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ACS 140

Programming Manual

ACS140-US-05

3AUA489002B4592R0101 Rev B

Effective: 7/1/98

Safety



Warning! Altering the parameter settings or device configurations will affect the function and performance of the ACS 140. Check that these changes do not cause any risk to persons or property.



Warning! The ACS 140 will start up automatically after an input voltage interruption if the external run command is active.



Warning! There are several automatic reset functions in the ACS 140. If selected, they reset the unit and resume operation after a fault. These functions should not be selected if other equipment is not compatible with this kind of operation, or dangerous situations can be caused by such action.

Note! For additional information regarding safety issues, see the ACS 140 User's Guide.

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Local Control vs. Remote Control. 57

Local Control 57

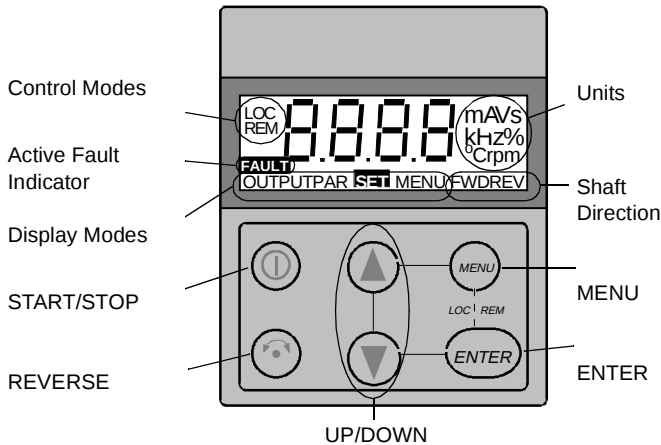
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Control Panel

This guide provides information on how to use the ACS 100-PAN control panel with an ACS 140 adjustable frequency drive. For additional information, refer to the ACS 140 User's Guide.

The control panel can be connected or detached from the inverter at any time. Additionally, the panel can be used to upload and download parameters to other ACS 140 drives. (copy function)



Control Modes

Upon initial application of power, the drive is controlled through the Control Terminals (remote control, **REM**). In local control, the ACS 140 is controlled from the control panel (**LOC**).

To Switch to local control (**LOC**), press and hold the MENU and ENTER buttons down simultaneously until first **Loc** or later **LCr** are displayed:

- If the buttons are released while **Loc** is displayed, the panel frequency reference is set to the current external reference and the drive is stopped.
- When **LCr** is displayed, the current run/stop status and the frequency reference are copied from the user I/O.

To start or stop the drive, press the START/STOP button.

To change the direction of the shaft, press the REVERSE button.

To switch back to remote control (**REM**), simultaneously press and hold the MENU and ENTER buttons down until **re** is displayed.

Shaft Direction

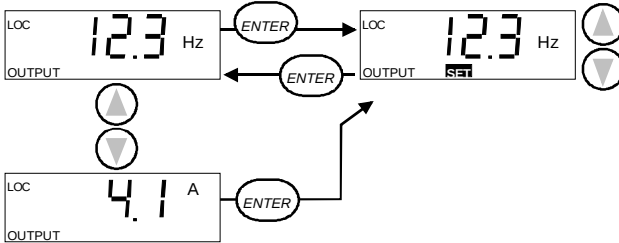
FWD / REV Visible	• Shaft direction is forward / reverse • Drive is running and at set point
FWD / REV <i>Blinking rapidly</i>	Drive is accelerating / decelerating.
FWD / REV <i>Blinking slowly</i>	Drive is stopped.

Output Display

When the control panel is initially powered, the panel displays the actual output frequency. Whenever the MENU button is pressed and held, the control panel resumes this **OUTPUT** display.

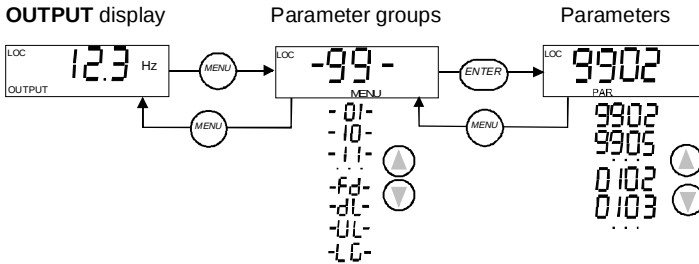
To toggle between output frequency and output current, press the UP or DOWN button.

To set the output frequency (**LOC**), press ENTER. Pressing the UP/DOWN buttons changes the output immediately. Press ENTER again, to return to the **OUTPUT** display.



Menu Structure

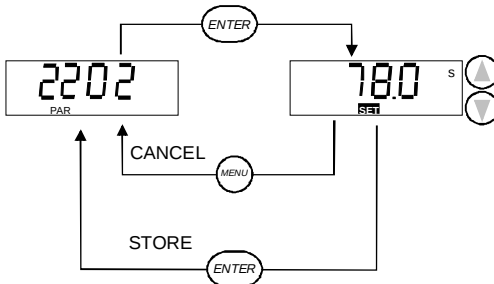
Note! The ACS 140 has a large number of parameters. Of these, only the **basic parameters** are initially visible. To display the full menu of parameters, press and hold ENTER while -LG- is displayed. The display will show -LG- indicating the full menu is selected...



Setting Parameter Value

Press ENTER to view the parameter value.

To set a new value, press and hold ENTER until **SET** is displayed.

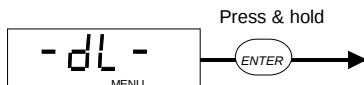


Note! **SET** *blinks*, if the parameter value is altered. **SET** is *not displayed*, if the value cannot be altered. To view the parameter default value, simultaneously press the UP/DOWN buttons.

Menu Functions

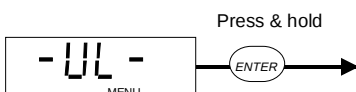
Scroll through the Parameter groups to the desired menu function. Press and hold ENTER until the display *blinks* to start the function.

1 . Copy parameters from panel to drive (download)



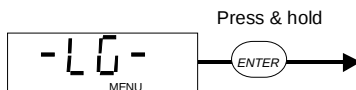
Note! The drive must be stopped and in local control. Parameter 1602 PARAMETER LOCK must be set to 1 (OPEN).

2 . Copy parameters from drive to panel (upload)



Note! The drive must be stopped and in local control. Parameter 1602 PARAMETER LOCK must be set to 1 (OPEN).

3 . Select between basic and full menu



Resetting the Drive from the Control Panel

When the red LED of the ACS 140 is *on* or *blinking*, a fault is active.

To reset a fault when the red LED is *on*, press the START/STOP button.

Caution! This may start the drive, when in remote control.

To reset a fault when the red LED is *blinking*, turn the power off.

Caution! Turning the power on again may start the drive immediately.

The relevant fault code (see Diagnostics) flashes in the panel display until the fault is reset or the display is “cleared”.

You can “clear” the display without resetting the fault by pressing any button. The word FAULT will be displayed.

Note! If no other button is pressed within 15 seconds and the fault is still active, the fault code will be displayed again.

After a power failure, the drive will revert to the same control mode (**LOC** or **REM**) as before the power failure.

Diagnostics

The control panel displays the following alarm and fault codes.

Alarms AL1-7 come from button operation. The Green LED *blinks* for alarms AL10-21, meaning that the ACS 140 cannot follow the control commands.

Table 1 Alarms.

Code	Description
AL 1	Parameter upload/download failed.
AL 2	Operation not allowed while start is active.
AL 3	Operation not allowed in remote control.
AL 5	Start/Stop, Dir from control panel is not followed. Possible causes: • Remote mode: parameters disable the buttons (APPENDIX) • Local mode: START/STOP button interlocked from I/O.
AL 6	Operation not allowed. Parameter 1602 PARAMETER LOCK is active.
AL 7	Use of factory macro disables operation.
AL10	Overcurrent controller active.
AL11	Overvoltage controller active.
AL12	Undervoltage controller active.
AL13	Direction lock. See parameter 1003 DIRECTION.
AL14	Serial communication loss alarm.
AL15	Modbus exception response is sent.
AL16	Analog input 1 loss. Analog input 1 value is less than MINIMUM AI1 (1301). See also parameter 3001 AI<MIN FUNCTION.
AL17	Analog input 2 loss. Analog input 2 value is less than MINIMUM AI2 (1306). See also parameter 3001 AI<MIN FUNCTION.
AL18	Panel loss. Panel is disconnected when Start/Stop, Dir or reference is coming from panel. See parameter 3002 PANEL LOSS and APPENDIX.
AL19	Hardware overtemperature (at 95% of the trip limit).
AL20	Motor overtemperature (at 95% of the trip limit).
AL21	Motor stall alarm. See parameter 3009 STALL FUNCTION.

Table 2 Faults.

Code	Description
FL 1	Overcurrent: - Possible mechanical problem. - Acceleration and/or deceleration times may be too short. - Input Power disturbances.
FL 2	DC overvoltage: - Input voltage too high. - Deceleration time may be too short.
FL 3	ACS 140 overtemperature: - Ambient temperature too high. - Sustained severe overload.
FL 4 *	Fault current: - Output ground fault (240V units). - Short circuit. - Input Power disturbances.
FL 5	Output overload.
FL 6	DC undervoltage.
FL 7	Analog input 1 fault. Analog input 1 value is less than MINIMUM AI1 (1301). See also parameter 3001 AI<MIN FUNCTION.
FL 8	Analog input 2 fault. Analog input 1 value is less than MINIMUM AI2 (1304). See also parameter 3001 AI<MIN FUNCTION.
FL 9	Motor overtemperature. See parameters 3004-3008.
FL10	Panel loss. Panel is disconnected when Start/Stop, Dir or reference is coming from panel. See parameter 3002 PANEL LOSS and APPENDIX. Note! If FL10 is active when the power is turned off, the ACS 140 will start in remote control (REM) when the power is turned back on.
FL11	Parameters inconsistent. Possible fault situations: - MINIMUM AI1 > MAXIMUM AI1 - MINIMUM AI2 > MAXIMUM AI2 - MINIMUM FREQ > MAXIMUM FREQ
FL12	Motor stall. See parameter 3009 STALL FUNCTION.
FL13	Serial communication loss.
FL14	External fault is active. See parameter 3003 EXTERNAL FAULT.
FL15	Output ground fault (480V units).
FL16 *	DC bus ripple too large. Check supply.
FL17	Analog input out of range. Check input voltage.
FL18 - FL22 *	Hardware error. Contact supplier.
Full display blinking	Serial link failure. Bad connection between the control panel and the ACS 140.

Note! Faults (*) that are indicated by a red *blinking* LED are reset by turning the power off and on. Other faults are reset by pressing the START/STOP button. See parameter 1604 for further details.

ACS 140 Basic Parameters

The ACS 140 has a large number of parameters. However, only the basic parameters are initially visible.

Setting up a few basic parameters is normally sufficient in applications where the ACS140 preprogrammed application macros can provide the desired functionality. For a full description of programmable features provided by the ACS140, see "ACS 140 Complete Parameter List", starting page 21.

The following table lists the basic parameters:

Code	Name	User	S
S= Parameters can be modified only when the drive is stopped.			
Group 99			
START-UP DATA			
9902	APPLIC MACRO Selects application macro. Refer to "Application Macros", starting page 11 for detailed description of each macro. 0 = FACTORY MACRO 4 = MOTOR POT 1 = ABB STANDARD 5 = HAND - AUTO 2 = 3-WIRE 6 = PID CONTROL 3 = ALTERNATE 7 = PREMAGN Default value: 0 (FACTORY MACRO)		✓
9905	MOTOR NOM VOLT Nominal motor voltage from motor rating plate. Range of this parameter depends on the type of the ACS 140 (200/400V unit). Selection for 200V units: Selection for 400V units: 200, 208, 220, 230, 240V 380, 400, 415, 440, 460, 480V Default value for 200V unit: 230V Default value for 400V unit: 400 or 440V depending on selected application macro.		✓
9906	MOTOR NOM CURR Nominal motor current from motor rating plate. Values for this parameter range from $0.5 \cdot I_N$ - $1.5 \cdot I_N$, where I_N is nominal current of the ACS 140. Default value: I_N		✓
9907	MOTOR NOM FREQ Nominal motor frequency from motor rating plate. Range: 0 - 250.0 Hz Default: 50.0 Hz or 60.0 Hz depending on selected application macro.		✓
9908	MOTOR NOM SPEED Nominal motor speed from motor rating plate. Range 0 - 3600 rpm. Default: 1440 or 1720 rpm depending on selected application macro.		✓

continued

Code	Name	User	S
S= Parameters can be modified only when the drive is stopped.			
Group 01			
OPERATING DATA			
0128	LAST FAULT Last recorded fault (0 = no fault). See "Diagnostics", starting page 5. Can be cleared with the control panel by simultaneously pressing the UP and DOWN buttons when in parameter set mode.		
Group 10			
COMMAND INPUTS			
1003	DIRECTION Rotation direction lock. 1 = FORWARD 2 = REVERSE 3 = REQUEST If you select REQUEST, the direction is set according to the given direction command. Default: 3 (REQUEST)		
Group 11			
REFERENCE SELECT			
1105	EXT REF1 MAX Maximum frequency reference in Hz. Range: 0 -250.0 Hz Default value: 50.0 Hz or 60.0 Hz depending on the selected application macro.		
Group 12			
CONSTANT SPEEDS			
1202	CONST SPEED 1 Range for all constant speeds: 0 - 250.0 Hz Default value: 5.0 Hz		
1203	CONST SPEED 2 Default value: 10.0 Hz		
1204	CONST SPEED 3 Default value: 15.0 Hz		

continued

Code	Name	User	S
S= Parameters can be modified only when the drive is stopped.			
Group 13 ANALOG INPUTS			
1301	MINIMUM AI1 Minimum value of AI1 in per cent. Defines relative analog input value where frequency reference reaches minimum value. Range: 0 - 100% Default value: 0%		
Group 15 ANALOG OUTPUT			
1503	AO CONTENT MAX Defines output frequency where analog output reaches 20 mA. Range: 0 - 250.0 Hz. Default value: 50.0 Hz or 60.0 Hz depending on the selected application macro. Note! Analog output content is programmable. Values given here are valid only if other analog output configuration parameters have not been modified. Description of all parameters is given in "Complete Parameter List."		
Group 20 LIMITS			
2003	MAX CURRENT Maximum output current. Range: $0.5 \cdot I_N - 1.5 \cdot I_N$, where I_N is nominal current of the ACS 140. Default value: $1.5 \cdot I_N$		
2008	MAXIMUM FREQ Maximum output frequency. Range: 0 - 250.0 Hz Default value: 50.0 Hz or 60.0 Hz depending on the selected application macro.		

