ACS 600

Firmware Manual

This manual includes:

- Start-Up Data
- Software Description
- Signals
- Parameters
- Overview of the CDP312 Control Panel
- Fault Tracing
- Terms

System Application Program 6.x

for ACS 600 Frequency Converters

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Firmware Manual

ACS 600

Code: 3BFE 63700177 R0425

EFFECTIVE: 02.05.2001
SUPERSEDES: 20.06.2000

FIDRI\EIF

Safety

General Safety Instructions

Note: Complete safety instructions can be found in the *Safety and Product Information* Manual (ACS 600 MultiDrive), or in the *Hardware Manual* (ACS/ACC 607).

These safety instructions are intended for all work on the ACS 600 MultiDrive and the ACS/ACC 607 (630 to 3000 kW) units. Neglecting these instructions can cause physical injury and death.

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

Any installation and maintenance work must be done with the power off and power is not to be reconnected until the installation work is complete. Dangerous residual voltages remain in capacitors when the disconnecting device is opened. Wait 5 minutes after switching off the supply before starting work. Always ensure that the measured voltage between terminals UDC+ and UDC- and frame is close to 0 V and that the supply has been switched off before performing any work on the equipment or making main circuit connections.

If the main circuit of the inverter unit is live, the motor terminals are also live even if the motor is not running!

Open the fuse switches of all parallel connected inverters before installation or maintenance work in any of them.

Check the cable connections at the shipping split joints before switching on the supply voltage.

If the auxiliary voltage circuit of the ACS 600 is powered from an external power supply, opening the disconnecting device does not remove all voltages. Control voltages of 115/230 VAC may be present on the digital inputs or outputs even though the inverter unit is not powered. Before starting work, check which circuits remain live after opening of the disconnecting device by referring to the circuit diagrams for you particular delivery. Ensure by measuring that the part of the cabinet you are working on is not live.

In ACx 600 frequency converters, control boards of the converterunit may be at the main circuit potential. Dangerous voltages may bepresent between the control cards and the frame of the converterunit, when the main circuit voltage is on. It is critical that the use of measuring instruments, such as an oscilloscope, are used with caution and safety and always a priority. The fault tracing instructionsgive a special mention of cases in which measurements may be performed on the control boards, also indicating the measuring method to be used.

Live parts on the inside of doors are protected against direct contact. Special attention shall be paid to safety when handling shrouds made of sheet metal.

Do not make any voltage withstand tests on any part of the unit while the unit is connected. Disconnect the motor cables before making any measurements on the motors or motor cables.

WARNING! Close fuse switches of all parallel connected inverters before starting the frequency converter.

Do not open the drive section switch fuses when the inverter is running.

Do not use Prevention of Unexpected Start for stopping the drive when the inverter is running. Give a Stop command instead.

CAUTION! Fans may continue to rotate for a while after the disconnection of the electrical supply.

CAUTION! Some parts, like heatsinks of power semiconductors inside of cabinet remain hot for a while after the disconnection of the electrical supply.

Table of Contents

Safety ..... **i**
General Safety Instructions i

Table of Contents ..... **iii**

Chapter 1 – Introduction to This Manual **1-1**
Overview 1-1
Before You Start 1-1
What This Manual Contains 1-1

Chapter 2 – Start-up **2-1**
Overview 2-1
General Start-up Instructions 2-1
POWER-UP 2-2
START-UP DATA 2-3
Entering and Checking Data 2-3
Activating the Optional Modules 2-4
Checking the I/O Communication 2-4
Checking the Prevention of Nexpected Start-up and Emergency Stop Circuit. 2-4
Checking the Motor Fan Circuit (if exists). 2-4
MOTOR ID RUN = MOTOR IDENTIFICATION RUN 2-5
Checking the Speed Measurement and Rotation Direction 2-5
Selecting the Motor ID Run Mode 2-7
Multi-Motor Drives 2-8
OPTIMISING THE STARTING TIME AND TORQUE 2-8
MOTOR PROTECTIONS 2-9
Motor Thermal Model Protection 2-9
Motor Protection with Temperature Measurement 2-10
TUNING THE SPEED CONTROLLER 2-11
Step Response Test 2-11
Low Speed Fine Tuning 2-13
Suppression of Oscillations 2-13
SCALAR CONTROL 2-14
Selecting the Scalar Control 2-14
IR Compensation 2-14
CONTROLLING THE DRIVE USING AN OVERRIDING SYSTEM 2-15
CONTROLLING THE DRIVE USING THE I/O SIGNALS 2-16
FIELDBUS ADAPTERS 2-17
UNDERVOLTAGE CONTROL 2-17
Activating the Undervoltage Control 2-17
AUTO RESTART FUNCTION 2-18
Activating the AUTO RESTART Function 2-18
CHECKING THE MASTER/FOLLOWER COMMUNICATION 2-18
Checking the Mode and Signals 2-18
DriveWindow Backup/Restore Function 2-20
Before You Start 2-20
Complete Backup 2-20
Parameter Saving 2-21

DriveWindow Restore 2-22

Chapter 3 – Software Description 3-1
Drive Functions 3-1
General 3-1
Application Program Identificatinon 3-2
Program Boot 3-2
Control Diagrams 3-2
Control Modes 3-5
REMOTE Mode 3-5
HAND/AUTO Function 3-5
LOCAL Mode 3-5
Emergency Stop 3-5
Emergency Stop Hardware 3-5
Torque Limit Ramping beginning of Emergency Stop 3-6
Emergency Stop Modes 3-6
Action if the Motor Is Stopped 3-6
Action if the Motor Is Running 3-6
Prevention of Unexpected Start-Up 3-7
Communication 3-8
DDCS Channels in NAMC CONTROLLERS 3-8
Fieldbus Communication Adapters on the Channel CH0 3-8
Fieldbus Signals 3-9
Addressing of Data Using Data Sets 10…33 3-9
The Mail Box Function 3-9
Integer Scaling on the DDCS Link 3-9
Received Data Set Table 3-10
Transmitted Data Set Table 3-11
Using the NPBA-02 PROFIBUS Adapter Module 3-12
PROFIBUS Parameters in Cyclic Communication 3-12
I/O Devices on Channel CH1 3-13
Master/Follower Link on Channel CH2 3-13
Commissioning and Supporting Tools on Channel CH3 3-13
Modbus Link 3-13
Register Read and Write 3-14
Register Mapping 3-14
Charging Logic of Inverter 3-15
ABB Drive Profile 3-15
Drive States 3-15
Main Control Word (MCW) 3-17
I/O Configurations 3-24
Digital Inputs 3-24
Hardware Source Selection for Digital Inputs 3-24
Digital Outputs 3-24
Hardware Source Selection for Digital Outputs 3-25
Analogue Inputs 3-25
I/O Speed Reference 3-25
NIOC-01 Basic I/O Board 3-26
NBIO-21/NIOB-01 Analogue Inputs 3-26
NAIO-03 Analogue I/O Extension Module 3-27
Analogue Outputs 3-28
NIOB-01 Basic I/O 3-31
Board Connections 3-31
Pulse Encoder Interface NTAC-02 3-34

The Master / Follower Link 3-34
General 3-34
Link Configuration 3-34
Master Drive 3-34
Follower Drive(s) 3-35
Flying Switching between Speed and Torque Control 3-35
Follower Diagnostics 3-36
Master/Follower Link Specification 3-36
Diagnostics 3-36
General 3-36
Fault and Event Loggers 3-36
AMC Time Format and Counting 3-36
Data Loggers 1 and 2 3-37
Positioning Counter 3-37
Positioning Counting Function 3-38
Back-Up of Parameters or Software 3-39
Spare NAMC Boards 3-39
DriveWindow Back-Up Function 3-40
DriveWindow Restore Function 3-40
Memory Handling 3-41
User Macros 3-41
Oscillation Damping 3-42
Tuning Procedure 3-42
AUTO RESTART Function 3-43

Chapter 4 – Signals 4-1
Overview 4-1
How to Read the Signal Table 4-1
AMC Table Signals 4-2
Group 1 Actual Signal 4-2
Group 2 Actual Signals 4-4
Group 3 Actual Signals 4-5
Group 4 Information 4-8
Group 7 Control Words 4-9
Group 8 Status Words 4-11
Group 9 Fault Words 4-14

Chapter 5 – Parameters 5-1
Overview 5-1
Parameter Groups 5-1
How to Read the Parameter Table 5-2
Group 10 Start/Stop/Dir 5-3
Group 11 Reference Select 5-6
Group 13 Analogue Inputs 5-6
Group 14 Digital Outputs 5-7
Group 15 Analogue Outputs 5-9
Group 16 System Control Inputs 5-12
Group 17 DC Hold 5-13
Group 18 LED Panel Control 5-14
Group 19 Data Storage 5-15
Group 20 Limits 5-16
Group 21 Start/Stop Functions 5-19
Group 22 Ramp Functions 5-22
Group 23 Speed Reference 5-24

Group 24 Speed Control 5-26
Proportional Gain Parameter of the Speed Controller 5-27
The Adaptive Speed Control as a Function of the Torque Reference 5-27
Set Point Weighting 5-28
Integration Time Parameters of the Speed Controller 5-29
Derivation Parameters of the Speed Controller 5-29
Acceleration Compensation Parameters 5-29
Adaptive Speed Control as Function of the Speed 5-30
Group 25 Torque Reference 5-31
Group 26 Torque Reference Handling 5-32
Group 27 Flux Control 5-33
Group 28 Motor Model 5-35
Group 29 Scalar Control 5-37
Group 30 Fault Functions 5-39
Motor Thermal Model User Mode 5-40
Stall Protection 5-42
Underload Protection 5-43
Motor Thermal Model User Mode Alarm and Fault Limits 5-45
Motor Temperature Feedback to the Motor Model 5-45
Group 31 Fault Functions 5-46
Group 35 Motor Fan Control 5-46
Group 36 Motor Cable Protection 5-47
Group 50 Speed Measurement 5-47
Group 51 Master Adapter (Field Bus Adapter) 5-50
Group 70 DDCS Control 5-51
Group 71 DriveBus Communication 5-54
Group 90 Data Set Receive Addresses 5-54
Group 91 Data Set Receive Addresses 5-55
Group 92 Data Set Transmit Addresses 5-55
Group 93 Data Set Transmit Addresses 5-56
Group 97 Drive 5-56
Group 98 Option Modules 5-56
Group 99 Start Up Data 5-62

Chapter 6 - Overview of the CDP 312 Control Panel 6-1
Overview 6-1
Panel Link 6-1
Display 6-2
Keys 6-2
Panel Operation 6-3
Keypad Modes 6-3
Identification Display 6-3
Actual Signal Display Mode 6-3
Parameter Mode 6-7
Function Mode 6-9
Copying Parameters from One Unit to Other Units 6-11
Setting the Contrast 6-11
Drive Selection Mode 6-11
Operational Commands 6-14
Start, Stop, Direction and Reference 6-14

Chapter 7 – Fault Tracing 7-1
Overview 7-1
Protections 7-1

I/O- Monitoring 7-1
Communication Monitoring 7-1
Inverter Overtemperature Fault 7-1
Ambient Temperature 7-1
Overcurrent 7-1
DC Overvoltage 7-2
DC Undervoltage 7-2
Local Control Lost Function 7-3
RUN ENABLE Interlocking Function 7-3
START INHIBITION Interlocking Function 7-3
Short Circuit 7-3
Intermediate DC Link Current Ripple Fault 7-3
Overspeed Fault 7-3
Earth/Fault Logics 7-4
Indicator LEDs in the NINT Board 7-5
Interpretation of the LEDs 7-5
Speed Measurement Fault 7-6
Switching from Measured Speed to Estimated Speed 7-7
Overswitching Frequency Fault 7-7
System Fault 7-7
Short Time Overloading 7-7
Overloading between $I_{AC\_Nominal}$ and $I_{AC\_1/5\ min}$ 7-7
Overloading between the $I_{AC\_1/5\ min}$ and Maximum Current 7-8
Motor Protections 7-9
Motor Thermal Protection Functions 7-9
Motor Thermal Model 7-9
Usage of PT100, PTC or KTY84-1xx Temperature Sensors 7-10
Stall Function 7-11
Underload Function 7-12
Motor Phase Loss Function 7-12
Earth Fault Protection Function 7-13
Motor Fan Diagnostics 7-13
Diagnostics 7-13
Fault and Alarm Messages 7-14
Fault Message Table 7-14
Alarm Message Table 7-21
Event Messages 7-25
Other Messages 7-25

Chapter 8 - Terms 8-1

Chapter 1 – Introduction to This Manual

Overview

This chapter describes the purpose, contents and the intended audience of this manual. It also explains the terms used in this manual and lists related publications.

Before You Start

The purpose of this manual is to provide you with the information necessary to control and program the drive.

Read through this manual before commencing start-up.

The installation and commissioning instructions given in the ACS 600 MultiDrive Hardware Manual must also be read before proceeding.

Study carefully the Safety Instructions before attempting any work on, or with, the unit.

What This Manual Contains

Safety Instructions can be found at the beginning of this manual.

Chapter 1 – Introduction to This Manual, the chapter you are reading now, introduces you to this manual.

Chapter 2 – Start-Up, explains the Start-up procedure.

Chapter 3 – Software Description, explains the operation of the System Application Program.

Chapter 4 – Signals, introduces you to the measured or calculated signals.

Chapter 5 – Parameters, lists the System Application Program parameters and explains their functions.

Chapter 6 – Overview of CDP 312 Control Panel, describes the operation of the CDP 312 Control Panel used for controlling and programming.

Chapter 7– Fault Tracing, introduces you to the protections and fault tracing of ACS 600.

Chapter 8 – Terms, gives complete listing of the terms used in this manual.

Chapter 2 – Start-up

Overview

This chapter describes the basic start-up procedure of the ACS 600. The instructions are given as a step-by-step table. A more detailed description of the parameters involved in the procedure is presented in the chapter Parameters.

General Start-up Instructions

The ACS 600 frequency converter can be operated:

- locally from its Control Panel or the Drive*Window* PC tool.
- externally via the I/O connections on the NIOC or NIOB board or fieldbus connection to the NAMC board.

The start-up procedure presented uses the Drive*Window* program. (For information on the functions of Drive*Window*, see its on-line help.) However, parameter settings can also be given via the Control Panel. To display references without Data Logger, connect and scale the analogue outputs to an oscilloscope.

The start-up procedure includes actions that need only be taken when powering up the ACS 600 for the first time in a new installation (e.g. entering the motor data). After the start-up, the ACS 600 can be powered up without using these start-up functions again. The start-up procedure can be repeated later if the start-up data needs to be altered.

Refer to the chapter Fault Tracing in case problems should arise. In case of a major problem, disconnect mains power and wait for 5 minutes before attempting any work on the unit, the motor, or the motor cable.

START-UP PROCEDURE

⚠	**Follow the safety instructions during the start-up procedure.** **The start-up procedure should only be carried out by a qualified electrician.**
☐	Check the mechanical and electrical installation and the commissioning of the drive section from the ACS 600 XXX Hardware Manual *(Code 3AFY 63700118).*
☐	Connect optical cables temporarily between the NAMC board channel CH3 and the DDCS communication (NISA) card or PCMCIA card in the PC. When using a PCMCIA card, follow the instructions included in the Drive*Window* kit.
☐	Disconnect the overriding system link from channel CH0 of the NAMC board.
1.	***POWER-UP***
☐	Apply mains power.
☐	Start the Drive*Window* program.
☐	Select the DDCS protocol.
☐	Switch the Drive*Window* program into Local control mode.

START-UP PROCEDURE

2. START-UP DATA

2.1 Entering and Checking Data

☐	Upload the parameter and signal list.	
☐	Select the language (if available). Reload the parameter and signal list from the Drive menu.	**99.01 LANGUAGE** _____
☐	Enter the motor data from the motor nameplate into the following parameters (Parameter Group 99): Set all motor data exactly as indicated on the motor nameplate. (For example, if the motor nominal speed is given as 1440 rpm on the nameplate, setting the value of Parameter 99.05 MOTOR NOM SPEED to 1500 rpm would result in the wrong operation of the drive.)	**99.02 MOTOR NOM VOLTAGE** _____ **99.03 MOTOR NOM CURRENT** _____ **99.04 MOTOR NOM FREQ** _____ **99.05 MOTOR NOM SPEED** _____ **99.06 MOTOR NOM POWER** _____ **99.12 MOTOR NOM COSFII** _____ If the nominal COS φ of the motor is unknown, set Parameter 99.13 POWER IS GIVEN to POWER.
☐	Download the parameters.	The Alarm Message **"ID MAGN REQ"** is displayed.

ABB Motors CE

3 ~ motor	M2AA 200 MLA 4						
	IEC 200 M/L 55						
		No					
		Ins.cl. F			IP 55		
V	Hz	kW	r/min	A	cos φ	IA/IN	$t_{E/s}$
690 Y	50	30	1475	32.5	0.83		
400 D	50	30	1475	56	0.83		
660 Y	50	30	1470	34	0.83		
380 D	50	30	1470	59	0.83		
415 D	50	30	1475	54	0.83		
440 D	60	35	1770	59	0.83		
Cat. no.	3GAA 202 001 - ADA						
6312/C3		6210/C3			180 kg		
			IEC 34-1				

ABB Motors CE

3 ~ motor	HXR 500 LH6				
	IEC				
		No			
		Ins.cl. F			IP 55
0	379	379	379	kW	
0	615	660	660	V/ Y	
0	26.1	28.0	75.3	Hz	
0	528	507	404	A	
0	520	558	1499	rpm	
0	0.70	0.68	0.86	cos φ	
Cat. no.					

Field Weakening Point Values!

START-UP PROCEDURE

2.2	***Activating the Optional Modules***	
☐	Activate all optional modules connected to channel CH1 of the NAMC board. ***Note:*** If the pulse encoder is used with NIOB-01 basic I/O board, set also Parameter 98.01 = YES	**Parameter Group 98 OPTION MODULES**
2.3	***Checking the I/O Communication***	
☐	Check the possible I/O signal selections.	**Parameter Groups 10 - 15**
2.4.	***Checking the Prevention of Nexpected Start-up and Emergency Stop Circuit.***	
☐	Check that the *prevention of unexpected start-up circuit* works including digital input START INHIBIT function. 1 = Active (NGPS-xx 230/115 VAC circuit is open) 0 = Normal State (circuit is closed)	**Signal 8.02 AUX STATUS** **WORD bit B8 START_INHIBITION.** **10.08 START INHIB DI**
☐	Set the mask for Preventation of Unexpected Start-up alarm for ALARM /FAULT logger, if the NGPS-xx is often de-energised. Otherwise the alarm / fault logger will be filled with START INHIBIT alarms.	**31.02 START INHIBIT ALM**
☐	Check that the *emergency stop circuit* is functioning correctly (DI1 and DO1). 1 = NO OFF 3.	Signal 8.01 MAIN STATUS WORD bit B5 OFF_3_STA
☐	Select the emergency stop mode.	**21.04 EME STOP MODE**
2.5.	***Checking the Motor Fan Circuit (if exists).***	
☐	Check the fan control circuit, set any required functions by parameters.	**35.01 MOTOR FAN CTRL** **35.02 FAN ACK DELAY** **35.03 FAN OFF DELAY** **35.04 FAN ON DELAY** **10.06 MOTOR FAN ACK**

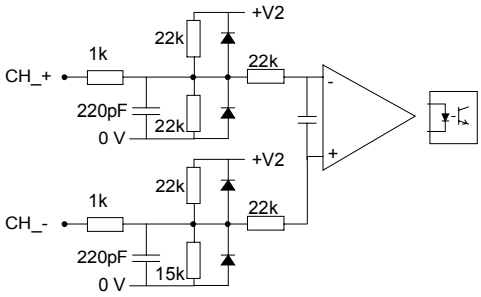
START-UP PROCEDURE

3. MOTOR ID RUN = MOTOR IDENTIFICATION RUN

3.1 Checking the Speed Measurement and Rotation Direction

With a pulse encoder			
↓	**Without a pulse encoder**		
☐	☐	Check the rated speed value of the motor (e.g. 1485 rpm).	**50.01 SPEED SCALING**
☐		Set Parameter 50.03 **SPEED FB SEL** to INTERNAL (default value).	**50.03 SPEED FB SEL**
☐		Set the number of pulses per revolution for the encoder.	**50.04 ENCODER PULSE NR.**
☐		Check the other parameters settings in Parameter Group 50.	**Parameter Group 50 SPEED MEASUREMENT**
☐	☐	Reset and start the motor. The stator resistance and other electrical losses are identified and stored into FPROM memory. The motor shaft is not rotating during the FIRST START.	**Drive*Window* Drives Panel** The Alarm Message "**ID MAGN**" is displayed.
☐	☐	The motor stops after the FIRST START has been performed.	The Alarm Message **"ID DONE"** is displayed.
☐	☐	Start the motor again.	**Drive*Window* Drives Panel**
☐	☐	Enter a small (e.g. 50 rpm) value for the speed reference.	**Drive*Window* Drives Panel**
☐		Check that the motor shaft actually turns to the correct direction and the polarity of the speed measurement is correct.	

START-UP PROCEDURE

☐		When the motor is rotating in the correct direction and the speed reference is positive, then the actual speed in Signal 1.03 **SPEED MEASURED** must be positive as well and equal to Signal 1.02 **SPEED ESTIMATED**. If this is not the case, the incorrect connection can be located as follows: • If the direction of rotation is correct and signal 1.03 SPEED MEASURED is negative, the phasing of the pulse encoder channel wires is reversed. • If the direction of rotation is incorrect and signal 1.03 SPEED MEASURED is negative, the motor cables are connected incorrectly. • If the direction of rotation is incorrect and signal 1.03 SPEED MEASURED is positive, both the motor and the pulse encoder are connected incorrectly. Changing the direction: • Disconnect mains power from the ACS 600, and wait about 5 minutes for the intermediate circuit capacitors to discharge! • Do the necessary changes and verify by applying mains power and starting the motor again. Check that the speed actual value is positive.  *An input channel connection of the NTAC-02.*	
☐	☐	Stop the motor.	
☐		Set Parameter 50.03 **SPEED FB SEL** to 2 = ENCODER.	**50.03 SPEED FB SEL**
☐		Start the motor.	
☐		Check that the signals SPEED ESTIMATED and SPEED MEASURED are the same.	**1.02 SPEED ESTIMATED** **1.03 SPEED MEASURED**
☐		Stop the motor.	

START-UP PROCEDURE

3.2 Selecting the Motor ID Run Mode

Warning!
The motor will run at up to approximately 50% - 80% of nominal speed during the Motor ID Run. BE SURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE MOTOR ID RUN!

☐ Select the Motor ID Run.

99.07 MOTOR ID RUN

During the Motor ID Run, the ACS 600 will identify the characteristics of the motor for optimum motor control. The ID Run may take a few minutes, depending on motor size.

Select the *STANDARD OR REDUCE*D ID Run if

- operation point is near zero speed,
- maximum dynamic torque performance is required (motor model optimisation) and operation without a pulse encoder is required.

Select the *FIRST START* ID Run if

- it is a pump or fan application,
- there are drive sections in which more than one motor is connected to one inverter. *See 3.3 Multi-Motor Drives.*

Note: The Motor ID Run cannot be performed if scalar control mode is selected for motor control (Parameter 99.08 MOTOR CTRL MODE is set to SCALAR).

1= NO (FIRST START)
The Motor ID Run is not performed. If the start command has been given, the motor model is calculated by the ACS 600 by magnetising the motor for 20 to 60 s at zero speed.

2 = STANDARD
Performing the Standard Motor ID Run guarantees the best possible control accuracy. The motor and the driven equipment must be uncoupled for the Standard ID Run.

3 = REDUCED
The Reduced ID Run should be selected (instead of Standard) if mechanical losses are higher than 20% (i.e. the motor cannot be uncoupled from the driven equipment), or flux reduction is not allowed when the motor is running (e.g. a braking motor in which the brake switches on when the flux falls below a certain level).

The Standard Motor ID run can also be performed if the machinery is coupled and there is only inertia but no continuous load. In this case the ID Run may take much longer than without any load.

WARNING! If the Standard ID run is to be performed with the machinery coupled to the motor, make sure the machinery is able to with stand the fast speed changes during the ID Run. Otherwise select the Reduced ID Run.

If you select the Standard ID Run, uncouple the driven equipment from the motor!

99.07 MOTOR ID RUN

Check that starting of the motor does not cause any danger!

☐ **Start the motor.**

☐ **The motor stops after the ID Run has been performed.**

When the ID Run has been successfully performed, **AUX STATUS WORD** signal 8.02 B7 IDENTIF_RUN_DONE is set to 1. Parameter 99.07 **MOTOR ID RUN** also changes back to NO.

START-UP PROCEDURE

⚠	***Note:*** If the Motor ID Run has not been successfully performed (for example it does not finish), see Chapter *Fault Tracing*.	**FAULT MESSAGE "ID RUN FLT"**
3.3	***Multi-Motor Drives***	
	These are drive sections in which more than one motor is connected to one inverter. The motors must have the same relative slip, nominal voltage and number of poles. **Notice!** If scalar control is used, then these limitations are not effective.	
☐	Set the sum of motor nominal currents.	**99.03 MOTOR NOM CURRENT**
☐	Set the sum of motor nominal powers.	**99.06 MOTOR NOM POWER**
☐	If the powers of the motors are close to each other or the same, but nominal speeds vary a little, Parameter 99.05 MOTOR NOM SPEED can be set to an average value of the motor speeds.	**99.05 MOTOR NOM SPEED**
	If the powers of the motors vary a great deal, then use of scalar control is recommended. **Notice!** If scalar control is used then these limitations are not effective.	
☐	Set the frequency of the motors (must be same).	**99.04 MOTOR NOM FREQ**
☐	The Motor ID Run can be performed with all the motors connected or without load.	**99.07 MOTOR ID RUN**

4.	***OPTIMISING THE STARTING TIME AND TORQUE***	
☐	Select the start function. *The fastest starting* is achieved when Parameter 21.01 **START FUNCTION** is set to 1 (AUTO, flying start). *The highest possible starting torque* is achieved when Parameter 21.01 **START FUNCTION** is set to 2 = DC magnetising or 3 = constant DC magnetising. ***Note:*** No support for flying start function.	**21.01 START FUNCTION**
☐	• When CONST DC MAGN mode is used: shaft movement during the magnetising can be minimised.	**21.11 START JERK COMP**
☐	Set the limit parameters according to process requirements.	**Parameter Group 20 LIMITS**

START-UP PROCEDURE

5. MOTOR PROTECTIONS

5.1 Motor Thermal Model Protection

☐		Select the motor thermal model protection mode. ***Note:*** DTC mode is used for ABB motors with I_N up to 800 A. Above that USER MODE is the only valid selection.	**30.01 MOTOR THERM PMODE**
With USER MODE set according to motor manufacturer data.			
↓	**With DTC mode**		
☐		Select the protection function for the motor thermal model protection. FAULT / WARNING / NO.	**30.02 MOTOR THERM PROT**
☐		Set the time for 63% temperature rise	**30.09 MOTOR THERM TIME**
☐	☐	Set the motor load curve current.	**30.10 MOTOR LOAD CURVE**
☐	☐	Set the zero speed load. Especially with forced cooling of the motor.	**30.11 ZERO SPEED LOAD**
☐	☐	Set the break point value for motor load curve.	**30.12 BREAK POINT**
☐	☐	Set the temperature alarm limit of the motor thermal model.	**30.28 THERM MOD ALM L**
☐	☐	Set the temperature trip limit of the motor thermal model.	**30.29 THERM MOD FLT L**
☐	☐	Set the motor nominal temperature rise. If ABB motor specifies MNTRC value on the rating plate, multiply value by 80 °C and enter the result here.	**30.30 MOT NOM TEMP RISE**
☐	☐	Set the typical ambient temperature of motor.	**30.31 AMBIENT TEMP**

START-UP PROCEDURE

5.2 Motor Protection with Temperature Measurement

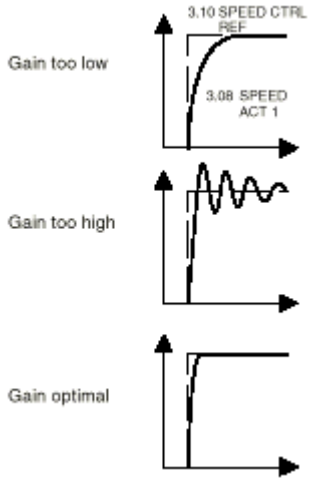
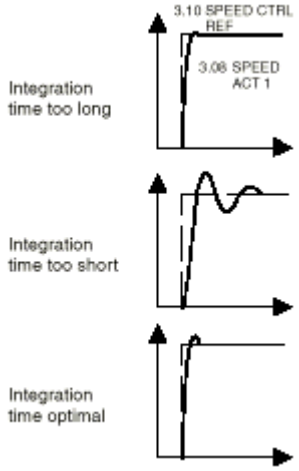
Sensor Type	Unit / Symbol	Scaling
PT100	Celsius / °C	
PTC	Ohm / Ω	Normal 0…1,5 kΩ Overtemperature ≥ 4 kΩ
KTY84-1xx Silicon temperature sensor	Ohm / Ω	90°C == 939 Ω 110°C == 1063 Ω 130°C == 1197 Ω 150°C == 1340 Ω

☐	Select the motor temperature measurement function for MOTOR 1.	**30.03 MOT1 TEMP AI1 SEL** **98.06 AI/O EXT MODULE 1**
☐	Set the temperature alarm limit for MOTOR 1.	**30.04 MOT1 TEMP ALM L**
☐	Set the temperature trip limit for MOTOR 1.	**30.05 MOT1 TEMP FLT L**
☐	Select the motor temperature measurement function for MOTOR 2.	**30.06 MOT2 TEMP AI2 SEL** **98.06 AI/O EXT MODULE 1**
☐	Set the temperature alarm limit for MOTOR 2.	**30.07 MOT2 TEMP ALM L**
☐	Set the temperature trip limit for MOTOR 2.	**30.08 MOT2 TEMP FLT L**

START-UP PROCEDURE

6.	***TUNING THE SPEED CONTROLLER***	
	When tuning the drive, change one parameter at a time, then monitor the response to a speed reference step possible oscillations. To achieve the best possible result, the step response tests should be carried out at different speeds, from minimum speed up to maximum speed.	
	The speed control values obtained depend mainly on: • Flux reference 27.03 **FLUX REF**. • The relationship between the motor power and the rotating mass. • Backlashes in the drive's mechanical structure (filtering).	
	Note: The Thyristor Supply Unit TSU may have to be set to normal operation mode for step response tests (signal 10407=0). If the TSU is in the diode bridge mode, an overvoltage alarm may trip the drive section when a stepped change down is given. Extra "jumps" may also appear in the step when the DC voltage rises, because no braking occurs.	
6.1.	***Step Response Test***	
	Automatic Tuning	
	The speed controller includes an automatic speed tuning function Parameter **24.01 PI TUNE**. The function is based on an estimate of the mechanical time constant. If this does not bring a satisfactory result, manual tuning can be performed as well.	
	Manual Tuning	
☐	Select, for example, the following signals on the Drive*Window* Monitoring Tool: • **1.07 MOTOR TORQUE FILT2**, actual torque • **1.03 SPEED MEASURED**, actual speed • **2.03 SPEED ERROR NEG**, filtered speed difference	
☐	Start the motor. Increase the speed slightly. Give a speed reference step and monitor the response. Repeat at a few test values across the whole speed range.	**Drive*Window* Drives Panel**
☐	Set step changes of 1% or 2% from the maximum speed of the drive for Drive*Window.*	**23.10 SPEED STEP**
☐	Optimise the P part of the speed controller: Set integration time to the maximum value. This turns the PI controller into a P controller.	**24.09 TIS**
☐	Give a step change up, e.g. 20 rpm. When the speed is stabilised, give a step change down e.g. 20 rpm.	**23.10 SPEED STEP**

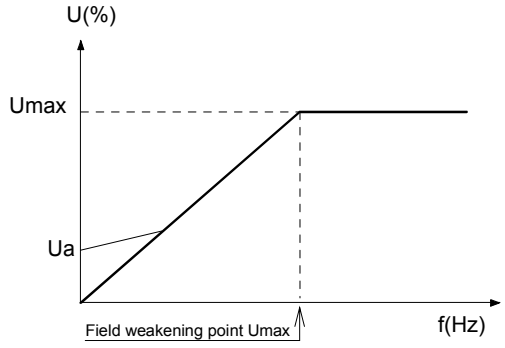
START-UP PROCEDURE

☐	Increase the relative gain until the response is sufficient.	**24.03 KPS** 
☐	Reduce the integral time constant until overshoot is observed in the response. The integral time constant is then adjusted such that there is no overshoot or only a slight overshoot (depending on the drive application). The function of the integral part is to remove the difference caused by the proportional control between the reference and the actual value as quickly as possible.	**24.09 TIS** 
	If the drive is stable and allows a high proportional gain, the integral time constant can be set short and an overcompensated step response is obtained.	

START-UP PROCEDURE

6.2	***Low Speed Fine Tuning***	
	In order to eliminate potentially harmful oscillations at low speeds (for example, during start), parameters 50.13 ZERO DETECT DELAY and 50.14 SPEED HOLD TIME should be adjusted at this point. The larger the mass of the driven equipment, the higher the value of 50.13 should be. As a rule of thumb, 50.14 should be set to approx. 60 % of 50.13. For example, typical values for a drive rotating a dryer section of a paper machine would be 50 ms and 30 ms respectively.	**50.13 ZERO DETECT DELAY** **50.14 SPEED HOLD TIME**
6.3	***Suppression of Oscillations***	
	The measured speed always has a small ripple because of gear play and flexible couplings. However, a small ripple is acceptable as long as it does not affect the control loops. Reduction of this ripple with filters may cause tuning problems later on. A long filter time constant and a fast acceleration time contradict each other.	
☐	If the speed measurement shows rapid oscillation, filter it by means of speed error filter and setting the time constant of the first order actual speed filter. With the combination “no gear box” and “ pulse encoder feedback”, decrease SP ACT FILT TIME to a minimum if fast oscillation is observed.	**23.06 SPEED ERROR FILT** **50.06 SP ACT FILT TIME**
☐	If there is substantial backlash in the drive, and if the drive oscillates at low torque due to the mechanism, the situation can be remedied by means of the adaptive control parameters. If the adaptivity has to be made abrupt (24.03 **KPS** high and 24.04 **KPS MIN** low), the drive may start to oscillate as the load varies. Use a step to test the functioning of the adaptivity. The step can be higher than 20 rpm (e.g. 50 rpm).	**24.04 KPSMIN** **24.05 KPS WEAKPOINT** **24.06 KPS WP FILT TIME**

START-UP PROCEDURE

7.	***SCALAR CONTROL***	
7.1	***Selecting the Scalar Control***	
	The scalar control mode is recommended for multimotor drives when the number of motors connected to ACS 600 is variable. Scalar control is also recommended when the nominal current of the motor is less than 1/6 of the nominal current of the inverter, or the inverter is used for test purposes with no motor connected.	
☐	Start the drive with DTC mode (FIRST START) before selecting the scalar control mode.	**99.07 MOTOR ID RUN**
☐	Select the scalar control mode. Parameter group 29 becomes visible after selection of scalar control. Parameters 29.02 **FREQUENCY MAX** and 29.03 **FREQUENCY MIN** are updated by software according to parameters 20.02 **MAXIMUM SPEED** and 20.01 **MINIMUM SPEED**.	**99.08 MOTOR CTRL MODE**
7.2	***IR Compensation***	
	IR compensation, or boosting the inverter output voltage, is often necessary to obtain an optimal start torque, or when the motor must rotate slowly, i.e. at a low frequency. Due to the stator winding resistance an additional voltage will be needed when even a slight load torque exists.	
☐	Set the operating range for the IR compensation. Starting voltage Ua (at zero frequency), can be set to 0% to 30% of motor nominal voltage. Select a combination at which the motor is able to start and run at a constant speed over the whole speed range.	**29.04 IR_COMPENSATION**
	 *U/F characteristic*	

START-UP PROCEDURE

	Always supervise the temperature rise in motors running at low speeds with IR compensation, particularly if no separate fan or temperature monitoring is included.
	The adequacy of IR compensation must be checked under actual load conditions.

8.	*CONTROLLING THE DRIVE USING AN OVERRIDING SYSTEM*	
	The drive can be controlled from an overriding system by using data sets 1, 2 or 10…33 with DDCS and DriveBus communication protocols.	
☐	Select the data sets used in the overriding system. Typically FBA DSET10.	**98.02 COMM MODULE**
☐	Connect the overriding system optic fibres to the channel CH0 of the NAMC board.	
☐	Set the node address for channel CH0 according to the application of the overriding system. **Controller** / **Node Addresses DDCS** / **Node Addresses DriveBus** / **Node Addresses ModuleBus** / **Par. 71.01 CH0 DRIVEBUS MODE** APC2 / 1 / - / - / NO AC70 / - / - / 17-125 / NO AC80 DriveBus / - / 1-12 / / YES AC80 ModuleBus / - / / 17-125 / NO FCI (CI810A) / - / - / 17-125 / NO	**70.01 CH0 NODE ADDR**
☐	Select the communication mode for channel CH0. See the table above. ***Note:*** This parameter is valid after the next power-up.	**71.01 CH0 DRIVEBUS MODE**
☐	Check that the communication is working.	
☐	Set the delay time before a communication break fault is indicated.	**70.04 CH0 TIMEOUT**
☐	Select the action upon a communication fault on channel CH0.	**70.05 CH0 COM LOSS CTRL**
☐	Select RING, if the CH0 channels on the NAMC boards have been connected to ring. (Default is STAR that is typically used with the branching units NDBU-95 / -85).	**70.19 CH0 HW CONNECTION**

START-UP PROCEDURE

☐	Set the node address for channel CH3. This is used for Drive*Window*. Use addresses 1…75 and 124…254. Rest of the addresses have been reserved for branching units (NDBU-95 or NDBU-85). If the CH3 channels of several drives have been connected in a ring or star (using a branching unit configuration), each one must be given a unique node address. The new node address becomes valid only on the next NAMC-03 power-on.	**70.15 CH3 NODE ADDR**
☐	Select RING, if the CH3 channels on the NAMC boards have been connected to ring. (Default is STAR that is typically used with the branching units NDBU-95 or NDBU-85).	**70.20 CH3 HW CONNECTION**
☐	Select the addresses for Receive and Transmit data according to the application of the overriding system. ***Note*** the different update intervals. See tables in the Chapter 3 *Fieldbus Communication Adapters on the Channel CH0*.	**Parameter Groups** **90…93**
☐	Test the functions with received and transmitted data.	

