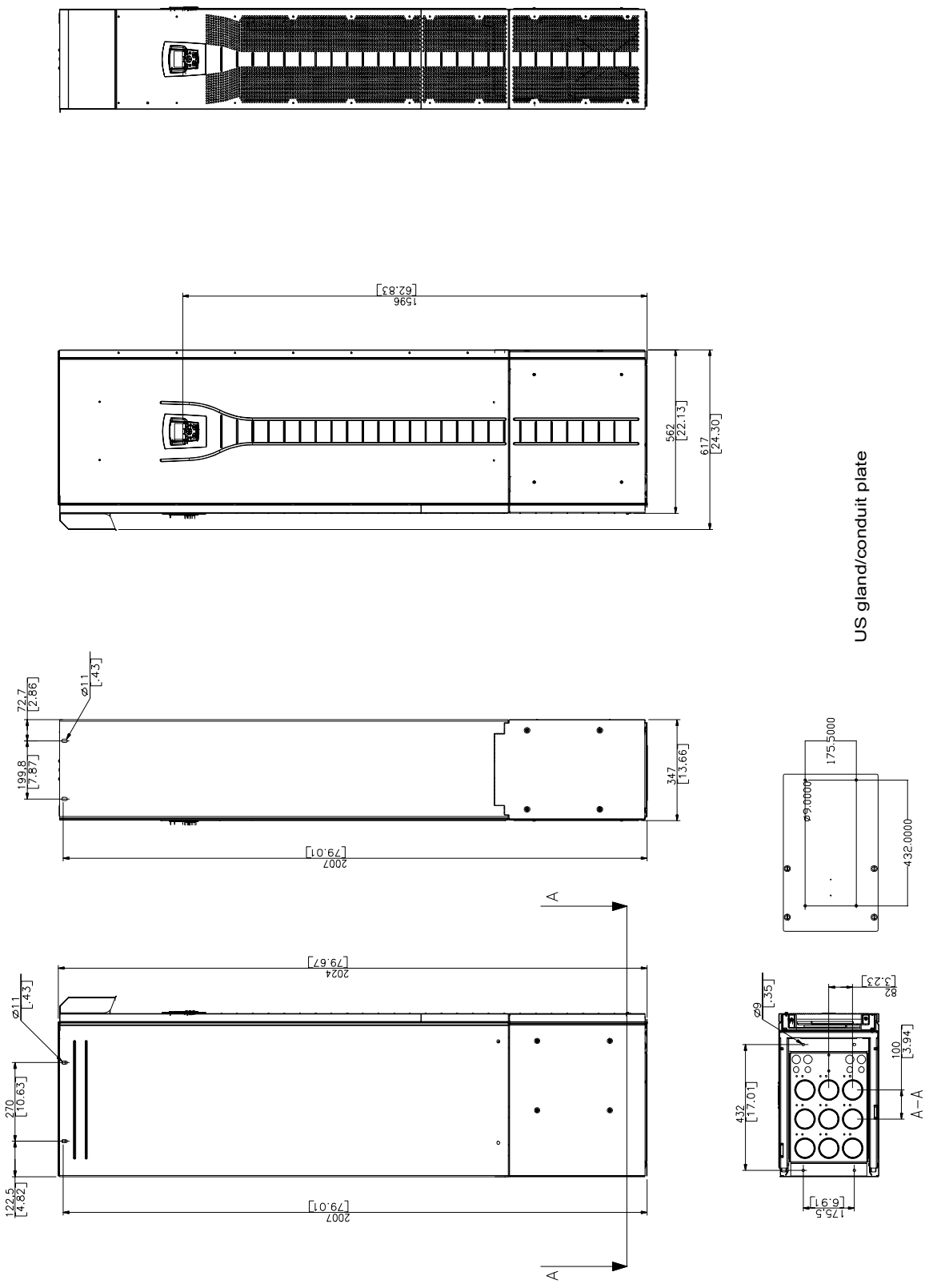
Dimension Drawings

The dimensions are given in millimetres and [inches].

Frame Size R7



Frame Size R8



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