continued

Code	Name	User	S
S= Parameters can be modified only when the drive is stopped.			
Group 21			
START/STOP			
2102	STOP FUNCTION Conditions during motor stopping. 1 = COAST Motor coasts to stop. 2 = RAMP Ramp deceleration as defined by the active deceleration time 2203 DECELER TIME 1 or 2205 DECELER TIME 2. Default value: 1 (COAST)		
Group 22			
ACCEL/DECEL			
2202	ACCEL TIME 1 Ramp 1: time from zero (0) to maximum frequency (0 - MAXIMUM FREQ). Range for all ramp time parameters is 0.1 - 1800 s. Default value: 5.0 s		
2203	DECEL TIME 1 Ramp 1: time from maximum to zero (0) frequency (MAXIMUM FREQ - 0). Default value: 5.0 s		
2204	ACCEL TIME 2 Ramp 2: time from zero (0) to maximum frequency (0 - MAXIMUM FREQ). Default value: 60.0 s		
2205	DECEL TIME 2 Ramp 2: time from maximum to zero (0) frequency (MAXIMUM FREQ - 0). Default value: 60.0 s		
Group 26			
MOTOR CONTROL			
2606	V/f RATIO V/f below field weakening point. 1 = LINEAR 2 = SQUARE LINEAR is preferred for constant torque applications. SQUARE is preferred for centrifugal pump and fan applications to increase motor efficiency and to reduce motor noise. Default value: 1 (LINEAR)		✓
Group 33			
INFORMATION			
3301	SW VERSION Software version code.		

Application Macros

Application Macros are preprogrammed parameter sets. They minimize the number of different parameters to be set during start-up. The Factory Macro is the factory-set default macro.

Note! Selecting an application macro with parameter 9902 APPLIC MACRO will set all other parameters (except the parameter lock 1602) to their default values. Default values of certain parameters depend on the selected macro. These are listed with the description of each macro.

For the below examples **note** the following:

- All the digital inputs are connected using negative logic.
- The signal type of analog input is selected with V/I jumper S1:1.

Frequency reference is given with	V/I Jumper S1:1 or S1:2	
voltage signal (0 - 10V)	open	
current signal (0 - 20 mA)	connected	

Note! The Factory Macro is intended for applications where there is no control panel available. When using the Factory Macro with the control panel, note that the parameters whose value depend on the digital input DI4, cannot be modified from the panel.

Application Macro Factory (0)

This macro is intended for applications where there is no control panel available. It provides a general purpose I/O configuration that is typically used in Europe.

The value of parameter 9902 is 0. DI4 is not connected.

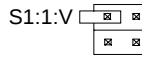
Input signals

- Start/Stop, Direction (DI1,2)
- Analog reference (AI1)
- Constant speed 1 (DI3)
- Ramp pair 1/2 selection (DI5)

Output signals

- Analog output AO: Frequency
- Relay output 1: Fault
- Relay output 2: Running

V/I jumper S1



Control Terminals	Function
1 SCR	
2 AI 1	External reference 1; 0...10V <=> 0...50 Hz
3 AGND	
4 10V	Reference voltage 10VDC
5 AI 2	Not used
6 AGND	
7 AO	Output frequency 0...20 mA <=> 0...50 Hz
8 DGND	
9 +12V	+12VDC
10 DCOM	
11 DI 1	Start/Stop. Close to start ACS 140
12 DI 2	Fwd/Rev. Close to reverse rotation direction
13 DI 3	Constant speed 1. Default: 5Hz
14 DI 4	Leave unconnected!*
15 DI 5	Ramp pair selection. Close to select ramp pair 2. Defaults: 5 s (ramp pair 1), 60 s (ramp pair 2)
16 DO 1A	Relay output 1
17 DO 1B	Fault: open
18 DO 2A	Relay output 2
19 DO 2B	Running: closed

***Note!** DI 4 is used to configure the ACS 140. It is read once when power is connected. When DI 4 is open (0) the following applies:

- Motor nominal values are 230/400V and 50 Hz and 1440 rpm.
- Input and output signals are scaled according to 50 Hz.
- Maximum frequency is 50 Hz.

Factory (0) parameter values:

9905 MOTOR NOM VOLT	230/400V	1105 EXT REF1 MAX	50 Hz
9907 MOTOR NOM FREQ	50 Hz	1106 EXT REF2 SELECT	0 (KEYPAD)
9908 MOTOR NOM SPEED	1440 rpm	1201 CONST SPEED SEL	3 (DI3)
1001 EXT 1 COMMANDS	2 (DI1,2)	1503 AO CONTENT MAX	50 Hz
1002 EXT 2 COMMANDS	0 (NOT SEL)	1601 RUN ENABLE	0 (NOT SEL)
1003 DIRECTION	3 (REQUEST)	2008 MAXIMUM FREQ	50 Hz
1101 KEYPAD REF SEL	1 (REF 1)	2105 PREMAGN SEL	0 (NOT SEL)
1102 EXT1/EXT2 SEL	6 (EXT1)	2201 ACC/DEC 1/2 SEL	5 (DI5)
1103 EXT REF1 SELECT	1 (AI1)		

Application Macro Factory (1)

This macro is intended for applications where there is no control panel available. It provides a general purpose I/O configuration that is typically used in North America.

The value of parameter 9902 is 0. DI 4 is connected.

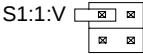
Input signals

- Start/Stop, Direction (DI1,2,3)
- Analog reference (AI1)
- Ramp pair 1/2 selection (DI5)

Output signals

- Analog output AO: Frequency
- Relay output 1: Fault
- Relay output 2: Running

V/I jumper S1



	Control Terminals		Function
	1	SCR	
	2	AI 1	External reference1; 0...10V <=> 0...60 Hz
	3	AGND	
	4	10V	Reference voltage 10VDC
	5	AI 2	Not used
	6	AGND	
	7	AO	Output frequency 0...20 mA <=> 0...60 Hz
	8	DGND	
	9	+12V	+12VDC
	10	DCOM	
	11	DI 1	Momentary close with DI2 activated: Start
	12	DI 2	Momentary open: Stop
	13	DI 3	Fwd/Rev ; Close to reverse rotation direction
	14	DI 4	Has to be connected!*
	15	DI 5	Ramp pair selection. Close to select ramp pair 2. Defaults: 5 s (ramp pair 1), 60 s (ramp pair 2)
	16	DO 1A	Relay output 1 Fault : open
	17	DO 1B	
	18	DO 2A	Relay output 2 Running : closed
	19	DO 2B	

***Note!** DI 4 is used to configure the ACS 140. It is read once when power is connected. When DI 4 is connected (1) the following applies:

- Motor nominal values are 230/480V and 60 Hz and 1720 rpm.
- Input and output signals are scaled according to 60 Hz.
- Maximum frequency is 60 Hz.

Note! Stop signal disabled: panel START/STOP button interlocked (local).

Factory (1) parameter values:

9905 MOTOR NOM VOLT	230/480V	1105 EXT REF1 MAX	60 Hz
9907 MOTOR NOM FREQ	60 Hz	1106 EXT REF2 SELECT	0 (KEYPAD)
9908 MOTOR NOM SPEED	1720 rpm	1201 CONST SPEED SEL	0 (NOT SEL)
1001 EXT 1 COMMANDS	4 (DI1P,2P,P)	1503 AO CONTENT MAX	60 Hz
1002 EXT 2 COMMANDS	0 (NOT SEL)	1601 RUN ENABLE	0 (NOT SEL)
1003 DIRECTION	3 (REQUEST)	2008 MAXIMUM FREQ	60 Hz
1101 KEYPAD REF SEL	1 (REF1)	2105 PREMAGN SEL	0 (NOT SEL)
1102 EXT1/EXT2 SEL	6 (EXT1)	2201 ACC/DEC 1/2 SEL	5 (DI5)
1103 EXT REF1 SELECT	1 (AI1)		

Application Macro ABB Standard

This general purpose macro is typically used in Europe. It gives two (2) more preset speeds compared to Factory Macro (0).

The value of parameter 9902 is 1.

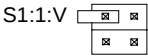
Input signals

- Start/Stop, Direction (DI1,2)
- Analog reference (AI1)
- Preset speed selection (DI3,4)
- Ramp pair 1/2 selection (DI5)

Output signals

- Analog output AO: Frequency
- Relay output 1: Fault
- Relay output 2: Running

V/I jumper S1



Control Terminals		Function
1	SCR	
2	AI 1	External reference1; 0...10V <=> 0...50 Hz
3	AGND	
4	10V	Reference voltage 10VDC
5	AI 2	Not used
6	AGND	
7	AO	Output frequency 0...20 mA <=> 0...50 Hz
8	DGND	
9	+12V	+12VDC
10	DCOM	
11	DI 1	Start/Stop: Close to start
12	DI 2	Fwd/Rev: Close to reverse rotation direction
13	DI 3	Constant speed selection*
14	DI 4	Constant speed selection*
15	DI 5	Ramp pair selection. Close to select ramp pair 2. Defaults: 5 s / 60 s (ramp pair 1/2)
16	DO 1A	Relay output 1 Fault: open
17	DO 1B	
18	DO 2A	Relay output 2 Running: closed
19	DO 2B	

*Constant speed selection: 0 = open, 1 = connected

DI3	DI4	Output
0	0	Reference through AI1
1	0	Const speed 1 (1202)
0	1	Const speed 2 (1203)
1	1	Const speed 3 (1204)

ABB Standard parameter values:

9905 MOTOR NOM VOLT	230/400V	1105 EXT REF1 MAX	50 Hz
9907 MOTOR NOM FREQ	50 Hz	1106 EXT REF2 SELECT	0 (KEYPAD)
9908 MOTOR NOM SPEED	1440 rpm	1201 CONST SPEED SEL	7 (DI3,4)
1001 EXT 1 COMMANDS	2 (DI1,2)	1503 AO CONTENT MAX	50 Hz
1002 EXT 2 COMMANDS	0 (NOT SEL)	1601 RUN ENABLE	0 (NOT SEL)
1003 DIRECTION	3 (REQUEST)	2008 MAXIMUM FREQ	50 Hz
1101 KEYPAD REF SEL	1 (REF1)	2105 PREMAGN SEL	0 (NOT SEL)
1102 EXT1/EXT2 SEL	6 (EXT1)	2201 ACC/DEC 1/2 SEL	5 (DI5)
1103 EXT REF1 SELECT	1 (AI1)		

Application Macro 3-wire

This macro is intended for those applications where the drive is controlled using momentary pushbuttons (pulse). It gives two (2) more preset speeds compared to Factory Macro (1) by using DI4 and DI5.

Note! Default frequency is 60 Hz.

The value of parameter 9902 is 2.

Input signals

- Start/Stop, Direction (DI1,2,3)
- Analog reference (AI1)
- Preset speed selection (DI4,5)

Output signals

- Analog output AO: Frequency
- Relay output 1: Fault
- Relay output 2: Running

V/I jumper S1

S1:1:V



Control Terminals	Function
1 SCR	
2 AI 1	External reference1; 0...10V <=> 0...60 Hz
3 AGND	
4 10V	Reference voltage 10VDC
5 AI 2	Not used
6 AGND	
7 AO	Output frequency 0...20 mA <=> 0...60 Hz
8 DGND	
9 +12V	+12VDC
10 DCOM	
11 DI 1	Momentary close with DI2 activated: Start
12 DI 2	Momentary open: Stop
13 DI 3	Close to reverse rotation: Fwd/Rev
14 DI 4	Constant speed select*
15 DI 5	Constant speed select*
16 DO 1A	Relay output 1 Fault: open
17 DO 1B	
18 DO 2A	Relay output 2 Running: closed
19 DO 2B	

*Constant speed selection: 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)

Note! Stop signal disabled: panel START/STOP button interlocked (local).

Application Macro 3-wire parameter values:

9905 MOTOR NOM VOLT	230/480V	1105 EXT REF1 MAX	60 Hz
9907 MOTOR NOM FREQ	60 Hz	1106 EXT REF2 SELECT	0 (KEYPAD)
9908 MOTOR NOM SPEED	1720 rpm	1201 CONST SPEED SEL	8 (DI4,5)
1001 EXT 1 COMMANDS	4 (DI1P,2P,3)	1503 AO CONTENT MAX	60 Hz
1002 EXT 2 COMMANDS	0 (NOT SEL)	1601 RUN ENABLE	0 (NOT SEL)
1003 DIRECTION	3 (REQUEST)	2008 MAXIMUM FREQ	60 Hz
1101 KEYPAD REF SEL	1 (REF1)	2105 PREMAGN SEL	0 (NOT SEL)
1102 EXT1/EXT2 SEL	6 (EXT1)	2201 ACC/DEC 1/2 SEL	0 (NOT SEL)
1103 EXT REF1 SELECT	1 (AI1)		

Application Macro Alternate

This macro offers an I/O configuration that is adopted to a sequence of DI control signals used when alternating the direction of drive rotation.

The value of parameter 9902 is 3.