9.	***CONTROLLING THE DRIVE USING THE I/O SIGNALS***	
	The drive can be controlled, instead of an overriding system, by using I/O signals. See also Par. **10.07 HAND/AUTO**.	
☐	Select the I/O control mode (1=NO). Digital inputs are selected in Group 10 Digital Inputs. To see the analogue selections see description of Parameter **98.06 AI/O EXT MODULE 1**. When an NIOC-01 I/O board is used, an mA-type speed reference signal can be selected with the parameter **11.01 EXT REF1 SEL**.	**98.02 COMM MODULE**

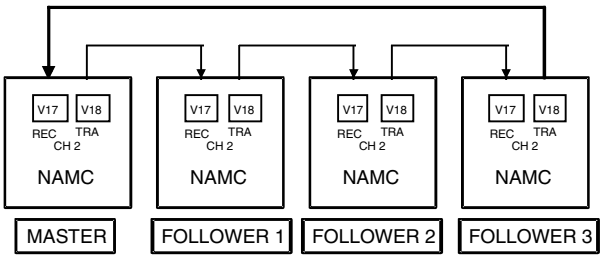
START-UP PROCEDURE

10.	***FIELDBUS ADAPTERS***	
	See the appropriate *Installation and Start-up Guide.* The fieldbus communication is set up with Parameter Group 51.	**Parameter Group 51**
☐	Select the DRIVEBUS MODE OFF and reconnect the power to the NDCU-unit.	**71.01 CH0 DRIVEBUS MODE**

11.	***UNDERVOLTAGE CONTROL***	
11.1	***Activating the Undervoltage Control***	
	It is possible to keep the drive running during a short power supply failure (max. 5 seconds) on the following provisions: • The NAMC board must be powered through a UPS. • Digital input DI2 circuit must remain closed during the power supply failure. • The inverter is permitted to run for max. 5 seconds without inverter fans. Please contact an ABB representative for more information.	
☐	Check that the auxiliary control circuit functions correctly during power supply failure.	
☐	Activate the undervoltage controller.	**30.22 UNDERVOLTAGE CTL**
☐	Deactivate the Adaptive UDC measurement if undervoltage control is in use with several drives connected to the same DC bus.	**20.14 ADAPTIVE UDC MEAS**
☐	Tune the generating load level according to the load with the gain of the P-controller.	**20.16 UNDERVOLT TORQ DN** and (20.15)

START-UP PROCEDURE

12.	*AUTO RESTART FUNCTION*	
12.1	***Activating the AUTO RESTART Function***	
	It is possible to restart the drive automatically after a short power supply failure using the AUTO RESTART function.	
☐	Activate the AUTO RESTART function if required. It is possible to restart the drive after a short power supply failure (max. 5 seconds) on the following provisions: • The NAMC board must be powered through a UPS. • Digital input DI2 circuit must remain closed during the power supply failure. • The inverter is permitted to run for max. 5 seconds without inverter fans.	**21.09 AUTO RESTART**
☐	Set the maximum allowed power supply failure time.	**21.10 AUTO RESTART TIME**
☐	Set the PPCC FAULT MASK to prevent PPCC link fault indications.	**30.24 PPCC FAULT MASK**

13.	*CHECKING THE MASTER/FOLLOWER COMMUNICATION*	
13.1	***Checking the Mode and Signals***	
	Required only if the application includes master/follower drives.  	
☐	Select the Master/Follower mode.	**70.08 CH2 M/F MODE**
☐	In the Master: If the speed reference is sent from the master drive to the follower drive, select the signal (to be sent to the follower).	**70.10 MASTER SIGNAL 2** ***Note:*** If Parameter 70.08 CH2 M/F MODE is set to 3 = FOLLOWER, this parameter is not used.

START-UP PROCEDURE

☐	In the Master: The torque reference is sent from the master drive to the follower drive. Select the signal to be sent as the torque reference (from the master drive to the follower).	**70.11 MASTER SIGNAL 3** ***Note:*** If Parameter 70.08 CH2 M/F MODE is set to 3 = FOLLOWER, this parameter is not used.
☐	In the Follower: If the speed reference is read from the master drive, set Parameter 70.17 FOLL SPEED REF to 1 = MASTER in the follower.	**70.17 FOLL SPEED REF**
☐	Test the load sharing in practice. Also test the function with an emergency stop.	**25.03 LOAD SHARE**

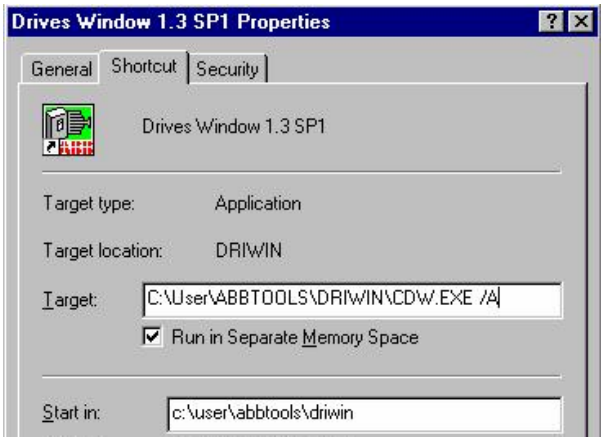
Drive*Window* Backup/Restore Function

When finishing the ACS 600 commissioning it is recommend making a **backup** file of the NAMC board parameters. If required the parameters can then be downloaded into a spare board of the same type.

Before You Start

For **COMPLETE BACKUP** function the **Drive*Window*** shortcut must be edited as follows.

1. Add parameter ' **/A**' to command line, *e.g.* '**C:\ABBTOOLS\DRIWIN\CDW.EXE /A**'
2. Mark the **Run in separate memory Space** field.



Drive*Window* Complete Backup:

COMPLETE BACKUP saves the PARAMETER.DDF file from the NAMC board including nominal values of the inverter. The file extension is *.DDB.

Make Complete Backup always after changing parameter values! Save also the parameter list after making changes.

Complete Backup

1

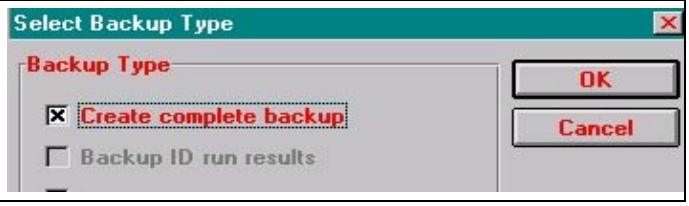
Start the Drive*Window;* all the connected drives are shown on tree display.

2

Select a drive by clicking on the icon with left mouse button.

3

In the Drive*Window* select: **Drive** >> **Backup** >> **Create complete backup** >> **OK**.



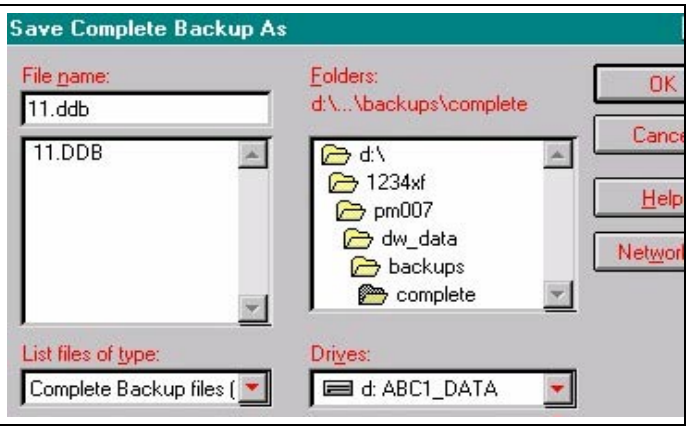
4

Select the disc and directory for saving the backup (e.g. D:\1234XF\pm007\dw_data\backups\complete).

5

Write file name (for example the drive number), maximum 8 characters.

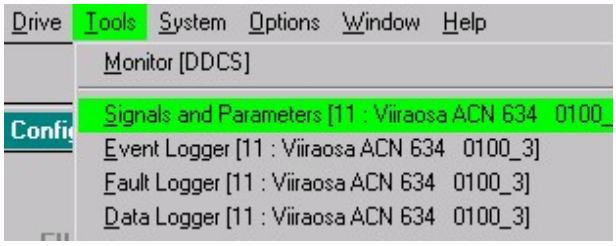
Notification **Backup Successfully Created** appears when Backup is completed.



Parameter Saving

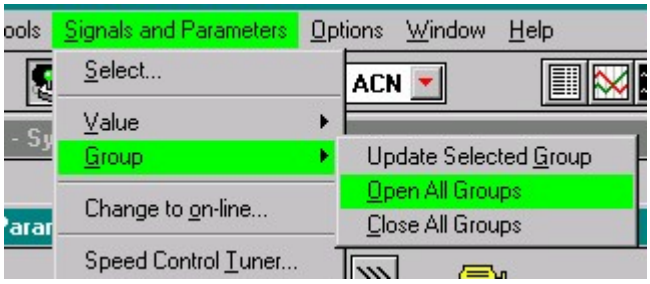
1

Select the drive by clicking the icon with left mouse button. Open parameter list.



2

Open all parameter groups.



3

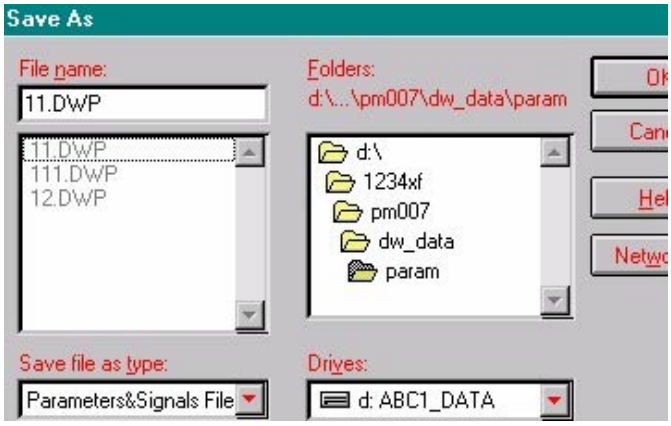
Select the disc and directory for saving the parameters (e.g. D:\1234xf\pm007\dw_data\param).

4

Write the file name (for example drive number), maximum 8 characters.

5

In the next window you can also write a comment.



Drive*Window* Restoring Complete Backup:

Restoring a **COMPLETE BACKUP** downloads the whole contents of the PARAMETER.DDF file to FPROM (Flash PROM memory) on the NAMC board. This is the easiest and the recommended way to download parameters to a spare board, because it also restores the inverter nominal values. **The board and loading package types (e.g. NAMC-21 and AM4B5230) of the original and spare board must match. See signal 4.1 in the drive.**

4	INFORMATION				
4.1	SW PACKAGE VER	AM4B5220			
4.2	DTC SW VERSION	0X00005220			
4.3	APPLIC SW VERSION	AMAB5220			

*Drive*Window *Restore*

1

Disconnect CH0 optical cable from the NAMC-board.

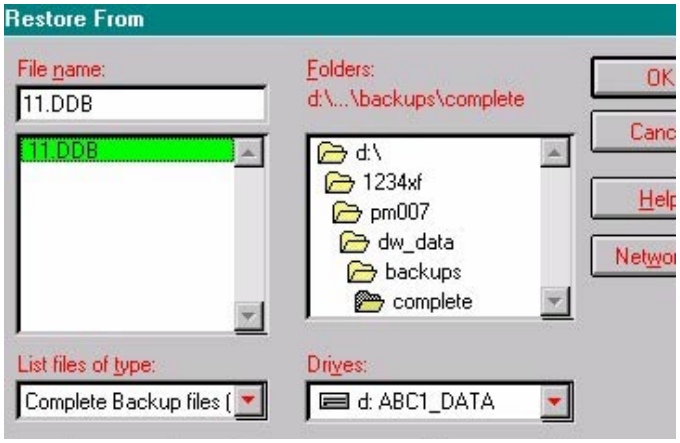
Connect Drive*Window* directly to NAMC-board CH3 with optical cable.

Power-on the NAMC-board.

2

In the Drive*Window* select: **Drive** >> **Restore** and select the directory, where complete Backup files is stored. ***Note:*** Complete Backup must not use for version updates (e.g. AM4B5230 -> AM4B5250).

(e.g. D:\1234xf\pm007\dw_data\backups\complete)



3

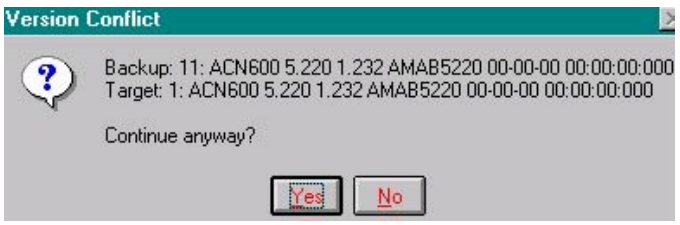
From **list files of type** selection box chance file type to 'Complete Backup Files'

4

Select file (e.g.11.DDB) and click **OK**.

5

Reset the error message **Version Conflict** by clicking **Yes**, if the only difference is that the Backup and Target Node numbers are different.



6

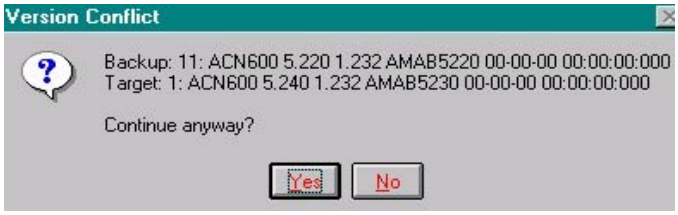
After the notification **Restore successfully done** and the error message (see the picture on right) have appeared, turn off and on the auxiliary voltage of the NAMC-board (restart). Connect D*W* to the drive and check parameters, step 8.

Version Conflict message, see step 7.

7

Notification **Version Conflict**: the system program and the backup file are of different versions. Load the correct system program. See a separate guide.

Otherwise continue from step 8.



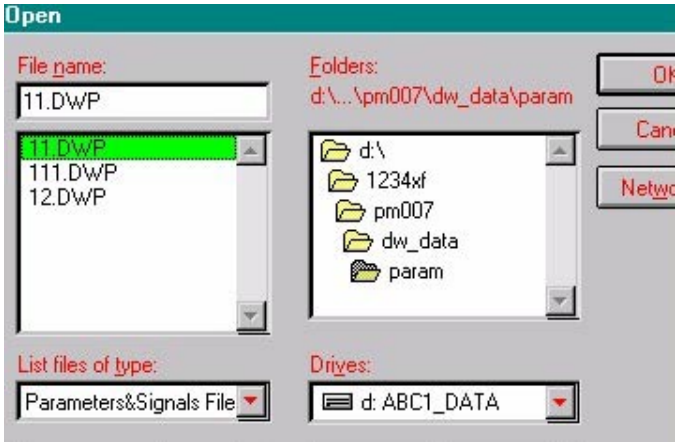
8

Open parameter list and open all parameter groups: **Signals and Parameters** >> **Group** >> **Open All Groups.**

9

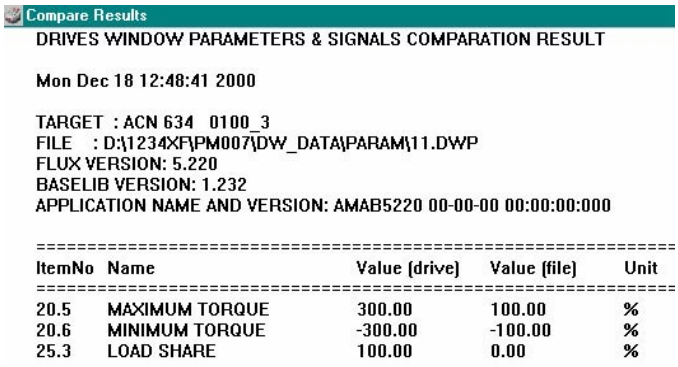
Compare the opened list to the saved parameter file:

File >> **Compare**, select the Parameter-file, e.g. (D:\1234xf\pm007\dw_data\param) '11.DWP'.



10

Some parameter groups may have different values, like reference values, limits and data (parameter groups: 19, 20, 21, 23, 25, 26), because the control system (AC 80, APC) updates the values.



11

Reinstall all connections as they were before making restore. Reconnect +24 V DC to the NAMC-51 board.

Chapter 3 – Software Description

Drive Functions

This chapter describes the typical functions of the ACS 600 drive.

General

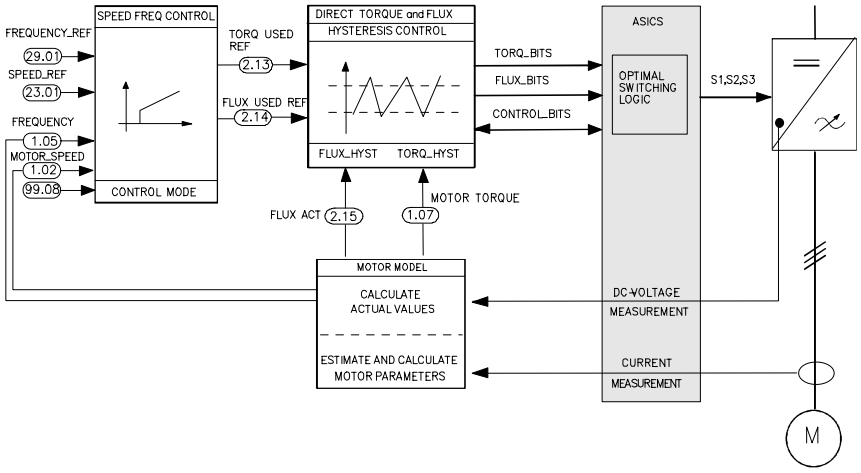


Figure 3 - 1 Block Diagram of the Direct Torque Control Method

The motor control of ACS 600 frequency converter is based on the direct control of motor torque (DTC) by means of the stator flux. The inverter power semiconductors (swithes) are regulated to achieve the required stator flux and torque of the motor. The power module “switching reference” is changed only if the values of the actual torque and the stator flux differ from their reference values more than the allowed hysteresis. The reference value for the torque controller comes either from the speed controller or directly from an external source.

The motor control requires the measurements of the intermediate circuit voltage and two phase currents of the motor. The stator flux is calculated by integrating the motor voltage in vector space. The torque of the motor is calculated as a cross product of the stator flux and rotor current. By utilising the identified motor model, the stator flux estimate is improved. The measurement of the shaft speed is not needed for the motor control. Good dynamic control performance is achieved providing the identification run is done during the commissioning.

The main difference between traditional control and the DTC is that the torque control is made at the same time level as the control of power switches (25 µs). There is no separate voltage and frequency controlled PWM modulator. All selections of the switches are based on the electromagnetic state of the motor.

The DTC can only be applied by using high speed signal processing technology. Digital signal processors (MOTOROLA 560xx) are used in ACS 600 products to achieve this performance.

Application Program Identificatinon

Each ACS 600 product has a product specific loading package, which contains all necessary software files to be downloaded to the NAMC board. The loading packages define for example the inverter ratings which are different for AC and DC supplied inverters. Loading Package type information can be identified from the signal **4.01 SW PACKAGE VER**. There are two different types of loading packages for ACS 600 System Application:

- **AM4G**6xxx for non parallel connected inverters (e.g. 100 kVA)
- **AM5G**6xxx for parallel connected inverters (e.g. 4 x R11i)

The downloaded application program version can be identifiable from signal **4.03 APPLIC SW VERSION**.

Program Boot

The application program on the NAMC board is saved into FPROM memory. After switching on the auxiliary power, the program starts routines for initialisation and loading of all tasks, parameters and application program from FPROM to RAM memory. This takes about 6 seconds. A reset is given at the end of the boot procedure, and the control mode of the drive is changed to REMOTE.

Control Diagrams

The speed control is executed once per millisecond in the fixed part of the software (speed ramp every 2 ms). The following figures show the speed and torque control chains.

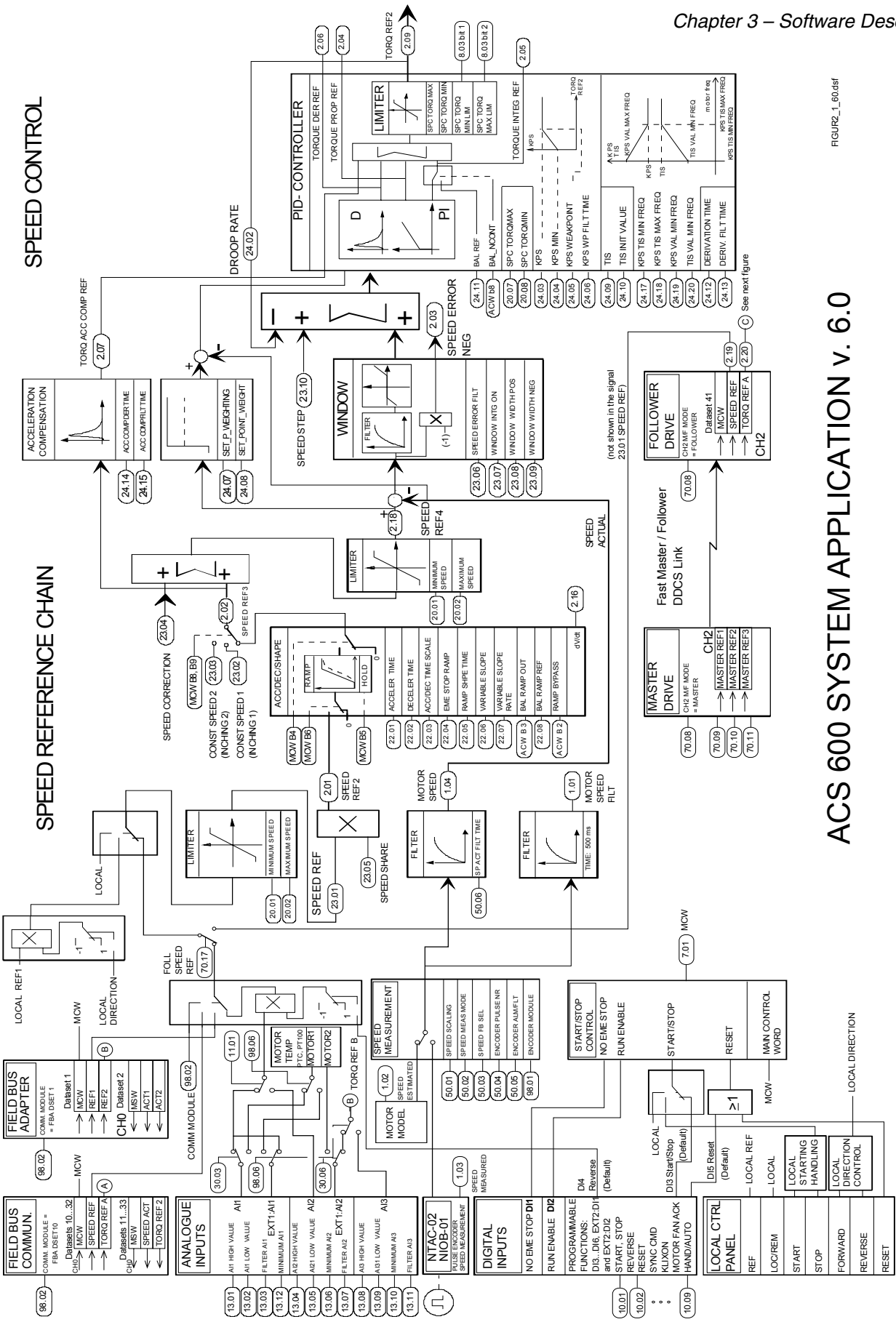


Figure 3 - 2 Speed Control Chain

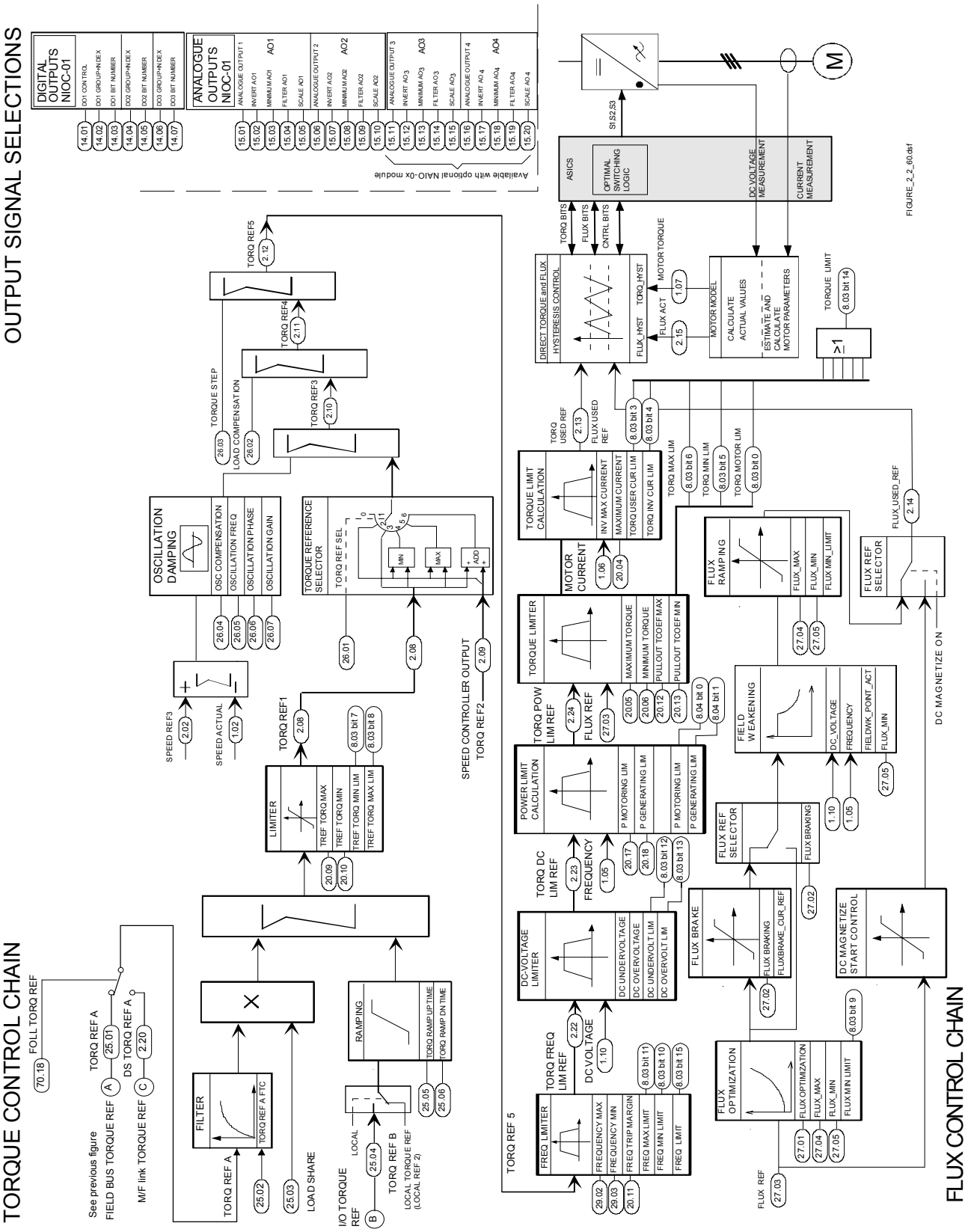


Figure 3 - 3 Torque Control Chain

Control Modes

The ACS 600 System Application Program has two main control modes: **REMOTE** and **LOCAL**. The mode is selected by the LOC/REM key on either from the CDP 312 control panel or the Drive*Window* tool.

REMOTE Mode

A drive is controlled either through the DDCS communication link from an overriding system or from the drive I/O. The desired alternative is selected by parameter **98.02 COMM MODULE**. A digital input can also be selected for changing the control location.

HAND/AUTO Function

This mode is suitable for applications requiring alternation between an overriding system (connected to CHO) and the digital and the analogue inputs. The active control location can be switched from the overriding system to I/O by using a digital input in REMOTE mode. See Parameter 10.07 **HAND/AUTO**.

LOCAL Mode

The local control mode is mainly used when commissioning and servicing. Local control is selected by the LOC/REM key on either the CDP 312 control panel or Drive*Window*. The controls from the overriding system have no effect in this mode. Changing the control location to LOCAL can be disabled with Parameter 16.04 **LOCAL LOCK**. Parameter values can always be monitored and changed regardless of the selected control mode.

Emergency Stop

The emergency stop function follows the principles of the Safety of Machinery standards EN 292-1: 1991, EN 292-2: 1991, EN 418: 1992, EN 954-1: 1996 and EN 60204-1: 1992 + Corr. 1993.

ACS 600 MultiDrive hardware and System Application Program fulfils the following emergency stop category classes:

- Class 0 Immediate removal of power.
- Class 1 Controlled emergency stop.

See also *ACS 600 MultiDrive Safety and Product Information (Code 3AFY 63982229).*

Emergency Stop Hardware

The Emergency stop signal is connected to digital input 1 (DI1) of the Basic I/O board (NIOC-01) or NDIO Extension module 1 and is activated by setting DI1 or Main Control Word **(MCW)** bit 2 to FALSE (0).

The emergency stop feedback signal is sent through relay output RO1 of NIOC-01 or NDIO module 1 to the ACU (Auxiliary Control Unit) which contains the control relays for the common emergency stop circuit. The purpose of the feedback signal is to confirm that the emergency stop function has been received and the drive program is running. If no feedback is received, the main AC supply will be switched off by hardware after the short delay defined by the ACU (Auxiliary Control Unit) adjustable relays.

Note: When an emergency stop signal is detected, the emergency stop cannot be cancelled even though the signal is cancelled (emergency stop push button is released).

Torque Limit Ramping beginning of Emergency Stop

The maximum and minimum torque limits ramping to low value for a while can be used to guarantee smooth direction change of power with regenerative supply units. This function can be selected by Parameter **21.08 EM STOP TORQ RAMP**.

Emergency Stop Modes

The emergency stop mode can be pre-selected by Parameter **21.04 EME STOP MODE**. On an emergency stop, the torque selector is always set to position SPEED CONTROL except when in the FOLLOWER STOP mode.

Action if the Motor Is Stopped

The following actions are taken it the motor is already at zero speed when the drive receives an emergency stop signal.

- Run and magnetising of motor is prevented.
- Bit 5 is set to a 0 of the **MAIN STATUS WORD (MCW)**
- Bit 1 of **ALARM WORD 1 (9.04) is set to 1.**
- Relay output RO1 is energised until the MCW bit 0 is set to 0.

Action if the Motor Is Running

The following actions are taken it the motor is running when the drive receives an emergency stop signal.

- The drive is stopped according to the emergency stop mode Parameter **EME STOP MODE (21.04)**.
- The application program locks the emergency stop procedure and energises the relay output1 until the motor has reached zero speed and the **(MCW) MAIN CTRL WORD (7.01)** bit 0 is set to “0” state.

- The application program supervises that the deceleration of the drive is within the window defined by Parameters **21.05 EMSTOP DER MIN L** and **21.06 EMSTOP DER MAX L**. This supervision starts according to **21.07 DECEL MON DELAY**. If the drive is not able to decelerate the motor within the window, it is stopped by coasting and **(ASW) AUX STATUS WORD (8.02)** bit 2 (EMERG_STOP_COAST) is set to 1.

Prevention of Unexpected Start-Up

The ACS 600 MultiDrive can be equipped with an optional prevention of unexpected start-up circuit. It conforms to the following standards: EN 292-1: 1991, EN 292-2: 1991, EN 954-1: 1996, EN 60204-1: 1992 + Corr. 1993 and EN 1037: 1995.

The function is realised by disconnecting the control voltage of the inverter power semiconductors. Thus it is not possible for the power semiconductors to switch and generate the AC voltage needed to rotate the motor.

WARNING! Prevention of unexpected start-up does not disconnect the voltage from the main and auxiliary circuits. Therefore, maintenance work on electrical parts can only be carried out after switching off the mains supply of the drive system.

The prevention of unexpected function operates as follows:
The operator activates the prevention of unexpected start-up with a switch mounted on the control desk. The drive application program diagnostics routine receives an internal signal from the NINT board that a prevention of unexpected start-up input has been detected. Then the voltage supply of the NGPS-0x board is disconnected. The program performs the following actions:

- Drive is stopped by coasting, if the function has been activated during run. This is at first hardware-controlled; the program only provides diagnostics at this point.
- Activates the alarm "**START INHIBI**" (start inhibition).
- **ALARM WORD_1 (9.04)** bit 0 is set to 1.
- **AUXILIARY STATUS WORD (8.02)** bit 8 is set to 1.

If a start command is given while the prevention of the unexpected start-up function is active, the fault "**START INHIBI**" is activated (start inhibition).

Communication

DDCS Channels in NAMC CONTROLLERS

In the following table there is described how the DDCS channels on the NAMC board is used.

The types of the optic components are also given (5 MBd or 10 MBd).

Table 3 - 1 Usage and Type of DDCS Channels in NAMC Controllers.

CH No	STANDARD USAGE		NAMC-51	
			DDCS Communication Option	
	ACS 600 MD	NAMC-51	NDCO-01	NDCO-02
CH0	- Applic. Controller - Fieldbus Interface	-	10 MBd DDCS/ DriveBus	5 MBd
CH1	- Basic I/O - Optional I/O	5 MBd	-	-
CH2	- Master / Follower	-	10 MBd	10 MBd
CH3	- Drive*Window* (PC, 1 Mbit/s)	-	10 MBd	10 MBd

Several communication protocols are supported by fieldbus adapters connected to DDCS channel 0 (CH0) on the NAMC board. The communication protocol of channels CH0...CH3 is DDCS (Distributed Drives Communication System). The NAMC-51 board CH0 supports either DriveBus or DDCS protocol. The Drivebus master can send one message that contains 1 data set for 10 drives during a 1 ms. The DDCS link between the overriding system and the drive uses data sets for the information exchange. The link sends the information of a transmitted data set to the data set table in the drive program and returns the content of the next data set to the overriding system as a “return message”. The data received from the overriding system affects only the RAM (not FPROM) memory on the NAMC board.

Fieldbus Communication Adapters on the Channel CH0

Fieldbus communication mainly uses data sets 1 and 2 between the fieldbus adapter and the NAMC board. Some of the adapters can transfer more data. For that purpose there is an offset parameter for the first transmitted data set in Parameter Group 51. For example, by setting the offset to 9, the first data set written to data set 10. Set parameter **71.01 CH0 DRIVEBUS MODE** off and reconnect the auxiliary power to NAMC-board.

Fieldbus Signals

Signal sources and targets have been fixed as shown in the table below. This mode is applied with selection **FBA DSET 1** for Parameter **98.02 COMM MODULE**. The signal updating interval is 10 ms.

Table 3 - 2 Fieldbus Signals

Data Set	Index	Signal	Source or Target	
1	index 1	MCW	7.01	MAIN CTRL WORD
	index 2	REF1	23.01 29.01	SPEED REF in DTC or FREQ REF in Scalar control
	index 3	REF2	25.04	TORQUE REF B
2	index 1	MSW	8.01	MAIN STATUS WORD
	index 2	ACT1	1.01	MOTOR SPEED FILT
	index 3	ACT2	1.08	MOTOR TORQUE

Addressing of Data Using Data Sets 10…33

This mode is typically used when the overriding system is able to communicate using the DDCS protocol and there is a need to transfer several control signals and actual values. This is selected by setting Parameter **98.02 COMM MODULE** to **FBA DSET10**. Every data set has a specified read and write task interval in the drive program. See the sections "*Received Data Set Table*" and "*Transmitted Data Set Table*". Addresses are assigned in the drive according to Parameter Groups 90...93, not sent through the link except the last data sets 32 and 33 which are dedicated for "mail box" use.

The Mail Box Function

Individual parameter values can be read and set from the overriding system simply by using data sets 32 and 33. Parameter transmit and receive addresses and data for data sets 32 and 33 are defined in the Overriding System application. They can be used as a "mail box" for setting or inquiring parameter values.

Integer Scaling on the DDCS Link

Due to the effectiveness of the communication method, the data is transferred as integer values through the link. Therefore the actual and reference values have to be scaled to 16-bit integers for the DDCS link. The integer scaling factor is mentioned in the AMC table parameter list in the column Integer scaling.

05	(161.3)	**CURRENT**		
Index	Description:	Measured motor current absolute value.		
unit: A	type: R	Min: 0	Max:	Integer scaling: 10 == 1A

Each parameter has two different gateways to write the value: integer format or decimal. Finally, the result is exactly same in the NAMC program. This relationship is always shown in the signal and parameter table as shown above.

Received Data Set Table

Data set target addresses are assigned by the CDP 312 control panel or Drive*Window* into Parameters 90...93, or by means of transmit data set 32.

Addresses for Data Received from the Overriding System

Data Set Number	Data Set Index	Interval NAMC-51	Default Address	Parameter Name (default values)	Address Set Parameter
	1	**2 ms**	701	MAIN CTRL WORD	90.01
10	2	**2 ms**	2301	SPEED REF	90.02
	3	**2 ms**	2501	TORQ REF A	90.03
	1	**4 ms**	702	AUX CTRL WORD	90.04
12	2	**4 ms**			90.05
	3	**4 ms**			90.06
	1	**10 ms**			90.07
14	2	**10 ms**			90.08
	3	**10 ms**			90.09
	1	**10 ms**			90.10
16	2	**10 ms**			90.11
	3	**10 ms**			90.12
	1	**100 ms**			90.13
18	2	**100 ms**			90.14
	3	**100 ms**			90.15
	1	**100 ms**			90.16
20	2	**100 ms**			90.17
	3	**100 ms**			90.18
	1	**100 ms**			91.01
22	2	**100 ms**			91.02
	3	**100 ms**			91.03
	1	**100 ms**			91.04
24	2	**100 ms**			91.05
	3	**100 ms**			91.06
26	1			Not in use	
28	2			Not in use	
30	3			Not in use	
	1	**100 ms**		Transmit address in NAMC program	
32	2	**100 ms**		Transmit data	
	3	**100 ms**		Inquire address	

Note: The given update times are the times within the drive is reading data from data sets to the AMC parameter table. Since the drive is a follower of the communication master, the actual communication cycle time depends on the communication cycle time of master.

Transmitted Data Set Table

Data set source addresses are set by the CDP 312 control panel or Drive*Window* into Parameters 90...93, or by means of transmit data set 32.

Signal Addresses for the Data Transmitted to the Overriding System

Data Set Number	Data Set Index	Interval NAMC-51	Default Address	Parameter Name (default values)	Address Set Parameter
	1	**2 ms**	801	MAIN STATUS WORD	92.01
11	2	**2 ms**	102	SPEED MEASURED	92.02
	3	**2 ms**	209	TORQUE REF 2	92.03
	1	**4 ms**	802	AUX STATUS WORD	92.04
13	2	**4 ms**	101	MOTOR SPEED	92.05
	3	**4 ms**	108	TORQUE	92.06
	1	**10 ms**	901	FAULT WORD 1	92.07
15	2	**10 ms**	902	FAULT WORD 2	92.08
	3	**10 ms**	906	FAULT WORD 3	92.09
	1	**10 ms**	904	ALARM WORD 1	92.10
17	2	**10 ms**	905	ALARM WORD 2	92.11
	3	**10 ms**			92.12
	1	**100 ms**	803	LIMIT WORD 1	92.13
19	2	**100 ms**	804	LIMIT WORD 2	92.14
	3	**100 ms**			92.15
	1	**100 ms**	111	TEMPERATURE (of heat sink)	92.16
21	2	**100 ms**	115	MOTOR MEAS TEMP	92.17
	3	**100 ms**			92.18
	1	**100 ms**			93.01
23	2	**100 ms**			93.02
	3	**100 ms**			93.03
	1	**100 ms**			93.04
25	2	**100 ms**			93.05
	3	**100 ms**			93.06
27				Not in use	
29				Not in use	
31				Not in use	
	1	**100 ms**		Transmit address feedback	
33	2	**100 ms**		Inquired data	
	3	**100 ms**		Inquired address feedback	

Note: The given update times are the times within the drive is writing data from the AMC parameter table to the data sets. Since the drive is a follower of the communication master, the actual communication cycle time depends on the communication cycle time of master.

Using the NPBA-02 PROFIBUS Adapter Module

The NPBA-02 PROFIBUS Adapter Module is compatible with the PROFIBUS-FMS and PROFIBUS-DP protocols. Configuration parameters of the module are set in Parameter Group 51. Note that the new settings take effect only when the module is powered up for the next time.

PPO type 5 supports 10 DW (16 bit) transmit and receive. See Parameter Groups 90...93 for information on assigning the data. The parameter service is also available (see parameter identification).

PPO5 Messages

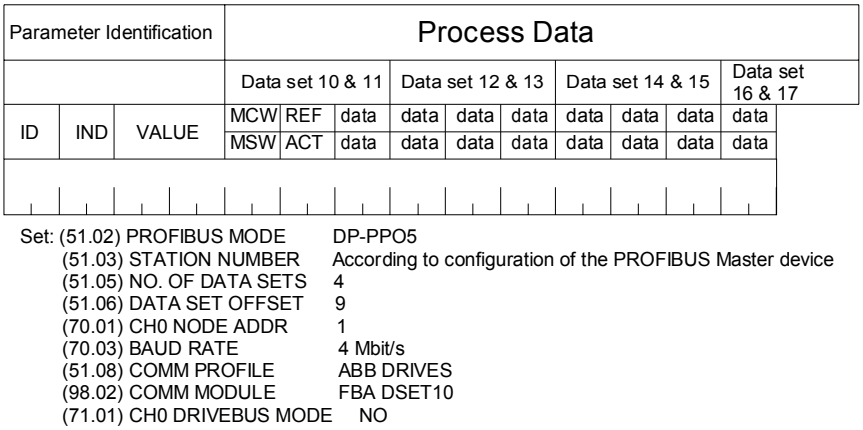


Figure 3 - 4 PROFIBUS configuration example using NPBA-02 adapter module to transfer 10 words between the drive and the overriding system in both directions.

See the chapter *Programming* in the *Installation and Start-up Guide for PROFIBUS Adapter Module NPBA-12 (Code 3BFE 64341588) or NPBA-02 (Code 3AFY 58995789)*.

PROFIBUS Parameters in Cyclic Communication

In addition to Process Data, parameters can be read and written using the protocol types PPO1, PPO2 and PPO5. See the chapter *Communication* in the *Installation and Start-up Guide for PROFIBUS Adapter Module NPBA-12 (Code 3BFE 64341588) or NPBA-02 (Code 3AFY 58995789)*.

With the formulas below you can calculate the Profibus parameter numbers (25 parameters / group) for the ACS 600 parameter groups 10...51:
The groups 10...51 and 98...99 have 25 parameters per group.
Profibus parameter number is calculated as follows:

Profibus parameter = **25** * {**Group no.** - **Offset** + (**Index/25)}**
The offset has the following values:

- Group no. 10 to 41 ==> Offset = 6
- Group no. 50 to 51 ==> Offset = 10
- Group no. 98 to 99 ==> Offset = 22

The groups 52...97 have 18 parameters per group instead of 25. Profibus parameter number is calculated as follows:

Profibus parameter = 1050 + (Group no. - 52) * 18 + Index no.
The signals in the groups 1 to 3 are translated into Profibus parameters as follows:

- Group no.1: parameter no. 1 to 50=> Profibus parameter no. 1 to 50
- Group no.2: parameter no. 1 to 25=> Profibus parameter no. 51 to 75
- Group no.3: parameter no. 1 to 25=> Profibus parameter no. 76 to 100

Example: Parameter 22.01 ACCELER TIME corresponds to PROFIBUS address

$$ADDR_{10} = 25 * \{22 - 6 + (1/25)\} = 401_{10} = 191_{16}$$

(Add 4000 in FMS Mode)

I/O Devices on Channel CH1

All of the drive I/O devices are connected in a ring to channel 1 (CH1) on the NAMC board. The NAMC is the master in the communication link. Each device has an individual address, set with DIP switches on the device. Before use, each I/O device must be activated from Parameter Group 98.

Master/Follower Link on Channel CH2

A Master/Follower link can be formed by connecting the CH2 channels of two or more drives in a ring. Parameters 70.07 to 70.14 define the mode and the references. The message type is broadcast.

Commissioning and Supporting Tools on Channel CH3

The Drive*Window* commissioning and other tools can be connected to channel CH3 on the NAMC board, either in a ring, or a star connection using NDBU-xx branching boards. Node numbers must be set for each drive unit before starting the communication through the connection: see Parameter **70.15 CH3 NODE ADDR**. This setting can be made by a point to point connection with either the control panel CDP 312 or Drive*Window*. The new node address becomes valid after auxiliary power shutdown of the NAMC-board. The NAMC-board channel 3 (CH3) has been configured to Slave in the communication point of view.

Modbus Link

The CDP 312 Control Panel, NLMD-01 Led Monitoring Display panel or Drive*Window* can be connected to the ACS 600 drive through a Modbus link. The communication speed is 9600 bit/s (8 data bits, 1 stop bit, odd parity). The connected device is the master of the communication link. An NBCI-01 bus connection units must be used if the distance between the panel and drive is over three metres.

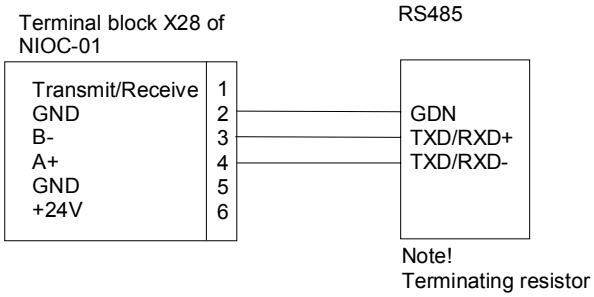


Figure 3 - 5 RS 485 Connection Principle

Modbus is designed for integration with Modicon PLCs or other automation devices, and the services closely correspond to the PLC architecture. The ACS 600 drive looks like a Modicon PLC on the network.

Register Read and Write

The ACS 600 drive parameter and data set information is mapped into the 4xxxx register area. This holding register area can be read from an external device, which can modify the register values by writing to them.

There are no setup parameters for mapping the data to the 4xxxx registers. The mapping is pre-defined and corresponds directly to the drive parameter grouping which is being used by the local drive panel.

All parameters are available for both reading and writing. The parameter writes are verified for correct value and for valid register addresses. Some parameters never allow write access (including actual values), some parameters allow write access only when the drive is stopped (including setup variables), and some parameters can be modified at any time (including actual reference values).

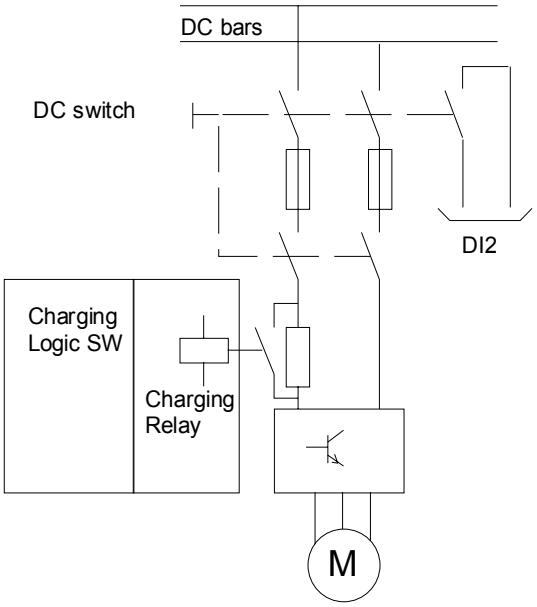
Register Mapping

The drive parameters are mapped to the 4xxxx area so that:
40101 – 40999 registers are reserved for the signal values
41000 – 49999 registers are reserved for the parameter data

In this mapping, the thousands and hundreds correspond to the group number, while the tens and ones correspond to the parameter number within a group.

Charging Logic of Inverter

Digital input DI2 is also used in the R2i…R6i inverter frames to indicate the position of the DC switch (optional) to the charging logic.



Three conditions must be fulfilled before the charging relay can be energised: DC voltage level or DC voltage, derivative = 0, DI2 = 1.

When the DC switch is opened, control pulses of the inverter are blocked as in the RUN ENABLE function and the charging relay is opened. In case of undervoltage in the supply, the charging relay opens after the undervoltage trip.

ABB Drive Profile

Drive States

The ABB Drive Profile is a PROFIBUS-based model to describe the drive interface between the state transitions under control of an overriding control system. In order to achieve this, the ABB Drive Profile defines general states. A control word generally commands transitions between these states. The table below gives an interpretation for the most important states and also the ABB names for these states.

Table 3 - 3 ABB Drive Profile States, see Chapter 4 – Signals for more Information on Status and Commands.

Action	Name of state	Explanation
Switch on inhibit	**ON_INHIBIT**	The drive is moved to this state after the EMERGENCY OFF/STOP or TRIPPED state. The main idea is to guarantee that the ON command is removed. Drive is moved to an OFF -state after the ON command has been removed.
Not ready for switch on	**OFF**	The drive stays in this state as long as the EMERGENCY OFF/STOP commands are active. After these commands have been deactivated and the command "Control from the automation unit" is activated, the drive is moved to the RDYON state.
Ready to switch on	**RDY_ON**	After an "ON" command the drive is allowed to perform equipment specific actions. For drives these are: - Flux ON - Stator pulses inhibited
Ready	**RDY_RUN**	After a "RUN" command the drive performs - enabling internal controllers, When all internal controllers are ready, the drive is moved to RDYREF state.
Enable operation	**RDY_REF**	The drive is following the given references.
RFG: enable output		This is actually the speed ramp control, all drive controllers are activated but the output of the speed ramp is clamped to zero. This causes the drive to decelerate to zero speed and regulate zero speed.
RFG: Acceleration enabled		This is also the speed ramp control, the ramping can be started or stopped (HOLD).
Operating status		This is also the speed ramp control, the input of ramp is released.
OFF 1 active		The ON command is removed. The drive deactivates all of its functions which were commanded by the ON command e.g. Drive is first decelerated to the zero speed by emergency stop ramp. - Stator and flux current to zero. After this the drive is shifted to the OFF-state.
OFF 2 active	**OFF_2_STA** EMERGENCY OFF	The voltage of the drive is immediately removed (coast stop), all functions created by the ON command are removed and after that the drive is shifted to ON INHIBIT state.
OFF 3 active	**OFF_3_STA** EMERGENCY STOP	The drive is decelerated to zero speed according to the parameter 21.04 EME STOP MODE, all of the functions created by the ON command are removed and after that the drive is shifted to the ON INHIBIT state.
Fault	**TRIPPED**	After tripping the drive remains in this state as long as the rising edge of the RESET-signal is sent to the drive. The drive is shifted to the ON INHIBIT state, so the ON command must first be turned OFF before the sequence is allowed to continue.

Main Control Word (MCW)

The table below defines the use of the ABB Drive Profile command word for drives application.

Table 3 - 4 Main Control Word Bits 0 to 7, see Chapter 4 – Signals for more Information on Status and Commands.

Bit	Name	Value	Description
0	**ON**	1	Command to "**RDYRUN**" –state.
	OFF1	0	Command to "**OFF**" state. (Can go immediately to "RDYON" -state if there are no other interlockings (OFF 2 / OFF 3). Drive stops down to the zero speed by ramp. Ramp time is defined by parameter 22.04 EME STOP RAMP. All pulses are removed, when in zero speed. Restart is not possible before zero speed.
1	**OFF 2**	1	No OFF 2 (Emergency OFF)
		0	Command to "**ON INHIBIT**" state. Inhibit pulses and drive coasts down. Sequence control handles: - Stator and flux current to zero - All pulses are removed
2	**OFF 3**	1	No OFF 3 (Emergency STOP)
		0	Command to "**ON INHIBIT**" state. Digital input 1 in the hardware operates parallel with this bit. Fast stop: The fastest possible deceleration, by current limit, fast ramp or coast stop. Defined in the parameter 21.04 EME STOP MODE. After zero speed the sequence control handles: - Stator and flux current to zero - All pulses are removed
3	**RUN**	1	**Enable Operation** Command to **RDYREF** -states. Enable stator/armature pulses. Raise flux to the nominal reference if not already in that value. Then accelerate via speed ramp to the given speed reference set-point.
		0	**Inhibit Operation**. Inhibit inverter pulses and the drive coasts, and goes into the "READY" status (refer to control word bit 0)
4	**RAMP-OUT-ZERO**	1	Operating condition.
		0	Ramp-function generator output is set to zero. Drive ramps down along the current limit or at the DC-link voltage limit.
5	**RAMP-HOLD**	1	Enable ramp-function generator.
		0	Speed ramping stopped. Freeze the actual setpoint from the ramp-function generator.
6	**RAMP-IN-ZERO**	1	Enable setpoint
		0	Inhibit setpoint. Speed ramp input is forced to zero.
7	**RESET**	1	Fault resetting with a positive edge.
		0	No significance

Table 3 - 5 COMMAND WORD Bits 8 to 10 meaning, see Chapter 4 – Signals for more Information on Status and Commands.

Bit	Name	Value	Description
8	**INCHING_1**	1	Drive accelerates as fast as possible to inching setpoint 1, if following conditions are fulfilled: - bit **RAMP-OUT-ZERO** = 0 - bit **RAMP-HOLD** = 0 - bit **RAMP-IN-ZERO** = 0
		0	Drive brakes as fast as possible if INCHING_1 was previously ON
9	**INCHING_2**	1	Drive accelerates as fast as possible to inching setpoint 2, if following conditions are fulfilled: - bit **RAMP-OUT-ZERO** = 0 - bit **RAMP-HOLD** = 0 - bit **RAMP-IN-ZERO** = 0
		0	Drive brakes as fast as possible if INCHING_1 was previously ON
10	**REMOTE_CMD**	1	Overriding computer is requesting to control the drive
		0	No control from the overriding system, except OFF1, OFF2 and OFF3 commands.

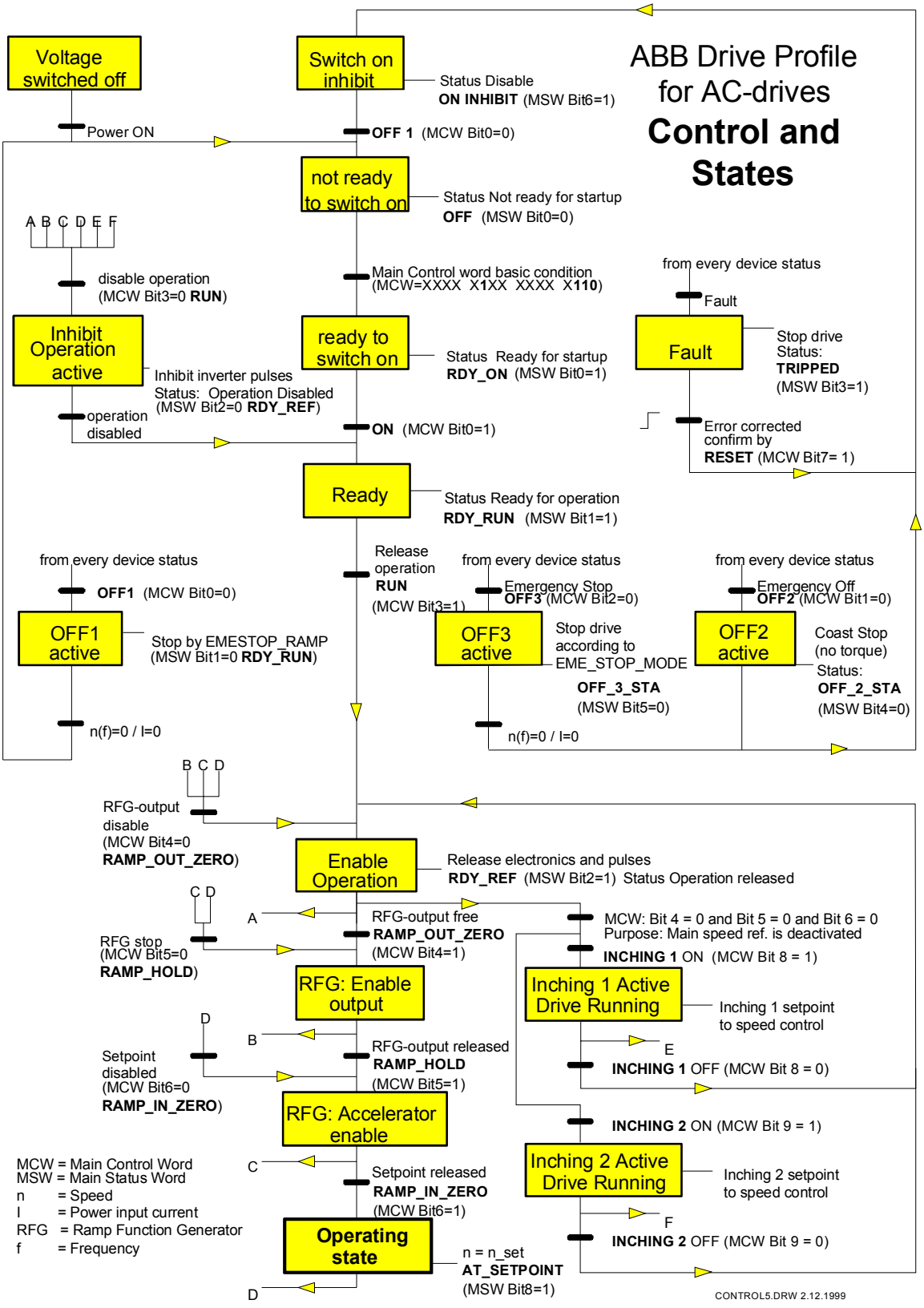


Figure 3 - 6 Control and State Diagram, see Chapter 4 – Signals for more Information on Status and Commands.

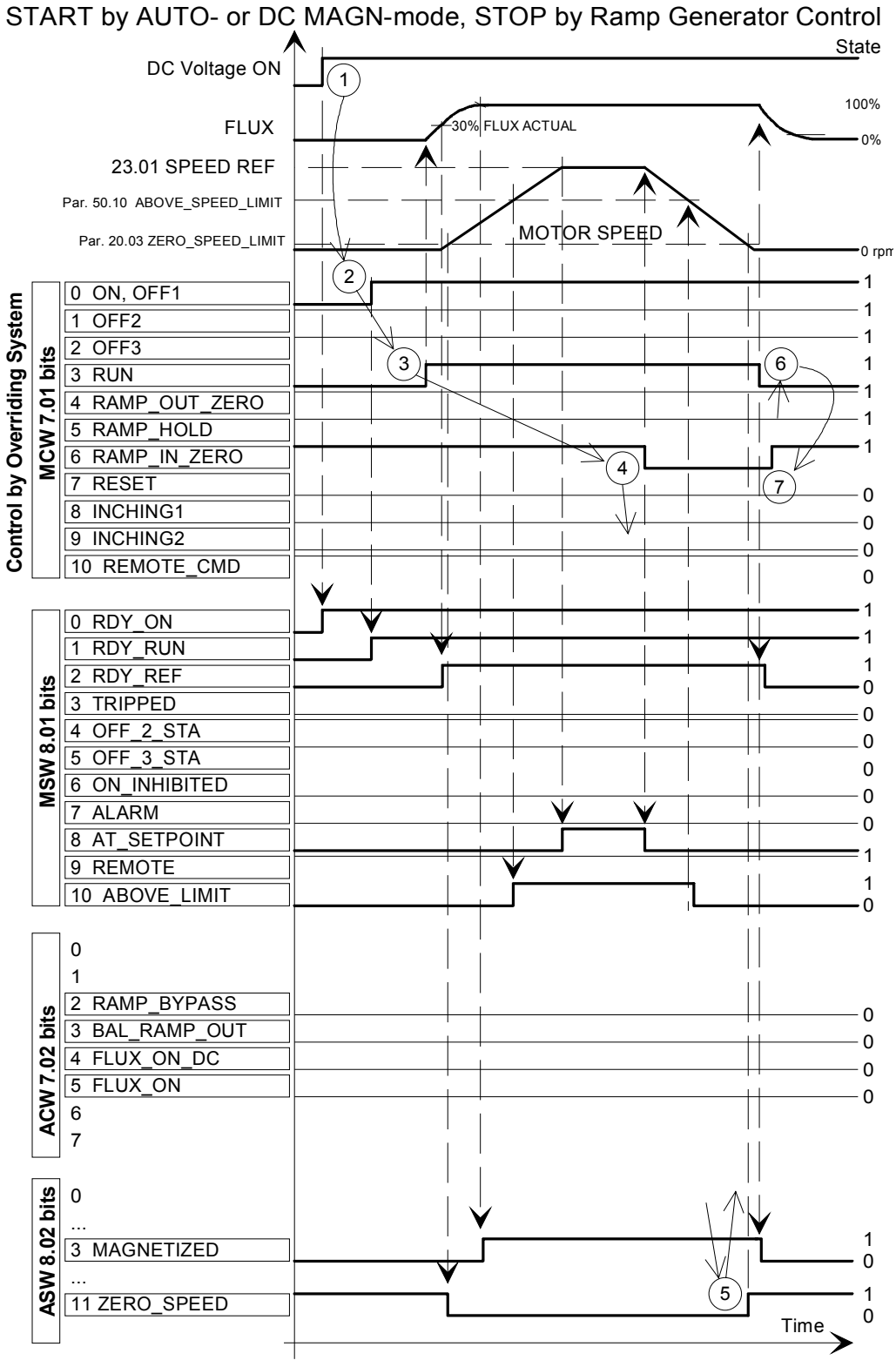


Figure 3 - 7 Control example: Start by AUTO or DC MAGN Mode, Stop by Ramp Generator, see Chapter 4 – Signals for more Information on Status and Commands.

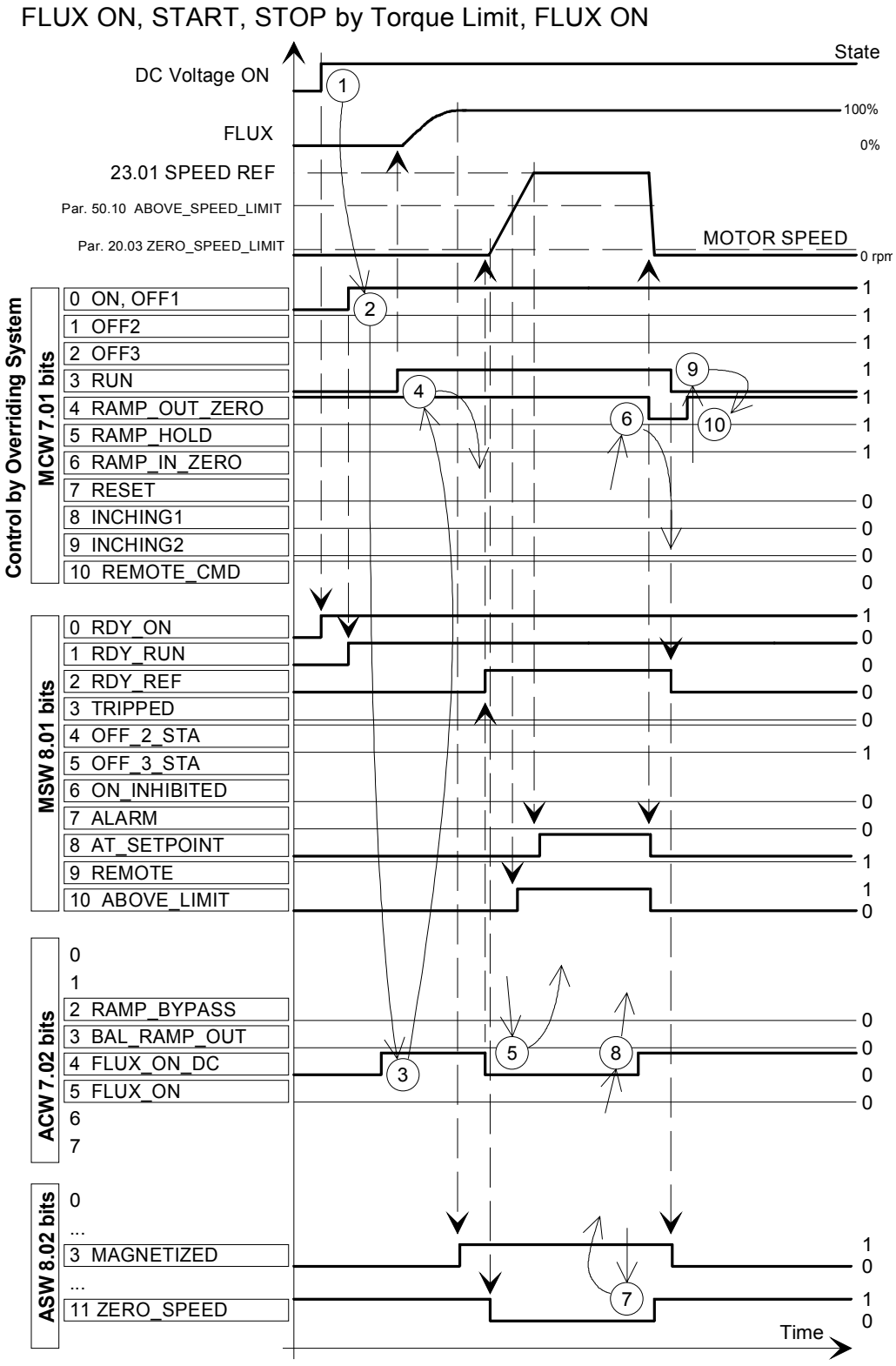


Figure 3 - 8 Control example: Start by FLUX ON DC Command, Stop by Torque Limit, see Chapter 4 – Signals for more Information on Status and Commands.

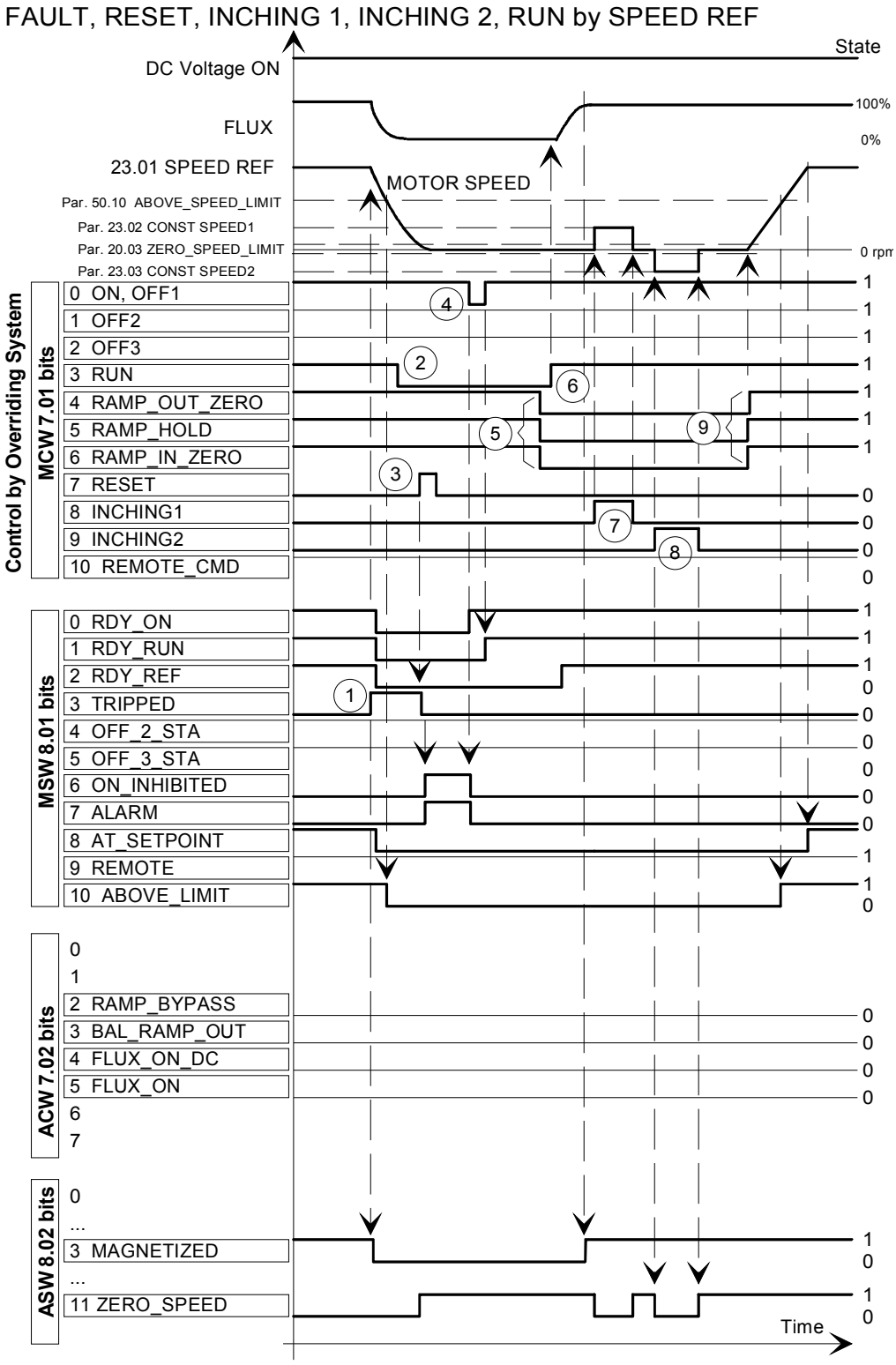


Figure 3 - 9 Control example: Fault Reset, Run by CONST SPEED 1 (Inching 1), CONST SPEED 2 (Inching 2) and SPEED REF, see Chapter 4 – Signals for more Information on Status and Commands.

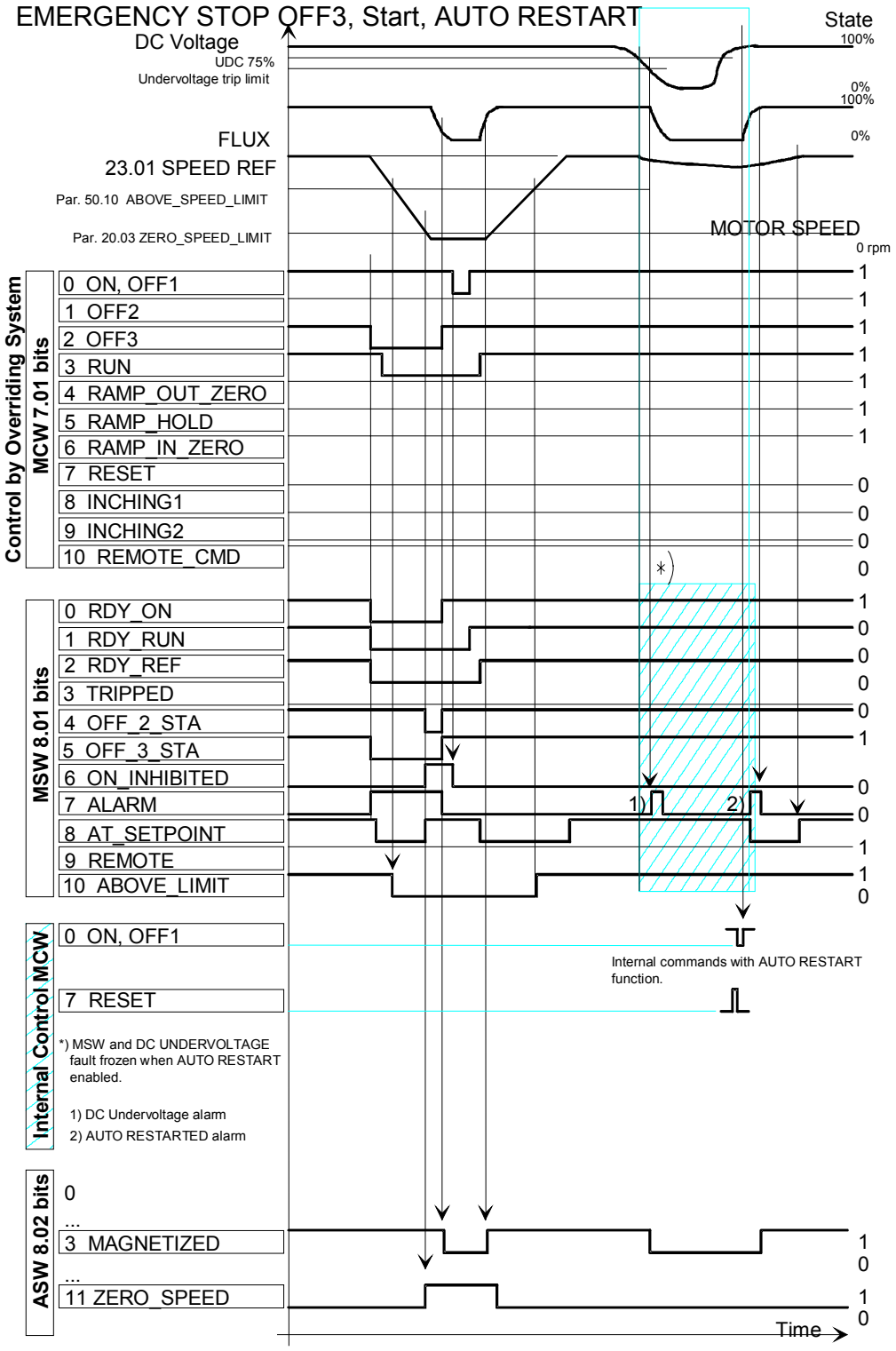


Figure 3 - 10 Control example: Emergency Stop with Ramp (OFF3) and AUTO RESTART after the Short Supply Power Failure, see Chapter 4 – Signals for more Information on Status and Commands.

I/O Configurations

Digital Inputs

All the inputs can be read by the overriding controller. See signals **DI6-1 STATUS (1.15)** and **DI STATUS WORD (8.05)**. Input functions are programmable and defined in parameter group 10.

Hardware Source Selection for Digital Inputs

The basic I/O board NIOC-01, NIOB-01 or NBIO-21 can be selected by parameter **98.07 BASIC I/O BOARD**.

The hardware source is selected by Parameters 98.03...98.05 and 98.07. There are five selections available:

1. NIOC-01 basic I/O board.
2. NBIO-21 I/O Unit as the basic I/O board.
3. NIOB-01 I/O Unit as the basic I/O board.
4. NDIO I/O Extension modules replace basic I/O board inputs.
5. NDIO I/O Extension modules extend the I/O.
   The maximum number of digital inputs is 12.

Software	NIOC-01 I/O Board						NDIO I/O						Parameter Selection
I/O Name	DI1	DI2	DI3	DI4	DI5	DI6	Ext1 DI1	Ext1 DI2	Ext2 DI1	Ext2 DI2	Ext3 DI1	Ext3 DI2	
DI1	1						2						1 = Par. 98.03 = NO
DI2		1						2					1 = Par. 98.04 = NO
DI3			1						3				1 = Par. 98.05 = NO
DI4 *)				1						3			2 = Par. 98.03 = REPLACE
DI5 *)					1						4		3 = Par. 98.04 = REPLACE
DI6 *)						1						4	4 = Par. 98.05 = REPLACE
EXT1_DI1							5						
EXT1_DI2								5					5 = Par. 98.03 = EXTEND
EXT2_DI1									6				6 = Par. 98.04 = EXTEND
EXT2_DI2										6			7 = Par. 98.05 = EXTEND
EXT3_DI1											7		
EXT3_DI2												7	

*) Not available with NBIO-21 and NIOB-01 I/O Unit

Digital Outputs

The following digital outputs are available in the AMC program. The outputs are programmable (see Parameter Group 14) and can also be controlled from the overriding system.

The use of DO2 and DO3 control upon a communication break can be defined by Parameter **21.07 COM LOSS RO**.

Digital outputs can also be controlled from the overriding system by means of Auxiliary Control Words 7.01 and 7.02.

Hardware Source Selection for Digital Outputs

The hardware source is selected by Parameters 98.03...98.05 and 98.07. There are five selections available:

1. NIOC-01 basic I/O board.
2. NBIO-21 I/O Unit as the basic I/O board.
3. NIOB-01 I/O Unit as the basic I/O board.
4. NDIO I/O Extension modules replace basic I/O board digital outputs and add EXT2_DO2, EXT3_DO1 and EXT3_DO2.
5. NDIO I/O Extension modules extend the I/O. The maximum numbers of digital inputs and outputs are 12 and 9 respectively. EXT2 DO1 and EXT2 DO2 can also be programmed from the group 14.

Software	**NIOC-01 I/O Board**			**NDIO I/O**						**Parameter Selection**
I/O Name	DO1	DO2	DO3	Ext1 DO1	Ext1 DO2	Ext2 DO1	Ext2 DO2	Ext3 DO1	Ext3 DO2	
DO1	1			2						1 = Par. 98.03...05=NO
DO2		1			2					2 = Par. 98.03=REPLACE
DO3 *)			1			3				3 = Par. 98.04=REPLACE
										4 = Par. 98.05=REPLACE
EXT1_DO1				5						5 = Par. 98.03=EXTEND
EXT1_DO2					5					6 = Par. 98.04=EXTEND
EXT2_DO1						6				7 = par. 98.05=EXTEND
EXT2_DO2							3,6			
EXT3_DO1								4,7		
EXT3_DO2									4,7	

*) Not available with NBIO-21 and NIOB-01 I/O Unit

Analogue Inputs

Analogue inputs can be used for motor temperature measurement, I/O speed / torque references and signals can be read by the overriding system.

I/O Speed Reference

If a bipolar type of analogue input is needed, the scaling to the speed units (integer value –20000…0…20000) is defined by Parameters **AIx HIGH VALUE** and **AIx LOW VALUE**. The digital input function **DIRECTION** is valid only with unipolar signals. See parameter **MINIMUM AI1** in Group 13.

Example:
Bipolar type of speed reference signal is needed. Range is –10V..0…+10V. Set **13.01 AI1 HIGH VALUE** to 20000 and **13.02 AI1 LOW VALUE** to –20000. Select **–10V** with **13.12 MINIMUM AI1**. 20000 units equals the speed in Parameter **50.01 SPEED SCALING**.

NIOC-01 Basic I/O Board

Three differential non-galvanically isolated analogue inputs (10 bits, accuracy +/- 0.5 %) are available on the basic (NIOC-01) I/O board. The updating interval is 10 ms for the speed reference chain. The overriding system can read the inputs if the motor temperature measurement is not selected.

NIOC-01	Input Type	Signal	Description
BASIC I/O board **AI 1**	0 ... 10V DC, R_i = 200 kΩ	MOTOR 1 _TEMP or SPEED REFERENCE	Motor temperature measurement by means of 1...3 PTC thermistor or 1...3 PT100 sensors. Speed reference if I/O control or HAND/AUTO selected If both functions have been incorrectly selected to the AI1, MOTOR1 TEMP is valid, speed reference is switched to zero and an alarm "**I/O SP REF**" is indicated.
BASIC I/O board **AI 2**	0(4) ... 20 mA R_i = 100 Ω	SPEED REFERENCE or not used	Alternative for speed reference (mA) if I/O control control or HAND/AUTO is selected.
BASIC I/O board **AI 3**	0(4) ... 20 mA R_i = 100 Ω	TORQUE REFERENCE or not used	Torque reference, if I/O control control or HAND/AUTO is selected

NBIO-21/NIOB-01 Analogue Inputs

Two bipolar 12 bit + sign analogue inputs are available on the NBIO-21 and NIOB-01 I/O Unit. The hardware range (–2V…0…+2V or -10V…0…+10V) is selected by parameters **13.13 NBIO/NIOB AI1 GAIN** and **13.14 NBIO/NIOB AI2 GAIN**. Voltage / current type input is selected separately for both channels with switch S2. The node address is A and selected with switch S1.