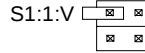
Input signals

- Start/Stop, Direction (DI1,2)
- Analog reference (AI1)
- Preset speed selection (DI3,4)
- Ramp pair 1/2 selection (DI5)

Output signals

- Analog output AO: Frequency
- Relay output 1: Fault
- Relay output 2: Running

V/I jumper S1



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Control Terminals	Function
1 SCR	
2 AI 1	External reference1; 0...10V <=> 0...50 Hz
3 AGND	
4 10V	Reference voltage 10VDC
5 AI 2	Not used
6 AGND	
7 AO	Output frequency 0...20 mA <=> 0...50 Hz
8 DGND	
9 +12V	+12VDC
10 DCOM	
11 DI 1	Start fwd ; If DI1 state is the same as DI2, drive stops
12 DI 2	Start reverse
13 DI 3	Constant speed select*
14 DI 4	Constant speed select*
15 DI 5	Ramp pair selection. Activate to select ramp pair 2. Defaults: 5 s / 60 s (ramp pair 1/2)
16 DO 1A	Relay output 1
17 DO 1B	Fault: open
18 DO 2A	Relay output 2
19 DO 2B	Running: closed

*Constant speed selection: 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)

Application macro Alternate parameter values:

9905 MOTOR NOM VOLT	230/400V	1105 EXT REF1 MAX	50 Hz
9907 MOTOR NOM FREQ	50 Hz	1106 EXT REF2 SELECT	0 (KEYPAD)
9908 MOTOR NOM SPEED	1440 rpm	1201 CONST SPEED SEL	7 (di3,4)
1001 EXT 1 COMMANDS	9 (DI1F,2R)	1503 AO CONTENT MAX	50 Hz
1002 EXT 2 COMMANDS	0 (NOT SEL)	1601 RUN ENABLE	0 (NOT SEL)
1003 DIRECTION	3 (REQUEST)	2008 MAXIMUM FREQ	50 Hz
1101 KEYPAD REF SEL	1 (REF1)	2105 PREMAGN SEL	0 (NOT SEL)
1102 EXT1/EXT2 SEL	6 (EXT1)	2201 ACC/DEC 1/2 SEL	5 (DI5)
1103 EXT REF1 SELECT	1 (AI1)		

Application Macro Motor Potentiometer

This macro provides a cost-effective interface for PLCs that vary the speed of the drive using only digital signals.

The value of parameter 9902 is 4.

Input signals

- Start/Stop, Direction (DI1,2)
- Reference up (DI3)
- Reference down (DI4)
- Preset speed selection (DI5)

Output signals

- Analog output AO: Frequency
- Relay output 1: Fault
- Relay output 2: Running

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Control Terminals		Function
1	SCR	
2	AI 1	Not used
3	AGND	
4	10 V	Reference voltage10 VDC
5	AI 2	Not used
6	AGND	
7	AO	Output frequency 0...20 mA <=> 0...50 Hz
8	DGND	
9	+12V	+12VDC
10	DCOM	
11	DI 1	Start/Stop: Close to start ACS 140
12	DI 2	Forward/Reverse: Close to reverse rotation
13	DI 3	Reference up: Close to increase reference*
14	DI 4	Reference down: Close to decrease reference*
15	DI 5	Constant speed 1
16	DO 1A	Relay output 1 Fault: open
17	DO 1B	
18	DO 2A	Relay output 2 Running: closed
19	DO 2B	

*Note!

- If both DI 3 and DI 4 are active or inactive, reference is kept stable.
- Reference is stored during stop or power down condition.
- Analog reference is not followed when motor potentiometer is selected.

Motor potentiometer parameter values:

9905 MOTOR NOM VOLT	230/400V	1105 EXT REF1 MAX	50 Hz
9907 MOTOR NOM FREQ	50 Hz	1106 EXT REF2 SELECT	0 (KEYPAD)
9908 MOTOR NOM SPEED	1440 rpm	1201 CONST SPEED SEL	5 (DI5)
1001 EXT 1 COMMANDS	2 (DI1,2)	1503 AO CONTENT MAX	50 Hz
1002 EXT 2 COMMANDS	0 (NOT SEL)	1601 RUN ENABLE	0 (NOT SEL)
1003 DIRECTION	3 (REQUEST)	2008 MAXIMUM FREQ	50 Hz
1101 KEYPAD REF SEL	1 (REF1)	2105 PREMAGN SEL	0 (NOT SEL)
1102 EXT1/EXT2 SEL	6 (EXT1)	2201 ACC/DEC 1/2 SEL	0 (NOT SEL)
1103 EXT REF1 SELECT	6 (DI3U,4D)		

Application Macro Hand - Auto

This macro offers an I/O configuration that is typically used in HVAC applications.

The value of parameter 9902 is 5.

Input signals

- Start/Stop (DI1,5) and rev (DI2,4)
- Two (2) analog references (AI1, AI2)
- Control location selection (DI3)

Output signals

- Analog output AO: Frequency
- Relay output 1: Fault
- Relay output 2: Running

V/I Jumper S1

S1:1:V 

S1:2: I

Control Terminals		Function
1	SCR	
2	AI 1	External reference 1: 0...10V <=> 0...50 Hz (Hand Control)
3	AGND	
4	10V	Reference voltage 10VDC
5	AI 2	External reference 2: 0...20 mA <=> 0...50 Hz (Auto Control)
6	AGND	
7	AO	Output frequency 0...20 mA <=> 0...50 Hz
8	DGND	
9	+12V	+12VDC
10	DCOM	
11	DI 1	Start/Stop: Close to start ACS 140 (Hand)
12	DI 2	Forward/Reverse: Close to reverse rotation direction (Hand)
13	DI 3	EXT1/EXT2 Select: Close to select Auto Control
14	DI 4	Forward/Reverse: Close to reverse rotation direction (Auto)
15	DI 5	Start/Stop: Close to start ACS 140 (Auto)
16	DO 1A	Relay output 1 Fault: open
17	DO 1B	
18	DO 2A	Relay output 2 Running: closed
19	DO 2B	

Hand-Auto parameter values:

9905 MOTOR NOM VOLT	230/400V	1105 EXT REF1 MAX	50 Hz
9907 MOTOR NOM FREQ	50 Hz	1106 EXT REF2 SELECT	2 (AI2)
9908 MOTOR NOM SPEED	1440 rpm	1201 CONST SPEED SEL	0 (NOT SEL)
1001 EXT 1 COMMANDS	2 (DI1,2)	1503 AO CONTENT MAX	50 Hz
1002 EXT 2 COMMANDS	7 (DI5,4)	1601 RUN ENABLE	0 (NOT SEL)
1003 DIRECTION	3 (REQUEST)	2008 MAXIMUM FREQ	50 Hz
1101 KEYPAD REF SEL	1 (REF1)	2105 PREMAGN SEL	0 (NOT SEL)
1102 EXT1/EXT2 SEL	3 (DI3)	2201 ACC/DEC 1/2 SEL	0 (NOT SEL)
1103 EXT REF1 SELECT	1 (AI1)		

Application Macro PID Control

This macro is intended for use with different closed-loop control systems such as pressure and flow control, etc.

The value of parameter 9902 is 6.

Input signals

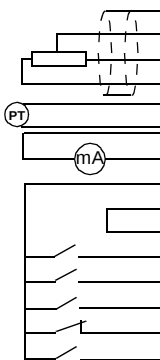
- Start/Stop (DI1,5)
- Analog reference (AI1)
- Actual value (AI2)
- Control location selection (DI2)
- Constant speed (DI3)
- Run enable (DI4)

Output signals

- Analog output AO: Frequency
- Relay output 1: Fault
- Relay output 2: Running

VII Jumper S1

S1:1: V 
S1:2: I 

	Control Terminals	Function
	1	SCR
	2	AI 1
	3	AGND
	4	10 V
	5	AI 2
	6	AGND
	7	AO
	8	DGND
	9	+12V
	10	DCOM
	11	DI 1
	12	DI 2
	13	DI 3
	14	DI 4
	15	DI 5
	16	DO 1A
	17	DO 1B
	18	DO 2A
	19	DO 2B

Relay output 1
Fault: open
Relay output 2
Running: closed

Note!

- * Critical frequencies (group 25) are ignored while in PID control (PID).
- ** Constant speed is not considered while in PID control (PID).

PID Control Parameters (group 40) do not belong to the Basic Parameter Set.

PID Control Parameter Values:

9905 MOTOR NOM VOLT	230/400V	1105 EXT REF1 MAX	50 Hz
9907 MOTOR NOM FREQ	50 Hz	1106 EXT REF2 SELECT	1 (AI1)
9908 MOTOR NOM SPEED	1440 rpm	1201 CONST SPEED SEL	3 (DI3)
1001 EXT 1 COMMANDS	1 (DI1)	1503 AO CONTENT MAX	50 Hz
1002 EXT 2 COMMANDS	6 (DI5)	1601 RUN ENABLE	4 (DI4)
1003 DIRECTION	1 (FORWARD)	2008 MAXIMUM FREQ	50 Hz
1101 KEYPAD REF SEL	1 (REF1)	2105 PREMAGN SEL	0 (NOT SEL)
1102 EXT1/EXT2 SEL	2 (DI2)	2201 ACC/DEC 1/2 SEL	0 (NOT SEL)
1103 EXT REF1 SELECT	1 (AI1)		

Application Macro Premagnetize

This macro is intended for those applications where the drive must start very quickly. Building up the flux in the motor always takes time. With the Premagnetize Macro, this delay can be eliminated.

The value of parameter 9902 is 7.

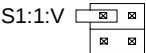
Input signals

- Start/Stop, Direction (DI1,2)
- Analog reference (AI1)
- Preset speed selection (DI3,4)
- Premagnetize (DI5)

Output signals

- Analog output AO: Frequency
- Relay output 1: Fault
- Relay output 2: Running

V/I Jumper S1



Control Terminals		Function
1	SCR	
2	AI 1	External reference1: 0...10V <=> 0...50 Hz
3	AGND	
4	10V	Reference voltage 10VDC
5	AI 2	Not used
6	AGND	
7	AO	Output frequency 0...20 mA <=> 0...50 Hz
8	DGND	
9	+12V	+12VDC
10	DCOM	
11	DI 1	Start/Stop: Close to start ACS 140
12	DI 2	Fwd/Rev: Close to reverse rotation direction
13	DI 3	Constant speed select*
14	DI 4	Constant speed select*
15	DI 5	Premagnetize: Close to start premagnetizing
16	DO 1A	Relay output 1 Fault: open
17	DO 1B	
18	DO 2A	Relay output 2 Running: closed
19	DO 2B	

*Constant speed selection: 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)

Premagnetize parameter values:

9905 MOTOR NOM VOLT	230/400V	1105 EXT REF1 MAX	50 Hz
9907 MOTOR NOM FREQ	50 Hz	1106 EXT REF2 SELECT	0 (KEYPAD)
9908 MOTOR NOM SPEED	1440 rpm	1201 CONST SPEED SEL	7 (DI3,4)
1001 EXT 1 COMMANDS	2 (DI1,2)	1503 AO CONTENT MAX	50 Hz
1002 EXT 2 COMMANDS	0 (NOT SEL)	1601 RUN ENABLE	0 (NOT SEL)
1003 DIRECTION	3 (REQUEST)	2008 MAXIMUM FREQ	50 Hz
1101 KEYPAD REF SEL	1 (REF1)	2105 PREMAGN SEL	5 (DI5)
1102 EXT1/EXT2 SEL	6 (EXT1)	2201 ACC/DEC 1/2 SEL	0 (NOT SEL)
1103 EXT REF1 SELECT	1 (KEYPAD)		

ACS 140 Complete Parameter List

Only the basic parameters (shaded grey in Table 3) are initially visible. The menu function -LG- can be used to make the full parameter set visible.

Table 3 Full parameter set.

S = Parameters can be modified only when the drive is stopped.							
M = Default value depends on the selected macro.							
Code	Name	Range	Resolution	Default	User	S	M
Group 99							
START-UP DATA							
9902	APPLIC MACRO	0-7	1	0 (FACTORY)		✓	
9905	MOTOR NOM VOLT	200, 208, 220, 230, 240, 380, 400, 415, 440, 460, 480V	-	*		✓	✓
9906	MOTOR NOM CURR	$0.5 \cdot I_N - 1.5 \cdot I_N$	0.1 A	I_N		✓	
9907	MOTOR NOM FREQ	0-250 Hz	1 Hz	*		✓	✓
9908	MOTOR NOM SPEED	0-3600 rpm	1 rpm	*		✓	✓
Group 01							
OPERATING DATA							
0102	SPEED	0-9999 rpm	1 rpm	-			
0103	OUTPUT FREQ	0-250 Hz	0.1 Hz	-			
0104	CURRENT	-	0.1 A	-			
0106	POWER	-	0.1 kW	-			
0107	DC BUS VOLTAGE	0-999.9V	0.1V	-			
0109	OUTPUT VOLTAGE	0-480V	0.1V	-			
0110	ACS 140 TEMP	0-150°C	0.1°C	-			
0111	EXT REF 1	0-250 Hz	0.1 Hz	-			
0112	EXT REF 2	0-100%	0.1%	-			
0113	CTRL LOCATION	0-2	1	-			
0114	RUN TIME	0-9999 h	1 h	-			
0115	kWh COUNTER	0-9999 kWh	1 kWh	-			
0116	APPL BLK OUTPUT	0-100%	0.1%	-			
0117	DI1-DI4 STATUS	0000-1111		-			
0118	AI1	0-100%	0.1%	-			
0119	AI2	0-100%	0.1%	-			
0121	DI5 & RELAYS	0000-0111		-			
0122	AO	0-20 mA	0.1 mA	-			
0124	ACTUAL VALUE 1	0-100%	0.1%	-			
0125	ACTUAL VALUE 2	0-100%	0.1%	-			
0126	CONTROL DEV	-100-100%	0.1%	-			
0128	LAST FAULT	0-22	1	0		-	
0129	PREVIOUS FAULT	0-22	1	0		-	
0130	OLDEST FAULT	0-22	1	0		-	
Group 10							
COMMAND INPUTS							
1001	EXT1 COMMANDS	0-10	1	*		✓	✓
1002	EXT2 COMMANDS	0-10	1	*		✓	✓
1003	DIRECTION	1-3	1	*		✓	✓