NBIO-21/NIOB-01	Input Type	Signal	Description
BIPOLAR MODE **AI1**	-20 ..0.. +20 mA 0(4) ... 20 mA R_i = 100 Ω -2 ..0.. +2 V DC -10 ..0.. 10 V DC R_i = 200 kΩ	MOTOR 1 TEMP or SPEED REFERENCE	Motor 1 temperature measurement by means of 1...3 PTC thermistors or PT100 sensors or Speed reference of the drive in the I/O-control mode
BIPOLAR MODE **AI2**	-20 ..0.. +20 mA 0(4) ... 20 mA R_i = 100 Ω -2 ..0.. +2 V DC -10..0..+10 V DC R_i = 200 kΩ	MOTOR 2 TEMP or TORQUE REFERENCE B	Motor 2 temperature measurement by means of 1...3 PTC thermistors or PT100 sensors. Bipolar torque reference in the I/O control mode.

NAIO-03 Analogue I/O Extension Module

It is possible to use an NAIO-03 Analogue I/O Extension Module to replace inputs AI1, AI2 and outputs AO1 and AO2 on the NIOC-01 Basic I/O board. The resolution of the NAIO-03 is 12 bits. The input range is selectable by DIP switches and the maximum voltage or milliampere value corresponds an integer value in the software, defined by parameter **AI**x **HIGH VALUE** in the group 13. The module selection is done by Parameter 98.06.

NAIO-03	Input Type	Signal	Description
UNIPOLAR MODE (NAIO-01 mode) AI/O Extension module 1 **AI1**	0(4) ... 20 mA R_i = 100 Ω 0 ... 2 V DC 0 ... 10V DC, R_i = 200 kΩ	MOTOR 1 TEMP or SPEED REFERENCE	Motor 1 temperature measurement by means of 1...3 PTC thermistors or PT100 sensors or Speed reference of the drive in the I/O-control mode
BIPOLAR MODE (NAIO-02 mode) AI/O Extension module 1 **AI1**	-20 ..0.. +20 mA 0(4) ... 20 mA R_i = 100 Ω -2 ...0.. +2 V DC -10 ..0..10 V DC R_i = 200 kΩ	MOTOR 1 TEMP or SPEED REFERENCE	Motor 1 temperature measurement by means of 1...3 PTC thermistors or PT100 sensors or Speed reference of the drive in the I/O-control mode
UNIPOLAR MODE (NAIO-01 mode) AI/O Extension module 1 **AI2**	0(4) ... 20 mA R_i = 100 Ω 0 ... 2 V DC 0 ... 10V DC R_i = 200 kΩ	MOTOR 2 TEMP or TORQUE REFERENCE B	Motor 2 temperature measurement by means of 1...3 PTC thermistors or PT100 sensors. Torque reference in the I/O control mode.
BIPOLAR MODE (NAIO-02 mode) AI/O Extension module 1 **AI2**	-20 ..0.. +20 mA 0(4) ... 20 mA R_i = 100 Ω -2 ...0...+2 V DC -10..0..+10 VDC R_i = 200 kΩ	MOTOR 2 TEMP or TORQUE REFERENCE B	Motor 2 temperature measurement by means of 1...3 PTC thermistors or PT100 sensors. Torque reference in the I/O control mode.

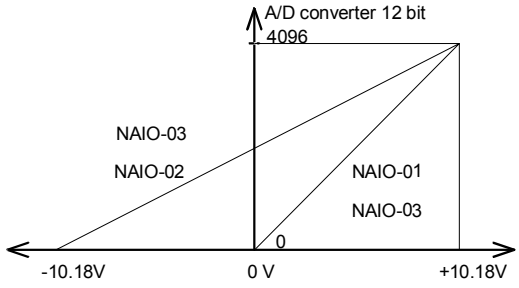


Figure 3 - 11 Resolution of the A/D Converter as a Function of the Input Voltage

Analogue Outputs

Two non-galvanically isolated analogue outputs (10 bits, accuracy +/- 1%) are available on the basic I/O board (NIOC-01). The output updating time is 10 ms.

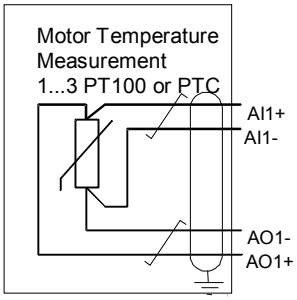
NIOC-01	Output Type	Signal	Description
BASIC I/O Board **AO 1**	0(4) ...20 mA R_i = 700 Ω	AO1_OUT	A programmable analogue output from the program. The output can be used also as a constant current source to supply the temperature measurement sensor PT100 or PTC. The current is set automatically according to the type of the sensor. (The overriding system application can control the output)
BASIC I/O Board **AO 2**	0(4) ...20 mA R_i = 700 Ω	AO2_OUT	

If an extension module is used, the resolution is 12 bits. Programmable analogue outputs can be extended using this module. See the different configurations at Parameter 98.06.

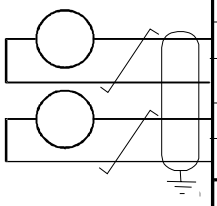
NAIO-03	I/O Type	Command	Description
AI/O Extension Module 1 **AO3**	0(4) ...20 mA R_i = 700 Ω Isolated from power supply	AO3_OUT	See Parameter 98.06 and Group 15
AI/O Extension Module 1 **AO4**	0(4) ...20 mA R_i = 700 Ω Isolated from power supply	AO4_OUT	See Parameter 98.06 and Group 15

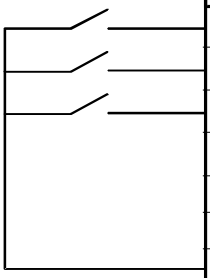
The NBIO-21 or NIOB-01 I/O Unit can be configured for unipolar 0…20 mA mode with a resolution of 12 bits, or bipolar –10V…0…+10 V mode with a resolution of 11 bits + sign.

NBIO-21/ NIOB-01	I/O Type	Command	Description
AO1	Voltage output – 10V…0…+10V 1 kΩ min or Current Output 0…20 mA Max load = 800 Ω. Isolated from power supply	AO1_OUT	See Parameter 98.07 and Group 15
AO2	Voltage output – 10V…0…+10V 1 kΩ min or Current Output 0…20 mA Max load = 800 Ω. Isolated from power supply	AO2_OUT	See Parameter 98.07 and Group 15



2) If par. 30.03 = 1..3xPT100 or PTC





1) Function according to the parameter selections

Use external power supply, if the total current consumption exceeds 250 mA

Terminal Block **X21**		**NIOC-01 I/O Board**
1	VREF	Reference voltage +10 V DC
2	GND	1 k...10 k ohm max. 10 mA
3	AI1+	Analogue Input 1 2)
4	AI1-	Motor temperature measurement 0...10 V
5	AI2+	Analogue Input 2
6	AI2-	0 ... 20mA
7	AI3+	Analogue Input 3
8	AI3-	0 ... 20mA
9	AO1+	Analogue Output 1 1)
10	AO1-	Motor Torque 0 ... 20 mA <-> 0 ... Motor nom. torque
11	AO2+	Analogue Output 2 1)
12	AO2-	Motor Speed 0 ... 20 mA <-> 0 ... Motor nom. speed
Terminal Block **X22**		
1	DI1	No Emergency Stop
2	DI2	Run Enable
3	DI3	Start Inhibit
4	DI4	By default not in use 1)
5	DI5	By default not in use 1)
6	DI6	By default not in use 1)
7	+24 V DC	
8	+24 V DC	+ 24 VDC max. 100 mA
9	DGND	Digital ground
Terminal Block **X23**		
1	+24 V DC	Aux. voltage output 24 V DC, 250 mA
2	GND	or 130 mA if NLMD-01 option included
Terminal Block **X25**		
1	RO11	Relay output 1 1)
2	RO12	
3	RO13	Emergency Stop
Terminal Block **X26**		
1	RO21	Relay output 2 1)
2	RO22	
3	RO23	Run (default)
Terminal Block **X27**		
1	RO31	Relay output 3 1)
2	RO32	
3	RO33	Fault (default)

Figure 3 - 12 NIOC-01 I/O Board Default Signals when the Drive is Controlled through the Communication Link (Parameter 98.02 is set to FBA DSET 1 or FBA DSET 10)

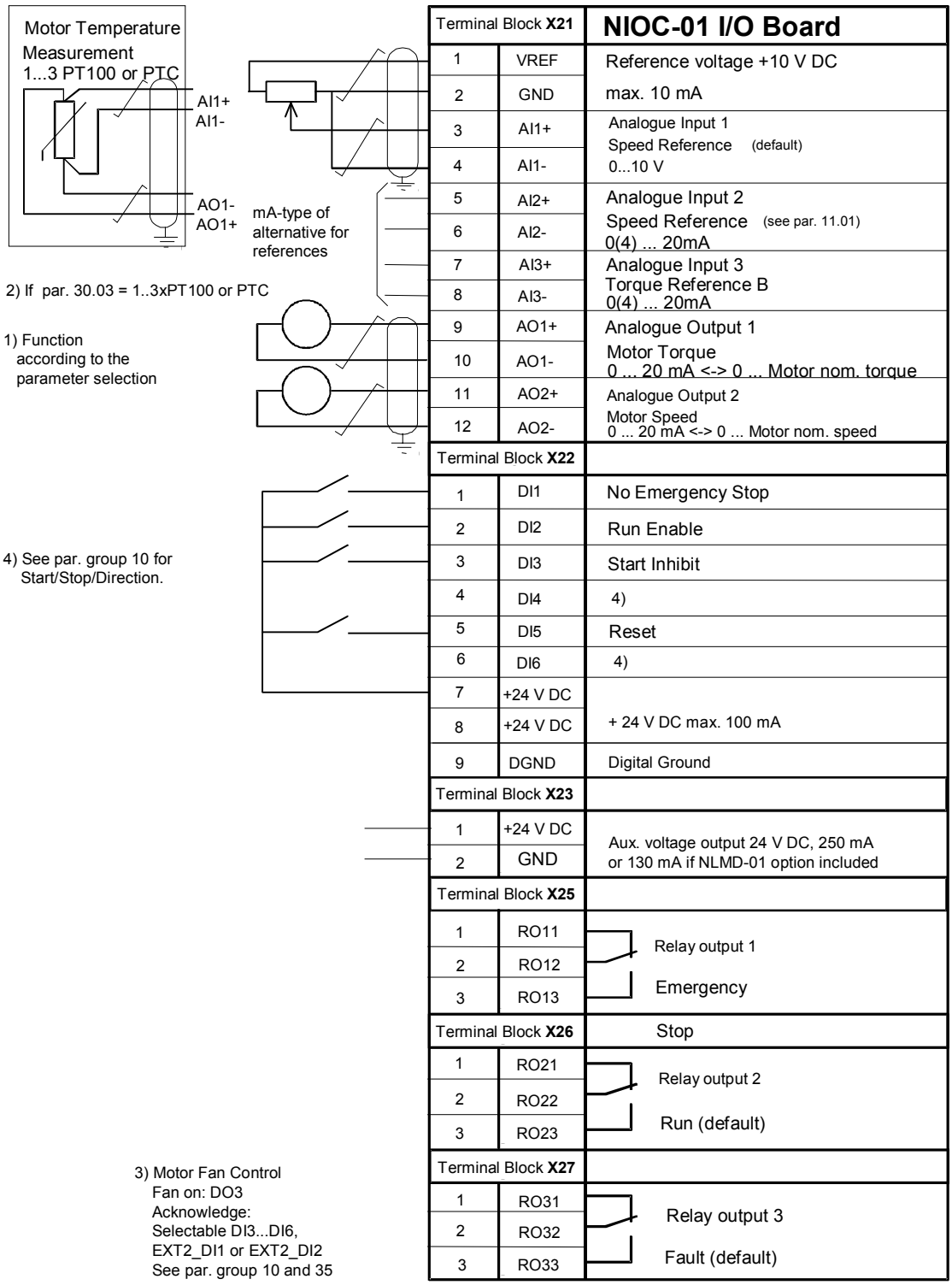


Figure 3 - 13 NIOC-01 I/O Board Default Signals when the Drive is Controlled from the I/O (Parameter 98.02 COMM MODULE is set to NO or in HAND/AUTO mode)

NIOB-01 Basic I/O Board Connections

Terminal Block Size:
0.5 to 2.5 mm² (20 to 14 AWG)

Connector **X14** for RS-485 connection.

1	$\overline{\text{TRANS}}$	Data direction, transmit / Receive (Open Collectory). Transmit = Active low.
2	Not Used	
3	DATA -	Negative terminal of differential data
4	DATA +	Positive terminal of differential data
5	0 V	RS-485 ground and power supply return
6	+24 V	+24 V power supply

Terminal Block **X16**		**NIOB-01 I/O Unit**
1	AI1+	Analogue Input AI1
2	AI1-	
3	AI2+	Analogue Input AI2
4	AI2-	
5	AO1U	Analogue Output AO1 (Voltage)
6	AO1I	Analogue Output AO1 (Current)
7	AO1C	Analogue Output AO1 (Common)
8	AO2U	Analogue Output AO2 (Voltage)
9	AO2I	Analogue Output AO2 (Current)
10	AO2C	Analogue Output AO2 (Common)
Terminal Block **X15**		
1	EA+	Positive pulse encoder input, channel A
2	EA-	Negative pulse encoder input, channel A
3	EB+	Positive pulse encoder input, channel B
4	EB-	Negative pulse encoder input, channel B
5	EZ+	Positive pulse encoder input, zero pulse
6	EZ-	Negative pulse encoder input, zero pulse
7	+24VE	Pulse encoder supply voltage (+24 V DC)
8	+15VE	Pulse encoder supply voltage (+15 V DC)
9	0VE	Pulse encoder supply return (0 V)
10	0VE	
Terminal Block **X13**		
1	24V	Positive power supply input (24 V DC)
2	0V	Power supply return
3	24V	Positive power supply input (24 V DC)
4	0V	Power supply return
Terminal Block **X12**		
1	DI1A	Digital Input DI1, terminal A
2	DI1A	
3	DI1B	Digital Input DI1, terminal B
4	DI1B	
5		Not in use
6	DI2A	Digital Input DI2, terminal A
7	DI2B	Digital Input DI2, terminal B
8		Not in use
9	DI3A	Digital Input DI3, terminal A
10	DI3B	Digital Input DI3, terminal B
Terminal Block **X11**		
1	RO1C	Relay Output RO1
2	RO1NO	
3		Not in use
4	RO2C	Relay Output RO2
5	RO2NO	

Figure 3 - 14 NIOB-01 I/O Unit Terminal Connections.

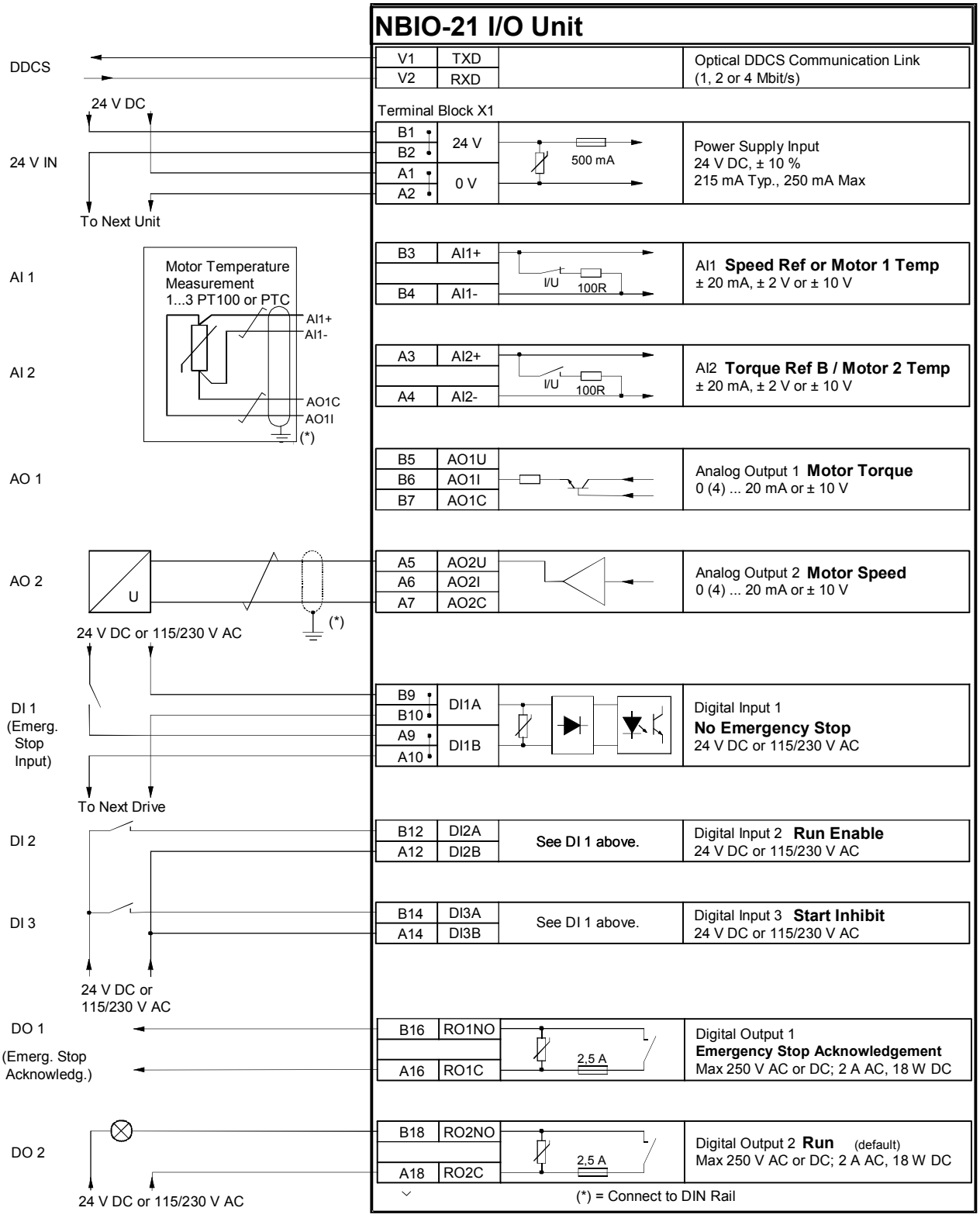


Figure 3 - 15 NBIO-21 I/O Unit Terminal Connections.

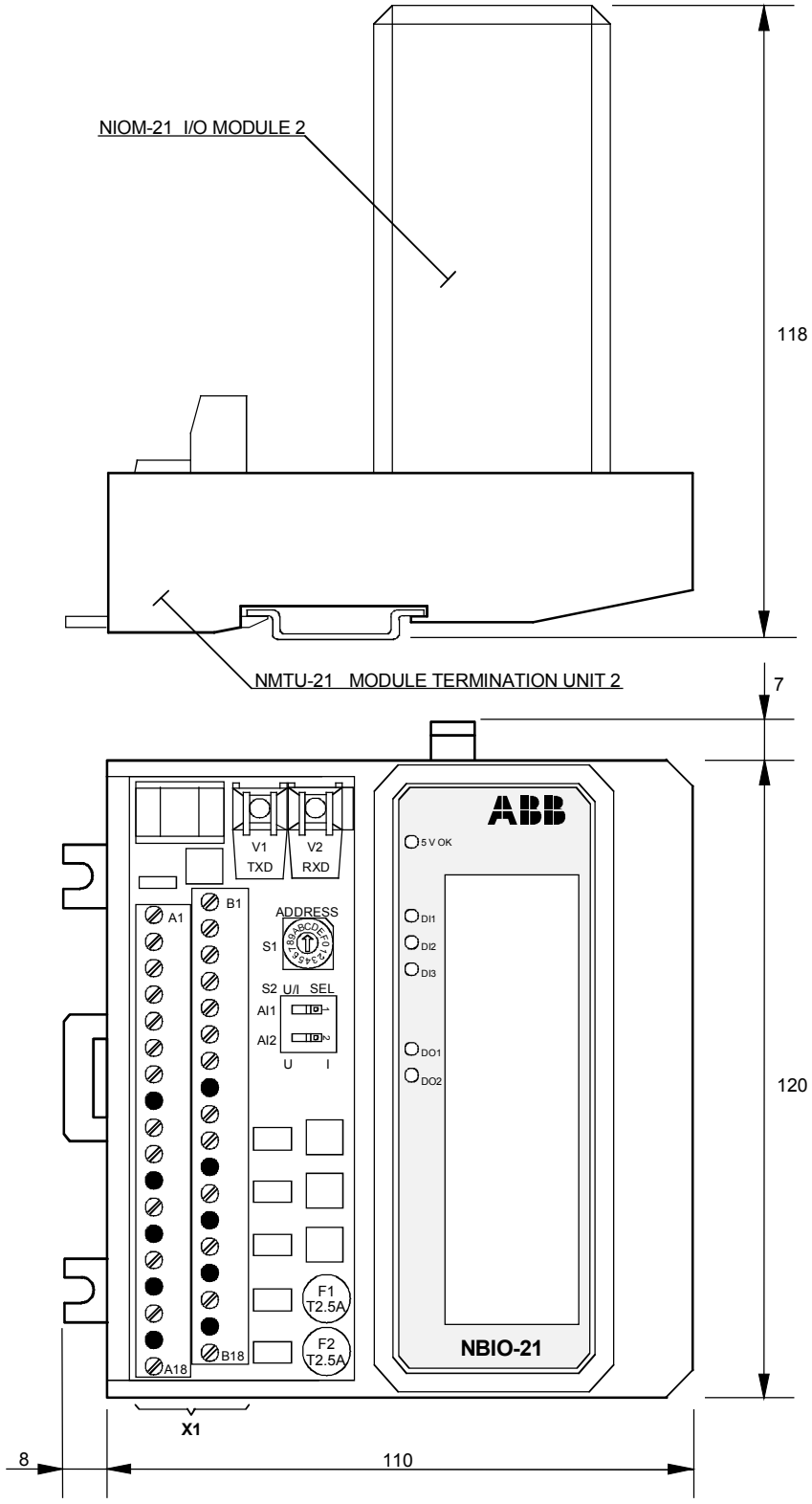


Figure 3 - 16 NBIO-21 I/O Unit Dimension Drawing.

Pulse Encoder Interface NTAC-02

The pulse encoder module (NTAC-02) is connected to channel CH1 on the NAMC board and activated by Parameter **98.01 ENCODER MODULE**. The parameter 98.01 must be activated also with NIOB-01 basic I/O board. See also parameter 98.07.

The feedback used is indicated in the **AUXILIARY STATUS WORD (8.02)** bit 12.

B12: 0 = External pulse encoder
1 = Internal speed

The Master / Follower Link

General

The Master/Follower Application macro is designed for applications in which the system is operated by several ACS 600 drives and the shafts are coupled to each other via gearing, chain, belt etc. The Master controls the Followers via a fibre optic serial communication link. The pulse encoder are recommended to use in both with the torque controlled followers.

The Master station is typically speed controlled and the other drives follow its torque or speed reference. In general, Torque control of the Follower should be used when the motor shafts of the Master and Follower drives are coupled fixedly to each other via gearing, a chain etc. and no speed difference between the drives is possible.

Link Configuration

Channel 2 (CH2) on the NAMC board is used for the Master/Follower link between the drives. The drive is programmable to be either the master or a follower in the communication. Typically the speed controlled process master drive is configured also to the communication master.

Master Drive

The torque reference source address is defined in the Master Drive by Parameter **70.11 MASTER REF3** to be sent as data set 41 to the follower drives. Speed reference **70.10 MASTER REF2** can also be sent through the link in the same DDCS message, if the follower is speed controlled. Typical parameter addresses are:

MASTER REF1 (70.09)	not in use	not in use
MASTER REF2 (70.10)	23.01	SPEED REF
MASTER REF3 (70.11)	2.10	TORQ REF 3

The parameters above have no meaning in the follower drive.

The Master Drive cyclically sends Master References 1...3 in one DDCS message, a broadcast every 2 milliseconds.

Follower Drive(s)

If the Follower mode is selected by Parameter **70.08 CH2 M/F MODE**, connections are fixed in the program as follows:

Signal Addresses in the Follower Drive					
Dataset Number	**Dataset Index**	**Interval**	**Address**	**Parameter Name**	**Signal to be Monitored**
41	1	2 ms		not in use	
	2	2 ms	23.01	SPEED REF	2.19 DS SPEED REF
	3	2 ms	25.01	TORQ REF A	2.20 DS TORQ REF A

The Follower mode includes only fast data read from data set 41 into the speed and torque reference chain. Therefore this mode can also be used with the overriding system connected to CH0, typically when fast communication is required but there is no need for a real Master/Follower application.

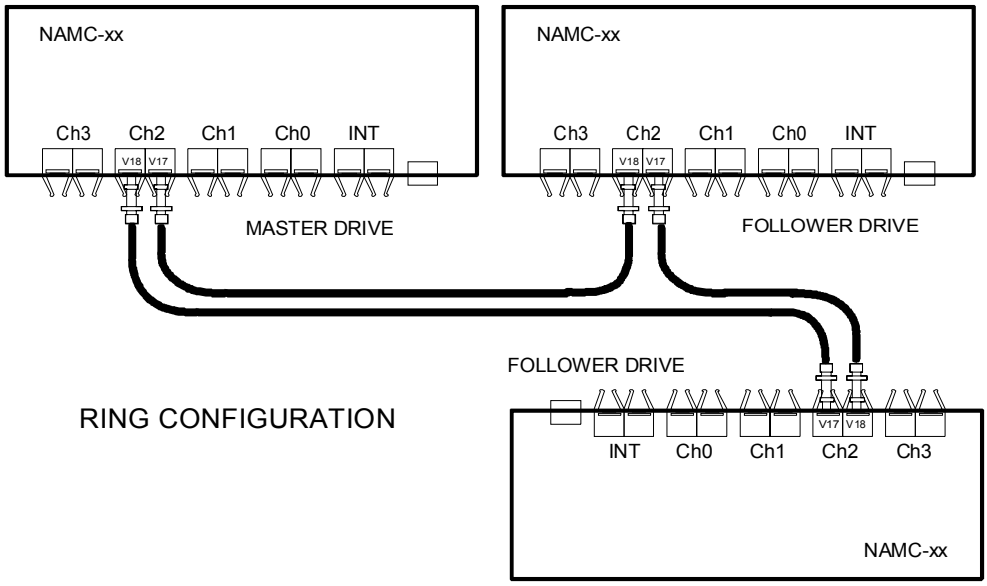


Figure 3 - 17 Master/Follower Fibre Optic Cable Connections

Flying Switching between Speed and Torque Control

In some applications, both speed and torque control of the Followers are required, e.g. if it is necessary to accelerate all drives along the same speed ramp up to a certain speed before torque control can be started. In those cases, a “flying” switching between speed and torque control is required. The switching is done by controlling parameter **26.01 TORQ REF SEL** from the overriding system. See also **ACW (7.02)** bit 7 for window control information.

Follower Diagnostics

All Followers receive the torque reference through the TORQUE REF A signal. The follower drive is able to detect a communication break, the action upon which is defined by Parameter **70.13 CH2 TIMEOUT** and **70.14 CH2 COM LOSS CTRL** . Diagnostics feedback from the followers must be handle by the overriding system through channel CH0 on the NAMC board.

Master/Follower Link Specification

Size of the Link: One Master and maximum 10 Follower stations. If more than 10 followers are required, an ABB representative should be consulted. The maximum length of the fibre optic cables (POF) is 10 metres.

Configuration: The Link is configurable by the application in the overriding system. (See Parameter **70.08 CH2 M/F MODE)**. This makes possible to change Master and Follower on-line through CH0 by an overriding system or application without changes in the hardware.

Transmission Rate: 4 Mbit/s

Total Performance of Link: < 5 ms to transfer references between the master and follower drives.

Protocol: Distributed Drives Communication System, DDCS

Diagnostics

General

A common method of drive diagnostics is to provide the user with information on previous conditions. Signals, data loggers, event loggers, and fault loggers are commonly implemented in most modern drives.

The following is a description of the data, event, and fault loggers available in the System Application Program.

Fault and Event Loggers

The fault logger collects 64 of the most recent faults into the fault buffer in the RAM memory. The latest 16 faults are stored into the FLASH memory at the beginning of an auxiliary power loss. The fault logger records all available information from the drive including faults, alarms, reset and system messages.

AMC Time Format and Counting

The Time for the logger fault is taken from the power-on counter, whose format is 9999 hr, xx min, yy.yyyy s. However, the counter can be updated cyclically from the overriding system if the system includes an overriding controller (for example AC 80). Drive*Window* and the CDP 312 Control Panel show the real date and time.

Data Loggers 1 and 2

The purpose of the Data Logger is to collect the history of signals related to an incident and store them for later retrieval and analysis. The contents of the Data Loggers are stored to the RAM memory. There are two Data loggers in the NAMC-51 board.

The both Data Loggers consist of 1...4 channels and the total memory size is 1024 bytes. The maximum number of samples depends on the data type:

- Integer type signal or parameters reserve 1 byte
- Real-type values reserve 2 bytes

Example: Four real-type signals are measured in the Data Logger 1. The maximum number of sample is 1024/(2 bytes x 4 channels) = 128.

The Data Loggers store the selected signals to the RAM memory every 5 milliseconds.

Default signals and parameters in Data Logger 1 are monitored:

1.01 MOTOR SPEED FILT
1.07 MOTOR TORQUE FILT
23.1 SPEED REF
25.1 TORQUE REF A

Default signals in Data Logger 2 are monitored:

1.02 SPEED ESTIMATED
1.10 DC VOLTAGE
1.12 PP TEMP
2.15 FLUX ACT

The signals to be monitored can be selected from Drive*Window*. The default triggering mode is Fault.

Positioning Counter

The number of Pulse Encoder pulses can be counted and set using 7.02 **ACW** bits B9...11. The SYNC_COMMAND can also be given by I/O to minimise the delays. See Parameter 10.04 **SYNC CMD**. The calculation has two output modes: counted number of pulses or number of revolutions and motor shaft position in degrees.

Actual signals for this function are described in group 3 (3.07...3.10), commands in the **ACW (7.02)** and the parameters in Group 50 (50.07...50.12).

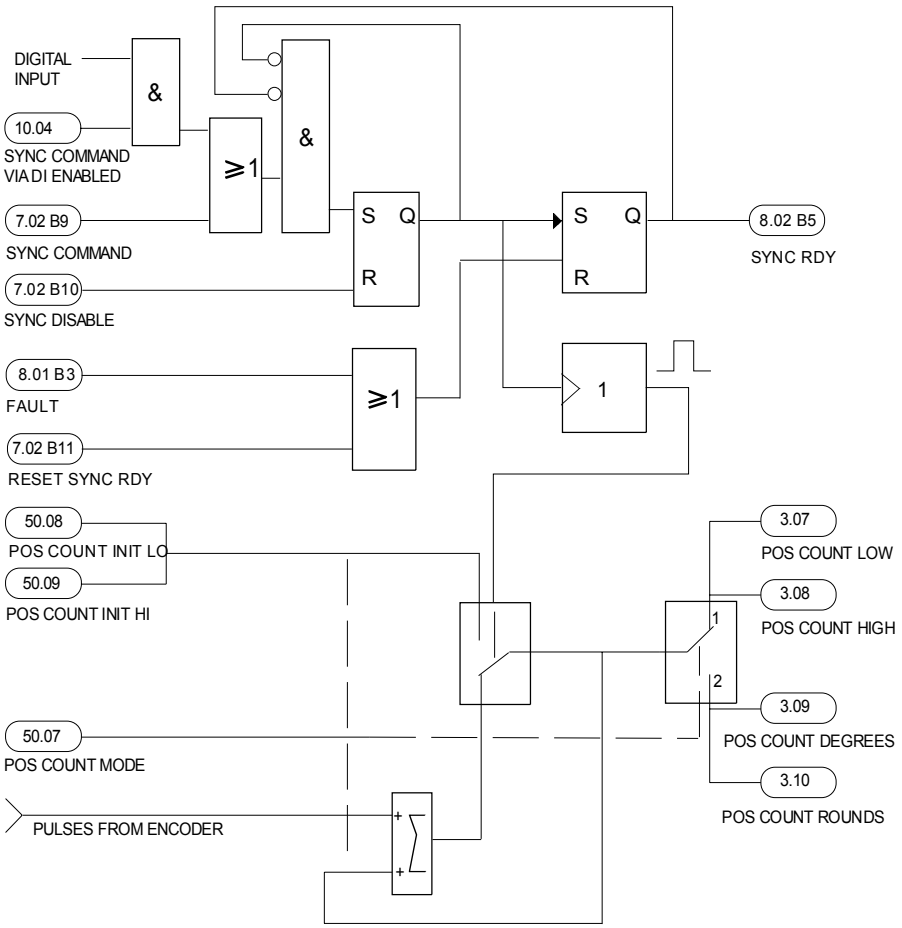


Figure 3 - 18 Positioning Counting Logic and Calculation Diagram

Positioning Counting Function

A basic function can be seen in the following diagram. When synchronisation is enabled (SYNC_DISABLE = 0) and the next positive edge of the SYNC_COMMAND is encountered, the initial values of POS COUNT INIT LOW and POS COUNT INIT HIGH are loaded into the counter and the counting continues. The Initial values can only be used for the pulse edges count mode. Status signal SYNC_RDY is set to indicate controlled SYNC_COMMAND. When the positioning has been completed by the overriding system (i.e. the motor can be stopped or some other sequence started), parameter SYNC_RDY can be reset by RESET_SYNC_RDY.

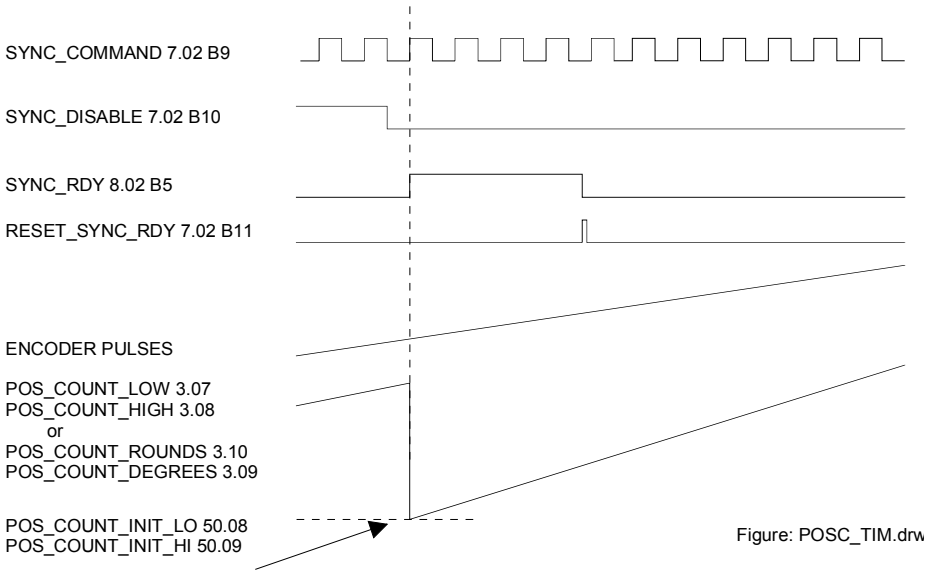


Figure 3 - 19 Example of the Positioning Counting Function

Back-Up of Parameters or Software

At the end of the commissioning of the ACS 600, backing up the (NAMC board) parameters is recommended. The results of the Motor ID Run should also be backed up. If necessary, the data can be restored later on (e.g. downloaded to a spare board of the same type). See instructions in appendix A.

The back-up can be done either with Drive*Window* or the CDP 312 control panel (there is an EEPROM memory in the panel). In case of CDP 312, see Chapter 6.

Spare NAMC Boards

One spare NAMC board or NDCU unit for each application software type (e.g. System, Standard, Crane etc.) cover the whole ACS 600 MultiDrive power range, downloaded with the same firmware as in the drives. See signal 4.01 in the drive for firmware version.

Inverter ratings can be NONE (no ratings entered) or any inverter type for spare part NAMC board.

Drive*Window* Back-Up Function

Drive*Window* has a back-up function. The back-up is activated from the DRIVE menu, and it has the following alternatives:

- **COMPLETE BACK-UP** saves the PARAMETER.DDF file from the NAMC board including nominal values of inverter. The file extension is *.DDB.
- **ID RUN** results: first start, Standard ID Run or Reduced ID Run.
- **USER's DATA** (parameter groups 10…98). The file extension for Motor ID RUN and USER's DATA is *.DWB. See instructions in appendix A.

Drive*Window* Restore Function

Restoring a **COMPLETE BACK-UP** downloads the whole contents of the PARAMETER.DDF file to FPROM (Flash PROM memory) on the NAMC board. This is the easiest and recommended way to restore parameters to a spare board, because it also restores **the inverter nominal values**. The board and loading package types (e.g. NAMC-51 and AM4G6000) of the original and spare board must match. See signal 4.01 in the drive.

By selecting both **ID RUN** results and **USER's DATA**, the saved parameters can be restored to a spare NAMC board which has the same or later loading package version. The warning message about different software versions is accepted in the version update. The Restore function is also activated from the DRIVE menu.

However, the user must be very careful to select the correct back-up file to be restored. It must always be verified that the restored inverter values match actual hardware. The compare function of Drive*Window* can be used for this.

Note: When USER MACROs are in use, the back-up and restore must be executed for both. First activate USER_MACRO1 by Parameter **99.11 APPLICATION MACRO** and make a back-up, then activate USER_MACRO2 and make another back-up. When restoring, save the restored parameters to USER_MACRO1 and USER_MACRO2 from the original back-up files.

The back-up files should be named logically and clearly to identify the corresponding ACS 600 drive. The process name of the drive can be typed into Parameter **97.01 DEVICE NAME** (example: Unwinder 1) and it can be seen in the Drive*Window* main menu (when drives are connected). This also helps the identification of the back-up files.

Memory Handling

- The Power-Up procedure loads all the needed files to the RAM. This takes about 6 seconds.
- Parameter value changes mode with Drive*Window* or CDP 312 are stored to RAM and FPROM.
- Parameter value changes by the overriding system are stored only to RAM. However, saving to FPROM can be executed by setting parameter **16.06 PARAMETER BACKUP** to SAVE. This function can be used when the parameter changes made by the overriding system are to be saved.
- The factory default settings can be restored in a similar way.
- The Power Down task saves 16 latest faults or alarms to the FPROM.

User Macros

There are three parameter files available in the FPROM memory: PARAMETER.DDF, USER_MACRO1.DDF and USER_MACRO2.DDF. There are two user macro parameter sets available. They can be saved and restored by Parameter 99.09 and 99.11.