S = Parameters can be modified only when the drive is stopped. M = Default value depends on the selected macro.							
Code	Name	Range	Resolution	Default	User	S	M
Group 11							
REFERENCE SELECT							
1101	KEYPAD REF SEL	1-2	1	*			✓
1102	EXT1/EXT2 SEL	1-8	1	*		✓	✓
1103	EXT REF1 SELECT	0-8	1	*		✓	✓
1104	EXT REF1 MIN	0-250 Hz	1 Hz	0 Hz			
1105	EXT REF1 MAX	0-250 Hz	1 Hz	*			✓
1106	EXT REF2 SELECT	0-8	1	*		✓	✓
1107	EXT REF2 MIN	0-100%	1%	0%			
1108	EXT REF2 MAX	0-500%	1%	100%			
Group 12							
CONSTANT SPEEDS							
1201	CONST SPEED SEL	0-10	1	*		✓	✓
1202	CONST SPEED 1	0-250 Hz	0.1 Hz	5 Hz			
1203	CONST SPEED 2	0-250 Hz	0.1 Hz	10 Hz			
1204	CONST SPEED 3	0-250 Hz	0.1 Hz	15 Hz			
1205	CONST SPEED 4	0-250 Hz	0.1 Hz	20 Hz			
1206	CONST SPEED 5	0-250 Hz	0.1 Hz	25 Hz			
1207	CONST SPEED 6	0-250 Hz	0.1 Hz	40 Hz			
1208	CONST SPEED 7	0-250 Hz	0.1 Hz	50 Hz			
Group 13							
ANALOG INPUTS							
1301	MINIMUM Ai1	0-100%	1%	0%			
1302	MAXIMUM Ai1	0-100%	1%	100%			
1303	FILTER Ai1	0-10 s	0.1 s	0.1 s			
1304	MINIMUM Ai2	0-100%	1%	0%			
1305	MAXIMUM Ai2	0-100%	1%	100%			
1306	FILTER Ai2	0-10 s	0.1 s	0.1 s			
Group 14							
RELAY OUTPUTS							
1401	RELAY OUTPUT 1	0-11	1	3 (FAULT)			
1402	RELAY OUTPUT 2	0-11	1	2 (RUN)			
Group 15							
ANALOG OUTPUT							
1501	AO CONTENT	102-130	1	103 (FREQ)			
1502	AO CONTENT MIN	x-y	z	0.0 Hz			
1503	AO CONTENT MAX	x-y	z	*			✓
1504	MINIMUM AO	0.0-20.0 mA	0.1 mA	0 mA			
1505	MAXIMUM AO	0.0-20.0 mA	0.1 mA	20 mA			
1506	FILTER AO	0-10 s	0.1 s	0.1 s			
Group 16							
SYSTEM CONTROLS							
1601	RUN ENABLE	0-6	1	*		✓	✓
1602	PARAMETER LOCK	0-2	1	1 (OPEN)			

S = Parameters can be modified only when the drive is stopped. M = Default value depends on the selected macro.								
Code	Name	Range	Resolution	Default	User	S	M	
1604	FAULT RESET SEL	0-7	1	6 (START/STOP)		✓		
Group 20								
LIMITS								
2003	MAX CURRENT	$0.5 \cdot I_N - 1.5 \cdot I_N$	0.1 A	$1.5 \cdot I_N$				
2005	OVERVOLT CTRL	0-1	1	1 (ENABLE)				
2006	UNDERVOLT CTRL	0-2	1	1 (ENABLE TIME)				
2007	MINIMUM FREQ	0-250 Hz	1 Hz	0 Hz				
2008	MAXIMUM FREQ	0-250 Hz	1 Hz	*				✓
Group 21								
START/STOP								
2101	START FUNCTION	1-4	1	1 (RAMP)				
2102	STOP FUNCTION	1-2	1	1 (COAST)				
2103	TORQ BOOST CURR	$0.5 \cdot I_N - 2.0 \cdot I_N$	0.1 A	$1.2 \cdot I_N$				
2104	STOP DC INJ TIME	0-250 s	0.1 s	0 s				
2105	PREMAGN SEL	0-6	1	*		✓		✓
2106	PREMAGN MAX TIME	0.0-25.0 s	0.15 s	2.05 s				
Group 22								
ACCEL/DECEL								
2201	ACC/DEC 1/2 SEL	0-5	1	*		✓		✓
2202	ACCELER TIME 1	0.1-1800 s	0.1; 1 s	5 s				
2203	DECELER TIME 1	0.1-1800 s	0.1; 1 s	5 s				
2204	ACCELER TIME 2	0.1-1800 s	0.1; 1 s	60 s				
2205	DECELER TIME 2	0.1-1800 s	0.1; 1 s	60 s				
2206	RAMP SHAPE	0-3	1	0 (LINEAR)				
Group 25								
CRITICAL FREQ								
2501	CRIT FREQ SEL	0-1	1	0 (OFF)				
2502	CRIT FREQ 1 LO	0-250 Hz	1 Hz	0 Hz				
2503	CRIT FREQ 1 HI	0-250 Hz	1 Hz	0 Hz				
2504	CRIT FREQ 2 LO	0-250 Hz	1 Hz	0 Hz				
2505	CRIT FREQ 2 HI	0-250 Hz	1 Hz	0 Hz				
Group 26								
MOTOR CONTROL								
2603	IR COMPENSATION	0-30V	1	10V		✓		
2604	IR COMP RANGE	0-250 Hz	1 Hz	50 Hz		✓		
2605	CARRIER FREQ. 1=LOW NOISE	0-1	1	0 (STANDARD)		✓		
2606	V/f RATIO	1-2	1	1 (LINEAR)		✓		
Group 30								
FAULT FUNCTIONS								
3001	AI<MIN FUNCTION	0-3	1	1 (FAULT)				
3002	PANEL LOSS	1-3	1	1 (FAULT)				
3003	EXTERNAL FAULT	0-5	1	0 (NOT SEL)				
3004	MOT THERM PROT	0-2	1	1 (FAULT)				

S = Parameters can be modified only when the drive is stopped.

M = Default value depends on the selected macro.

Code	Name	Range	Resolution	Default	User	S	M
3005	MOT THERM TIME	256-9999 s	1 s	500 s			
3006	MOT LOAD CURVE	50-150%	1%	100%			
3007	ZERO SPEED LOAD	25-150%	1%	70%			
3008	BREAK POINT	1-250 Hz	1 Hz	35 Hz			
3009	STALL FUNCTION	0-2	1	0 (NOT SEL)			
3010	STALL CURRENT	$0.5 \cdot I_N - 1.5 \cdot I_N$	0.1 A	$1.2 \cdot I_N$			
3011	STALL FREQ HI	0.5-50 Hz	0.1 Hz	20 Hz			
3012	STALL TIME	10...400 s	1 s	20 s			

Group 31

AUTOMATIC RESET

3101	NR OF TRIALS	0-5	1	0			
3102	TRIAL TIME	1.0-180.0 s	0.1 s	30 s			
3103	DELAY TIME	0.0-3.0 s	0.1 s	0 s			
3104	AR OVERCURRENT	0-1	1	0 (DISABLE)			
3105	AR OVERVOLTAGE	0-1	1	0 (DISABLE)			
3106	AR UNDERVOLTAGE	0-1	1	0 (DISABLE)			
3107	AR AI<MIN	0-1	1	0 (DISABLE)			

Group 32

SUPERVISION

3201	SUPERV 1 PARAM	102 -130	1	103			
3202	SUPERV 1 LIM LO	x-y	z	0			
3203	SUPERV 1 LIM HI	x-y	z	0			
3204	SUPERV 2 PARAM	102 - 130	1	103			
3205	SUPERV 2 LIM LO	x-y	z	0			
3206	SUPERV 2 LIM HI	x-y	z	0			

Group 33

INFORMATION

3301	SW VERSION	0.0.0.0-f.f.f.f	-	-			
3302	TEST DATE	yy.ww	-	-			

Group 40

PID-CONTROL

4001	PID GAIN	0.1-100	0.1	1.0			
4002	PID INTEG TIME	0.1-320 s	0.1 s	60 s			
4003	PID DERIV 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	0-1	1	0 (NO)			
4006	ACTUAL VAL SEL	1-9	1	1 (ACT1)		✓	
4007	ACT1 INPUT SEL	1-2	1	2 (AI2)		✓	
4008	ACT2 INPUT SEL	1-2	1	2 (AI2)		✓	
4009	ACT1 MINIMUM	-1000-1000%	1%	0%			
4010	ACT1 MAXIMUM	-1000-1000%	1%	100%			
4011	ACT2 MINIMUM	-1000-1000%	1%	0%			
4012	ACT2 MAXIMUM	-1000-1000%	1%	100%			
4013	PID SLEEP DELAY	0.0-3600 s	0.1; 1 s	60 s			

S = Parameters can be modified only when the drive is stopped. M = Default value depends on the selected macro.							
Code	Name	Range	Resolution	Default	User	S	M
4014	PID SLEEP LEVEL	0.0-120 Hz	0.1 Hz	0 Hz			
4015	WAKE-UP LEVEL	0.0-100%	0.1%	0%			

S = Parameters can be modified only when the drive is stopped. M = Default value depends on the selected macro.							
Code	Name	Range	Resolution	Default	User	S	M
Group 52 SERIAL COMM							
For descriptions of parameters in this group, refer to ACS 140 Modbus Manual.							

☐ Basic parameters.

Group 99: Start-up Data

The Start-up Data parameters are for setting up the ACS 140 and for entering motor information.

Code	Description
9902	APPLIC MACRO Application macro selection. This parameter is used to select the Application Macro which will configure the ACS 140 for a particular application. Refer to Application Macros, starting page 11, for a list and description of available Application Macros.
9905	MOTOR NOM VOLT Nominal motor voltage from motor rating plate. This parameter sets the maximum output voltage supplied to the motor. MOTOR NOM FREQ sets the frequency at which output voltage is equal to the MOTOR NOM VOLT. The ACS 140 cannot supply the motor with a voltage greater than the input voltage. See Figure 8.
9906	MOTOR NOM CURR Nominal motor current from rating plate. The allowed range is $0.5 \cdot I_N \dots 1.5 \cdot I_N$ of ACS 140.
9907	MOTOR NOM FREQ Nominal motor frequency from rating plate (field weakening point). See Figure 8.
9908	MOTOR NOM SPEED Nominal motor speed from rating plate.

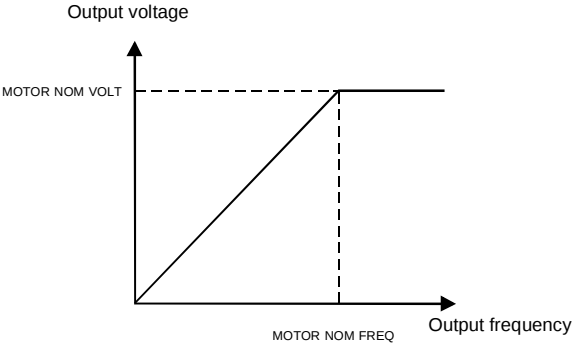
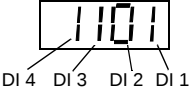
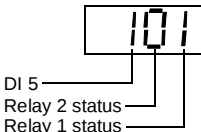


Figure 1 Output voltage as a function of output frequency.

Group 01: Operating Data

Operating Data monitor ACS 140 functions. They do not affect the performance of the ACS 140. Operating Data values are measured or calculated by the drive and cannot be changed by the user.

Code	Description
0102	SPEED Displays the calculated speed of the motor (rpm).
0103	OUTPUT FREQ Displays the frequency (Hz) applied to the motor. (Also shown in OUTPUT display.)
0104	CURRENT Displays the motor current, as measured by the ACS 140. (The same value is shown in the OUTPUT display mode.)
0106	POWER Displays the measured motor power in kW. Note! ACS100-PAN will not display the unit ("kW").
0107	DC BUS VOLTAGE Displays the DC bus voltage, as measured by the ACS 140. The voltage is displayed in Volts DC.
0109	OUTPUT VOLTAGE Displays the voltage applied to the motor.
0110	ACS 140 TEMP Displays the temperature of the ACS 140 heatsink in degrees centigrade (°C).
0111	EXT REF 1 The value of external reference 1 in Hz.
0112	EXT REF 2 The value of external reference 2 in %.
0113	CTRL LOCATION Displays the active control location. Alternatives are: 0 = LOCAL 1 = EXT1 2 = EXT2 See APPENDIX for description of different control locations.
0114	RUN TIME Shows the total running time of the ACS 140.
0115	kWh COUNTER Counts the kilowatt hours of ACS 140 in operation.
0116	APPL BLK OUTPUT The reference value in percent (%) received from the application block (PID control block). This value has significance only when the PID Control macro is used.
0117	DI1-DI4 STATUS Status of the four (4) digital inputs. If the input is activated, the display will indicate 1. If the input is deactivated, the display will be 0. 
0118	AI1 Relative value of analog input 1 displayed in %.
0119	AI2 Relative value of analog input 2 displayed in %.

Code	Description
0121	DI5 & RELAYS Status of digital input 5 and relay outputs. 1 indicates that the relay is energized and 0 indicates that the relay is de-energized.  DI 5 ——— Relay 2 status ——— Relay 1 status ———
0122	AO Value of analog output signal in milliamperes (mA).
0124	ACTUAL VALUE 1 PID Controller actual value 1 (ACT1), displayed in percent (%).
0125	ACTUAL VALUE 2 PID Controller actual value 2 (ACT2), displayed in percent (%).
0126	CONTROL DEV Displays the difference between the reference value and the actual value of the PID process controller.
0128	LAST FAULT Last recorded fault (0=no fault). See "Diagnostics", starting page 5. Can be cleared with the control panel by simultaneously pressing the UP and DOWN buttons, when in parameter set mode.
0129	PREVIOUS FAULT Previous recorded fault. See "Diagnostics", starting page 5. Can be cleared with the control panel by simultaneously pressing the UP and DOWN buttons, when in parameter set mode.
0130	OLDEST FAULT Oldest recorded fault. See "Diagnostics". See "Diagnostics", starting page 5. Can be cleared with the control panel by simultaneously pressing the UP and DOWN buttons, when in parameter set mode.