Normally, when the user macros are not used, all the parameter changes are saved automatically to file PARAMETER.ddf. When the User Macros are in use, all the parameter changes must be saved to the corresponding User Macro file by parameter **99.11 APPLICATION MACRO**.

User Macros can also be activated by **ACW2 (7.03)** bit 12 (TRUE = USER MACRO2, FALSE = USER MACRO1), if the function is enabled by parameter **16.05 USER MACRO CHG**. The status of the active macro can be seen in the **ASW (8.02)** bit 14 USER MACRO 1 and bit 15 USER MACRO 2.

Oscillation Damping

Oscillation Damping algorithm has been developed in order to damp mechanical oscillations. As an output the algorithm produces a sine wave. This sine wave can be summed to torque reference with suitable gain and phase.

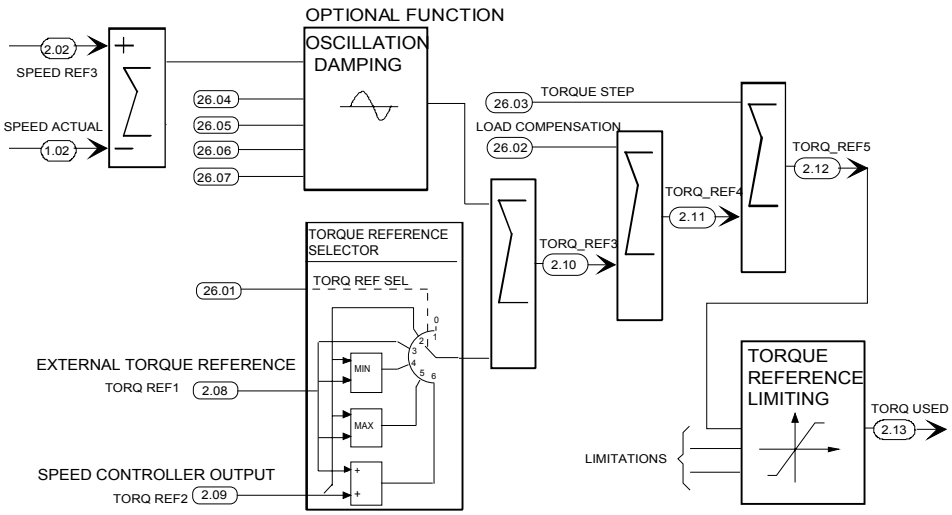


Figure 3 - 20 Torque Reference Chain

Algorithm has four parameters:

26.04 OSC COMPENSATION
ON/OFF Enables/disables calculations
26.05 OSCILLATION FREQ
0-60 Hz Frequency of the oscillation
26.06 OSCILLATION PHASE
0-360° Phase angle of the sine wave
26.07 OSCILLATION GAIN
0-100% Relative gain
(scaled according to speed controller gain)

Tuning Procedure

Tuning is done as follows:

1. Set parameter **OSC COMPENSATION** ON and **OSCILLATION GAIN** to value 0%.
2. Calculate the oscillation frequency and set parameter **OSCILLATION FREQ**.
3. **OSCILLATION PHASE** can be in its default value or you can change it.
4. Increase **OSCILLATION GAIN** gradually (5%, 10%,...) so that you can see whether the used phase angle is good (oscillation amplitude decreases) or bad (oscillation is being amplified).
5. If amplitude of the oscillation decreases, increase gain and change phase sensitively. Otherwise try a different phase angle until the oscillation amplitude decreases.

6. When the **OSCILLATION PHASE** is set so that oscillation amplitude decreases, increase the gain to supress the oscillation totally.

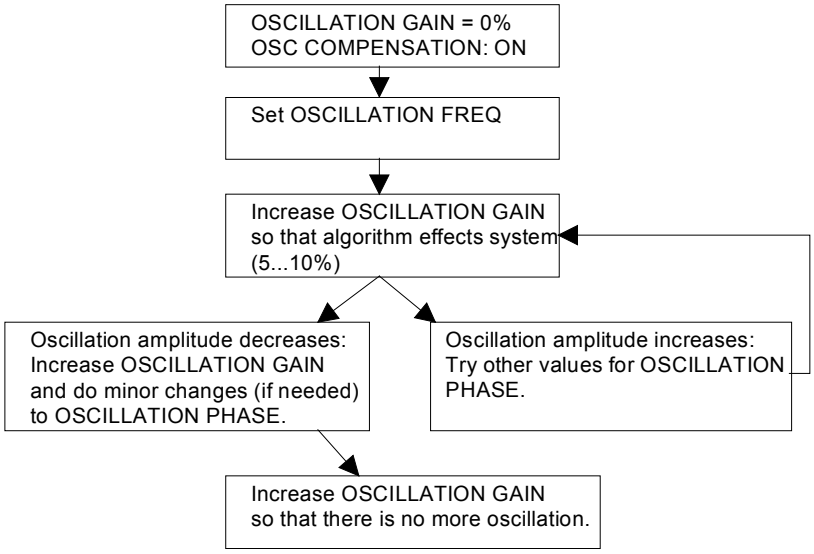


Figure 3 - 21 Tuning Procedure for the Oscillation Damping

Note: Changing the speed error lowpass filter time constant and speed controller's integration time may have an impact on the oscillation damping algorithm tuning. It is recommended to tune speed controller before tuning this algorithm. Speed controller gain can be altered after tuning the oscillation damping algorithm.

AUTO RESTART Function

It is possible to restart the drive(s) with the AUTO RESTART function after a short (max. 5 seconds) power supply failure without actions by the overriding system. This function is enabled by Par**. 21.09 AUTO RESTART**. Par. **21.10 AUTO RESTART TIME** defines the maximum duration of the power failure. Actions on the net break are:

- Main Status Word is frozen and the **FW2** bit 2 DC UNDERVOLT fault is masked in the Fault Word.
- The undervoltage fault is reset internally
- An undervoltage alarm is set in the AW2 bit 14.
- MCW bit 0 is changed 1 --> 0 --> 1
- Flying start mode is forced temporarily (21.01 = AUTO).
- After a successful restart: MSW freezing, FW masking and the original START MODE are reinstated otherwise after 6 seconds.
- An alarm "AUTORESTARTED" is given.

Chapter 4 – Signals

Overview

This chapter describes the measured and calculated actual signals, and the content of the control, status, limit, fault, and alarm words of the ACS 600.

How to Read the Signal Table

Before you start to read the signal table, we first recommend you read this description.

ACS 600 Signals

Group + Index	Description	Quantity
1.1...1.27	Actual Signals	27
2.1...2.24	Actual Signals	24
3.1...3.15	Actual Signals	15
4.1...4.3	Information	3
5.1...5.32	(reserved for the application)	
6.1...6.32	(reserved for the application)	
7.1...7.3	Control Words	3
8.1...8.6	Status Words, Limit Words	6
9.1...9.7	Fault Words, Alarm Words	7
	Total	**85**

05	(161.3)	CURRENT		
Index	Description:	Measured motor current absolute value.		
unit: A	type: R	Min: 0	Max:	Integer Scaling 10 == 1A

Figure 4 - 1 Sample of an Actual Signal table

- All signals are read-only. However the overriding system can write to the control words, but it only affects the RAM memory.
- If the overriding control system reads or writes individual bits of a word with an Advant CONV_IB element, (for example AUX CONTROL WORD 7.02) the bit B15 corresponds to the SIGN outputs of the element.
- If signal type is R (real value), it also has an integer scaling relation mentioned in the column Integer scaling. For example, if the CURRENT signal is read to the overriding system, an integer value of 10 corresponds to 1 Ampere. All the read and sent values are limited to 16 bits (-32768...32767).
- The unit of the signal value can be seen on the lower left-hand corner of the signal description.
- Minimum and maximum values are shown in decimal format.
- Data type is given with a short code:
  I = 16-bit signed integer B = Boolean value
  PB = Packed Boolean value R = Real value

AMC Table Signals

Group 1 Actual Signal

1	Group name:	ACTUAL SIGNALS		
	Description:	Measured or calculated values		
01 Index		**MOTOR SPEED FILT**		
	Description:	Filtered actual speed according to the speed feedback selection. Filter time constant is adjustable by Par. 50.12 MOTOR SP FILT TIME. Default filter time constant is 500 ms + Parameter 50.06 SP ACT FILT TIME with pulse encoder. See also Parameter 50.03.		
unit: rpm	type: R	Min:	Max:	Integer scaling: see Parameter 50.01
02 Index		**SPEED ESTIMATED**		
	Description:	Internally calculated actual speed.		
unit: rpm	type: R	Min:	Max:	Integer scaling: see Parameter 50.01
03 Index		**SPEED MEASURED**		
	Description:	Measured actual speed from the pulse encoder.		
unit: rpm	type: R	Min:	Max:	Integer scaling: see Parameter 50.01
04 Index		**MOTOR SPEED**		
	Description:	Actual speed to the speed error calculation of the speed controller.		
unit: rpm	type: R	Min:	Max:	Integer scaling: see Parameter 50.01
05 Index		**FREQUENCY**		
	Description:	Calculated frequency of the motor.		
unit: Hz	type: R	Min:	Max:	Integer scaling: 100 == 1Hz
06 Index		**MOTOR CURRENT**		
	Description:	Measured motor current absolute value.		
unit: A	type: R	Min:	Max:	Integer scaling: 10 == 1A
07 Index		**MOTOR TORQ FILT2**		
	Description:	Filtered motor torque in percent of the rated motor torque. See also parameter 25.07.		
unit: %	type: R	Min:	Max:	Integer scaling: 100 == 1%
08 Index		**MOTOR TORQUE**		
	Description:	Motor torque in percent of the rated motor torque.		
unit: %	type: R	Min:	Max:	Integer scaling: 100 == 1%
09 Index		**POWER**		
	Description:	Motor power in percent of the rated motor power.		
unit: %	type: R	Min:	Max:	Integer scaling: 10 == 1%
10 Index		**DC VOLTAGE**		
	Description:	Measured dc bus voltage		
unit: V	type: R	Min:	Max:	Integer scaling: 1 == 1V
11 Index		**MOTOR VOLTAGE**		
	Description:	Calculated motor output voltage.		
unit: V	type: R	Min:	Max:	Integer scaling: 1 == 1 V
12 Index		**PP TEMP**		
	Description:	Temperature of the heat sink plate in degrees centigrade.		
unit: °C	type: R	Min:	Max:	Integer scaling: 1 == 1°
13 Index		**TIME OF USAGE**		
	Description:	This actual signal is an elapsed mains-on time indicator.		
unit: h	type: R	Min:	Max:	Integer scaling: 1 == 1 h
14 Index		**KILOWATT HOURS**		
	Description:	This actual signal counts the kilowatt hours in operation.		
unit: kWh	type: R	Min:	Max:	Integer scaling: 1 == 1 kWh

1	Group name:	*ACTUAL SIGNALS*		
15	Interval: 10 ms	**DI6-1 STATUS**		
Index	Description:	Status of the digital inputs DI6...DI1 in the software. Example: DI1 and DI4 are activated. Table format: 0001001 (CDP 312 display) DI name 654321		
unit:	type: I	Min: 0	Max: 127	Integer scaling: 1 == 1
16	Interval: 500 ms	**MOTOR 1 TEMP**		
Index	Description:	Value of analogue input 1 displayed in °C (PT100 measurement) or Ω(PTC measurement).		
unit: °C	type: R	Min:	Max:	Integer scaling: 1 == 1° or 1 Ω
17	Interval: 500 ms	**MOTOR 2 TEMP**		
Index	Description:	Value of analogue input 2 displayed in °C (PT100 measurement) or Ω (PTC measurement).		
unit: °C	type: R	Min:	Max:	Integer scaling: 1 == 1° or 1 Ω
18		**MOTOR TEMP EST**		
Index	Description:	Calculated motor temperature when the thermal model (DTC or User mode) is used for motor overtemperature protection.		
unit: °C	type: R	Min:	Max:	Integer scaling: 1 == 1°
19	Interval: 100 ms	**AI1 [V]**		
Index	Description:	Non-scaled value of analogue input AI1. See Parameters 13.01...13.02.		
unit:	type: R	Min: 0	Max: 10	Integer scaling: 10000 == 10V or 20 mA
20	Interval: 100 ms	**AI2 [mA]**		
Index	Description:	Non-scaled value of analogue input AI2. See Parameters 13.04...13.05.		
unit:	type: R	Min: 0	Max: 20	Integer scaling: 20000 == 20mA, 2 V or 10 V
21	Interval: 100 ms	**AI3 [mA]**		
Index	Description:	Non-scaled value of analogue input AI3. See Parameters 13.08...13.09.		
unit:	type: R	Min: 0	Max: 20	Integer scaling: 20000 == 20mA
22	Interval: 500 ms NAMC-2x: 100 ms	**RO3-1 STATUS**		
Index	Description:	Status of the basic I/O board relay outputs RO3 ... RO1. Example: RO2 and RO3 are activated. Table format: 0000110 (CDP 312 display view) RO name 321		
unit:	type:	Min: 0	Max:	Integer scaling:
23	Interval: 500 ms NAMC-2x: 100 ms	**AO1 [mA]**		
Index	Description:	Value of analogue output AO1 in milliamperes. See Parameter Group 15 for signal selection and scaling.		
unit: mA	type: R	Min: 0 mA	Max: 20 mA	Integer scaling: 20000 == 20mA
24	Interval: 500 ms NAMC-2x: 100 ms	**AO2 [mA]**		
Index	Description:	Value of analogue output AO2 in milliamperes. See Parameter Group 16 for signal selection and scaling.		
unit: mA	type: R	Min: 0 mA	Max: 20 mA	Integer scaling: 20000 == 20mA
25	Interval: 500 ms NAMC-2x: 100 ms	**CONTROL MODE**		
Index	Description:	Control mode in use: 1 = Speed control 2 = Torque control (TORQ_REF_1 affects the output of TORQ REF 3)		
unit:	type: I	Min: 1	Max: 2	Integer scaling:
26	Interval: 500 ms NAMC-2x: 100 ms	**LED PANEL OUTPUT**		
Index	Description:	Output monitoring of the NLMD-01 LED panel. See Parameter Group 18.		
unit: %	type: R	Min:	Max:	Integer scaling: 1 == 1

1	Group name:	*ACTUAL SIGNALS*			
27		**CABLE TEMPERATURE**			
Index	Description:	Output monitoring of the motor cable thermal model. See Parameter Group 36.			
unit: %	type: R	Min: 0 %	Max: 100 %	Integer scaling: 1 == 1	

Group 2 Actual Signals

2	Group name:	*ACTUAL SIGNALS*			
	Description:	Measured or calculated values in the speed and torque reference chain.			
01		**SPEED REF2**			
Index	Description:	Limited speed reference.			
unit: rpm	type: R	Min: -18000 rpm	Max: 18000rpm	Integer scaling:	see Par. 50.01
02		**SPEED REF3**			
Index	Description:	Speed reference after the speed ramp.			
unit: rpm	type: R	Min: -18000 rpm	Max: 18000rpm	Integer scaling:	see Par. 50.01
03		**SPEED ERROR NEG**			
Index	Description:	Difference between reference and the actual value. If parameter WINDOW_SEL_ON is enabled, SPEED_ERROR_NEG is filtered through the window function.			
unit: %	type: R	Min:	Max:	Integer scaling:	see Par. 50.01
04		**TORQUE PROP REF**			
Index	Description:	P part effect at the output of the PID controller. Output of the PID controller is formed from the output parameters TORQUE PROP REF, TORQUE INTEG REF and TORQ ACC COMP REF.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
05		**TORQUE INTEG REF**			
Index	Description:	I part effect at the output of the PID controller. Output of the PID controller is formed from the output parameters TORQUE PROP REF, TORQUE INTEG REF, TORQ DER REF and TORQ ACC COMP REF.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
06		**TORQUE DER REF**			
Index	Description:	D part effect at the output of the PID controller. Output of the PID controller is formed from the output parameters TORQUE PROP REF, TORQUE INTEG REF, TORQ DER REF and TORQ ACC COMP REF.			
unit: %	type: f	Min:	Max:	Integer scaling:	100 == 1%
07		**TORQ ACC COMP REF**			
Index	Description:	Output of the acceleration compensation.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
08		**TORQUE REF 1**			
Index	Description:	Limited torque reference value in the torque reference chain.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
09		**TORQUE REF 2**			
Index	Description:	Final torque reference from the speed control chain.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
10		**TORQUE REF 3**			
Index	Description:	Torque reference after the torque selector block.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
11		**TORQUE REF 4**			
Index	Description:	Sum of TORQUE REF 3 and LOAD COMPENSATION.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
12		**TORQUE REF 5**			
Index	Description:	Sum of TORQUE REF 4 and TORQUE STEP.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%

2	Group name:	*ACTUAL SIGNALS*			
13		**TORQ USED REF**			
Index	Description:	Limited torque reference. This is the final torque input for the internal torque controller.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
14		**FLUX USED REF**			
Index	Description:	Flux reference used.			
unit: %	type: R	Min:	Max:	Integer scaling:	10 == 1%
15		**FLUX ACT**			
Index	Description:	Flux actual value.			
unit: %	type: R	Min:	Max:	Integer scaling:	10 == 1%
16		**dV/dt**			
Index	Description:	Speed reference change in rpm/s at the output of the speed ramp generator.			
unit: rpm/s	type: R	Min:	Max:	Integer scaling:	See Parameter 50.01
18		**SPEED REF4**			
Index	Description:	Speed reference before speed error calculation.			
unit: rpm	type: R	Min: -18000 rpm	Max: 18000rpm	Integer scaling:	See Parameter 50.01
19		**DS SPEED REF**			
Index	Description:	Speed reference from the Master Follower link to be monitored in the Follower drive.			
unit: rpm	type: R	Min: -18000 rpm	Max: 18000rpm	Integer scaling:	See Parameter 50.01
20		**DS TORQ REF A**			
Index	Description:	Torque reference from the Master Follower link be monitored in the Follower drive.			
unit: rpm	type: R	Min: -18000 rpm	Max: 18000rpm	Integer scaling:	See Parameter 50.01
21		**FIELDWK POINT ACT**			
Index	Description:	Actual field weaking point.			
unit: Hz	type: R	Min:	Max:	Integer scaling:	100 == 1%
22		**TORQ FREQ LIM REF**			
Index	Description:	Torque reference after frequency limiter block.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
23		**TORQ DC LIM REF**			
Index	Description:	Torque reference after DC-voltage limiter block.			
unit: %	type: R	Min:	Max:	Integer scaling:	100 == 1%
24		**TORQ POW LIM REF**			
Index	Description:	Torque reference after power limiter block			
unit: %	type: R	Min: -600.00	Max: 600.00	Integer scaling:	10 == 1%

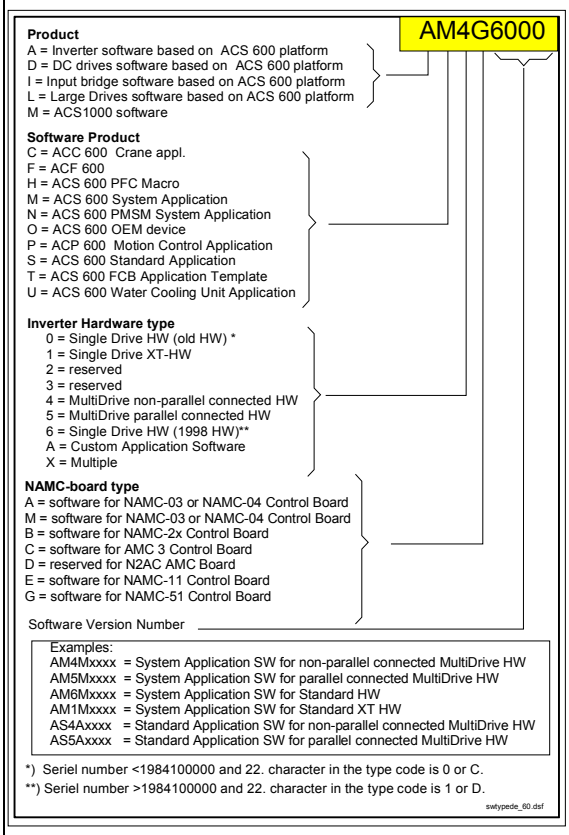
Group 3 Actual Signals

3	Group name:	*ACTUAL SIGNALS*			
	Description:	Data values			
01		**APPL DUTY**			
Index	Description:	Microprocessor load measurement. Value 100% indicates microprocessor overload, which results in delays in task executions.			
unit: %	type: R	Min:	Max:	Integer scaling:	1 == 1%

3	Group name:	*ACTUAL SIGNALS*		
02 Index		**APPLICATION OVERL**		
	Description:	Possible overload of each application task can be detected by means of this signal in the Packed Boolean format. Bit 0 Application Task 1 overload 1 Application Task 2 overload 2 Application Task 3 overload 3 Application Task 4 overload 4 Application Task 5 overload 5 Application Task 6 overload		
unit:	type: PB	Min: 0	Max:	Integer scaling: 1 == 1
03 Index		**RS**		
	Description:	Estimated stator resistance R_s		
unit: Ω	type: R	Min: 0	Max:	Integer scaling: 100 == 1 Ω
04 Index		**LS**		
	Description:	Estimated stator inductance L_s		
unit: mH	type: R	Min: 0	Max:	Integer scaling: 100 == 1 mH
05 Index		**SIGMALS**		
	Description:	Estimated value of σ_{LS}		
unit: Ω	type: R	Min: 0	Max:	Integer scaling: 100 == 1 Ω
06 Index		**TR**		
	Description:	Estimated time constant of the rotor.		
unit: ms	type: R	Min: 0	Max:	Integer scaling: 1 == 1 ms
07 Index		**POS COUNT LOW**		
	Description:	Position counter value in pulses (low word).		
unit:	type: I	Min: 0	Max: 65536	Integer scaling: 1 == 1
08 Index	(160.11)	**POS COUNT HIGH**		
	Description:	Position counter value in pulses (high word).		
unit:	type: I	Min: 0	Max: 65536	Integer scaling: 1 == 1
09 Index		**POS COUNT DEGREES**		
	Description:	Position counter value in degrees, when parameter 50.07 POS COUNT MODE has selection ROUND&DEG. This signal is used together with signal 3.10 POS COUNT ROUNDS.		
unit: deg	type: R	Min: -360 deg	Max: 360 deg	Integer scaling: 1 == 1 deg
10 Index		**POS COUNT ROUNDS**		
	Description:	Position counter value in total shaft revolutions, when Parameter 50.07 POS COUNT MODE is set to ROUND&DEG.		
unit:	type: R	Min: -8388608	Max: 8388608	Integer scaling: 1 == 1

3	Group name:	*ACTUAL SIGNALS*		
11		**DATALOG1 STATUS**		
Index	Description:	Data logger 1 STATUS WORD B0 = triggering conditions: fault B1 = triggering conditions: level B2 = triggering conditions: alarm B3 = triggering conditions: limit B4 = triggered by user B5 = triggered from level B6 = trend triggered from difference B7 = initialising B8 = over_write (readpointer has reached write pointer) B9 = filled B10 = running B11 = initialised B12 = not initialised B13 = B14 = B15 =		
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:
12		**PP 0 TEMP**		
Index	Description:	The highest power plate temperature in degrees celsius from the module 0 in the parallel connected inverter. The IGBT module with the highest temperature is indicated by the LEDs in the NINT board. This measurement is active only with parallel connected inverters.		
unit: °C	type: R	Min:	Max:	Integer scaling: 1 == 1
13		**PP 1 TEMP**		
Index	Description:	The highest power plate temperature in degrees celsius from the module 1 in the parallel connected inverter. The IGBT module with the highest temperature is indicated by the LEDs in the NINT board. This measurement is active only with parallel connected inverters.		
unit: °C	type: R	Min:	Max:	Integer scaling: 1 == 1
14		**PP 2 TEMP**		
Index	Description:	The highest power plate temperature in degrees celsius from the module 2 in the parallel connected inverter. The IGBT module with the highest temperature is indicated by the LEDs in the NINT board. This measurement is active only with parallel connected inverters.		
unit: °C	type: R	Min:	Max:	Integer scaling: 1 == 1
15		**PP 3 TEMP**		
Index	Description:	The highest power plate temperature in degrees celsius from the module 3 in the parallel connected inverter. The IGBT module with the highest temperature is indicated by the LEDs in the NINT board. This measurement is active only with parallel connected inverters.		
unit: °C	type: R	Min:	Max:	Integer scaling: 1 == 1

Group 4 Information

4	Group name:	*INFORMATION*			
	Description:	This signal group consists of information about the downloaded software on the NAMC board.			
01 Index		**SOFTWARE VERSION**			
	Description:	This signal gives information on the downloaded loading package information. 			
unit:	type: C	Min:	Max:		
02 Index		**DTC SW VERSION**			
	Description:	Flux software version. This fixed part of the application program consists of motor control, operational system, communication control of the DDCS channels, and Modbus software for the control panel.			
unit:	type: C	Min:	Max:		
03 Index		**APPLIC SW VERSION**			
	Description:	Application software name. This part of the application program has been written using PC element programming.			
unit:	type: C	Min:	Max:		

Group 7 Control Words

7	Group name:	*CONTROL WORDS*			
	Description:	ABB Drive Profile Control Word.			
01	Interval: 10 ms	*MAIN CTRL WORD (MCW)*			
Index		**Bit**	**Name**	**Value**	**Meaning**
		B0	ON	1 0	Command to "**RDYRUN**"-state Command to "**OFF**"-state
		B1	OFF 2	1 0	No OFF2 (Emergency OFF or Coast Stop) Command to "**ON INHIBIT**" state
		B2	OFF 3	1 0	No OFF 3 (Emergency STOP) Command to "**ON INHIBIT**" state
		B3	RUN	1 0	Command to "RDYREF"- states Stop by coasting
		B4	RAMP_OUT_ZERO	1 0	No other activities Speed ramp output is forced to zero
		B5	RAMP_HOLD	1 0	No other activities Speed ramping stopped
		B6	RAMP_IN_ZERO	1 0	No other activities Speed ramp input is forced to zero
		B7	RESET	1 0	Fault resetting with a positive edge
		B8	INCHING1	1 0	Constant speed 1 defined by a parameter
		B9	INCHING2	1 0	Constant speed 2 defined by a parameter
		B10	REMOTE_CMD	1 0	Overriding computer is req. to control the drive Only OFF commands are valid
		B11	reserved	1 0	(reserved)
		B12	reserved	1 0	(reserved)
		B13	reserved	1 0	(reserved)
		B14	reserved	1 0	(reserved)
		B15	reserved	1 0	(reserved)
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:	

7	Group name:	*CONTROL WORDS*	
02	Interval: 10 ms	*AUX CONTROL WORD 1 (ACW_1)*	
Index:	**Description:**	**Bit**	**Drive-specific auxiliary control word**
	not available	B0 RESTART_DLOG	Restart data logger (rising edge).
	not available	B1 TRIGG_LOGGER	Data logger triggering (rising edge)
		B2 RAMP_BYPASS	Bypass Speed ramp.
		B3 BAL_RAMP_OUT	Force ramp output.
		B4 FLUX ON DC	Flux on DC. (Flux off: set this bit and MCW bit 3 to 0).
		B5 FLUX ON	Flux on (zero torque).
		B6 HOLD_NCONT	Hold the integral part in the speed controller.
		B7 WINDOW_CTRL	FALSE = ADD CONTROL, TRUE = Window Control.
		B8 BAL_NCONT	Force speed controller output.
		B9 SYNC_COMMAND	Position counting: synchronise command.
		B10 SYNC_DISABLE	Position counting: disable synchronise command.
		B11 RESET_SYNC_RDY	Position counting: reset synchronous ready command.
		B12 (reserved)	
		B13 DO1 CONTROL	SW DO1 control (see also Par. 14.01, 14.02 and 98.03).
		B14 DO2 CONTROL	SW DO2 control (see also Par. 14.04 and 98.03).
		B15 DO3 CONTROL	SW DO3 control (see also Par. 14.06 and 98.04).
unit:	type: I	Min: -32768	Max: 32767 / Integer scaling:
03	Interval: 10 ms	*AUX CONTROL WORD 2 (ACW_2)*	
Index:	**Description:**	**Bit**	**Drive-specific auxiliary control word**
		B0 EXT1_DO1 CONTROL	NDIO extension module 1 DO1 control.
		B1 EXT1_DO2 CONTROL	NDIO extension module 1 DO2 control.
		B2 EXT2_DO1 CONTROL	NDIO extension module 2 DO1 control.
		B3 EXT2_DO2 CONTROL	NDIO extension module 2 DO2 control.
		B4 EXT3_DO1 CONTROL	NDIO extension module 3 DO1 control.
		B5 EXT3_DO2 CONTROL	NDIO extension module 3 DO2 control.
		B6	
		B7	
		B8	
		B9	
		B10	
		B11	
		B12 USER MACRO CTRL	Macro change request. TRUE= macro 2, FALSE= macro 1
		B13	
		B14	
		B15	
unit:	type: I	Min: -32768	Max: 32767 / Integer scaling:

Group 8 Status Words

8	Group name:	*STATUS WORDS*			
	Description:	Status signals of the drive according to the ABB Drive Profile.			
01	Interval: 10 ms	*MAIN STATUS WORD (MSW)*			*INPUT*
Index		**Bit**	**Name**	**Value**	**Meaning**
		B0	RDYON	1 0	Ready to switch on Not ready to switch on
		B1	RDYRUN	1 0	Ready Not ready
		B2	RDYREF	1 0	Operation enabled (RUNNING) Operation inhibited
		B3	TRIPPED	1 0	Fault
		B4	OFF_2_STA	1 0	No OFF 2 OFF 2
		B5	OFF_3_STA	1 0	No OFF 3 OFF3
		B6	SWC ON INHIB	1 0	Switch on inhibit
		B7	ALARM	1 0	Alarm
		B8	AT_SETPOINT	1 0	Setpoint/act. value monitoring in the tolerance
		B9	REMOTE	1 0	Remote control Local control
		B10	ABOVE_LIMIT	1 0	frequency or speed > par. 50.10 Speed Above Limit
		B11	...		(reserved)
		B12	INTERNAL_INTERLOCK	1 0	Motor par. typed and no prev. of unexpected start-up
		B13			(reserved)
		B14			(reserved)
		B15			(reserved)
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:	

8	Group name:	*STATUS WORDS*		
02	Interval: 10 ms	*AUX STATUS WORD (ASW)*		
Index	**Description:**	**Bit**		**Drive specific auxiliary status word**
		B0	LOGG_DATA_READY	Content of data logger is readable.
		B1	OUT_OF_WINDOW	Actual speed is outside of the defined window.
		B2	EMERG_STOP_COAST	Emergency stop function has failed.
		B3	MAGNETIZED	A flux has been formed in the motor.
		B4	RUN_DISABLED	External interlocking (DI2) prevents the run.
		B5	SYNC_RDY	Position counter synchronous ready status.
		B6	1_START_NOT_DONE	Not started after the setting of Group 99.
		B7	IDENTIF_RUN_DONE	Motor Identification run has been completed.
		B8	START_INHIBITION	Prevention of unexpected start-up is active.
		B9	LIMITING	Control at a limit. (See signals 8.03-8.04).
		B10	TORQ_CONTROL	Drive is torque controlled.
		B11	ZERO_SPEED	Motor actual speed is below the zero speed lim.
		B12	INTERNAL_SPEED_FB	Internal speed feedback selected.
		B13	M_F_COMM_ERR_ASW	CH2 Master/Follower link break.
		B14	USER MACRO 1	User macro 1 activated.
		B15	USER MACRO 2	User macro 2 activated.
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:
03	Interval: 2 ms	**LIMIT WORD 1**		
Index	Description:	B0	TORQ_MOTOR_LIM	
		B1	SPC_TORQ_MIN_LIM	
		B2	SPC_TORQ_MAX_LIM	
		B3	TORQ_USER_CUR_LIM	
		B4	TORQ_INV_CUR_LIM	
		B5	TORQ_MIN_LIM	
		B6	TORQ_MAX_LIM	
		B7	TREF_TORQ_MIN_LIM	
		B8	TREF_TORQ_MAX_LIM	
		B9	FLUX_MIN_LIMIT	
		B10	FREQ_MIN_LIMIT	
		B11	FREQ_MAX_LIMIT	
		B12	DC_UNDERVOLT_LIM	
		B13	DC_OVERVOLT_LIM	
		B14	TORQUE_LIMIT	
		B15	FREQ_LIMIT	
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:
04	Interval: 10 ms	**LIMIT WORD 2**		
Index	Description:	B0	P MOT LIM	POWER MOTORING LIMIT is active.
		B1	P GEN LIM	POWER GENERATING LIMIT is active.
		B2…15		(reserved)
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:

8	Group name:	*STATUS WORDS*		
05 Index	Interval: 10 ms	**DI STATUS WORD**		
	Description:	**BIT**		**Drive specific auxiliary status word**
		B0	DI1	Digital input 1 status on the NIOC-01 board.
		B1	DI2	Digital input 2 status on the NIOC-01 board.
		B2	DI3	Digital input 3 status on the NIOC-01 board.
		B3	DI4	Digital input 4 status on the NIOC-01 board.
		B4	DI5	Digital input 5 status on the NIOC-01 board.
		B5	DI6	Digital input 6 status on the NIOC-01 board.
		B6	EXT1_DI1	Digital input 1 status on NDIO Ext. Module 1.
		B7	EXT1_DI2	Digital input 2 status on NDIO Ext. Module 1.
		B8	EXT2_DI1	Digital input 1 status on NDIO Ext. Module 2.
		B9	EXT2_DI2	Digital input 2 status on NDIO Ext. Module 2.
		B10	EXT3_DI1	Digital input 1 status on NDIO Ext. Module 3.
		B11	EXT3_DI2	Digital input 2 status on NDIO Ext. Module 3.
		B12	DI1 NBIO-21/ NIOB	Digital input 1 status on NBIO-21/ NIOB-01 I/O Unit.
		B13	DI2 NBIO-21/ NIOB	Digital input 2 status on NBIO-21/ NIOB-01 I/O Unit.
		B14	DI3 NBIO-21/ NIOB	Digital input 3 status on NBIO-21/ NIOB-01 I/O Unit.
		B15		
				If NDIO I/O Extension Modules are installed, see also Parameters 98.03...98.05 and Chapter 4 - *I/O Configuration, Digital Inputs.*
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:
06 Index	Interval: 10 ms	**AUX STATUS WORD 2**		
	Description:	**BIT**		**Drive specific auxiliary status word 2**
		B0	FAN ON CMD	Motor Fan control signal for digital output control.
		B1		
		B2		
		B3		
		B4		
		B5		
		B6		
		B7		
		B8		
		B9		
		B10		
		B11		
		B12		
		B13		
		B14		
		B15		
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:

Group 9 Fault Words

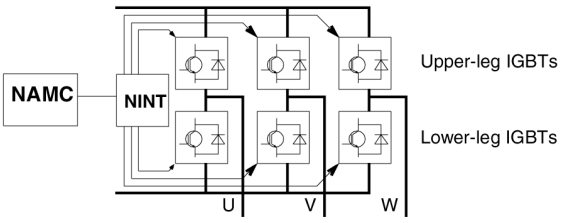
9	Group name:	*FAULT WORDS*			
	Description:	Fault signals of the drive.			
01	Interval: 500 ms	*FAULT WORD 1*			
Index	Description:	B0	SHORT CIRC	Short circuit in the main circuit.	
		B1	OVERCURRENT	Overcurrent.	
		B2	DC OVERVOLT	Intermediate circuit DC overvoltage.	
		B3	ACS 600 TEMP	Power plate overtemperature.	
		B4	EARTH FAULT	Earth fault.	
		B5	MOTOR TEMP M	Motor overtemperature (measured).	
		B6	MOTOR TEMP	Motor overtemperature (calculated).	
		B7	SYSTEM_FAULT	A fault is indicated by the System Fault Word 9.03.	
		B8	UNDERLOAD	Underload fault. See parameter 30.16.	
		B9	OVERFREQ	Overspeed fault.	
		B10		(reserved)	
		B11	CH2 COM LOS	CH2 Master/Follower communication fault.	
		B12	SC (INU1)	short circuit in parallel connected INU 1.	
		B13	SC (INU2)	short circuit in parallel connected INU 2.	
		B14	SC (INU3)	short circuit in parallel connected INU 3.	
		B15	SC (INU4)	short circuit in parallel connected INU 4.	
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:	
02	Interval: 500 ms	*FAULT WORD 2*			
Index	Description:	B0	SUPPLY PHASE	High supply section ripple voltage.	
		B1	NO MOTOR DATA	No motor data entered in Group 99.	
		B2	DC UNDERVOLT	Intermediate circuit DC undervoltage.	
		B3	CABLE TEMP	Motor cable overtemperature.	
		B4	RUN DISABLD	External interlocking on DI2 active.	
		B5	ENCODER FLT	Speed measurement fault.	
		B6	IO FAULT	I/O device fault on CH1.	
		B7	CABIN TEMP F	Drive cabinet overtemperature (meas. by NIOC-01)	
		B8		(reserved)	
		B9	OVER SWFREQ	Over switching frequency fault.	
		B10	AI<MIN FUNC	Current-type input below 4 mA on AI2 or AI3.	
		B11	PPCC LINK	NINT board current measurement or comm. fault.	
		B12	CH0 COM LOS	Communication break on CH0.	
		B13	PANEL LOST	Local control lost.	
		B14	MOTOR STALL	Motor stalled.	
		B15	MOTOR PHASE	Motor circuit fault.	
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:	

9	Group name:	*FAULT WORDS*		
03		*SYSTEM FAULT WORD*		
Index	Description:	**Bit**		
		B0	FLT (F1_7)	Factory default parameter file error.
		B1	USER MACRO	User macro file error.
		B2	FLT (F1_4)	FPROM operating error.
		B3	FLT (F1_5)	FPROM data error.
		B4	FLT (F2_12)	Internal time level T2 overflow (100µs).
		B5	FLT (F2_13)	Internal time level T3 overflow (1ms).
		B6	FLT (F2_14)	Internal time level T4 overflow (50ms).
		B7	FLT (F2_15)	Internal time level T5 overflow (1s).
		B8	FLT (F2_16)	State machine overflow.
		B9	FLT (F2_17)	Application program execution error.
		B10	FLT (F2_18)	Application program execution error.
		B11	FLT (F2_19)	Illegal instruction.
		B12	FLT (F2_3)	Register stack overflow.
		B13	FLT (F2_1)	System stack overflow.
		B14	FLT (F2_0)	System stack underflow.
		B15		
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:
04	Interval: 500 ms	*ALARM WORD 1*		
Index	Description:	**Bit**		
		B0	START INHIBI	Preventation of unexpected start-up active.
		B1	EM STOP	Emergency stop function has been activated DI1=0.
		B2	MOTOR TEMP M	Motor overtemperature (measured).
		B3	MOTOR TEMP	Overtemperature alarm of the thermal model.
		B4	ACS 600 TEMP	Power plate overtemperature.
		B5	ENCODER ERR	Pulse encoder error. See Param. 50.05.
		B6	T MEAS ALM	Temperature measurement failure.
		B7	DIO ALARM	Basic digital I/O alarm (NIOC-01).
		B8	AIO ALARM	Basic analogue I/O alarm (NIOC-01).
		B9	EXT DIO ALM	External digital I/O alarm (NDIO).
		B10	EXT AIO ALM	External analogue I/O alarm (NAIO).
		B11	CH2 COM LOS	CH2 Master/Follower communication error.
		B12		
		B13		
		B14	EARTH FAULT	Earth fault.
		B15	SAFETY SWITC	Safety Switch alarm.
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:

9	Group name:	*FAULT WORDS*		
05	Interval: 500 ms	*ALARM WORD 2*		
Index	Description:	**Bit**		
		B0	MOTOR FAN	Acknowledge not received from ext. motor fan circ.
		B1	UNDERLOAD	Underload.
		B2	INV OVERLOAD	Inverter overloading cycle $I_{ac\ 10/60\ s}$ time elapsed.
		B3	CABLE TEMP	Motor cable overtemperature.
		B4		(not in use)
		B5		(not in use)
		B6		(not in use)
		B7	POWFAIL FILE	Error in restoring 'powerfail.ddf'.
		B8	POWDOWN FILE	Error in restoring 'powerdown.ddf'.
		B9	MOTOR STALL	Motor stalling.
		B10	AI<MIN FUNC	Current-type input below 4 mA on AI2 or AI3.
		B11	CH0 TIMEOUT	DDCS communication time-out on CH0.
		B12		(not in use)
		B13	PANEL LOST	Local control lost.
		B14	DC UNDERVOLT	DC undervoltage indication during the Auto Restart.
		B15	RESTARTED	Motor has been restarted after the net break, if Auto Restart function enabled (see par. 21.09).
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:
06	Interval: 500 ms	*FAULT WORD 3*		
Index	Description:	**Bit**		
		B0	MOTOR FAN	Acknowledge not received from ext. motor fan circ.
		B1	START INHIBIT HW	Failure in Prevention of unexpected start-up circuit.
		B2	SAFETY SWITC	Safety Switch fault.
		B3	LINE CONV ERR	Lineconverter fault. Used in ACS611 or ACS617.
		B4		
		B5		
		B6		
		B7		
		B8		
		B9		
		B10		
		B11		
		B12		
		B13		
		B14		
		B15		
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:

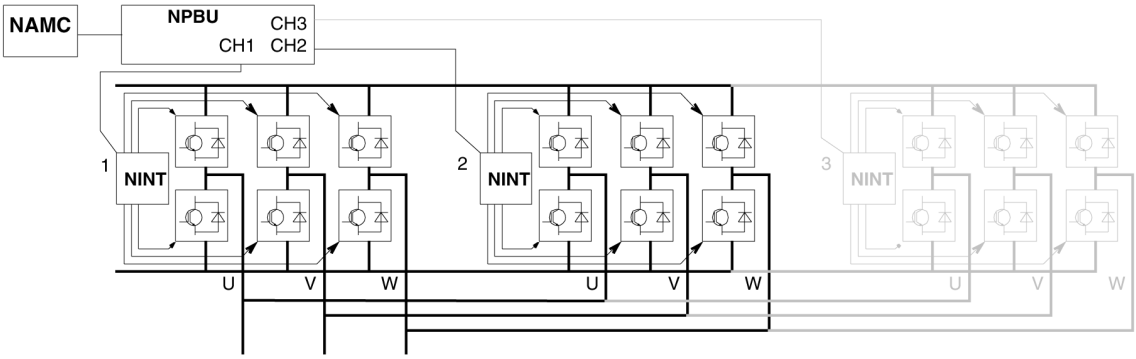
9	Group name:	*FAULT WORDS*		
07	Interval: 2 ms	*INT FAULT INFO*		
Index	Description:			This Word includes collected information on the location of faults PPCC LINK, OVERCURRENT, EARTH FAULT and SHORT CIRCUIT. The bits 0…4 indicate the source of the active fault and bits b6…b11 give detailed information on a short circuit.
		Bit		
		B0	NINT 1 FAULT	NINT 1 board fault *
		B1	NINT 2 FAULT	NINT 2 board fault *
		B2	NINT 3 FAULT	NINT 3 board fault *
		B3	NINT 4 FAULT	NINT 4 board fault *
		B4	NPBU FAULT	NPBU board fault * (Branching Unit board)
		B5		
		B6	U-PH SC U	Phase U upper-leg IGBT(s) short circuit
		B7	U-PH SC L	Phase U lower-leg IGBT(s) short circuit
		B8	V-PH SC U	Phase V upper-leg IGBT(s) short circuit
		B9	V-PH SC L	Phase V lower-leg IGBT(s) short circuit
		B10	W-PH SC U	Phase W upper-leg IGBT(s) short circuit
		B11	W-PH SC L	Phase W lower-leg IGBT(s) short circuit
		B12		
		B13		
		B14		
		B15		
				* In use only with parallel inverters. NINT 0 is connected to NPBU CH1, NINT 1 to CH2 etc.
unit:	type: I	Min: -32768	Max: 32767	Integer scaling:

Inverter Block Diagram



NAMC Application and Motor Control Board
NINT Main Circuit Interface Board
NPBU PPCS Link Branching Unit

Inverter Unit Block Diagram (two to four parallel Inverters)



Chapter 5 – Parameters

Overview

This chapter explains the function of, and valid selections for, each parameter.