Group 10: Command Inputs

Start/Stop, Direction commands can be given from the control panel or from two (2) external locations (EXT1, EXT2). The selection between the two (2) external locations is made with parameter 1102 EXT1/EXT2 SEL. For more information on control locations refer to "APPENDIX", starting page 55.

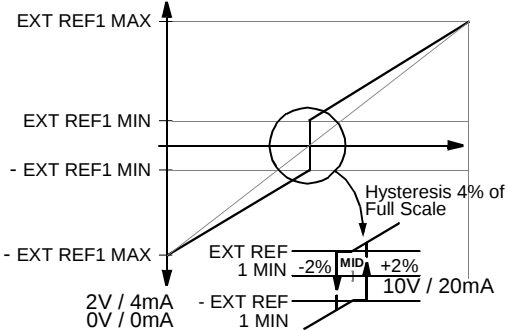
Code	Description
1001	EXT1 COMMANDS Defines the connections and the source of Start/Stop, Direction commands for External control location 1 (EXT1). 0 = NOT SEL No Start/Stop, Direction command source for EXT1 is selected. 1 = DI1 Two- (2-) wire Start/Stop connected to digital input DI1. DI1 open = Stop; DI1 closed = Start. * 2 = DI1,2 Two- (2-) wire Start/Stop, Direction. Start/Stop is connected to digital input DI1 as above. Direction is connected to digital input DI2. DI2 open = Forward; DI2 closed = Reverse. To control direction, value of parameter 1003 DIRECTION should be REQUEST. 3 = DI1P,2P Three- (3-) wire Start/Stop. Start/Stop commands are given by momentary push buttons ("pulse" action). The Start button is normally open, and connected to digital input DI1. The Stop button is normally closed, and connected to digital input DI2. Multiple Start buttons are connected in parallel; multiple Stop buttons are connected in series. * 4 = DI1P,2P,3 Three- (3-) wire Start/Stop, Direction. Start/Stop connected as with DI1P,2P. Direction is connected to digital input DI3. DI3 open = Forward; DI3 closed = Reverse. To control Direction, value of parameter 1003 DIRECTION should be REQUEST. 5 = DI1P,2P,3P Start Forward, Start Reverse, and Stop/Start, Direction commands are given simultaneously by momentarily pressing two (2) separate buttons ("pulse" action). The Stop button is normally closed, and connected to digital input DI3. The Start Forward and Start Reverse buttons are normally open, and connected to digital inputs DI1 and DI2 respectively. Multiple Start buttons are connected in parallel, and multiple Stop buttons are connected in series. To control direction, value of parameter 1003 DIRECTION should be REQUEST. 6 = DI5 Two- (2-) wire Start/Stop, connected to digital input DI5. DI5 open = Stop and DI5 closed = Start. * 7 = DI5,4 Two- (2-) wire Start/Stop, Direction. Start/Stop is connected to digital input DI5. Direction is connected to digital input DI4. DI4 open = Forward and DI4 closed = Reverse. To control direction, value of parameter 1003 DIRECTION should be REQUEST. 8 = KEYPAD The Start/Stop, Direction commands are given from the control panel when External control location 1 is active. To control direction, value of parameter 1003 DIRECTION should be REQUEST. 9 = DI1F,2R Start forward command is given when DI1= closed and DI2= open. Start reverse command is given if DI1=0 and DI2=1. In other cases Stop command is given. 10 = COMM The Start/Stop, Direction commands are given through serial communication. *Note! In cases 1, 3, & 6, direction is set with parameter 1003 DIRECTION. Selecting value 3 (REQUEST) fixes direction to Forward.

1002	EXT2 COMMANDS Defines the connections and the source of Start/Stop, Direction commands for external control location 2 (EXT2). Refer to parameter 1001 EXT1 COMMANDS above.
1003	DIRECTION 1 = FORWARD 2 = REVERSE 3 = REQUEST Rotation direction lock. This parameter allows you to fix the direction of rotation of the motor to forward or reverse. If you select 3 (REQUEST), the direction is set according to the given direction command.

Group 11: Reference Select

Reference commands can be given from the control panel or from two (2) external locations. The selection between the two (2) external locations is made with parameter 1102 EXT1/EXT2 SEL. For more information on control locations, refer to "APPENDIX", starting page 55.

Code	Description
1101	KEYPAD REF SEL Selection of active control panel reference. 1 = REF1 (Hz) Control panel reference is given in Hz. 2 = REF2 (%) Control panel reference is given as a percentage (%).
1102	EXT1/EXT2 SEL Sets the input used for selecting the external control location, or fixes it to EXT1 or EXT2. The external control location of both Start/Stop, Direction commands and reference is determined by this parameter. 1...5 = DI1...DI5 External control location 1 or 2 is selected according to the state of the selected digital input (DI1 ... DI5), where open = EXT1 and closed = EXT2. 6 = EXT1 External control location 1 (EXT1) is selected. The control signal sources for EXT1 are defined with parameter 1001 (Start/Stop, Direction commands) and parameter 1103 (reference). 7 = EXT2 External control location 2 (EXT2) is selected. The control signal sources for EXT2 are defined with parameter 1002 (Start/Stop, Direction commands) and parameter 1106 (reference). 8 = COMM External control location 1 or 2 is chosen through serial communication.

1103	EXT REF1 SELECT This parameter selects the signal source of external reference 1. 0 = KEYPAD Reference is given from the control panel. 1 = AI 1 Reference is given through analog input 1. 2 = AI 2 Reference is given through analog input 2. 3 = AI1/JOYST; 4 = AI2/JOYST Reference is given through analog input 1 (or 2 accordingly) configured for a joystick. The minimum input signal runs the drive at maximum reference in the reverse direction. The maximum input signal runs the drive at maximum reference in the forward direction (See Figure 2). See also parameter 1003 DIRECTION. Caution: Minimum reference for joystick should be 0.3V (0.6 mA) or higher. If a 0 ... 10V signal is used, the ACS 140 will operate at maximum reference in the reverse direction, if the control signal is lost. Set parameter 1301 MINIMUM AI1 to a value 0.3V or higher, and parameter 3001 AI<MIN FUNCTION to 1 (FAULT), and the ACS 140 will stop, if the control signal is lost.  Figure 2 Joystick control. Maximum for external reference 1 is set with Parameter 1105 and minimum with Parameter 1104. 5 = DI3U,4D(R) Speed reference is given through digital inputs as motor potentiometer control. Digital input DI3 increases the speed (the U stands for "up"), and digital input DI4 decreases the speed (the D stands for "down"). (R) indicates that the reference will be reset to zero (0) when a Stop command is given. The rate of change of the reference signal is controlled by parameter 2204 ACCELER TIME 2. 6 = DI3U,4D Same as above, except that the speed reference is not reset to zero (0) on a Stop command. When the ACS 140 is started, the motor will ramp up at the selected acceleration rate to the stored reference. 7 = DI4U,5D Same as above, except that the digital inputs in use are DI4 and DI5. 8= COMM The reference is given through serial communication.
1104	EXT REF1 MIN Sets the minimum frequency reference for external reference 1 in Hz. When the analog input signal is at minimum, external reference 1 equals to EXT REF1 MIN. See Figure 3 on page 34.
1105	EXT REF1 MAX Sets the maximum frequency reference for external reference 1 in Hz. When the analog input signal is at maximum, external reference 1 equals to EXT REF1 MAX. See Figure 3 on page 34.
1106	EXT REF2 SELECT This parameter selects the signal source for external reference 2. The alternatives are the same as with external reference 1.

1107	EXT REF2 MIN Sets the minimum reference in %. When analog input signal is at minimum value, external reference 2 equals to EXT REF2 MIN. See Figure 3. • If the PID Control macro is selected, this parameter sets the minimum process reference. • If any other macro than PID is selected, this parameter sets the minimum frequency reference. This value is given as a percentage (%) of the maximum frequency.
1108	EXT REF2 MAX Sets the maximum reference in percent (%). When analog input signal is at maximum, external reference 2 equals to EXT REF2 MAX. See Figure 3. • If the PID Control macro is selected, this parameter sets the maximum process reference. • If any other macro than PID Control is selected, this parameter sets the maximum frequency reference. This value is given as percentage (%) of maximum frequency.

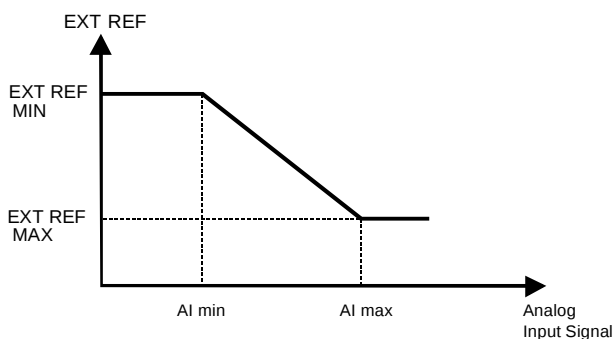
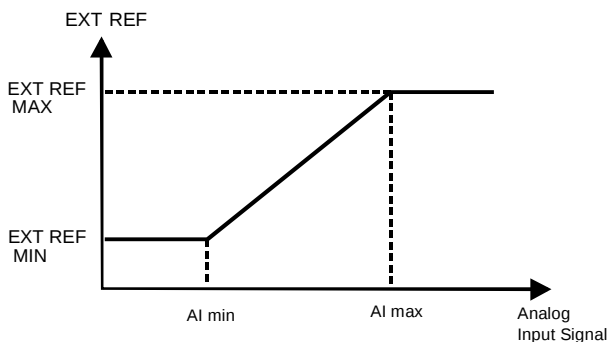


Figure 3 Setting EXT REF MINIMUM and EXT REF MAXIMUM. The range of the analog input signal is set by parameters 1301 and 1302 or parameters 1304 and 1305, depending on the analog input used.

Group 12: Constant Speeds

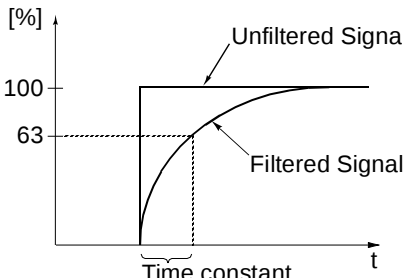
The ACS 140 has seven (7) programmable constant speeds, ranging from 0 to 250 Hz. Negative speed values cannot be given for constant speeds.

Constant speed selections are ignored if the process PID reference is followed (see PID Control Macro).

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

Code	Description																																																			
1201	CONST SPEED SEL This parameter defines which digital inputs are used to select Constant Speeds. 0 = NOT SEL Constant speed function disabled. 1...5 = DI1...DI5 Constant Speed 1 is selected with digital inputs DI1-DI5. Digital input activated = Constant Speed 1 activated. 6 = DI1,2 Three (3) Constant Speeds (1 ... 3) are selected with two (2) digital inputs. Constant Speed selection with digital inputs DI1,2. <i>Table 4 Constant Speed selection with digital inputs DI1,2.</i> <table><tr><th>DI1</th><th>DI2</th><th>Function</th></tr><tr><td>0</td><td>0</td><td>No constant speed</td></tr><tr><td>1</td><td>0</td><td>Constant speed 1 (1202)</td></tr><tr><td>0</td><td>1</td><td>Constant speed 2 (1203)</td></tr><tr><td>1</td><td>1</td><td>Constant speed 3 (1204)</td></tr></table> 7 = DI3,4 Three (3) Constant Speeds (1 ... 3) are selected with two (2) digital inputs as in DI1,2. 8 = DI4,5 Three (3) Constant Speeds (1 ... 3) are selected with two (2) digital inputs as in DI1,2. 9 = DI1,2,3 Seven (7) Constant Speeds (1 ... 7) are selected with three (3) digital inputs. <i>Table 5 Constant Speed selection with digital inputs DI1,2,3.</i> <table><tr><th>DI1</th><th>DI2</th><th>DI3</th><th>Function</th></tr><tr><td>0</td><td>0</td><td>0</td><td>No const. speed</td></tr><tr><td>1</td><td>0</td><td>0</td><td>Constant speed 1 (1202)</td></tr><tr><td>0</td><td>1</td><td>0</td><td>Constant speed 2 (1203)</td></tr><tr><td>1</td><td>1</td><td>0</td><td>Constant speed 3 (1204)</td></tr><tr><td>0</td><td>0</td><td>1</td><td>Constant speed 4 (1205)</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Constant speed 5 (1206)</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Constant speed 6 (1207)</td></tr><tr><td>1</td><td>1</td><td>1</td><td>Constant speed 7 (1208)</td></tr></table> 0=DI open, 1=DI closed 10 = DI3,4,5 Seven (7) Constant Speeds (1 ... 7) are selected with three (3) digital inputs as in DI1,2,3.	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)	DI1	DI2	DI3	Function	0	0	0	No const. 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)
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)																																																		
DI1	DI2	DI3	Function																																																	
0	0	0	No const. 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)																																																	
1202 -1208	CONST SPEED 1... CONST SPEED 7 Constant speeds 1-7.																																																			

Group 13: Analog Inputs

Code	Description
1301	MINIMUM AI1 Relative minimum value of AI1 (%). Value corresponds to minimum reference set by parameter 1104 EXT REF1 MIN or 1107 EXT REF2 MIN. See Figure 3 on page 34.
1302	MAXIMUM AI1 Maximum value of AI1 (%). Value corresponds to maximum reference set by parameter 1105 EXT REF1 MAX or 1108 EXT REF2 MAX. See Figure 3 on page 34.
1303	FILTER AI1 Filter time constant for analog input AI1. As the analog input value changes, 63% of the change takes place within the time specified by this parameter. Note! Even if you select 0 s for the filter time constant, the signal is still filtered with a time constant of 0.1 microseconds (μ s) due to the signal interface hardware. This cannot be changed by any parameters.  Figure 4 Filter time constant for analog input AI1.
1304	MINIMUM AI2 Minimum value of AI2 (%). Value corresponds to minimum reference set by parameter 1104 EXT REF1 MIN or 1107 EXT REF2 MIN.
1305	MAXIMUM AI2 Maximum value of AI2 (%). Value corresponds to maximum reference set by parameter 1105 EXT REF1 MAX or 1108 EXT REF2 MAX.
1306	FILTER AI2 Filter time constant for AI2. Refer to parameter 1303 FILTER AI1.

Group 14: Relay Outputs

Code	Description
1401	RELAY OUTPUT 1 Relay output 1 content. Selects which information is indicated with relay output 1. 0 = NOT SEL Relay is not used and is de-energized. 1 = READY The ACS 140 is ready to function. The relay is energized unless no run enable signal is present or a fault exists. Also Stop must be active and voltage within range. 2 = RUN Relay energized when the ACS 140 is running. 3 = FAULT Relay energized when power is applied, and de-energized upon a fault trip. 4 = FAULT (-1) Relay energized when a fault is active. 5 = ALARM Relay energized when an alarm (AL10-22) is active. 6 = REVERSED Relay energized when motor rotates in reverse direction. 7 = SUPRV1 OVER Relay energized when first supervised parameter (3201) exceeds the limit (3203). See "Group 32: Supervision", starting page 50. 8 = SUPRV1 UNDER Relay energized when first supervised parameter (3201) drops below the limit (3202). See "Group 32: Supervision", starting page 50. 9 = SUPRV2 OVER Relay energized when second supervised parameter (3204) exceeds the limit (3206). See "Group 32: Supervision", starting page 50. 10 = SUPRV2 UNDER Relay energized when second supervised parameter (3204) drops below the limit (3205). See "Group 32: Supervision", starting page 50. 11 = AT SET POINT Relay energized when output frequency is equal to reference frequency.
1402	RELAY OUTPUT 2 Relay output 2 content. Refer to parameter 1401 RELAY OUTPUT 1.

Group 15: Analog Output

Analog output is used to output the value of any parameter of the Operating Data group (Group 1) as a current signal. Output current minimum and maximum values are configurable, as are the allowed minimum and maximum values for the observed parameter.

If output current maximum value is set to less than minimum value, output current is inversely proportional to the value of the observed parameter.

Code	Description
1501	AO CONTENT Content for analog output. Number of any parameter of the Operating Data group (Group 01).
1502	AO CONTENT MIN Analog output content minimum. Display depends on parameter 1501.
1503	AO CONTENT MAX Analog output content maximum. Display depends on parameter 1501.
1504	MINIMUM AO Analog output signal minimum.
1505	MAXIMUM AO Analog output signal maximum.
1506	AO FILTER Filter time constant for AO.

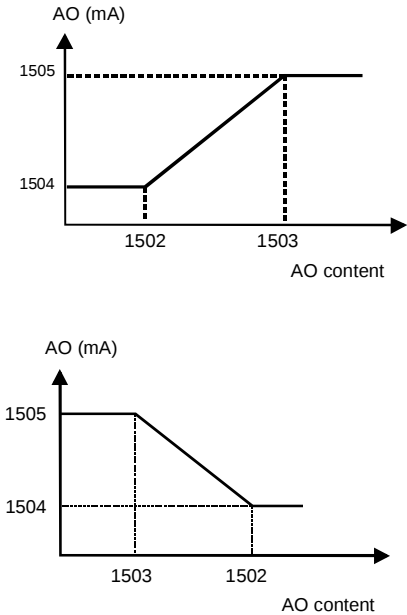


Figure 5 Analog output scaling.

Group 16: System Controls

Code	Description
1601	RUN ENABLE Selects the source of the run enable signal. 0 = NOT SEL The ACS 140 is ready to start without an external run enable signal. 1...5 = DI1 ... DI5 To activate the run enable signal, the selected digital input must be activated. If the voltage drops and deactivates the selected digital input, the ACS 140 will coast to stop and will not start until the run enable signal resumes. 6 = COMM The run enable signal is given through serial communication.
1602	PARAMETER LOCK 0 = LOCKED Control panel START/STOP and REVERSE buttons and parameter modification disabled. Parameter value viewing is allowed. 1 = OPEN Panel operations are allowed. 2 = NOT SAVED Modified values not stored in permanent memory. Note! Option 0 (LOCKED) can be selected only in remote mode. Note! This parameter is not affected by macro selection.
1604	FAULT RESET SEL Fault reset source. Note! Fault reset is always possible using the control panel. 0 = KEYPAD ONLY Fault reset is executed from the control panel keypad. 1...5 = DI1 ... DI5 If a digital input is selected, fault reset is executed from an external switch. Reset is activated by opening the input. 6 = START/STOP Fault reset is activated by Stop command. 7 = COMM Fault reset is executed through serial communication.

Group 20: Limits

Code	Description
2003	MAX CURRENT Maximum output current. The maximum output current that the ACS 140 will supply to the motor. The default value is $1.5 \cdot I_N$.
2005	OVERVOLT CTRL DC overvoltage controller enable. Fast braking of a high inertia load may cause the DC bus voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. Caution! If a braking chopper and a braking resistor are connected to the ACS 140, this parameter value must be set to 0 to ensure proper operation of the chopper. 0 = DISABLE 1 = ENABLE
2006	UNDERVOLT CTRL DC undervoltage controller enable. If the DC bus voltage drops due to loss of input power, the undervoltage controller will decrease the motor speed in order to keep the DC bus voltage above the lower limit. By decreasing the motor speed, the inertia of the load will cause regeneration back into the ACS 140, thus keeping the DC bus charged, and preventing an undervoltage trip. This will increase power loss ride-through on systems with a high inertia, such as a centrifuge or fan. 0 = DISABLE 1 = ENABLE (TIME) Enable with 500 μ s time limit for operation. 2 = ENABLE Enable without time limit for operation.
2007	MINIMUM FREQ Operating range minimum output frequency. Note! Keep MINIMUM FREQ < MAXIMUM FREQ.
2008	MAXIMUM FREQ Operating range maximum output frequency.

Group 21: Start/Stop

ACS 140 supports several start and stop modes, including flying start and torque boost at start. DC current can be injected either before the start command (premagnetizing) or automatically right after the start command (starting with DC hold).

DC hold can be used when stopping the drive with ramp. If the drive is programmed for coast to stop, DC braking can be used.

Code	Description
2101	START FUNCTION Conditions during motor acceleration. 1 = RAMP Ramp acceleration as set. 2 = FLYING Flying start. Use this setting if the motor is already rotating and the drive will start smoothly at the reference frequency. 3 = TORQUE BOOST Automatic torque boost might be necessary for loads with high starting torque. Torque boost is only applied at start. Boosting is stopped when output frequency exceeds 20 Hz or when output frequency is equal to reference. See also parameter 2103 TORQ BOOST CURR. 4 = FLY + BOOST Activates both the flying start and torque boost.
2102	STOP FUNCTION Conditions during motor deceleration. 1 = COAST Motor coasts to stop. 2 = RAMP Ramp deceleration as defined by the active deceleration time 2203 DECELER TIME 1 or 2205 DECELER TIME 2.
2103	TORQ BOOST CURR Maximum supplied current during torque boost. See also parameter 2101 START FUNCTION.
2104	STOP DC INJ TIME DC injection time after modulation has stopped. If 2102 STOP FUNCTION is 1 (COAST), ACS 140 uses DC braking. If 2102 STOP FUNCTION is 2 (RAMP), ACS 140 uses DC hold after ramp.
2105	PREMAGN SEL Options 1- 6 select source for premagnetizing command. Option 7 selects start with DC hold. 0 = NOT SEL Premagnetizing not used. 1...5 = DI1...DI5 Premagnetizing command is received through a digital input. 6 = CONST Constant premagnetizing time after start command. Time is defined by parameter 2106 PREMAGN MAX TIME.
2106	PREMAGN MAX TIME Maximum premagnetizing time.

Note! Excessive DC injection time will cause excessive motor heating.

Group 22: Accel/Decel

Two (2) acceleration/deceleration ramp pairs can be used. If both ramp pairs are used, selection can be made between these in run time through a digital input. The S curve of the ramps is adjustable.

Code	Description
2201	ACC/DEC 1/2 SEL Selects the source for the ramp pair selection signal. 0 = NOT SEL The first ramp pair is used (ACCELER TIME 1/DECELER TIME 1). 1...5 = DI1...DI5 Ramp pair selection is done through a digital input (DI1 to DI5). Digital input deactivated = Ramp pair 1 (ACCELER TIME 1/DECELER TIME 1) is used. Digital input activated = Ramp pair 2 (ACCELER TIME 2/DECELER TIME 2) is used.
2202	ACCELER TIME 1 Ramp 1: time from zero to maximum frequency (0 - MAXIMUM FREQ).
2203	DECELER TIME 1 Ramp 1: time from maximum frequency to zero (MAXIMUM FREQ - 0).
2204	ACCELER TIME 2 Ramp 2: time from zero to maximum frequency (0 - MAXIMUM FREQ).
2205	DECELER TIME 2 Ramp 2: time from maximum frequency to zero (MAXIMUM FREQ - 0).
2206	RAMP SHAPE Acceleration/deceleration ramp shape selection 0 = LINEAR 1 = FAST S CURVE 2 = MEDIUM CURVE 3 = SLOW S CURVE

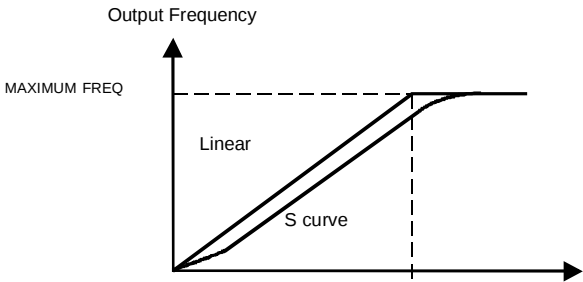


Figure 6 Definition of acceleration/deceleration ramp time.

Group 25: Critical Freq

In some mechanical systems, certain speed ranges can cause mechanical resonance problems. With this parameter group, it is possible to set up to two (2) different speed ranges that the ACS 140 will skip over.

Note! Critical frequencies are ignored when using PID Control.

Code	Description
2501	CRIT FREQ SEL Critical frequencies activation. 0 = OFF 1 = ON
2502	CRIT FREQ 1 LO Critical frequency 1 start. Note! If LOW > HI, no critical frequency lock-out will occur.
2503	CRIT FREQ 1 HI Critical frequency 1 end.
2504	CRIT FREQ 2 LO Critical frequency 2 start.
2505	CRIT FREQ 2 HI Critical frequency 2 end. Note! If LOW > HI, no critical frequency lock-out will occur.

Example: A fan system vibrates badly from 18 Hz to 23 Hz and from 46 Hz to 52 Hz. Set the parameters as follows:

CRIT FREQ 1 LO = 18 Hz and CRIT FREQ 1 HI = 23 Hz

CRIT FREQ 2 LO = 46 Hz and CRIT FREQ 2 HI = 52 Hz

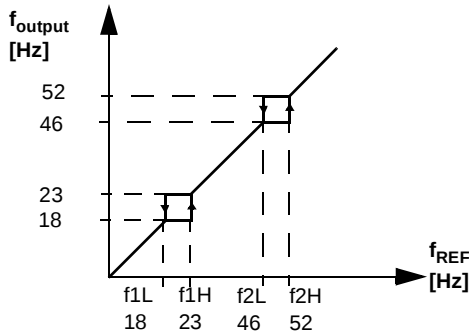


Figure 7 Example of critical frequencies setting in a fan system with bad vibrations at frequency ranges 18 Hz to 23 Hz and 46 Hz to 52 Hz.

Group 26: Motor Control

Code	Description																																				
2603	IR COMPENSATION IR compensation voltage at 0 Hz. Note! IR compensation should be kept as low as possible to prevent motor overheating. Refer to Table 6. Table 6 Typical IR compensation values. <table><tr><th colspan="7">240V Units</th></tr><tr><td>P_N / Hp</td><td>0.5</td><td>0.75</td><td>1.0</td><td>1.5</td><td>2.0</td><td>3.0</td></tr><tr><td>IR comp / V</td><td>25</td><td>21</td><td>18</td><td>16</td><td>14</td><td>13</td></tr></table> <table><tr><th colspan="5">480V Units</th></tr><tr><td>P_N / Hp</td><td>1.0</td><td>1.5</td><td>2.0</td><td>3.0</td></tr><tr><td>IR comp / V</td><td>30</td><td>27</td><td>25</td><td>23</td></tr></table>	240V Units							P _N / Hp	0.5	0.75	1.0	1.5	2.0	3.0	IR comp / V	25	21	18	16	14	13	480V Units					P _N / Hp	1.0	1.5	2.0	3.0	IR comp / V	30	27	25	23
240V Units																																					
P _N / Hp	0.5	0.75	1.0	1.5	2.0	3.0																															
IR comp / V	25	21	18	16	14	13																															
480V Units																																					
P _N / Hp	1.0	1.5	2.0	3.0																																	
IR comp / V	30	27	25	23																																	
2604	IR COMP RANGE IR compensation range. Defines frequency after which IR compensation is 0V.																																				
2605	LOW NOISE Motor accoustical noise option 0 = STANDARD (switching frequency 4 kHz) 1 = LOW NOISE (switching frequency 8 kHz) Note! When the low noise setting is used, the maximum loadability of the ACS 140 is I ₂ at 30°C ambient temperature or 0.9 * I ₂ at 40°C. (See User’s Guide.)																																				
2606	V/F RATIO V/f ratio below field weakening point. 1 = LINEAR 2 = SQUARE Linear is preferred for constant torque applications and Square for centrifugal pump and fan applications. (Square offers lower accoustical noise for most operating frequencies.)																																				