Parameter Groups

The parameters are arranged into groups by their function. The figure below illustrates the organisation of the parameter groups.

ACS 600 Parameters

Group + Index	Description	Quantity
10.01...10.08	Start/Stop/Dir	8
11.01	I/O Reference select	1
13.01...13.14	Analogue Inputs	14
14.01...14.12	Digital Outputs	12
15.01...15.22	Analogue Outputs	22
16.01...16.06	System Control Inputs	6
17.01...17.03	DC Hold	3
18.01...18.02	LED Panel Control	2
19.01...19.08	Data Storage	8
20.01...20.18	Limits	18
21.01...21.11	Start/Stop Functions	11
22.01...22.08	Accel/Decel	8
23.01...23.11	Speed Reference	11
24.01...24.20	Speed Control	20
25.01...25.07	Torque Reference	7
26.01...26.07	Torque Reference Handling	7
27.01...27.08	Flux Control	8
28.01...28.10	Motor Model	11
29.01...29.04	Scalar Control	4
30.01...30.32	Fault Functions	32
31.01...31.02	Fault Functions	2
35.01...35.04	Motor Fan Control	4
36.01...36.02	Motor Cable	2
50.01...50.14	Speed Measurement	14
51.01...51.15	Master Adapter	15
70.01...70.20	DDCS Control	20
71.01…71.05	DriveBus Communication	1
90.01...90.18	Data Set Receive Addresses	18
91.01...91.06	Data Set Receive Addresses	6
92.01...92.18	Data Set Transmit Addresses	18
93.01...93.06	Data Set Transmit Addresses	6
97.01	Drive	1
98.01...98.07	Option Modules	7
99.01...99.13	Start-Up Data	13
	Total	**340**

How to Read the Parameter Table

Before you start to read the parameter table, we first recommend you read this description.

- Parameter change by Drive*Window* or the CDP 312 is stored to FPROM memory; changes made by the overriding system are only stored to RAM.
- If the overriding control system reads or writes individual bits of a word with an Advant CONV_IB element, (for example AUX CONTROL WORD 7.02) the bit B15 corresponds to the SIGN outputs of the element.
- From DriveWindow and the control panel, parameter values are set in decimal.
- Unit of the parameter value can be seen on the lower left-hand corner of the parameter description.
- Minimum, maximum and default values are shown in decimal format.
- Data type is given with a short code:
  I = 16-bit signed integer value B = Boolean value
  PB = Packed Boolean value R = Real value
- Communication between the overriding system and the drive uses 16 bit integer values (-32768...32767). To change a parameter value from the overriding system, an integer value for the parameter must be calculated using the information given in the **Integer scaling** column.

Example 1: If TREF TORQMAX (real) is set from the overriding system, an integer value of 100 corresponds to 1 % (see below).

09		**TREF TORQMAX**			
Index	Description:	Maximum torque reference as a percentage of the motor nominal torque.			
unit: %	type: R	Min: 0 %	Max: 300 %	Def: 300 %	Integer scaling: 100 == 1%

Figure 5 - 1 Sample of the Parameter Table

Example 2: Speed reference from the overriding system.

- Speed reference input is given by Parameter 23.01 SPEED REF. The Integer scaling box reads “see Par. 50.01”. Parameter 50.01 defines the motor speed (in rpm) at maximum reference (20000 for the overriding system). Thus, sending a value of 20000 from the overriding system into Parameter 23.01 sets the speed reference to the rpm value given with Parameter 50.01.

Group 10 Start/Stop/Dir

10	Group name:	*DIGITAL INPUTS*			
	Description:	This parameter group defines the functions for digital inputs.			
01		**START/STOP**			
Index:	Description:	Digital input for Start/Stop command, when I/O control has been activated either by changing Parameter 98.02 COMM MODULE to NO or HAND is selected using the options at Parameter **10.07 HAND/AUTO**. 1 = **NO** 2 = **DI3** Start by rising edge (0->1), 0 = stop 3 = **DI4** Start by rising edge (0->1), 0 = stop 4 = **DI5** Start by rising edge (0->1), 0 = stop 5 = **DI6** Start by rising edge (0->1), 0 = stop 6 = **EXT2 DI1** Start by rising edge (0->1), 0 = stop, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**. 7 = **EXT2 DI2** Start by rising edge (0->1), 0 = stop, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**.			
unit:	type: I	Min: 1	Max: 7	Def: 1	Integer scaling:
02		**DIRECTION**			
Index:	Description:	This parameter allows fixing the direction of rotation of motor to FORWARD or REVERSE, if unipolar speed reference has been selected in I/O control by Parameter **13.12 MINIMUM AI1**. **Note:** I/O control is activated either by setting Parameter **98.02 COMM MODULE** to value **NO** or HAND is selected using the options at Parameter **10.07 HAND/AUTO**. 1 = **FORWARD** 2 = **DI3** 1 = reverse, 0 = forward 3 = **DI4** 1 = reverse, 0 = forward 4 = **DI5** 1 = reverse, 0 = forward 5 = **DI6** 1 = reverse, 0 = forward 6 = **EXT2 DI1** 1 = reverse, 0 = forward, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to **EXTEND**. 7 = **EXT2 DI2** 1 = reverse, 0 = forward, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to **EXTEND**.			
unit:	type: I	Min: 1	Max: 7	Def: 1	Integer scaling:
03		**RESET**			
Index:	Description:	Digital input for Reset function, when I/O control has been activated either by changing Parameter **98.02 COMM MODULE** to value **NO** or HAND is selected using the options at Parameter **10.07 HAND/AUTO**. 1 = **NO** 2 = **DI3** Reset by rising edge (0->1). 3 = **DI4** Reset by rising edge (0->1). 4 = **DI5** Reset by rising edge (0->1). 5 = **DI6** Reset by rising edge (0->1). 6 = **EXT2 DI1** Reset by rising edge, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**. 7 = **EXT2 DI2** Reset by rising edge, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**.			
unit:	type: I	Min: 1	Max: 7	Def: 4	Integer scaling:

10	Group name:	*DIGITAL INPUTS*
04		**SYNC CMD**
Index:	Description:	Digital input for SYNC COMMAND for the positioning count. This is a faster alternative for synchronising by **(7.02) ACW** bit 9. Active in all control modes. 1 = **NO** (default) 2 = **DI3** High = SYNC COMMAND 3 = **DI4** High = SYNC COMMAND 4 = **DI5** High = SYNC COMMAND 5 = **DI6** High = SYNC COMMAND 6 = **EXT2 DI1** High = SYNC COMMAND, NDIO I/O extension module 2. Parameter (**98.04**) **DI/O EXT MODULE 2** must be set to value **EXTEND**. 7 = **EXT2 DI2** High = SYNC COMMAND, NDIO I/O extension module 2. Parameter (**98.04**) **DI/O EXT MODULE 2** must be set to value **EXTEND**.
unit:	type: I	Min: 1 / Max: 7 / Def: 1 / Integer scaling:
05		**KLIXON**
Index:	Description:	Digital input for motor overtemperature protection. Input for thermal switch (KLIXON) or thermistor relay can be selected freely, but the PTC-sensor is connected only to D16 of the I/O board NIOC-01. See Chapter 2 "*Motor protections".* 1 = **NO** (default) 2 = **DI3** High = OK, low = trip 3 = **DI4** High = OK, low = trip 4 = **DI5** High = OK, low = trip 5 = **DI6** High = OK, low = trip 6 = **EXT2 DI1** High = OK, low = trip, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**. 7 = **EXT2 DI2** High = OK, low = trip, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**.
unit:	type: I	Min: 1 / Max: 7 / Def: 1 / Integer scaling:
06		**MOTOR FAN ACK**
Index:	Description:	Selection of the acknowledge source for motor fan diagnostics. An acknowledge signal indicates, that the contactor of the fan motor is closed. See Parameter Group 35. 1 = **NO** No acknowledge required. No alarm or fault. (default) 2 = **DI3** Acknowledge ok = high 3 = **DI4** Acknowledge ok = high 4 = **DI5** Acknowledge ok = high 5 = **DI6** Acknowledge ok = high 6 = **EXT2 DI1** Acknowledge ok = high, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**. 7 = **EXT2 DI2** Acknowledge ok = high, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**.
unit:	type: I	Min: 1 / Max: 7 / Def: 1 / Integer scaling:

10	Group name:	*DIGITAL INPUTS*			
07		**HAND/AUTO**			
Index:	Description:	Digital input for switching between HAND control (I/O) and AUTO (through overriding system) control. This selection has a higher priority than Parameter **98.02 COMM MODULE**. 1 = **NO** (default) 2 = **DI3** High = HAND, low = AUTO 3 = **DI4** High = HAND, low = AUTO 4 = **DI5** High = HAND, low = AUTO 5 = **DI6** High = HAND, low = AUTO 6 = **EXT2 DI1** High = HAND, low = AUTO, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**. 7 = **EXT2 DI2** High = HAND, low = AUTO, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**.			
unit:	type: I	Min: 1	Max: 7	Def: 1	Integer scaling:
08		**START INHIB DI**			
Index:	Description:	Digital input for the Prevention of Unexpected Start-Up function. Selected digital input acts as an AND type interlocking with bit 3 (RUN) of Main Control Word. See Chapter 7. See the **START INH HW** fault diagnostics. 1 = **NO** No Prevention of Unexpected Start-Up circuit in use 2 = **DI3** High = Prevention of Unexpected Start-Up circuit is OFF, low = ON 3 = **DI4** High = Prevention of Unexpected Start-Up circuit is OFF, low = ON 4 = **DI5** High = Prevention of Unexpected Start-Up circuit is OFF, low = ON 5 = **DI6** High = Prevention of Unexpected Start-Up circuit is OFF, low = ON 6 = **EXT2 DI1** High = Prevention of Unexpected Start-Up circuit is OFF, low = ON, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**. 7 = **EXT2 DI2** High = Prevention of Unexpected Start-Up circuit is OFF, low = ON, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**.			
unit:	type: I	Min: 1	Max: 7	Def: 2	Integer scaling:
08		**SAFETY SWITCH**			
Index:	Description:	Digital input for motor safety switch. The status of the safety switch is indicated in drive diagnostics either faulting, if the switch was opened during run or by alarming, if the drive was already stopped.. 1 = **NO** (default) 2 = **DI3** High = OK, low = TRIP 3 = **DI4** High = OK, low = TRIP 4 = **DI5** High = OK, low = TRIP 5 = **DI6** High = OK, low = TRIP 6 = **EXT2 DI1** High = OK, low = TRIP, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**. 7 = **EXT2 DI2** High = OK, low = TRIP, NDIO I/O extension module 2. Parameter **98.04 DI/O EXT MODULE 2** must be set to value **EXTEND**.			
unit:	type: I	Min: 1	Max: 7	Def: 1	Integer scaling:

Group 11 Reference Select

11	Group name:	*REFERENCE SELECT*			
	Description:	This parameter group is visible only when 98.02 COMM MODULE is set to NO or HAND mode is selected by parameter 10.07 HAND/AUTO, i.e. the drive is controlled through its I/O connections. When the drive is controlled by the overriding system, Group 11 parameters are ineffective. See also configuration figure of Parameter 98.06.			
01		**EXT REF1 SELECT**			
Index:	Description:	EXT REF1 is a speed reference given via analogue input. There are two alternatives available for the NIOC-01 board. 1 = **STD AI1** 0…10 V speed reference input 2 = **STD AI2** 0(4)…20 mA speed reference input			
unit:	type: I	Min: 1	Max: 2	Def: 1	Integer scaling:

Group 13 Analogue Inputs

13	Group name:	*ANALOGUE INPUTS*			
	Description:				
01		**AI1 HIGH VALUE**			
Index:	Description:	This value corresponds to the maximum input voltage on AI1 produced by the device used. With I/O control, value 20000 corresponds to the speed defined by Parameter 50.01 SPEED SCALING. This parameter is not active when AI1 is used for motor 1 temperature measurement. See Parameter **30.03 MOT1 TEMP AI1 SEL**.			
unit:	type: I	Min: -32768	Max: 32767	Def: 20000	Integer scaling:
02		**AI1 LOW VALUE**			
Index:	Description:	This value corresponds to the minimum input voltage on AI1. With I/O control, it defines the minimum speed. If bipolar I/O reference is used, value -20000 corresponds the maximum negative speed based on Parameter 50.01 SPEED SCALING. This parameter is not active when AI1 is used for motor 1 temperature measurement. See Parameter **30.03 MOT1 TEMP AI1 SEL**.			
unit:	type: I	Min: -32768	Max: 32767	Def: 0	Integer scaling:
03		**FILTER AI1**			
Index:	Description:	Filter time constant for analogue input AI1. The hardware filter time constant is 20 ms.			
unit: ms	type: I	Min: 0 ms	Max: 30000 ms	Def: 1000 ms	Integer scaling:
04		**AI2 HIGH VALUE**			
Index:	Description:	This value corresponds to the maximum input in milliamperes (20 mA). This parameter is not active when used for motor 2 temperature measurement. See parameter **30.06 MOT2 TEMP AI2 SEL**.			
unit:	type: I	Min: -32768	Max: 32767	Def: 0	Integer scaling:
05		**AI2 LOW VALUE**			
Index:	Description:	This value corresponds to the minimum input in milliamperes (0 or 4 mA). This parameter is not active when used for motor 2 temperature measurement. See parameter **30.06 MOT2 TEMP AI2 SEL**.			
unit:	type: I	Min: -32768	Max: 32767	Def: 0	Integer scaling:
06		**MINIMUM AI2**			
Index:	Description:	Minimum value of AI2. This value corresponds to the minimum reference. 1 = **0 mA** (0...20 mA) 2 = **4 mA** (4...20 mA) 3 = **-20 mA** (Used with bipolar type of analogue input)			
unit:	type: I	Min: 1	Max: 2	Def: 1	Integer scaling:
07		**FILTER AI2**			
Index:	Description:	Filter time constant for analogue input AI2. The hardware filter time constant is 20 ms.			
unit: ms	type: I	Min: 0 ms	Max: 30000 ms	Def: 1000 ms	Integer scaling:

13	Group name:	*ANALOGUE INPUTS*			
08		**AI3 HIGH VALUE**			
Index:	Description:	This value corresponds to the maximum input in milliamperes (20 mA).			
unit:	type: I	Min: -32768	Max: 32767	Def: 10000	Integer scaling:
09		**AI3 LOW VALUE**			
Index:	Description:	This value corresponds to the minimum input in milliamperes (0 or 4 mA).			
unit:	type: I	Min: -32768	Max: 32767	Def: 0	Integer scaling:
10		**MINIMUM AI3**			
Index:	Description:	Minimum value of AI3. This value corresponds to the minimum reference. 1 = **0 mA** 2 = **4 mA**			
unit:	type: I	Min: 1	Max: 2	Def: 1	Integer scaling:
11		**FILTER AI3**			
Index:	Description:	Filter time constant for analogue input AI3. The hardware filter time constant is 20 ms.			
unit: ms	type: R	Min: 0 ms	Max: 30000 ms	Def: 1000 ms	Integer scaling:
12		**MINIMUM AI1**			
Index:	Description:	Minimum value of AI1. This value corresponds to the minimum reference. 1 = **0** 2 = **2 V** (Used also in range 4...20 mA in the NAIO extension module) 3 = **-10 V** (Used with bipolar type of analogue input)			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
13		**NBIO/NIOB AI1 GAIN**			
Index:	Description:	Analogue input AI1 hardware gain selection for NBIO-21 or NIOB-01 board. 0 = **0…+-10V** 1 = **0+-2V/+-20mA**			
unit:	type: B	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1
14		**NBIO/NIOB AI2 GAIN**			
Index:	Description:	Analogue input AI2 hardware gain selection for NBIO-21 or NIOB-01 board. 0 = **0…+-10V** 1 = **0+-2V/+-20mA**			
unit:	type: B	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1

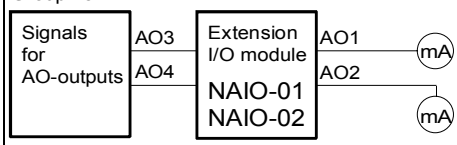
Group 14 Digital Outputs

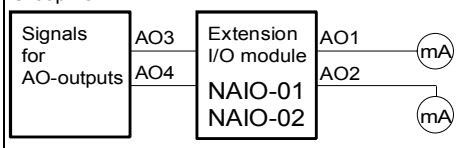
14	Group name:	*DIGITAL OUTPUTS*			
	Description:	Control of the digital outputs.			
01		**DO1 CONTROL**			
Index	Description:	An emergency stop command energises DO1 until MAIN CONTROL WORD bit 0 is set to a 0 state and zero speed has been detected. If the emergency stop function is not activated (by Parameter 21.04), the output can be controlled from the overriding system. 0 = **OFF** An emergency stop command controls the DO1. 1 = **ON** DO1 signal is selected by Parameter 14.02 and 14.03.			
unit:	type: B	Min:	Max:	Def: OFF	Integer scaling: 1 == 1
02		**DO1 GROUP+INDEX**			
Index	Description:	Digital output 1 is controlled by a selectable (see Par. 14.03) bit of the signal selected with this parameter. The format is **(-)xyy**, where **(-)** = inversion, **x** = Group, **yy** = Index. Examples: If Parameters 14.02 and 14.03 are set to 801 and 1 respectively (default), digital output DO1 is active when 8.01 MAIN STATUS WORD bit 1 (READY) 14.02 and 14.03 are set to –801 and 3 respectively, digital output DO1 is active when 8.01 MAIN STATUS WORD bit 3 (TRIPPED) is 0. If this parameter is set to 0, digital output DO1 is controlled by the overriding system (7.02 AUX CTRL WORD bit 13).			
unit:	type: I	Min: -30000	Max: 30000	Def: 801	Integer scaling:

14	Group name:	*DIGITAL OUTPUTS*			
03 Index		**DO1 BIT NUMBER**			
	Description:	This parameter specifies the bit number for the signal selected at Parameter 14.02.			
unit:	type: I	Min: 0	Max: 23	Def: 1	Integer scaling:
04 Index		**DO2 GROUP+INDEX**			
	Description:	Digital output 2 control. See parameter 14.02. If this parameter is set to 0, digital output DO2 is controlled by the overriding system (7.02 AUX CTRL WORD bit 14). See also Par. 14.12 **DO2 GRP+INDEX MOD**.			
Unit:	type: I	Min: -30000	Max: 30000	Def: 801	Integer scaling:
05 Index		**DO2 BIT NUMBER**			
	Description:	This parameter specifies the bit number for the signal selected at Parameter 14.04			
unit:	type: I	Min: 0	Max: 23	Def: 2	Integer scaling:
06 Index		**DO3 GROUP+INDEX**			
	Description:	Digital output 3 control. See parameter 14.02. If this parameter is set to 0, digital output DO3 is controlled by the overriding system (7.02 AUX CTRL WORD bit 15).			
unit:	type: I	Min: -30000	Max: 30000	Def: 801	Integer scaling:
07 Index		**DO3 BIT NUMBER**			
	Description:	This parameter specifies the bit number for the signal selected at Parameter 14.06			
unit:	type: I	Min: 0	Max: 23	Def: 3	Integer scaling:
08 Index		**EXT2 DO1 GR+INDEX** (not available with NAMC-03/04)			
	Description:	Extension module 2 digital output DO1 control. See parameter 14.02. If this parameter is set to 0, digital output DI1 can be controlled by the overriding system (7.03 AUX CTRL WORD 2 bit 2). To activate this extension module see Parameter 98.04.			
unit:	type: I	Min: -30000	Max: 30000	Def: 801	Integer scaling:
09 Index		**EXT2 DO1 BIT NR** (not available with NAMC-03/04)			
	Description:	This parameter specifies the bit number for the signal selected at Parameter 14.08.			
unit:	type: I	Min: 0	Max: 23	Def: 1	Integer scaling:
10 Index		**EXT2 DO2 GR+INDEX** (not available with NAMC-03/04)			
	Description:	Extension module 2 digital output DO2 control. See parameter 14.02. If this parameter is set to 0, digital output can be controlled by the overriding system (7.03 AUX CTRL WORD bit 3). To activate this extension module see Parameter 98.04.			
unit:	type: I	Min: -30000	Max: 30000	Def: 806	Integer scaling:
11 Index		**EXT2 DO2 BIT NR** (not available with NAMC-03/04)			
	Description:	This parameter specifies the bit number for the signal selected at Parameter 14.10.			
unit:	type: I	Min: 0	Max: 23	Def: 0	Integer scaling:
12 Index		**DO2 GRP+INDEX MOD** (not available with NAMC-03/04)			
	Description:	This parameter defines the DO2 control in LOCAL and REMOTE modes. 0 = **REM/LOCAL** = DO2 Group + Index parametrisation with Par. 14.04 and 14.05 affects in REMOTE and LOCAL mode. 1 = **LOCAL** = DO2 Group + Index parametrisation is effective only in LOCAL mode. In the REMOTE mode, signal 7.02 ACW bit 14 controls DO2.			
unit:	type: B	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1

Group 15 Analogue Outputs

15	Group name:	*ANALOGUE OUTPUTS*			
	Description:	It is possible to select a signal or parameter to control the analogue outputs. The outputs can also be controlled from the overriding system. The outputs are updated every 10 milliseconds.			
01 Index		**ANALOGUE OUTPUT 1**			
	Description:	To direct a measured signal to analogue output AO1, set this parameter according to the format (x)xyy. Where (x) is the group and yy the index of the desired signal; eg. 2301 denotes Par. 23.01. A signal from the overriding system can also control the analogue output. The data set in which the signal is transmitted to the drive is directed into one of the DATA parameters (19.01...19.08) using Parameters 90.01...91.18. The DATA parameter is then coupled to the analogue output with this parameter. If temperature measurement (Parameter 30.03) is selected, analogue output AO1 is used for supplying a constant current for the sensor.			
unit:	type: I	Min: 0	Max: 30000	Def: 106 (Mot curr)	Integer scaling:
02 Index		**INVERT AO1**			
	Description:	Analogue output AO1 signal inversion. 0 = **NO** minimum signal value corresponds to the minimum output value. 1 = **YES** maximum signal value corresponds to the minimum output value.			
unit:	type: B	Min:	Max:	Def: NO	Integer scaling: 1 == 1
03 Index		**MINIMUM AO1**			
	Description:	Analogue output 1 signal offset in milliamperes. This parameter is not effective if motor 1 temperature measurement is activated by Parameter 30.03. Otherwise, the following settings are available. 1 = **0 mA** 2 = **4 mA** 3 = **10 mA** 50% offset in the range 0...20 mA for testing or indication of direction (torque, speed etc.)			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
04 Index		**FILTER AO1**			
	Description:	Filter time constant for analogue output AO1.			
unit: s	type: R	Min: 0 s	Max: 10 s	Def: 0.1 s	Integer scaling: 100 == 1s
05 Index		**SCALE AO1**			
	Description:	Nominal value of the analogue output AO1 signal which is selected in Parameter 15.01. This value corresponds to 20 mA at the output.			
unit:	type: R	Min: 0	Max: 65536	Def: 100	Integer scaling: 1 == 1
06 Index		**ANALOGUE OUTPUT 2**			
	Description:	To direct a measured signal to analogue output AO1, set this parameter according to the format (x)xyy. Where (x) is the group and yy the index of the desired signal; eg. 1506 denotes Par. 15.06. A signal from the overriding system can also control the analogue output. the data set in which the signal is transmitted to the drive is directed into one of the DATA parameters (19.01...19.08) using Parameters 90.01...91.18. The DATA parameter is then coupled to the analogue output with this parameter. If temperature measurement (Parameter 30.06) is selected, analogue output AO2 is used for supplying a constant current for the sensor.			
unit:	type: I	Min: 0	Max: 30000	Def: 101 (Mot spd)	Integer scaling:

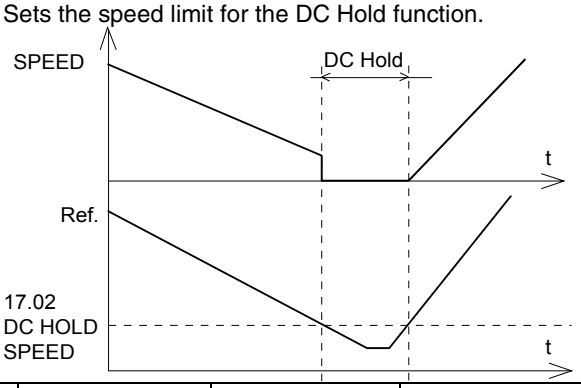
15	Group name:	*ANALOGUE OUTPUTS*			
07 Index		**INVERT AO2**			
	Description:	Analogue output AO2 signal inversion. 0 = **NO** minimum signal value corresponds to the minimum output value. 1 = **YES** maximum signal value corresponds to the minimum output value.			
unit:	type: B	Min:	Max:	Def: NO	Integer scaling: 1 == 1
08 Index		**MINIMUM AO2**			
	Description:	Analogue output AO2 signal offset in milliamperes. 1 = **0 mA** 2 = **4 mA** 3 = **10 mA** 50% offset in the range of 0...20 mA for testing or indication of direction (torque, speed etc.)			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
09 Index		**FILTER AO2**			
	Description:	Filter time constant for analogue output AO2.			
unit: s	type: R	Min: 0 s	Max: 10 s	Def: 0.1 s	Integer scaling: 100 == 1s
10 Index		**SCALE AO2**			
	Description:	Nominal value of analogue output AO2 signal which is selected in Parameter 15.06. This value corresponds to 20 mA at the output.			
unit:	type: R	Min: 0	Max: 65536	Def: 3000	Integer scaling: 1 == 1
11 Index		**ANALOGUE OUTPUT 3**			
	Description:	Analogue Outputs AO3 and AO4 are available when a NAIO I/O extension is used and Parameter 98.06 is set to **UNIPOLAR AI** or **BIPOLAR AI**. See also the hardware connections at Parameter 98.06. Group 15  This parameter selects the signal to be connected to analogue output AO3. See Parameter 15.01 ANALOGUE OUTPUT 1.			
unit:	type: I	Min: 0	Max: 30000	Def: 101 (speed)	Integer scaling:
12 Index		**INVERT AO3**			
	Description:	Analogue output AO3 signal inversion. 0 = **NO** Minimum signal value corresponds to the minimum output value. 1 = **YES** Maximum signal value corresponds to the minimum output value.			
unit:	type: B	Min:	Max:	Def: NO	Integer scaling: 1 == 1
13 Index		**MINIMUM AO3**			
	Description:	Analogue output AO3 signal offset in milliamperes. 1 = **0 mA** 2 = **4 mA** 3 = **10 mA** 50% offset in the range of 0...20 mA for testing or indication of direction (torque, speed etc.) 4 = **12 mA** Used for 4…20 mA signal for meters which have zero point in the middle of the range (e.g. -1000…0…1000 rpm)			
unit:	type: I	Min: 1	Max: 4	Def: 1	Integer scaling:
14 Index		**FILTER AO3**			
	Description:	Filter time constant for analogue output AO3.			
unit: s	type: R	Min: 0 s	Max: 10 s	Def: 0.1 s	Integer scaling: 100 == 1s
15 Index		**SCALE AO3**			
	Description:	Nominal value of analogue output AO3 signal which is selected in Parameter 15.11. This value corresponds to 20 mA at the output.			
unit:	type: R	Min: 0	Max: 65536	Def: 3000	Integer scaling: 1 == 1

15	Group name:	*ANALOGUE OUTPUTS*			
16		**ANALOGUE OUTPUT 4**			
Index	Description:	Analogue Outputs AO3 and AO4 are available when a NAIO I/O extension is used and Parameter 98.06 is set to **UNIPOLAR AI** or **BIPOLAR AI**. See also the hardware connections at parameter 98.06. Group 15  This parameter selects the signal to be connected to analogue output AO4. See parameter 15.01 ANALOGUE OUTPUT 1.			
unit:	type: I	Min: 0	Max: 30000	Def: 101 (speed)	Integer scaling:
17		**INVERT AO4**			
Index	Description:	Analogue output AO4 signal inversion. 0 = **NO** minimum signal value corresponds to the minimum output value. 1 = **YES** maximum signal value corresponds to the minimum output value.			
unit:	type: B	Min:	Max:	Def: NO	Integer scaling: 1 == 1
18		**MINIMUM AO4**			
Index	Description:	Analogue output AO4 signal offset in milliamperes. 1 = **0 mA** 2 = **4 mA** 3 = **10 mA** 50% offset in the range of 0...20 mA for testing or indication of direction (torque, speed etc.) 4 = **12 mA** Used for 4…20 mA signal for meters which have zero point in the middle of the range (e.g. –1000…0…1000 rpm)			
unit:	type: I	Min: 1	Max: 4	Def: 1	Integer scaling:
19		**FILTER AO4**			
Index	Description:	Filter time constant for analogue output AO4.			
unit: s	type: R	Min: 0 s	Max: 10 s	Def: 0.1 s	Integer scaling: 100 == 1s
20		**SCALE AO4**			
Index	Description:	Nominal value of analogue output AO4 signal which is selected in Parameter 15.16. This value corresponds to 20 mA at the output.			
unit:	type: R	Min: 0	Max: 65536	Def: 3000	Integer scaling: 1 == 1
21		**NBIO/NIOB AO1 MODE**			
Index	Description:	If NBIO-21 or NIOB-01 I/O board is selected as the Basic I/O board by Par. 98.07, it replaces NIOC-01 analogue outputs 1 and 2. NBIO-21 and NIOB-01 I/O boards have separate current and voltage output terminals. **Note: MINIMUM AO1** has no function when –10V…0…+10V is selected. Selection of the analogue output type is either current 0…20 mA or voltage –10V…0…+10V. 0 = **0…20mA** 1 = **-10V 0 +10V**			
unit:	type: B	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1
22		**NBIO/NIOB AO2 MODE**			
Index	Description:	If NBIO-21 or NIOB-01 I/O board is selected as the Basic I/O board by Par. 98.07, it replaces NIOC-01 analogue outputs 1 and 2. NBIO-21 and NIOB-01 I/O boards have separate current and voltage output terminals. **Note: MINIMUM AO2** has no function when –10V…0…+10V is selected. Selection of the analogue output type either current 0…20 mA or voltage –10V…0…+10V. 0 = **0…20mA** 1 = **-10V 0 +10V**			
unit:	type: B	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1

Group 16 System Control Inputs

16	Group name:	SYSTEM CTR INPUTS			
	Description:				
01 Index		**RUN ENABLE**			
	Description:	This parameter activates the RUN ENABLE input. Digital Input DI2 is dedicated for this input permanently. 2 = **DI2** To activate the RUN ENABLE signal, voltage must be connected to digital input DI2. If the voltage drops to 0V, the drive coasts to stop and a run enable fault is generated.			
unit:	type: I	Min: 2	Max: 2	Def: 2	Integer scaling:
02 Index		**PARAMETER LOCK**			
	Description:	This parameter selects the state of the parameter lock. With the parameter lock you can prevent unauthorised changes by CDP 312 or the Drive*Window* Tool for Parameter Groups 0 ... 99. 1 = **LOCKED** Parameter changes are disabled. 0 = **OPEN** Parameter changes are enabled.			
unit:	type: B	Min:	Max:	Def: OPEN	Integer scaling: 1 == 1
03 Index		**PASS CODE**			
	Description:	This parameter enters the pass code for the Parameter Lock. The default value of this parameter is 0. In order to open the Parameter Lock, change the value to 358. After the Parameter Lock is opened, the value is automatically changed back to 0.			
unit:	type: I	Min: 0	Max: 30000	Def: 0	Integer scaling:
04 Index		**LOCAL LOCK**			
	Description:	Control place change of the drive from remote to local can be disabled by setting this parameter to TRUE. If LOCAL LOCK is activated during local control, it takes effect only after the control place is changed back to remote. 0 = **FALSE** No locking for control place change. 1 = **TRUE** Local control is disabled.			
unit:	type: B	Min:	Max:	Def: FALSE	Integer scaling: 1 == 1
05 Index		**USER MACRO CHG**			
	Description:	User macro change by 7.03 AUX CONTROL WORD 2 bit 12 is enabled by means of this parameter. See also Parameter 99.11. 1 = **NOT SEL** Not selected. 2 = **ACW2 BIT 12** Selection by ACW2 (7.03) bit 12 enabled.			
unit:	type: I	Min: 1	Max: 2	Def: 1	Integer scaling:
06 Index		**PARAMETER BACKUP**			
	Description:	Parameter save from the RAM memory to FPROM. This is needed only when parameter changes by overriding system have to be stored to FPROM memory instead of RAM. **Note:** Do not use the Parameter Backup function unnecessarily. **Note:** Parameter changes by CDP 312 Control Panel or Drive*Window* are immediately saved to FPROM. 0 = **DONE** Parameter value after the saving has been completed. 1 = **SAVE** Parameter save to FPROM.			
unit:	type: B	Min:	Max:	Def: DONE	Integer scaling: 1 == 1

Group 17 DC Hold

17	Group name:	*DC HOLD*			
	Description:				
01 Index		**DC HOLD**			
	Description:	DC Hold is activated when both the speed reference and the actual speed drop below the defined DC HOLD SPEED. The drive will then stop generating sinusoidal current and inject DC current into the motor. The DC current value is set by the DC HOLD CURR parameter. When the speed reference rises above the DC HOLD SPEED, the DC current will be removed and normal operation resumed. This function is only possible in DTC control mode. 1 = **YES** DC HOLD is enabled 0 = **NO** DC HOLD is disabled			
unit:	type: B	Min:	Max:	Def: NO	Integer scaling: 1 == 1
02 Index		**DC HOLD SPEED**			
	Description:	Sets the speed limit for the DC Hold function.  			
unit: rpm	type: R	Min: 0 rpm	Max: 3600 rpm	Def: 5 rpm	Integer scaling: 1 == 1
03 Index		**DC-HOLD CURRENT**			
	Description:	Sets the DC current to be applied to the motor when the DC Hold function is activated.			
unit: %	type: R	Min: 0 %	Max: 100 %	Def: 30 %	Integer scaling: 1 == 1

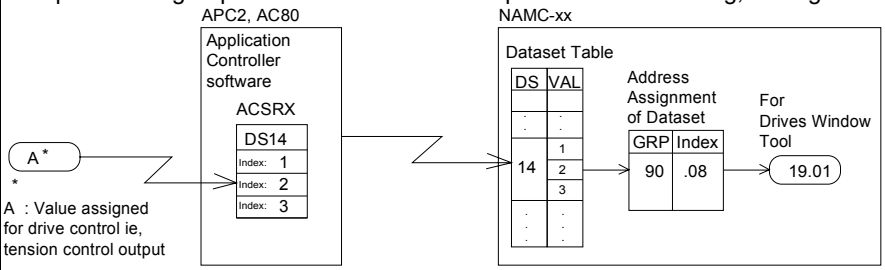
Group 18 LED Panel Control

18	Group name:	*LED PANEL CTRL*				
	Description:	The NLMD-01 Monitoring Display has a 0...150% LED bar to show an absolute real type value. The source and the scale of this display signal is defined by this parameter group. **Note:** If NLMD -01 and CDP 312 control panel are used together, the first signal selected in the Actual Signal Display Mode of CDP 312 must be the default value **1.26 LED PANEL OUTP**. Otherwise the NLMD-01 LED bar display will not show the correct value. 				
01 Index	Interval 100 ms	**LED PANEL OUTPUT**				
	Description:	Signal group and index for the LED monitor display. The default value for this signal is 1.07 **MOTOR TORQUE FILT**.				
unit:	type: I	Min: 0	Max: 30000	Def: 107	Integer scaling:	
02 Index		**SCALE PANEL**				
	Description:	The signal value (defined in Parameter 18.01) which corresponds to 100% on the LED bar display.				
unit:	type: R	Min: 0	Max: 65536	Def: 100	Integer scaling: 1 == 1	

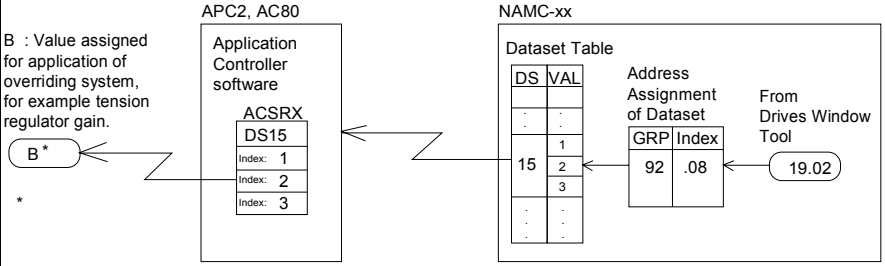
Group 19 Data Storage

19	Group name:	*DATA STORAGE*

This parameter group consists of unconnected parameters for linking, testing and commissioning purposes.



Address of the Dataset 14 index 2 is 90.08. By setting parameter 90.08 to value 1901, the value A* can be trended with the Drive*Window* monitor tool.



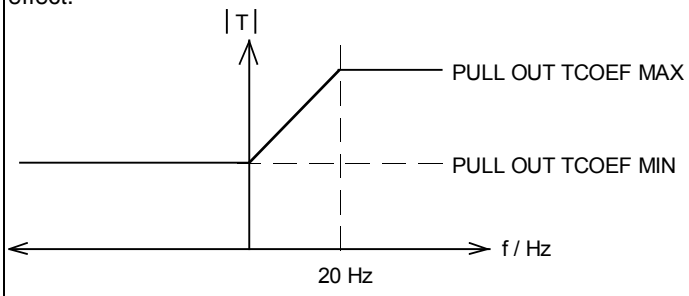
Setting 92.08 to the value 1902 by a CDP 312 Control Panel or Drive*Window*, it allows value being sent, for example gain value for tension regulator.

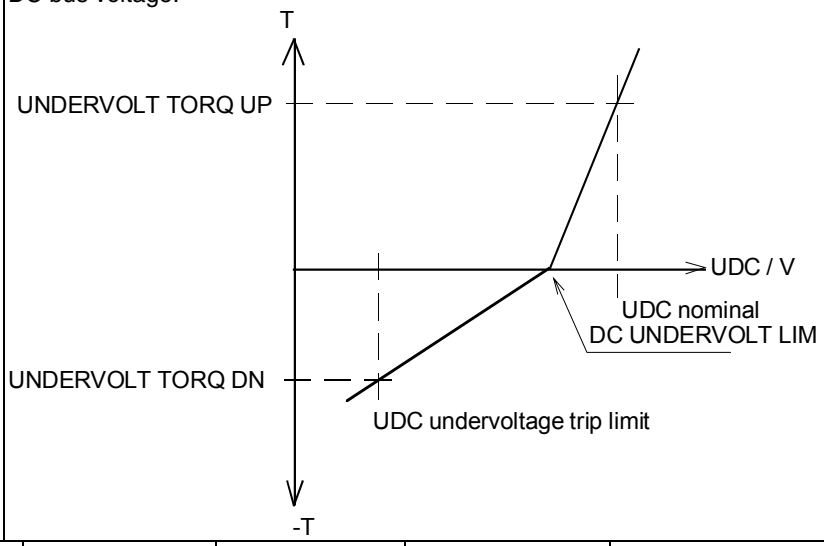
01 Index		**DATA 1**			
	Description:	A storage parameter for receiving from or sending to the overriding system. For example, if the signal from data set 18 word 3 (DW 18.3) is required for monitoring by Drive*Window*, first set Parameter 90.15 DATA SET 18 VAL 3 to 1901 (denoting Par. 19.01), then select Parameter 19.01 DATA1 for the desired Drive*WIndow* monitoring channel.			
unit:	type: R	Min: -32768	Max: 32767	Integer scaling: 1 == 1	
02 Index		**DATA 2**			
	Description:	See 19.01 DATA 1			
unit:	type: R	Min: -32768	Max: 32767	Integer scaling: 1 == 1	
03 Index		**DATA 3**			
	Description:	See 19.01 DATA 1			
unit:	type: R	Min: -32768	Max: 32767	Integer scaling: 1 == 1	
04 Index		**DATA 4**			
	Description:	See 19.01 DATA 1			
unit:	type: R	Min: -32768	Max: 32767	Integer scaling: 1 == 1	
05 Index		**DATA 5**			
	Description:	See 19.01 DATA 1			
unit:	type: R	Min: -32768	Max: 32767	Integer scaling: 1 == 1	
06 Index		**DATA 6**			
	Description:	See 19.01 DATA 1			
unit:	type: R	Min: -32768	Max: 32767	Integer scaling: 1 == 1	

19	Group name:	*DATA STORAGE*			
07 Index	Description:	**DATA 7** See 19.01 DATA 1			
unit:	type: R	Min: -32768	Max: 32767	Integer scaling: 1 == 1	
08 Index	Description:	**DATA 8** See 19.01 DATA 1			
unit:	type: R	Min: -32768	Max: 32767	Integer scaling: 1 == 1	

Group 20 Limits

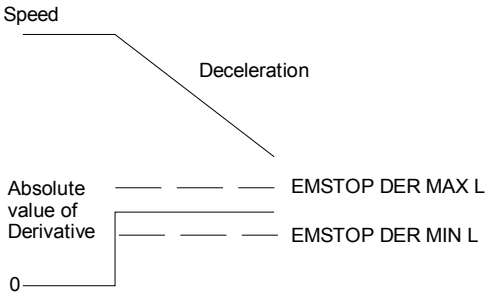
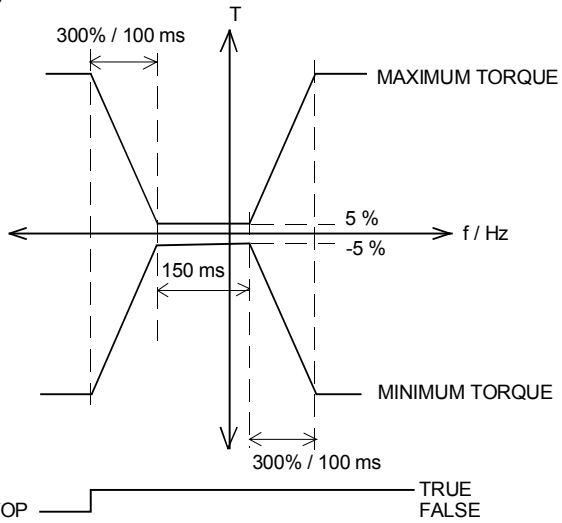
20	Group name:	*LIMITS*			
	Description:	This parameter group defines the maximum and minimum limits for the speed, frequency, current and torque algorithms. **Note:** The absolute nominal torque is calculated in the application program from the motor parameters (see Parameter Group 99).			
01 Index	Description:	**MINIMUM SPEED** Negative speed reference limit in rpm.			
unit: rpm	type: R	Min: -18000 rpm	Max: 18000rpm	Def: See 99.05	Integer scaling: See 50.01
02 Index	Description:	**MAXIMUM SPEED** Positive speed reference limit in rpm.			
unit: rpm	type: R	Min: -18000 rpm	Max: 18000rpm	Def: See 99.05	Integer scaling: See 50.01
03 Index	Description:	**ZERO SPEED LIMIT** The absolute speed value at which the drive coasts after a stop command.			
unit: rpm	type: R	Min: 0 rpm	Max: 15000rpm	Def: 60 rpm	Integer scaling: See 50.01
04 Index	Description:	**MAXIMUM CURRENT** Maximum output current I_{2max} as a percentage of the drive. The maximum values are limited according to the duty cycle tables. There are two loading cycles defined: 10 s / 60 s and 1 min / 4 min. See the ACS 600 MultiDrive catalogue.			
unit: %I2ma	type: R	Min: 0 %	Max: 200 %	Def: 170 %	Integer scaling: 100 == 1%
05 Index	Description:	**MAXIMUM TORQUE** Maximum positive output torque as a percentage of the motor nominal torque.			
unit: %	type: R	Min: 0 %	Max: 300 %	Def: 300 %	Integer scaling: 100 == 1%
06 Index	Description:	**MINIMUM TORQUE** Minimum negative output torque as a percentage of the motor nominal torque.			
unit: %	type: R	Min: -300 %	Max: 0 %	Def: -300 %	Integer scaling: 100 == 1%
07 Index	Description:	**SPC TORQMAX** Maximum speed controller output limit as a percentage of the motor nominal torque.			
unit: %	type: R	Min: 0 %	Max: 600 %	Def: 300 %	Integer scaling: 100 == 1%
08 Index	Description:	**SPC TORQMIN** Minimum speed controller output limit as a percentage of the motor nominal torque.			
unit: %	type: R	Min: -600 %	Max: 0 %	Def: -300 %	Integer scaling: 100 == 1%
09 Index	Description:	**TREF TORQMAX** Maximum torque reference as a percentage of the motor nominal torque.			
unit: %	type: R	Min: 0 %	Max: 300 %	Def: 300 %	Integer scaling: 100 == 1%
10 Index	Description:	**TREF TORQMIN** Minimum torque reference as a percentage of the motor nominal torque.			
unit: %	type: R	Min: -300 %	Max: 0 %	Def: -300 %	Integer scaling: 100 == 1%

20	Group name:	*LIMITS*			
11 Index		**FREQ TRIP MARGIN**			
	Description:	The purpose of this parameter is to protect the process against an overspeed condition. This parameter defines, together with parameters SPEEDMAX and SPEEDMIN (FREQ MAX and FREQ MIN in scalar control mode) the maximum allowed frequency of the drive. If this frequency is reached, an OVER SPEED FAULT is activated. Example: If the maximum process speed is 1420 rpm (Parameter 20.01 SPEED MAX = 1420 rpm == 50 Hz) and this parameter (20.11) is 10 Hz, the drive trips at 60 Hz.			
unit: Hz	type: R	Min: 0 Hz	Max: 500 Hz	Def: 50 Hz	Integer scaling: 100 == 1 Hz
12 Index		**PULLOUT TCOEF MAX**			
	Description:	Maximum torque limit from the calculated pull out torque. ACS 600 calculates the pull out torque value and limits the maximum motoring torque to prevent the pull out.			
unit: %	type: R	Min: 40 %	Max: 100%	Def: 70 %	Integer scaling: 1 == 1
13 Index		**PULLOUT TCOEF MIN**			
	Description:	Minimum torque limit from the pull out torque without pulse encoder feedback mode. ACS 600 calculates pull out torque value and limits the maximum motor torque to prevent pull out effect. 			
unit: %	type: R	Min: 0 %	Max: 100%	Def: 50 %	Integer scaling: 1 == 1
14 Index		**ADAPTIVE UDC MEAS**			
	Description:	The adaptive DC voltage measurement function can be disabled by this parameter. This parameter is typically used in position OFF with undervoltage controller function to define similar operating point with undervoltage controllers between the drives connected to the same DC bus. 100% == 1.35 * U_{1max} . When this parameter is ON, a DC voltage reference is floating according to network condition. 0 = **OFF** 1 = **ON**			
unit:	type: B	Min: 0	Max: 1	Def: 1	Integer scaling: 1 == 1

20	Group name:	*LIMITS*			
15 Index		**UNDERVOLT TORQ UP**			
	Description:	The undervoltage controller limiting value of maximum motor torque (%), when at nominal DC bus voltage. 			
unit: %	type: R	Min: 0 %	Max: 600 %	Def: 500%	Integer scaling: 10 ==1 %
16 Index		**UNDERVOLT TORQ DN**			
	Description:	The undervoltage controller limiting value of the minimum torque (%) at undervoltage trip (60%) point. This parameter is used together with the undervoltage controller function to tune the generating torque level of the drive during the supply power failure. See figure at Par. 20.15.			
unit: %	type: R	Min: -500 %	Max: 0 %	Def: -125 %	Integer scaling: -10 == -1 %
17 Index		**P MOTORING LIM**			
	Description:	Maximum motoring power. 100% == motor nominal power.			
unit: %	type: R	Min: 0 %	Max: 600 %	Def: 300 %	Integer scaling: 100 == 1 %
18 Index		**P GENERATING LIM**			
	Description:	Maximum generating power. 100% == motor nominal power.			
unit: %	type: R	Min: -600 %	Max: 0 %	Def: -300 %	Integer scaling: 100 == 1 %

Group 21 Start/Stop Functions

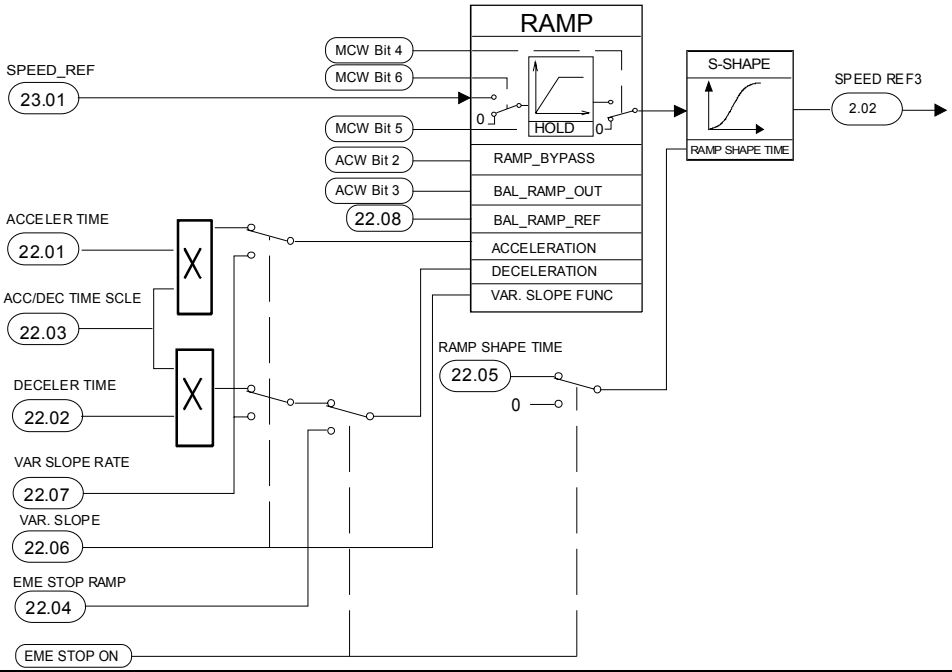
21	Group name:	*START/STOP FUNC*				
	Description:	Start and stop functions. **Note:** Coast stop is always the stop mode in a fault situation.				
01 Index		**START FUNCTION**				
	Description:	1 = **AUTO** This setting is selected when starting to a rotating machine (Flying Start). 2 = **DC MAGN** If this setting is selected, a higher starting torque can be achieved. The optimal magnetising current is calculated on the basis of the motor parameters. The pre-magnetising time is calculated using the motor information. 3 = **CNST DCMAGN** Selects the constant magnetising mode. This is the fastest starting method if the motor is at a standstill. The optimal magnetising current is calculated on the basis of the motor parameters. The pre-magnetising time is defined by parameter 21.02 (CONST MAGN TIME). To ensure full magnetising, set the value the same as or higher than the rotor time constant. If not known, use the rule-of-thumb value given below. This mode remembers last position of the motor shaft until next auxiliary voltage break of the NAMC board. This minimises possible shaft movement during the next start. See also **Parameter 21.11 START JERK COMP**. **MOTOR RATED POWER** — **Constant Magnetising Time** <10 kW — > 100 to 200 ms 10 to 200 kW — >200 to 1000 ms 200 to 1000 kW — > 1000 to 2000 ms **Warning!** The starting to a rotating machine is not possible when DC magnetising is selected. DC magnetising cannot be selected in the scalar mode.				
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:	
02 Index		**CONST MAGN TIME**				
	Description:	Defines the magnetising time for the constant magnetising mode.				
unit: ms	type: R	Min: 30 ms	Max: 10000 ms	Def: 300 ms	Integer scaling: 1 == 1 ms	
03 Index		**STOP FUNCTION**				
	Description:	Conditions during motor deceleration in the LOCAL and I/O control modes. 1 = **STOP RAMPING** Stop by the deceleration ramp DECEL TIME (22.02) 2 = **STOP TORQ** Stop by the torque limit. 3 = **COAST STOP** Torque is zero.				
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:	
04 Index		**EME STOP MODE**				
	Description:	1 = **STOP RAMPNG** Stop by the emergency stop ramp. See Parameter 22.04 2 = **STOP TORQ** Stop by the torque limit. 3 = **COAST STOP** Torque is zero. 4 = **FOLLOW STOP** Emergency stop has no function to the torque selector. Thus it is possible to stop the follower drive by torque reference of the master drive.				
unit:	type: I	Min: 1	Max: 4	Def: 1	Integer scaling:	
05 Index		**EMSTOP DER MAX L**				
	Description:	This parameter defines the maximum deceleration rate for emergency stop monitoring. See also Parameter 21.05 above. Using the default value disables the monitoring of minimum deceleration.				
unit: rpm/s	type: R	Min: 0 rpm/s	Max: 18000 rpm/s	Def: 1800 rpm/s	Integer scaling: 1 == 1	

21	Group name:	*START/STOP FUNC*			
06		**EMSTOP DER MIN L**			
Index	Description:	This parameter defines the minimum deceleration rate for emergency stop monitoring. The deceleration speed of the drive is supervised during an emergency stop condition. This supervision starts 5 seconds after the drive has received an emergency stop signal. If the drive is not able to decelerate within the window, whose minimum limit is defined by this parameter and maximum limit by parameter 21.06 **EMSTOP DER MAX L**, it is stopped by issuing a coast stop and setting **8.02 AUX CONTROL WORD** bit 2 (EMERG_STOP_COAST) to 1. Using the default value disables the monitoring of maximum deceleration. Selected deceleration actual value can be monitored from the signal **(2.12) dV/dt**.  			
unit: rpm/s	type: R	Min: 0 rpm/s	Max: 18000 rpm/s	Def: 0 rpm/s	Integer scaling: 1 == 1
07		**EMSTOP DEC MON DEL**			
Index	Description:	This parameter defines the delay before the starting of deceleration monitoring in the emergency stop. See also Parameter 21.05 and 21.06 above.			
unit: s	type: R	Min: 0 s	Max: 100 s	Def: 20 s	Integer scaling: 10 == 1s
08		**EM STOP TORQ RAMP**			
Index	Description:	This parameter activates the torque limit ramping function at the beginning of an emergency stop. The purpose is to change direction of power smoothly and prevent a possible current peak in the incoming supply unit. This function is recommended for use with regenerative thyristor supply.  0 = **OFF** 1 = **ON**			
unit:	type:	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1

21	Group name:	*START/STOP FUNC*			
09 Index		**AUTO RESTART**			
	Description:	An automatic restart using flying start after a short supply power failure (0…5 s) can be activated by this parameter. The MAIN STATUS WORD (MSW) is frozen if the DC voltage dips below 75 % and released again after restart. FAULT WORD 2 (FW2) bit 2 is masked if the drive detects an undervoltage fault, and alarm "**DC UNDERVOLT**" is generated. Note the HW requirements! 0 = **OFF** 1 = **ON**			
unit:	type: B	Min: 0	Max: 1	Def: OFF	Integer scaling: 1 == 1
10 Index		**AUTO RESTART TIME**			
	Description:	The maximum power failure duration for the auto restart function. This time also includes the charging delay of the inverters.			
unit: S	type: R	Min: 0 s	Max: 5 s	Def: 5 s	Integer scaling: 10 == 1s
11 Index		**START JERK COMP**			
	Description:	If the start mode is CONST DCMAGN, it is possible to use internal positioning control during the magnetising of the motor to minimise shaft movement. Find the setting that gives the smallest shaft movement. Setting this parameter to 0 disables the function.			
unit: %	type: R	Min: 0 %	Max: 100 %	Def: 0 %	Integer scaling: 1 == 1%

Group 22 Ramp Functions

22	Group name:	*RAMP FUNCTIONS*
	Description:	Speed reference ramp functions.



01 Index	Description:	**ACCELER TIME** The time within the drive accelerates from zero speed to the speed defined by parameter **50.01 SPEED SCALING**. The maximum acceleration time is 1800 s defined together with parameter 22.03. **Note:** The ramp time function with previous software versions is defined from the zero speed to maximum speed. See Parameter 20.02 MAXIMUM SPEED.

unit: s	type: R	Min: 0 s	Max: 1000 s	Def: 20 s	Integer scaling: 100 == 1s

02 Index	Description:	**DECELER TIME** The time within the drive decelerates from the speed defined by parameter **50.01 SPEED SCALING** to zero speed. The maximum deceleration time is 1800 s defined together with parameter 22.03. **Note:** The ramp time function until 5.1 software versions is defined from maximum speed to the zero speed. See Parameter 20.02 MAXIMUM SPEED.

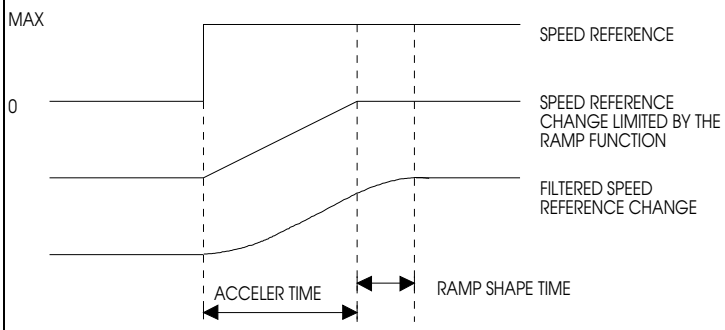
unit: s	type: R	Min: 0 s	Max: 1000 s	Def: 20 s	Integer scaling: 100 == 1s

03 Index	Description:	**ACC/DEC TIME SCLE** Multiplier for ACCELER TIME and DECELER TIME parameters to expand the time.

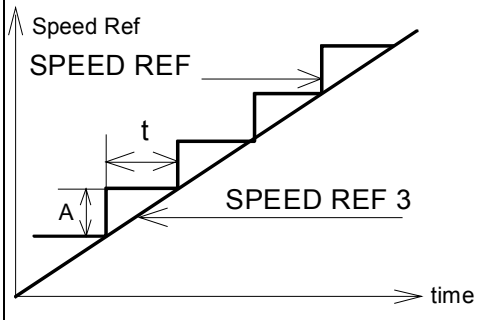
unit:	type: R	Min: 0.1	Max: 100	Def: 1	Integer scaling: 100 == 1

04 Index	Description:	**EME STOP RAMP** If an emergency stop is activated and Parameter EME STOP MODE 21.04 = 1 (STOP BY RAMP), the drive will decelerate according to this parameter to zero speed.

unit: s	type: R	Min: 0 s	Max: 3000 s	Def: 20 s	Integer scaling: 10 == 1s

22	Group name:	*RAMP FUNCTIONS*
05 Index		**SHAPE TIME**
	Description:	Speed reference softening time. This function is deactivated during an emergency stop condition. 

unit: s	type: R	Min: 0 s	Max: 1000 s	Def: 0 s	Integer scaling: 100 == 1s

06 Index		**VARIABLE SLOPE**
	Description:	This function is used to control the slope of the speed ramp during a speed reference change. The time t for step A is defined by Parameter 22.07 VAR SLOPE RATE, where t = updating interval time of the overriding system. A = speed reference change during the time t. 1 = **ON** Variable slope is enabled; the slope rate is defined by Parameter 22.07 VARIABLE SLOPE RATE. 0 = **OFF** Function is disabled. Example: The overriding system transmit interval time for the speed reference and the VAR SLOPE RATE value are equal. As a result, the shape of SPEED REF 3 is a straight line. This function is active only in REMOTE mode. 

unit:	type: B	Min:	Max:	Def: OFF	Integer scaling: 1 == 1

07 Index		**VAR SLOPE RATE**
	Description:	This parameter defines speed ramp time t for the speed reference change A, when Parameter 22.06 VARIABLE SLOPE is ON. Set this parameter to the same value as the updating interval time of the overriding system.

unit: ms	type: R	Min: 4.05 ms	Max: 30 000 ms	Def: 4.05 ms	Integer scaling: 1 == 1 ms

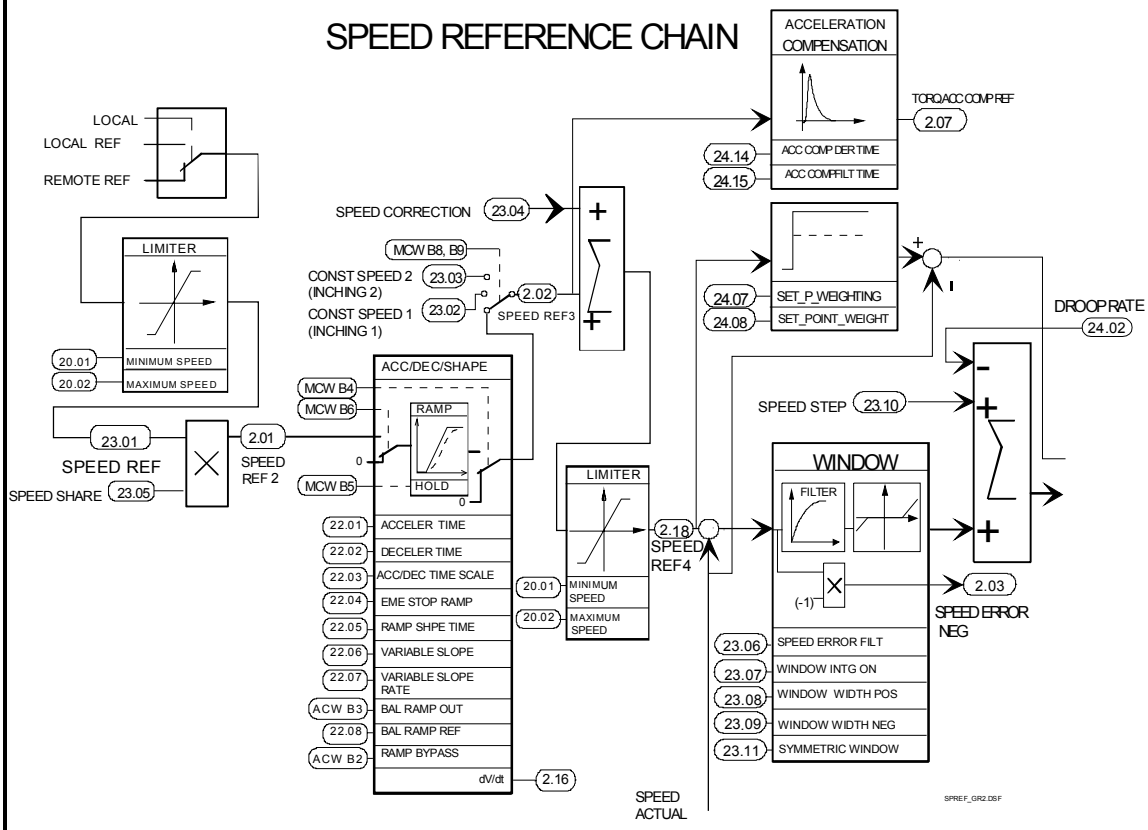
08 Index		**BAL RAMP REF**
	Description:	The output of the speed ramp can be forced to the value defined by this parameter. The function is activated by setting 7.02 AUX CONTROL WORD bit 3 to 1.

unit: rpm	type: R	Min: See 20.01	Max: See 20.02	Def: 0 rpm	Integer scaling: See Par 50.01

Group 23 Speed Reference

23	Group name:	SPEED REF

Description: Speed reference functions.

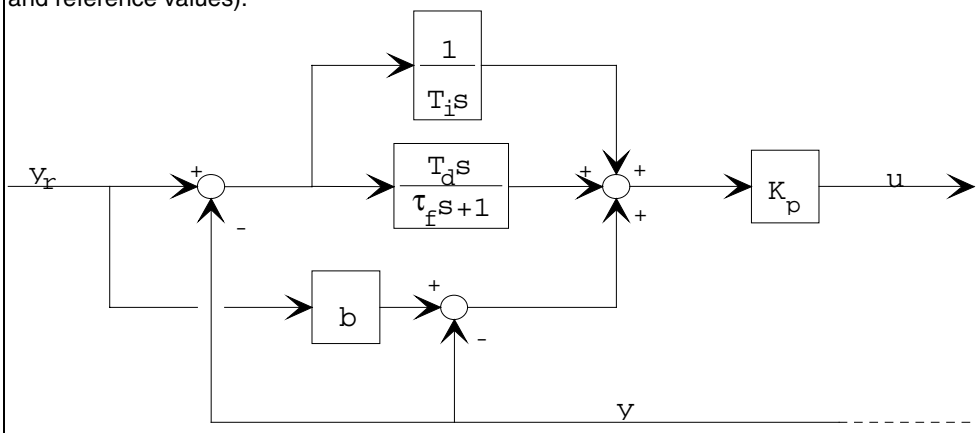


01		SPEED REF				INPUT
Index	Description:	Main speed reference input for the speed control of the drive.				
unit: rpm	type: R	Min: See 20.01	Max: See 20.02	Def: 0 rpm	Integer scaling: See Par. 50.01	
02		**CONST SPEED 1**				
Index:	Description:	Constant speed reference is activated from 7.01 MAIN CTRL WORD bit 8. See also MCW bits 4...6.				
unit:	type: I	Min: -18000 rpm	Max: 18000 rpm	Def: 0	Integer scaling: 1 == 1	
03		**CONST SPEED 2**				
Index:	Description:	Constant speed reference is activated from 7.01 MAIN CTRL WORD bit 9. See also MCW bits 4...6.				
unit:	type: I	Min: -18000 rpm	Max: 18000 rpm	Def: 0	Integer scaling: 1 == 1	

23	Group name:	*SPEED REF*			
04		**SPEED CORRECTION**			***INPUT***
Index	Description:	This parameter value can be added to the filtered reference value. **Note:** If the overriding system or NAMC application itself sends a reference value into this parameter, it must be set to zero before a stop command of the drive.			
unit: rpm	type: R	Min: See 99.05	Max: See 99.05	Def: 0 rpm	Integer scaling: See Par. 50.01
05		**SPEED SHARE**			
Index	Description:	Speed reference share coefficient.			
unit: %	type: R	Min: 0 %	Max: 400 %	Def: 100 %	Integer scaling: 10 == 1%
06		**SPEED ERROR FILT**			
Index	Description:	Speed reference and actual error filter time.			
unit: ms	type: R	Min: 0 ms	Max: 999999 ms	Def: 0 ms	Integer scaling: 1 == 1 ms
07		**WINDOW INTG ON**			
Index	Description:	1 = **ON** Integrator of the speed controller is released when window control is on. 0 = **OFF** Integrator of the speed controller is blocked when window control is on. **The Idea of Window Control** The idea of Window Control is to deactivate speed control as long as the speed deviation remains within the window set by Parameters 23.08 WINDOW WIDTH POS and 23.09 WINDOW WIDTH NEG. This allows the external torque reference to affect the process directly. For example, in Master/Follower drives, where the follower is torque controlled, window control is used to keep the speed deviation of the follower under control. The speed error output to the speed controller is zero, when speed error is within the window. If the load of the follower disappears due to a disturbance in the process, the speed error will be outside the window. The speed controller reacts and its output is added to the torque reference. Speed control (only with P-control) brings the speed to the value SPEED REF4 + WINDOW WIDTH, if not integrator used. **Note** the permanent error of the P-control. This function could be called overspeed or underspeed protection in the torque control mode. To activate the window control it must be set 26.01 TORQUE SELECTOR to value ADD and set ACW1 (7.02) bit 7 WINDOW CTRL to 1.			
unit:	type: B	Min: 0	Max: 1	Def: OFF	Integer scaling: 1 == 1
08		**WINDOW WIDTH POS**			
Index	Description:	Positive speed limit for the window control, when the calculated speed error is positive. Speed error = speed reference – speed actual. See also Par. 23.11. **Note:** Window width positive and negative is forced to zero, if SPEED REF4 + WINDOW WIDTH POS is > MAXIMUM SPEED or < MINIMUM SPEED.			
unit: rpm	type: R	Min: 0 rpm	Max: See 99.05	Def: 0 rpm	Integer scaling: See Par 50.01
09		**WINDOW WIDTH NEG**			
Index	Description:	Negative speed limit for the window control, when the calculated speed error is negative. The maximum limit is the absolute value of Parameter 23.08 WINDOW WIDTH POS. **Note:** Window width positive and negative is forced to zero, if SPEED REF4 + WINDOW WIDTH NEG is > MAXIMUM SPEED or < MINIMUM SPEED.			
unit: rpm	type: R	Min: 0	Max: See 99.05	Def: 0 rpm	Integer scaling: See Par 50.01
10		**SPEED STEP**			***INPUT***
Index	Description:	An additional speed step can be given to the speed controller directly as an additive error input. **Note:** If the overriding system or NAMC application itself sends a reference value into this parameter, it must be set to zero before a stop command of the drive.			
unit: rpm	type: R	Min: See 20.01	Max: See 20.02	Def: 0 rpm	Integer scaling: See Par 50.01

23	Group name:	SPEED REF			
11 Index		**SYMMETRIC WINDOW**			
	Description:	If this parameter is activated, the values of **WINDOW WIDTH POS** and **WINDOW WIDTH NEG** are calculated from the absolute value of the speed, not from the signed speed. Thus window width functions are symmetric for both directions of rotation. Parameter **23.09 WINDOW WIDTH NEG** functions as **WINDOW WIDTH OVERSPEED** and **23.08 WINDOW WIDTH POS** as **WINDOW WIDTH UNDERSPEED**. 0 = **OFF** 1 = **ON**			
unit:	type: B	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1

Group 24 Speed Control

24	Group name:	SPEED CONTROL			
	Description:	The speed controller is based on the PID algorithm, which continuous time is presented as follows: $$u(s) = KPS\left[(bY_r(s) - Y(s)) + \left(\frac{1}{sTIS} + \frac{T_d s}{T_f s + 1}\right)e(s)\right]$$ Variable u is the output of the controller, e is the speed error (difference between the actual and reference values).  The PID controller also has set point weighting. y is the output; y_r is the set point; u is the controller's output.			
01 Index		**PI TUNE**			
	Description:	This parameter activates automatic tuning for the speed controller which is based on the estimation of the mechanical time constant. Parameters 24.03 KPS, 24.09 TIS and 24.15 ACC COMP DER TIME are updated after the PI TUNE test. 0 = **OFF** 1 = **ON** PI TUNE is activated.			
unit:	type: B	Min:	Max:	Def: OFF	Integer scaling: 1 == 1

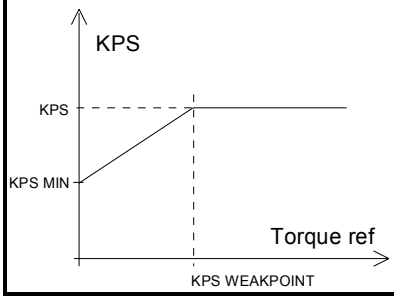
24	Group name:	*SPEED CONTROL*			
02 Index		**DROOP RATE**			
	Description:	The amount of speed decrease caused by the load is determined by means of this parameter. Asetting of 1% causes (with nominal torque reference) a 1% decrease in speed from the rated speed.			
unit: %	type: R	Min: 0 %	Max: 100 %	Def: 0 %	Integer scaling: 10 == 1%

Proportional Gain Parameter of the Speed Controller

03 Index		**KPS**			
	Description:	Relative gain for the speed controller. If you select a value of 1, a 10% change in the error value (e.g. reference - actual value) causes also the speed controller output to change by 10%.			
unit:	type: R	Min: 0	Max: 250	Def: 10	Integer scaling: 100 == 1

24	Group name:	*SPEED CONTROL*

The Adaptive Speed Control as a Function of the Torque Reference



The adaptive gain of the speed controller is used to smooth out disturbances which are caused by low load and backlash. Moderate filtering of the speed error (Parameter 23.04) is typically not enough to tune the drive.

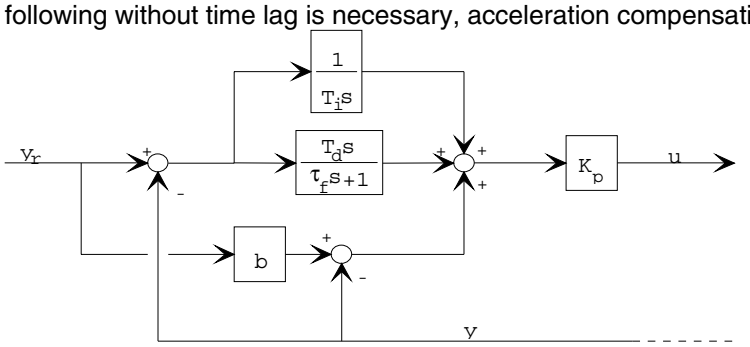
04 Index		**KPS MIN**			
	Description:	KPS MIN determines the proportional gain when the speed controller output is zero.			
unit:	type: R	Min: 0	Max: 150	Def: 10	Integer scaling: 100 == 1
05 Index		**KPS WEAKPOINT**			
	Description:	The value of the speed controller output where the gain is KPS			
unit: %	type: R	Min: 0 %	Max: see 20.05	Def: 0 %	Integer scaling: 100 == 1%
06 Index		**KPS WP FILT TIME**			
	Description:	The rate of change for the proportional gain can be softened by this parameter.			
unit: ms	type: R	Min: 0 ms	Max: 999999 ms	Def: 100 ms	Integer scaling: 1 == 1 ms

24	Group name:	SPEED CONTROL

Set Point Weighting

Set point weighting is a well known method in control engineering. In this method, the set point is weighted by a factor b<1. This weighting is applied only to the P term. Integral and derivative terms have a normally weighted (b=1) setpoint and speed error.

This kind of manipulation leads to a situation where, in a steady state, the P term is not zero. The controller output is still 'right' because the integral part compensates the P term error. Thus, in a steady state, the controller works normally; the integral term "sees" error caused by load and noise. In set point changes, however, the controller's overshoot can be reduced by weighting factor b. Thus, good load rejection is not anymore related to huge overshoot. In applications where ramp following without time lag is necessary, acceleration compensation is the right tool.