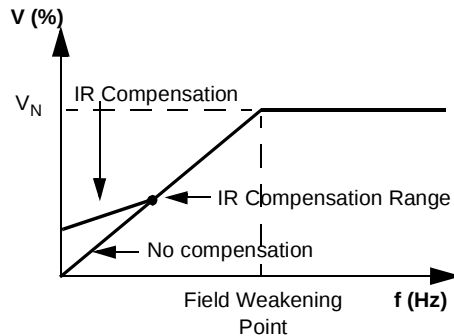


Figure 8 Operation of IR compensation

Group 30: Fault Functions

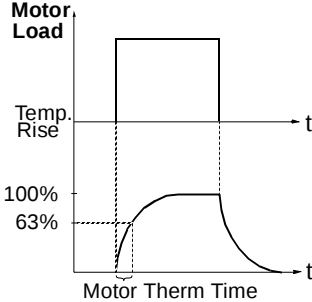
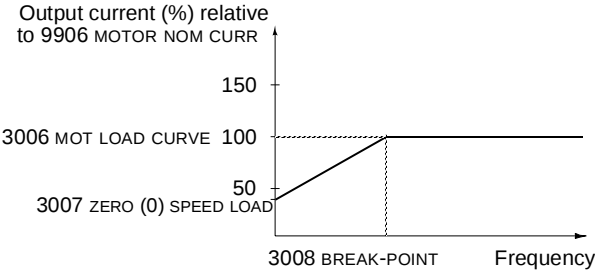
The ACS 140 can be configured to respond to certain abnormal external conditions such as: analog input fault, external fault signal and panel loss.

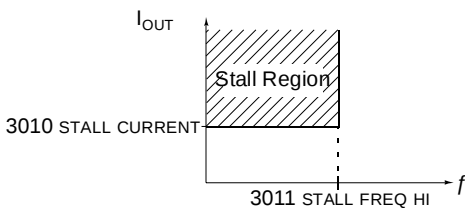
In these cases, the drive can either continue operation at current speed or at a preset speed while showing an alarm, ignore the condition, or trip on a fault and stop.

Motor thermal protection parameters 3004 - 3008 provide a means of adjusting the motor load curve. For example, limiting the load near zero (0) speed might be necessary if the motor does not have a cooling fan.

Stall protection (parameters 3009 - 3012) includes parameters for stall frequency, stall time and current.

Code	Description
3001	AI<MIN FUNCTION Operation in case of AI signal drops below minimum limit. 0 = NOT SEL No operation. 1 = FAULT A fault indication is displayed and the motor coasts to stop. 2 = CONST SPEED 7 A warning indication is displayed and the speed is set according to parameter 1208 CONST SPEED7. 3 = LAST SPEED A warning indication is displayed and the speed is set to the level the ACS 140 was last operating at. This value is determined by the average speed over the last 10 seconds. Caution: If you select CONST SPEED 7 or LAST SPEED, make sure that it is safe to continue operation in case analog input signal is lost.
3002	PANEL LOSS Operation in case of control panel loss fault. 1 = FAULT A fault indication is displayed and the ACS 140 stops according to the setting of parameter 2103 STOP FUNCTION. 2 = CONST SPEED7 A warning indication is displayed and the speed is set according to parameter 1208 CONST SPEED7. 3 = LAST SPEED A warning indication is displayed and the speed is set to the level the ACS 140 was last operating at. This value is determined by the average speed over the last 10 seconds. Caution: If you select CONST SPEED 7 or LAST SPEED, make sure that it is safe to continue operation in case analog input signal is lost.
3003	EXTERNAL FAULT External fault input selection. 0 = NOT SEL External fault signal is not used. 1...5 = DI1...DI5 This selection defines the digital input used for an external fault signal. If an external fault occurs, i.e. digital input is opened, the ACS 140 is stopped and the motor coasts to stop and fault indication is displayed.

Code	Description
3004	MOTOR THERM PROT Motor overtemperature function. This parameter defines the operation of the motor thermal protection function, which protects the motor from overheating. 0 = NOT SEL 1 = FAULT Displays a warning indication at the warning level (95% of the nominal value). Displays a fault indication and stops the ACS 140 when the motor temperature reaches the 100% level. 2 = WARNING A warning indication is displayed when the motor temperature reaches the warning level (95% of the nominal value).
3005	MOT THERM TIME Time for 63% temperature rise. This is the time within which the motor temperature reaches 63% of the final temperature rise. Figure 9 shows motor thermal time definition. If Thermal protection, according to UL requirements for NEMA class motors is desired, use this rule of thumb - MOTOR THERM TIME equals 35 times t_6 (t_6 in seconds is the time that the motor can safely operate at six (6) times its rated current, given by the motor manufacturer). 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.  <i>Figure 9 Motor thermal time.</i>
3006	MOT LOAD CURVE Motor current maximum limit. MOTOR 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. The load curve level should be adjusted if the ambient temperature differs from the nominal value.  <i>Figure 10 Motor load curve.</i>
3007	ZERO SPEED LOAD This parameter defines the maximum allowable current at zero (0) speed relative to 9906 MOTOR NOM CURR. Refer to Figure 10.

Code	Description
3008	BREAK POINT Break point is the point at which output current is decreased due to the diminished motor cooling capacity. Refer to Figure 10 for an example of a motor load curve. See Figure 12.
3009	STALL FUNCTION This parameter defines the operation of stall protection. The protection is activated if the output current becomes too high, compared to output frequency, refer to Figure 11. 0 = NOT SEL Stall protection is not used. 1 = FAULT When the protection is activated the ACS 140 stops and a fault indication is displayed. 2 = WARNING A warning indication is displayed. The indication disappears in half the time set by parameter 3012 STALL TIME. .  Figure 11 Motor stall protection.
3010	STALL CURRENT Current limit for stall protection. Refer to Figure 11.
3011	STALL FREQ HI This parameter sets the frequency value for the stall function. Refer to Figure 11.
3012	STALL TIME This parameter sets the time value for the stall function.

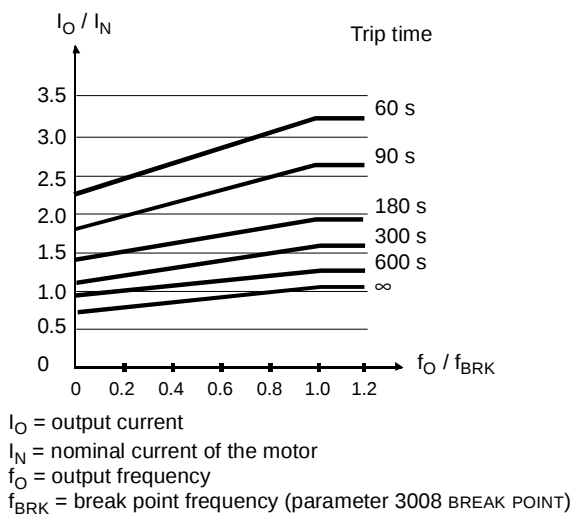


Figure 12 Thermal protection trip times when parameters 3005 MOT THERM TIME, 3006 MOT LOAD CURVE and 3007 ZERO SPEED LOAD have default values.

Group 31: Automatic Reset

Automatic reset can be used for resetting overcurrent, overvoltage, undervoltage and analog input loss faults automatically. The number of allowed automatic reset operations within a certain time is selectable.

Code	Description
3101	NR OF TRIALS Sets the number of allowed autoresets within a certain time. The time is defined with parameter 3102 TRIAL TIME. The ACS 140 prevents additional autoresets and remains stopped until a successful reset is performed from the control panel or from a place selected by parameter 1604 FAULT RESET SEL.
3102	TRIAL TIME The time within which a limited number of fault autoresets is allowed. The allowed number of faults per this time period is given with parameter 3101 NR OF TRIALS.
3103	DELAY TIME This parameter sets the time that the ACS 140 will wait after a fault occurs before attempting to reset. If set to zero (0), the ACS 140 will attempt reset immediately.
3104	AR OVERCURRENT 0 = DISABLE 1 = ENABLE If 1 is selected, the fault (motor overcurrent) is reset automatically after delay time (parameter 3103).
3105	AR OVERVOLTAGE 0 = DISABLE 1 = ENABLE If 1 is selected, the fault (DC bus overvoltage) is reset automatically after delay time (parameter 3103).
3106	AR UNDERVOLTAGE 0 = DISABLE 1 = ENABLE If 1 is selected, the fault (DC bus undervoltage) is reset automatically after delay time (parameter 3103).
3107	AR AI<MIN 0 = DISABLE 1 = ENABLE If 1 is selected, the fault (analog input signal under minimum level) is reset automatically, after delay time (parameter 3103).



Warning! If parameter 3107 AR AI<MIN is enabled, the drive may restart, even after a long period of time, when the analog input signal is restored. Ensure that the use of this feature will not cause physical injury and/or damage equipment.

Group 32: Supervision

Parameters in this group are used in conjunction with relay output parameters 1401 RELAY OUTPUT 1 and 1402 RELAY OUTPUT 2. Any two (2) parameters from the Operating Data group (Group 1) can be monitored within the Supervision Group. Relays can be configured to be energized when the values of supervised parameters are either too low or too high.

Code	Description
3201	SUPERV 1 PARAM First supervised parameter from the Operating Data group (Group 01).
3202	SUPERV 1 LIM LO First supervision limit low. Display of this parameter depends on selected supervised parameter (3201).
3203	SUPERV 1 LIM HI First supervision limit high. Display of this parameter depends on selected supervised parameter (3201).
3204	SUPERV 2 PARAM Second supervised parameter from the Operating Data group (Group 01).
3205	SUPERV 2 LIM LO Second supervision limit low. Display of this parameter depends on selected supervised parameter (3204).
3206	SUPERV 2 LIM HI Second supervision limit high. Display of this parameter depends on selected supervised parameter (3204).

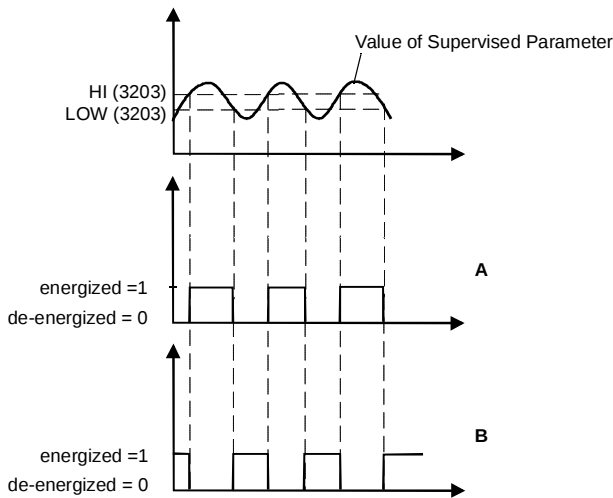


Figure 13 Operating data supervision using relay outputs.

A = Parameter 1401 RELAY OUTPUT 1 (1402 RELAY OUTPUT 2) value is SUPRV1 OVER or SUPRV2 OVER

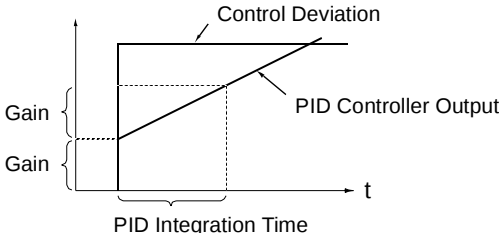
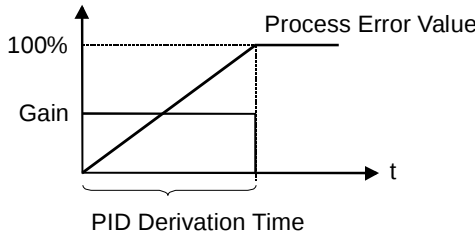
B = Parameter 1401 RELAY OUTPUT 1 (1402 RELAY OUTPUT 2) value is SUPRV1 UNDER or SUPRV2 UNDER

Group 33: Information

Code	Description
3301	SW VERSION Software version.
3302	TEST DATE Displays the test date of the ACS 140 (yy.ww).

Group 40: PID Control

The PID Control Macro allows the ACS 140 to take a reference signal (setpoint) and an actual signal (feedback), and automatically adjust the speed of the drive to match the actual signal to the reference. Figure 19 on page 58 (APPENDIX), shows the connections of internal signals when the PID Control macro is selected.

Code	Description												
4001	PID GAIN This parameter defines the gain of the PID Controller. The setting range is 0.1... 100. If you select 1, a 10% change in error value causes the PID Controller output to change by 10%. <i>Table 7 Effect of gain when MAXIMUM FREQ is 50 Hz.</i> <table><tr><th>PID Gain</th><th>Frequency Change for a 10%% Change in Error</th><th>Frequency Change for a 50% Change in Error</th></tr><tr><td>0.5</td><td>2.5 Hz</td><td>12.5 Hz</td></tr><tr><td>1.0</td><td>5 Hz</td><td>25 Hz</td></tr><tr><td>3.0</td><td>15 Hz</td><td>50 Hz *</td></tr></table> * Limited by parameter 2008 MAXIMUM FREQ.	PID Gain	Frequency Change for a 10%% Change in Error	Frequency Change for a 50% Change in Error	0.5	2.5 Hz	12.5 Hz	1.0	5 Hz	25 Hz	3.0	15 Hz	50 Hz *
PID Gain	Frequency Change for a 10%% Change in Error	Frequency Change for a 50% Change in Error											
0.5	2.5 Hz	12.5 Hz											
1.0	5 Hz	25 Hz											
3.0	15 Hz	50 Hz *											
4002	PID INTEG TIME PID controller integration time. Defined as the time in which the maximum output is achieved if a constant error value exists and the gain is 1. Integration time 1 s denotes that a 100% change is achieved in 1 s. 												
4003	PID DERIV TIME PID controller derivation time. If the process error value changes linearly, D adds a constant value into the PID controller output. The derivative is filtered with a one- (1-) pole filter. The time constant of the filter is defined by parameter 4004 PID DERIV FILTER. 												
4004	PID DERIV FILTER Time constant for the filter of D. By increasing the filter time constant, it is possible to smooth the effect of D and suppress noise.												

Code	Description
4005	ERROR VALUE INV Process error value inversion. Normally, a decrease in feedback signal causes an increase in drive speed. If a decrease in feedback signal is desired to cause a decrease in speed, set ERROR VALUE INV to 1 (YES). 0 = NO 1 = YES
4006	ACTUAL VAL SEL PID controller feedback (actual) signal selection. The Feedback signal can be a combination of two (2) actual values ACT1 and ACT2. Source for actual value 1 is selected by parameter 4007 and source for actual value 2 is selected by parameter 4008. 1 = ACT1 Actual value 1 is used as the feedback signal. 2 = ACT1-ACT2 Difference of actual values 1 and 2 is used as the feedback signal. 3 = ACT1+ACT2 Sum of actual values 1 and 2. 4 = ACT1*ACT2 Product of actual values 1 and 2. 5 = ACT1/ACT2 Quotient of actual values 1 and 2. 6 = MIN (A1, A2) Smaller of actual values 1 and 2. 7 = MAX (A1, A2) Greater of actual values 1 and 2. 8 = $\sqrt{A1-A2}$ Square root of difference of actual values 1 and 2. 9 = $\sqrt{A1} + \sqrt{A2}$ Sum of square roots of actual values 1 and 2.
4007	ACT1 INPUT SEL Source for actual value 1 (ACT1). 1 = AI 1 Analog input 1 is used as actual value 1. 2 = AI 2 Analog input 2 is used as actual value 1.
4008	ACT2 INPUT SEL Source for actual value 2 (ACT2). 1 = AI 1 Analog input 1 is used as actual value 2. 2 = AI 2 Analog input 2 is used as actual value 2.

Code	Description
4009	ACT1 MINIMUM Minimum value for actual value 1 (ACT1). Defined as % of the difference between the maximum and minimum values of the selected analog input. The setting range is -1000 to +1000%. Refer to Group 13 parameters for analog input minimum and maximum settings. The value of this parameter can be calculated using the formula below. The minimum of the actual value refers to the minimum of the span of the actual value. $\text{ACT1 MINIMUM} = \frac{\text{Minimum of actual value (V or mA)} - \text{MINIMUM AI (1 or 2)}}{\text{MAXIMUM AI (1 or 2)} - \text{MINIMUM AI (1 or 2)}} \cdot 100\%$ Example: The pressure of a pipe system is to be controlled between 0 and 10 bar. The pressure transducer has an output span from 4 to 8V for pressure between 0 and 10 bar. The minimum output voltage of the transducer is 2V and the maximum 10V, so the minimum and the maximum of the analog input is set to 2V and 10V. ACT1 MINIMUM is calculated as follows: $\text{ACT1 MINIMUM} = \frac{4\text{V} - 2\text{V}}{10\text{V} - 2\text{V}} \cdot 100\% = 25\%$
4010	ACT1 MAXIMUM Maximum value for actual value 1 (ACT1). Defined as % of the difference between the maximum and minimum values of the selected analog input. The setting range is -1000 to +1000%. Refer to Group 13 parameters for analog input minimum and maximum settings. The value of this parameter can be calculated using the formula below. The maximum of the actual value refers to the maximum of the span of the actual value. $\text{ACT1 MAXIMUM} = \frac{\text{Maximum of actual value (V or mA)} - \text{MINIMUM AI (1 or 2)}}{\text{MAXIMUM AI (1 or 2)} - \text{MINIMUM AI (1 or 2)}} \cdot 100\%$ Refer to the description of the example at parameter 4009. ACT1 MAXIMUM in this case is: $\text{ACT1 MAXIMUM} = \frac{8\text{V} - 2\text{V}}{10\text{V} - 2\text{V}} \cdot 100\% = 75\%$

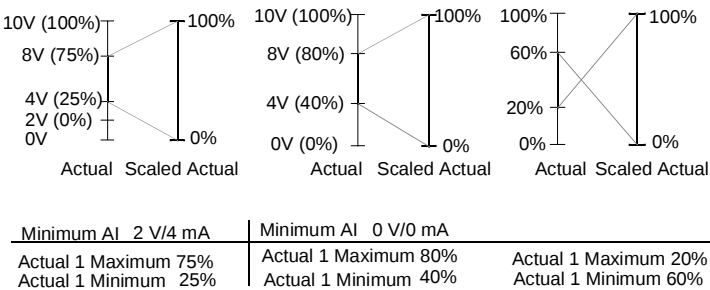


Figure 14 Actual value scaling.

Code	Description
4011	ACT2 MINIMUM Minimum value for actual value 2 (ACT2). Refer to parameter 4009.
4012	ACT2 MAXIMUM Maximum value for actual value 2 (ACT2). Refer to parameter 4010.
4013	PID SLEEP DELAY Time delay for the sleep function, see Figure 15. If the ACS 140 output frequency is below a set level (parameter 4014 SLEEP LEVEL) longer than PID SLEEP DELAY, ACS 140 is stopped.
4014	PID SLEEP LEVEL Level for activation of sleep function, see Figure 15. When the ACS 140 output frequency falls below the sleep level, the sleep delay counter is started. When the ACS 140 output frequency rises above the sleep level, the sleep delay counter is reset. Note! Sleep level comparison is also inverted when error value is inverted using parameter 4005 ERROR VALUE INV.
4015	WAKE-UP LEVEL Level for deactivation of sleep function. This parameter sets a process actual value limit for the sleep function (see Figure 15). When the actual value falls below the limit, the sleep function is interrupted.

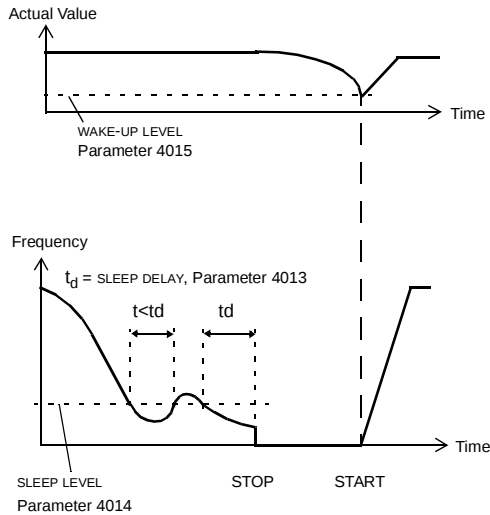


Figure 15 Sleep function operation.

Group 52: Serial Communication

The serial communication link for the ACS 140 uses Modicon Modbus protocol. For description of the ACS 140 serial communication capabilities, as well as for the descriptions of the parameters of this group, refer to ACS 140 Modbus Manual.

APPENDIX

Local Control vs. Remote Control

The ACS 140 can be controlled from two (2) remote control locations, or from the control panel. Figure 16, below, shows the ACS 140 control locations.

The selection between local control (**LOC**) and remote control (**REM**) can be done by pressing the MENU and ENTER buttons simultaneously.

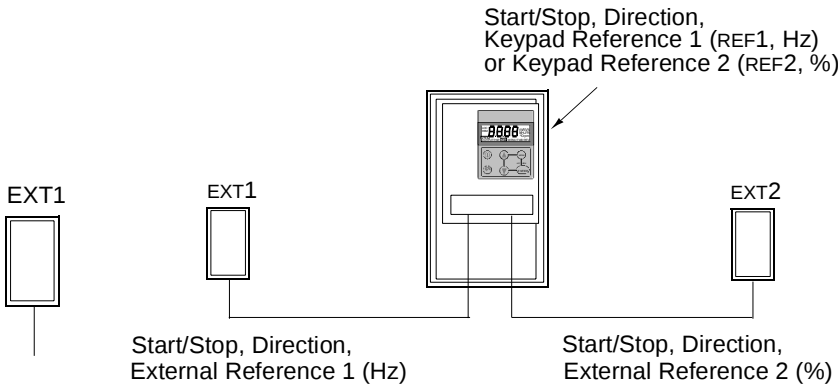
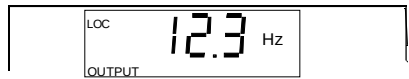


Figure 16 Control locations.

Local Control

The control commands are given from the control panel when the ACS 140 is in local control. This is indicated by **LOC** on the control panel display.



Parameter 1101 KEYPAD REF SEL is used to select keypad reference, which can be either REF1 (Hz) or REF2 (%). If REF1 (Hz) is selected, the type of reference is frequency and it is given to the ACS 140 in Hz. If REF2 (%) is selected, the reference is given in percent.

If PID Control macro is used, reference REF2 is fed directly to the PID controller as percentage (%). Otherwise, reference REF2 (%) is converted to frequency so that 100% corresponds to MAXIMUM FREQ (parameter 2008).

Remote Control

When the ACS 140 is in remote control (**REM**), the commands are given primarily through digital and analog inputs, although commands can also be given through the control panel or serial communication port.

Parameter 1102 EXT1/EXT2 SELECT selects between the two (2) external control locations EXT1 and EXT2.

For EXT1, the source of the Start/Stop, Direction commands is defined by parameter 1001 EXT1 COMMANDS, and the reference source is defined by parameter 1103 EXT REF1 SELECT. External reference 1 is always a frequency reference.

For EXT2, the source of the Start/Stop, Direction commands is defined by parameter 1002 EXT2 COMMANDS, and the reference source is defined by parameter 1106 EXT REF2 SELECT. External reference 2 can be a frequency reference, or a process reference, depending on the application macro selected.

In remote control, constant speed operation can be programmed by parameter 1201 CONST SPEED SEL. Digital inputs can be used to select between the external frequency reference and seven (7) configurable constant speeds (1202 CONST SPEED 1... 1208 CONST SPEED 7).

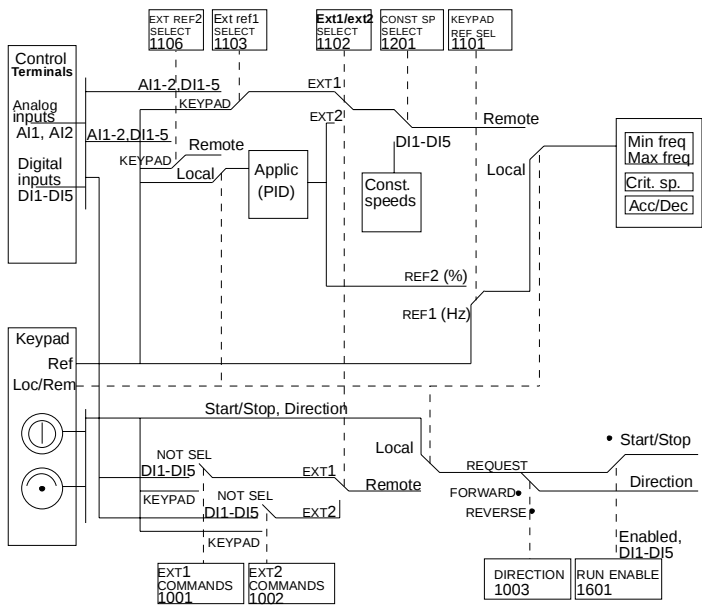


Figure 17 Selecting control location and control source.

Internal Signal Connections for the Macros

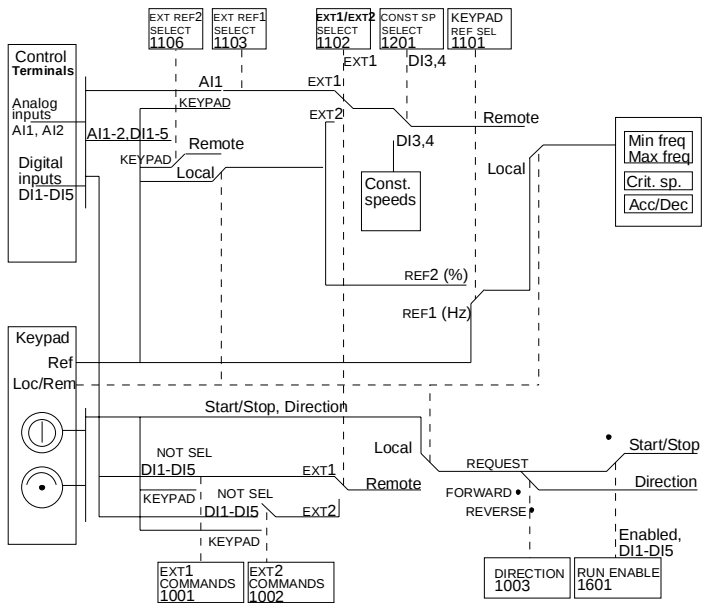


Figure 18 The control signal connections of the ABB Standard, Alternate and Premagnetize macros.

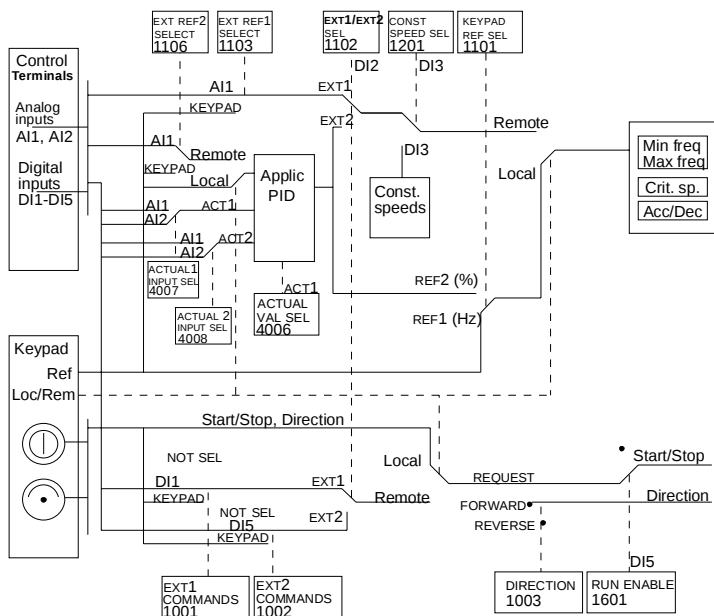


Figure 19 The control signal connections of the PID Control macro.



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