There is no overshoot in a set point change when factor b is set correctly (b<1). This results in the integral term's energy compensating the error caused by the P term. For example, if y_r=1 and b=0.9, the P term set point is actually 0.9 which naturally causes a 10% error for the integral termhandle.

24	Group name:	SPEED CONTROL			
07 Index		**SET P WEIGHTING**			
	Description:	Set Point Weighting is enabled by this parameter. The change over is smooth which enables the on-line changing of weighting. 0 = **OFF** 1 = **ON** SET POINT WEIGHTING is activated.			
unit:	type: B	Min:	Max:	Def: OFF	Integer scaling: No
08 Index		**SET POINT WEIGHT**			
	Description:	The value of the speed controller output, where the gain is KPS.			
unit: %	type: R	Min: 30 %	Max: 100 %	Def: 100 %	Integer scaling: 1 == 1%

24	Group name:	*SPEED CONTROL*

Integration Time Parameters of the Speed Controller

09 Index		**TIS**			
	Description:	Integration time for the speed controller. This defines the time within which the maximum output is achieved if a constant error value exists and the relative gain of the speed controller is 1.			
unit: s	type: R	Min: 0.01 s	Max: 1000 s	Def: 2.5 s	Integer scaling: 1000 == 1s
10 Index		**TIS INIT VALUE**			
	Description:	Initial value of the integrator.			
unit: %	type: R	Min: see 20.06	Max: see 20.05	Def: 0 %	Integer scaling: 100 == 1%
11 Index		**BAL REF**			
	Description:	External value to be forced to the output of the speed controller when 7.02 AUX CONTROL WORD bit 8 BAL_NCONT is 1.			
unit: %	type: R	Min: see 20.06	Max: see 20.05	Def: 0 %	Integer scaling: 100 == 1%

Derivation Parameters of the Speed Controller

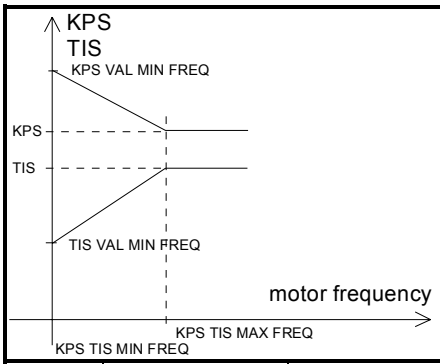
12 Index		**DERIVATION TIME**			
	Description:	Derivation time for speed controller. Defines the time within which he speed controller derives the error value before the output of the speed controller is changed. If this is set to zero, the controller works as a PI controller, otherwise as a PID controller.			
unit: ms	type: R	Min: 0 ms	Max: 10000 ms	Def: 0 ms	Integer scaling: 1 == 1 ms
13 Index		**DERIV FILT TIME**			
	Description:	The derivation filter time constant.			
unit: ms	type: R	Min: 0 ms	Max: 100000 ms	Def: 8 ms	Integer scaling: 1 == 1 ms

Acceleration Compensation Parameters

14 Index		**ACC COMP DER TIME**			
	Description:	Derivation time used during compensation of acceleration. In order to compensate inertia during acceleration, the derivative of the reference is added to the output of the speed controller. The function is deactivated by setting the parameter to 0.			
unit: s	type: R	Min: 0 s	Max: 1000 s	Def: 0 s	Integer scaling: 10 == 1s
15 Index		**ACC COMPFILT TIME**			
	Description:	Acceleration compensation term filter coefficient.			
unit: ms	type: R	Min: 0 ms	Max: 999999 ms	Def: 8 ms	Integer scaling: 1 == 1 ms
16 Index		**SLIP GAIN**			
	Description:	This parameter Is effective only when the calculated internal speed is used as actual speed feedback. 100% means full slip compensation. 0% corresponds no slip compensation (the calculated speed equals to motor frequency).			
unit: %	type: R	Min: 0 %	Max: 400 %	Def: 100 %	Integer scaling: 1 == 1%

24	Group name:	SPEED CONTROL

Adaptive Speed Control as Function of the Speed



The adaptive speed control as a function of speed

In certain applications it is useful to increase the relative gain and decrease the integration time at low speeds, which improves the performance of the speed control at low speeds. The linear increase and decrease of these parameters is started at the speed of KPS TIS MIN FREQ and ended at KPS TIS MAX FREQ. Changing the rate of relative gain and integration time is done by parameters KPS VAL MIN FREQ and TIS VAL MIN FREQ.

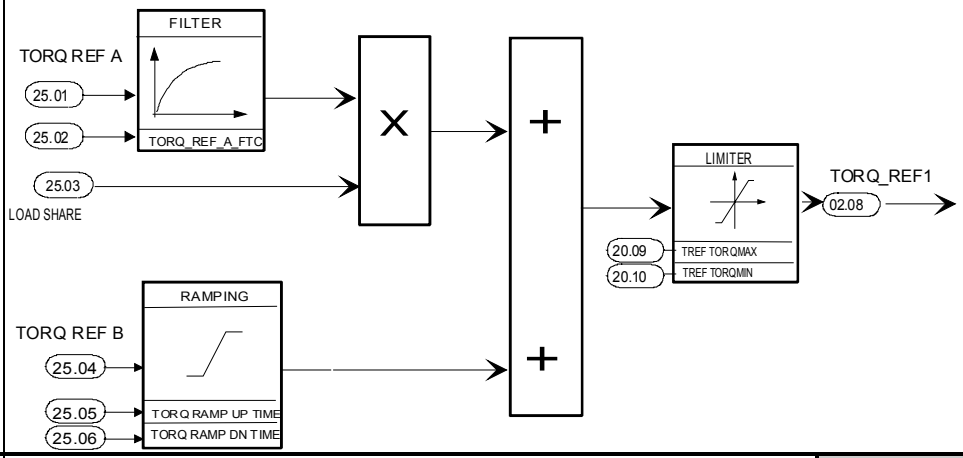
17		**KPS TIS MIN FREQ**			
Index	Description:	The minimum motor frequency limit above which the relative gain and integral time is defined by parameters KPS VAL MIN FREQ and TIS VAL MIN FREQ.			
unit: Hz	type: R	Min: 0 Hz	Max: 200 Hz	Def: 5 Hz	Integer scaling: 100 == 1 Hz

18		**KPS TIS MAX FREQ**			
Index	Description:	The frequency point at which KPS and TIS become constant.			
unit: Hz	type: R	Min: 0 Hz	Max: 200 Hz	Def: 11.7 Hz	Integer scaling: 100 == 1 Hz

19		**KPS VAL MIN FREQ**			
Index	Description:	Relative gain percentage of KPS at the speed defined by KPS TIS MIN FREQ.			
unit: %	type: R	Min: 100 %	Max: 500 %	Def: 100 %	Integer scaling: 1 == 1%

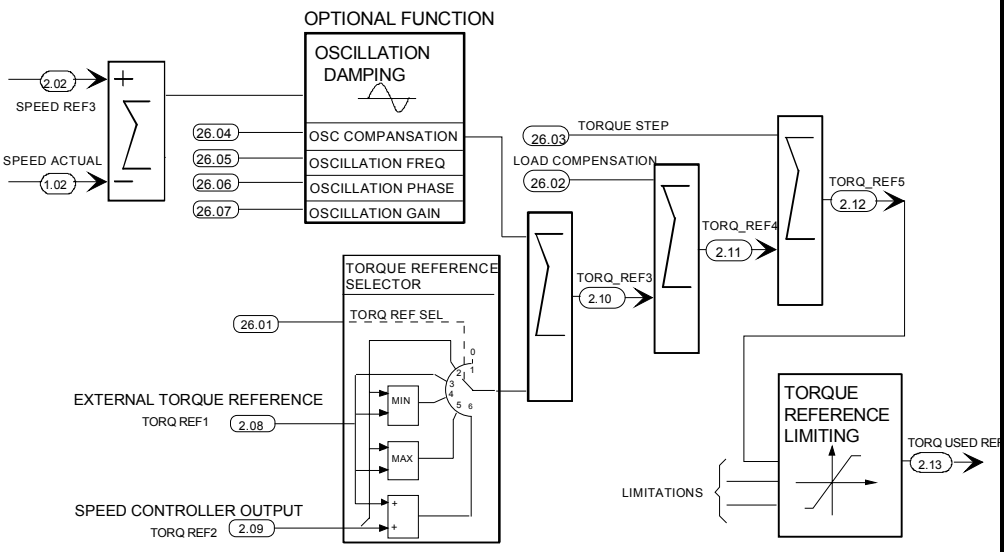
20		**TIS VAL MIN FREQ**			
Index	Description:	Relative integral time percentage of TIS at the speed defined by KPS TIS MIN FREQ.			
unit: %	type: R	Min: 100 %	Max: 500 %	Def: 100 %	Integer scaling: 1 == 1%

Group 25 Torque Reference

25	Group name:	*TORQUE REF*				
	Description:	Torque reference chain.  				
01		**TORQUE REF A**				***INPUT***
Index	Description:	Torque reference. TORQUE REF A can be scaled by the parameter LOAD SHARE. **Note:** This signal is reset (one shot) upon switching to I/O control. See the AUTO/HAND function.				
unit: %	type: R	Min: see 20.06	Max: see 20.05	Def: 0 %	Integer scaling:	100 == 1%
02		**TORQ REF A FTC**				
Index	Description:	TORQUE REF A low pass filter time constant.				
unit: ms	type: R	Min: 0 ms	Max: 60000 ms	Def: 0 ms	Integer scaling:	1 == 1 ms
03		**LOAD SHARE**				
Index	Description:	TORQ REF A scaling factor which scales the external torque reference to a required level.				
unit: %	type: R	Min: -400 %	Max: 400 %	Def: 100 %	Integer scaling:	10 == 1%
04		**TORQUE REF B**				***INPUT***
Index	Description:	Torque reference. Torque reference B is ramped by the parameters TORQ RAMP UP TIME and TORQ RAMP DN TIME. **Note:** This signal is reset (one shot) upon switching to overriding system control (par. 98.02 = FBA DS1 or FBA DS10). See the AUTO/HAND function.				
unit: %	type: R	Min: see 20.06	Max: see 20.05	Def: 0 %	Integer scaling:	100 == 1%
05		**TORQ RAMP UP**				
Index	Description:	Torque reference B ramp time from 0 % to 100 %.				
unit: s	type: R	Min: 0 s	Max: 120 s	Def: 0 s	Integer scaling:	100 == 1s
06		**TORQ RAMP DOWN**				
Index	Description:	Torque reference B ramp time from 100 % to 0 %.				
unit: s	type: R	Min: 0 s	Max: 120 s	Def: 0 s	Integer scaling:	100 == 1s
07		**TORQ ACT FILT TIME**				
Index	Description:	Filter time constant for signal **1.07 MOTOR TORQFILT2** used for torque actual monitoring purposes.				
unit: ms	type: R	Min: 2 ms	Max: 20000 ms	Def: 100 ms	Integer scaling:	1 == 1 ms

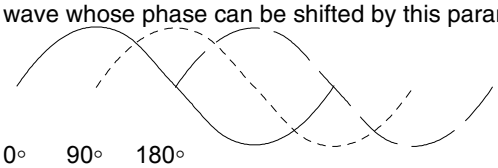
Group 26 Torque Reference Handling

26	Group name:	*TORQ REF HANDLING*				
	Description:	The torque reference can be given from the speed reference chain (TORQ REF2) or from the torque reference chain (TORQ REF1) depending on the control mode. This group defines how to handle the reference after the torque selector block.				



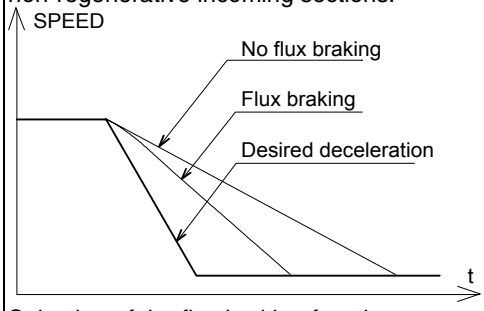
01 Index		TORQUE SELECTOR				
	Description:		The torque reference selector includes.			
		1 = **ZERO**	Zero control			
		2 = **SPEED**	Speed control			
		3 = **TORQUE**	Torque control **Note:** To prevent the torque limitation in generating mode, keep the minimum torque limits < 0 (zero) e.g. during fast deceleration in the positive speed direction.			
		4 = **MINIMUM**	Minimum control. The drive follows smaller value of the TORQ REF1 and TORQ REF2. However, if the speed error becomes negative the drive follows TORQ REF2 until the speed error becomes positive again (latch function). Thus the drive never accelerates uncontrolled if the load is lost in the torque control.			
		5 = **MAXIMUM**	Maximum control. The drive follows bigger value of the TORQ REF1 and TORQ REF2. However if the speed error becomes positive the drive follows TORQ REF2 until the speed error becomes negative again (latch function). Thus the drive never accelerates uncontrolled if the load is lost in the torque control.			
		6 = **ADD**	Add control. The output of the torque selector is a sum of the TORQ REF1 and TORQ REF2. When the Window Control is required, a bit 7 WINDOW_CTRL must be activated in the ACW2 (7.02).			
unit:	type: I	Min: 1	Max: 6	Def: 2 SPEED	Integer scaling:	

02 Index		LOAD COMPENSATION			*INPUT*
	Description:	Load compensation added to TORQ REF3. **Note:** If the overriding system or the NAMC application itself sends a reference value into this parameter, it must be set to zero before the stop command of the drive.			
unit: %	type: R	Min: See 20.06	Max: See 20.05	Def: 0 %	Integer scaling: 100 == 1%

26	Group name:	*TORQ REF HANDLING*			
03		**TORQUE STEP**			***INPUT***
Index	Description:	Additional torque step added to TORQ REF4. **Note:** If the overriding system or the NAMC application itself sends a reference value into this parameter, it must be set to zero before the stop command of the drive.			
unit: %	type: R	Min: See 20.06	Max: See 20.05	Def: 0 %	Integer scaling: 100 == 1%
04		**OSC COMPENSATION**			
Index	Description:	TORSIONAL VIBRATION DAMPING The filter uses the speed error as an input. The bandpass filter searches for certain frequencies and calculates a sine wave which is summed to the torque reference after the phase shift. The phase shift can be set to phase angles between 0-360 degrees. Typically this function is needed to dampen the mechanical oscillations. The following three parameters also belong to this function. 0 = **ON** function is enabled 1 = **OFF** function is disabled			
unit:	type: B	Min:	Max:	Def: OFF	Integer scaling: 1 == 1
05		**OSCILLATION FREQ**			
Index	Description:	**OSCILLATION FREQ** is the oscillation frequency (Hz). Oscillation frequency is determined by viewing the speed difference signal and the following equation: $f = \frac{N_{peaks}}{T}$, where N_{peaks} is the number of peaks in the time window T (seconds). For example, if we see 11 peaks in 1.5 seconds the frequency is f =11/1.5=7.3 Hz.			
unit: Hz	type: R	Min: 0 Hz	Max: 60 Hz	Def: 31 Hz	Integer scaling: 100 == 1 Hz
06		**OSCILLATION PHASE**			
Index	Description:	Oscillation phase is the phase angle of the sine wave. The control algorithm produces a sine wave whose phase can be shifted by this parameter.  0◦ 90◦ 180◦			
unit: ° deg	type: R	Min: 0 °	Max: 360 °	Def: 0 °	Integer scaling: 1 == 1.41°
07		**OSCILLATION GAIN**			
Index	Description:	Oscillation gain determines how much the sine wave is amplified before it is summed to the speed error signal. Oscillation gain is scaled according to the speed controller gain so that changing the speed controller gain will not disturb the oscillation damping.			
unit: %	type: R	Min: 0 %	Max: 100 %	Def: 0 %	Integer scaling: 100 == 1%

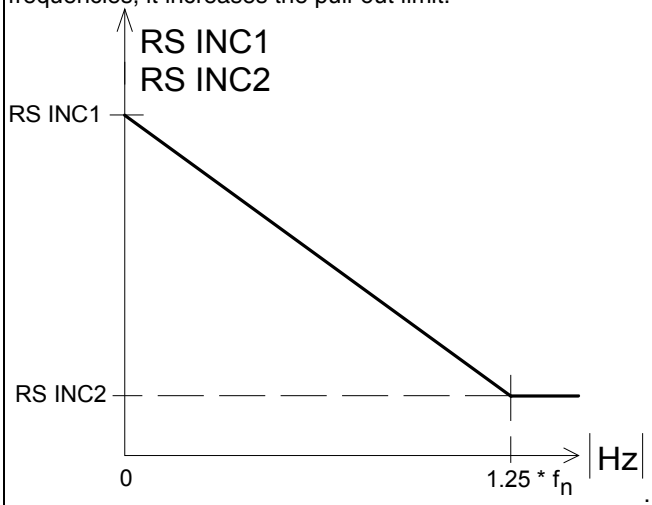
Group 27 Flux Control

27	Group name:	*FLUX CONTROL*			
	Description:				
01		**FLUX OPTIMIZATION**			
Index	Description:	The motor flux can be optimised in order to minimise the motor losses and reduce motor noise. Flux optimisation is used in drives that usually operate below nominal load. 1 = **YES** flux optimisation enabled. 0 = **NO** flux optimisation disabled.			
unit:	type: B	Min:	Max:	Def: NO	Integer scaling: 1 == 1

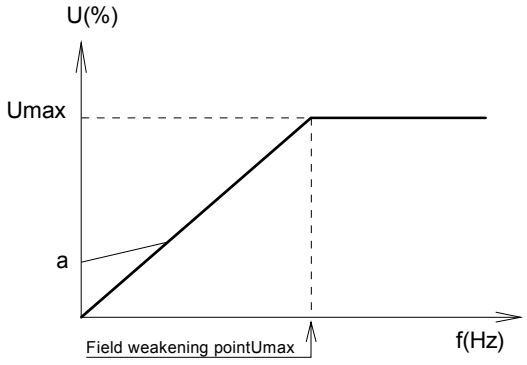
27	Group name:	*FLUX CONTROL*			
02		**FLUX BRAKING**			
Index	Description:	The braking ability of the drive can be highly improved by utilising flux braking. During braking, the mechanical energy of the driven equipment has to be dissipated in the motor and inverter. By modifying the magnetising level of the motor, thermal losses can be increased and the motor can be stopped more effectively. This function can be used with the non-regenerative incoming sections.  Selection of the flux braking function. 1 = **YES** Flux braking enabled. 0 = **NO** Flux braking disabled.			
unit:	type: B	Min:	Max:	Def: OFF	Integer scaling: 1 == 1
03		**FLUX REF**			
Index	Description:	Flux reference value in percentage. This value is stored to FPROM memory when set by CDP 312 or Drive*Window*.			
unit: %	type: R	Min: see 27.05	Max: see 27.04	Def: 100 %	Integer scaling: 10 == 1%
04		**FLUX MAX**			
Index	Description:	Maximum limit of the flux percentage.			
unit: %	type: R	Min: 100 %	Max: 140 %	Def: 140 %	Integer scaling: 10 == 1%
05		**FLUX MIN**			
Index	Description:	Minimum limit of the flux percentage.			
unit: %	type: R	Min: 0 %	Max: 100 %	Def: 25 %	Integer scaling: 10 == 1%
08		**HEX FIELD WEAKEN**			
Index:	Description:	This parameter selects whether motor flux is controlled along a circular or a hexagonal pattern in the field weaking area of the frequency range. **1 = ON Enabled** Motor flux is controlled along a circular pattern below the field weaking point (FWP, typically 50 or 60 Hz), and along a hexagonal pattern in the field weaking range. The applied pattern is changed gradually as the frequency increases from 100% to 120% of the FWP. Using the hexagonal flux pattern, maximum output voltage can be reached; the peak load capacity is higher than with the circular flux pattern but the continuous load capacity is lower in the frequency range of FWP to 1.6 x FWP, due to increased losses. **0 = OFF Disabled** ACS600 controls the motor flux insuch a way that the rotating flux vector follows a circular pattern. This is the default value and ideal for most applications. However, when operated in the field weaking range, it is not possible to reach 100% output voltage. The peak load capacity of the drive is lower than with the full voltage.			
unit:	type: B	Min: 0	Max: 1	Def: OFF	Integer scaling: 1 == 1

Group 28 Motor Model

28	Group name:	*MOTOR MODEL*			
	Description:	The parameters 28.01...28.05 are ineffective**, if a pulse encoder is used**. These parameters only affect the motor model fine tuning and are required adjustment only in special cases.			
01 Index		**ZER COEF1**			
	Description:	This coefficient affects to the sensitivity of the pull-out prevention within the generator quadrant, with the speed below 20% of nominal speed and the torque above 30%. This parameter is automatically set according to an estimation during the Motor ID run or first start-up and normally requires no alteration. If the motor is prone to pull out at low speeds within the generator quadrant, decrease the coefficient. If motor is unstable at zero speed, increase the coefficient.			
unit: %	type: R	Min: 0 %	Max: 100 %	Def: 6 %	Integer scaling: 1 == 1 %
02 Index		**ZER GAIN**			
	Description:	This coefficient also affects the sensitivity of the pull-out prevention within the generator quadrant, but inversely to Parameter 28.01.			
unit: %	type: R	Min: 0 %	Max: 4 %	Def: 7 %	Integer scaling: 1 == 1 %
03 Index		**MOT COEF**			
	Description:	This parameter affects the accuracy and linearity of the torque control at low frequencies (<10%) within the motor quadrant, when the torque is >30%. This parameter is essential in maximising breakaway torque, as well as the stability of torque above 100% Decreasing the value improves the ability to reach the maximum allowed torque. Too low a value makes the motor prone to pull out at low frequencies within the motor quadrant.			
unit: %	type: R	Min: 0 %	Max: 100 %	Def: 40 %	Integer scaling: 1 == 1 %
04 Index		**GEN COEF**			
	Description:	This parameter affects the stability of torque at low frequencies (<30%) within the generator quadrant. A greater value results in a more stable torque, however increasing the susceptibility to pulling out at a particular operation point if torque is above 40%. Increasing this value is useful in straightening out vibration problems.			
unit: %	type: R	Min: 0 %	Max: 100 %	Def: 0 %	Integer scaling: 1 == 1 %
05 Index		**MG COEF**			
	Description:	This parameter affects to the accuracy and linearity of the torque control at low frequencies and torque within all quadrants. This parameter has no effect when frequency is >30% or torque is >80%.			
unit: %	type: R	Min: 0 %	Max: 100 %	Def: 0 %	Integer scaling: 1 == 1 %
06 Index		**CABLE LENGTH**			
	Description:	This is used only, if the motor power is below 10 kW and the cable is longer than 80 metres. Otherwise it is not advisable to change this parameter value. This parameter affects to the switching frequency at low frequency reference (<20% of motor nominal).			
unit: m	type: R	Min: 0 m	Max: 1000 m	Def: 10 m	Integer scaling: 1 == 1 m
07 Index		**LONG DISTANCE MOD**			
	Description:	Long Distance Mode. This function is used to limit maximum voltage peaks in the motor circuit and to reduce the switching frequency of the inverter. This parameter is used as standard on 690 V inverter units; it can also be used when the motor cables are long. 1 = **ON** Long distance mode enabled. 0 = **OFF** Long distance mode disabled.			
unit:	type: B	Min:	Max:	Def: ON	Integer scaling: 1 == 1

28	Group name:	*MOTOR MODEL*			
08 Index		**TR TUNE**			
	Description:	This coefficient affects the calculated rotor time constant according to the motor rating plate values. It is used if the nominal speed value of the motor rating plate does not correspond to the real speed. For example, if the real slip speed is 10% higher than the calculated slip speed stated on the motor rating plate, a coefficient value of 10% is set into this parameter. See also signal 3.06 TR. **Note:** This parameter is effective only if a pulse encoder is used.			
unit: %	type: R	Min: -60 %	Max: 200 %	Def: 0 %	Integer scaling: 1 == 1
09 Index		**RS INC1**			
	Description:	RS INC1 and RS INC2 coefficient parameters together define a function, which affects the measured stator resistance value. By increasing the stator resistance value at low frequencies, it increases the pull-out limit.  			
unit: %	type: R	Min: -60 %	Max: 100 %	Def: 25 %	Integer scaling: 10 == 1 %
10 Index		**RS INC2**			
	Description:	This coefficient defines the coefficient value of the stator resistance at 1.25 * motor nominal frequency. See parameter RS INC1.			
unit: %	type: R	Min: -60 %	Max: 100 %	Def: 0 %	Integer scaling: 10 == 1 %
11 Index		**CALC CURRENT CORR**			
	Description:	Determines the proportional gain that is used to correct the calculated current (Icalc) based on the measured current (Imeas): Lcalc = Icals(-1) + (calc_current_corr/100)*(Imeas – Icalc(-1)). The default value (= 100%) forces the calculated current to follow the measured current and there is no reason to reduce this parameter from 100%, if there is no interferences in current measurements. However, if instantaneous current readings are corrupted by current oscillations caused by long motor cables (or LC-filter), then the noise immunity can be greatly improved by decreasing this parameter. Normally 10% is a suitable value to make DTC work with long cables (without LONG DISTANCE MODE). This parameter has no effect when using scalar control.			
unit: %	type: R	Min: 5 %	Max: 100 %	Def: 100 %	Integer scaling: 10 == 1 %

Group 29 Scalar Control

29	Group name:	*SCALAR CONTROL*				
	Description:	Scalar control is activated by selecting SCALAR at Parameter 99.08 CONTROL MODE. This parameter group is invisible when DTC control mode is selected. **Note:** The following Start-Up parameters have no effect in scalar control: 99.03 MOTOR NOM CURRENT 99.05 MOTOR NOM SPEED 99.06 MOTOR NOM POWER **Note:** Parameter 50.01 SPEED SCALING has only affect for scaling of the actual speed in the Scalar motor control mode. Scalar control parameters can be seen in the Control Diagram. The scalar control mode is recommended for multimotor drives when the number of motors connected to the ACS 600 is variable. Scalar control is also recommended when the nominal current of the motor is less than 1/6 of the nominal current of the inverter, or the inverter is used for test purposes with no motor connected. The motor identification Run, flying start, torque control, DC HOLD, motor phase loss check, and stall functions are disabled in the scalar control mode.				
01		**FREQUENCY REF**				***INPUT***
Index	Description:	This is an input for the frequency reference.				
unit: Hz	type: R	Min: See 29.03	Max: See 29.02	Def: 0	Integer scaling: 100 == 1 Hz	
02		**FREQUENCY MAX**				
Index	Description:	Operating range maximum frequency. This parameter has an internal link to the parameter SPEED MAX; if SPEED MAX is changed, this parameter is changed accordingly by the application program.				
unit: Hz	type: R	Min: See 29.03	Max: 300 Hz	Def: See 20.01	Integer scaling: 100 == 1 Hz	
03		**FREQUENCY MIN**				
Index	Description:	Operating range maximum frequency. This parameter has an internal link to the parameter SPEED MIN; if SPEED MIN is changed, this parameter is changed accordingly by the application program.				
unit: Hz	type: R	Min: -300 Hz	Max: See 29.02	Def: See 20.02	Integer scaling: 100 == 1 Hz	
04		**IR COMPENSATION**				
Index	Description:	This parameter sets the extra relative voltage that is fed to the motor at zero frequency. The range is 0...30% of motor nominal voltage.  				
unit: %	type: R	Min: 0 %	Max: 30 %	Def: 0	Integer scaling: 100 == 1	

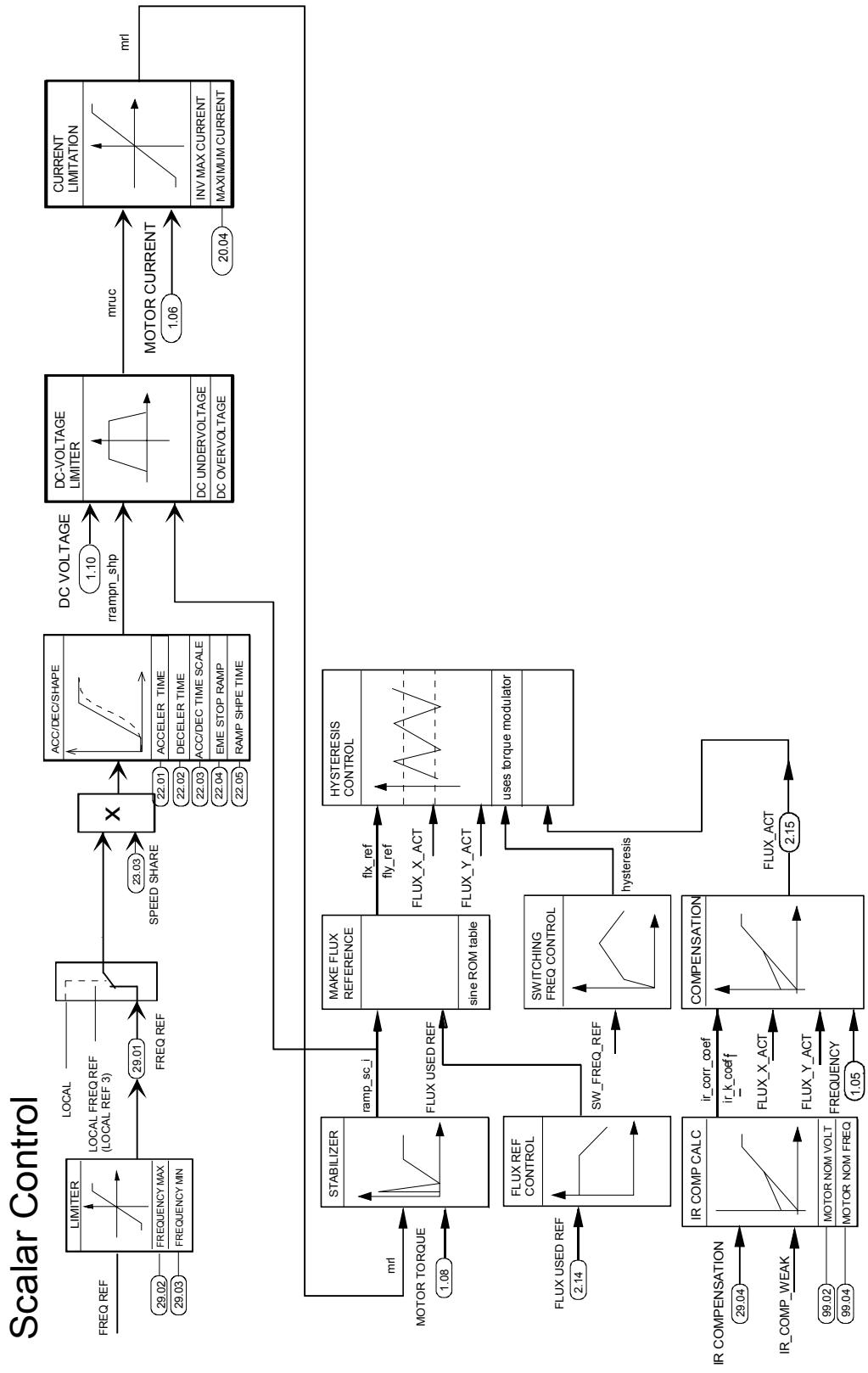


Figure 5 - 2 Scalar Control diagram

Group 30 Fault Functions

30	Group name:	*FAULT FUNCTIONS*			
	Description:				
01 Index		**MOT THERM P MODE**			
	Description:	Motor thermal protection mode selection. The selections are based on the thermal model defined by the drive (DTC) or the user (USER MODE). Motor heat-up is calculated assuming a load curve. **Note:** Motor thermal model can only be used when one motor is connected to the output of the inverter. 1 = **DTC** The drive defines the thermal model values during the Motor Identification Run. (See Parameter 99.06.) **Note:** This mode can be used for ABB motors up to 800 A of I_N. Above that, USER MODE is the only valid selection. 2 = **USER MODE** The user can define the thermal model values using Parameters 30.09...30.12 and 30.28…30.31.			
unit:	type: I	Min: 1	Max: 2	Def: 1	Integer scaling: 1 == 1
02 Index		**MOTOR THERM PROT**			
	Description:	Operation in case of an overload based on the motor thermal model protection (par. 30.01). 1 = **FAULT** 2 = **WARNING** 3 = **NO** No thermal model protection and feedback to the motor model. **Note:** PT100 or PTC measurement and monitoring is activated by Parameter 30.03 MOT1 TEMP AI1 SEL and 30.06 MOT2 TEMP AI2 SEL.			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
03 Index:		**MOT1 TEMP AI1 SEL**			
	Description:	This parameter is used to activate an external motor temperature measurement circuit connected to analogue input AI1 with NIOC-01 and NBIO-21 I/O-boards. See par. **98.07 BASIC I/O BOARD**. Analogue output AO1 supplies a constant current according to the selections shown below. The measurement circuit employs 1 to 3 PT100 sensors or PTC thermistors. See the circuit diagrams at Parameter 98.06. 1 = **NOT IN USE** Analogue input AI1 is not in use for motor temperature measurement. 2 = **1xPT100** One PT100 sensor; 9.1 mA current generator, (0...10V or 0...2V with NAIO-01, NAIO-02, NAIO-03 or NBIO-21 extension module. 3 = **2xPT100** Two PT100 sensors; 9.1 mA current generator, 0...10V. 4 = **3xPT100** Three PT100 sensors; 9.1 mA current generator, 0...10V. 5 = **1...3 PTC** 1 to 3 PTC thermistors or KTY84-xx silicon temperature sensor; 01.6 mA current generator, 0...10V.			
unit:	type: I	Min: 1	Max: 5	Def: 1	Integer scaling:
04 Index		**MOT 1 TEMP ALM L**			
	Description:	Motor 1 temperature alarm is activated when the measured temperature rises above this limit. PT100 [°C], PTC (Ω).			
unit: °C or Ω	type: R	Min: -10 °C or 0Ω	Max: 180 °C or 5000Ω	Def: 110 °C or 0Ω	Integer scal: 1 = 1°C or 1Ω
05 Index		**MOT 1 TEMP FLT L**			
	Description:	Motor 1 temperature trip is activated when the measured temperature rises above this limit. PT100 [°C], PTC (Ω).			
unit: °C or Ω	type: R	Min: -10 °C or 0Ω	Max: 180 °C or 5000Ω	Def: 130 °C or 0Ω	Integer scal: 1 = 1°C or 1Ω

30	Group name:	*FAULT FUNCTIONS*				
06		**MOT2 TEMP AI2 SEL**				
Index:	Description:		This parameter is used to activate a second external motor temperature measurement circuit connected to NAIO I/O extension module or NBIO-21 I/O module, analogue input AI2. Analogue output AO2 supplies a constant current. The measurement circuit employs 1 to 3 PT100 sensors or PTC thermistors. See the circuit diagrams at Parameter 98.06. **Note:** Both measurement circuits (motor 1 and motor 2) have to be connected to the NAIO I/O extension module, if NIOC-01 exists. Not in use for motor temperature measurement (0...10V range).
		1 = **NOT IN USE**	One PT100 temperature sensor (9.1 mA current gen., select 0...2V			
		2 = **1xPT100**	range by DIP switches in the NAIO extension module.)			
			Two PT100 temperature sensors (9.1 mA current gen., 0...10V)			
		3 = **2xPT100**	Three PT100 temperature sensors (9.1 mA current gen., 0...10V)			
		4 = **3xPT100**	1...3 PTC thermistor or KTY84-xxsilicon temperature sensor;			
		5 = **1...3 PTC**	(1.6 mA current generator, 0...10V range).			
unit:	type: I	Min: 1	Max: 5	Def: 1	Integer scaling:	
07		**MOT 2 TEMP ALM L**				
Index	Description:	Motor 2 temperature alarm is activated when the measured temperature rises above this limit. PT100 [°C], PTC (Ω)[°C].				
unit: °C or Ω	type: R	Min: -10 °C or 0Ω	Max: 180 °C or 5000Ω	Def: 110 °C or 0Ω	Int. scal: 1 = 1°C or 1Ω	
08		**MOT 2 TEMP FLT L**				
Index	Description:	Motor 2 temperature trip is activated when the measured temperature rises above this limit. PT100 [°C], PTC (Ω)[°C].				
unit: °C or Ω	type: R	Min: -10 °C or 0Ω	Max: 180 °C or 5000Ω	Def: 130 °C or 0Ω	Int. scal: 1 = 1°C or 1Ω	

Motor Thermal Model User Mode

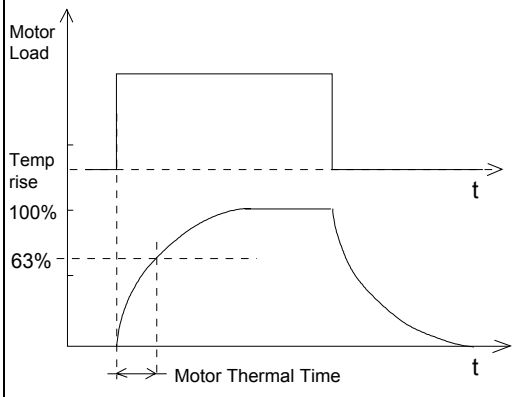
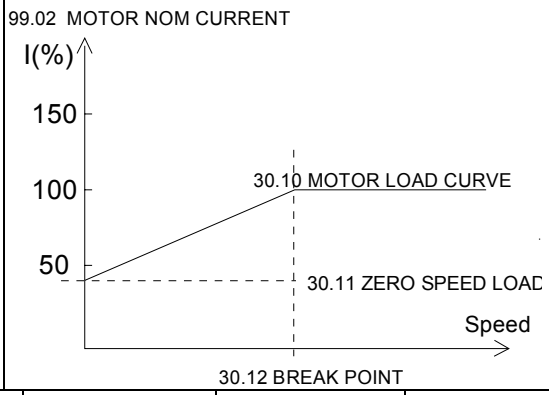
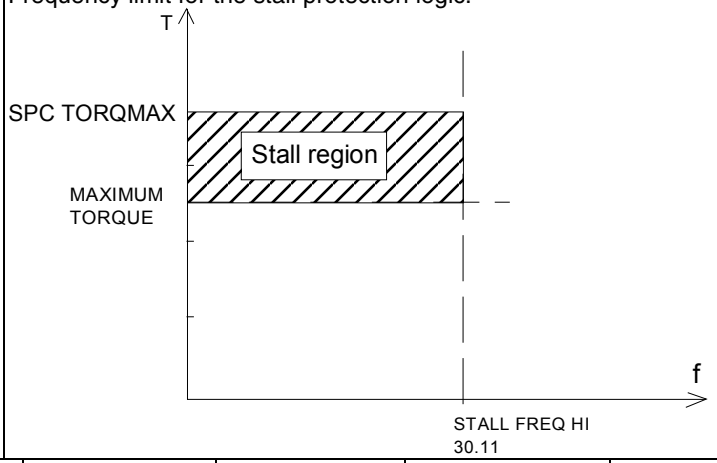
09		**MOTOR THERM TIME**			
Index	Description:	Time for 63% temperature rise. Used with the motor thermal model when parameter 30.01 MOT THERM P MODE is set to USER MODE. For monitoring of the calculated temperature, see signal 1.18 MOTOR TEMP EST. The USER MODE is only used when motor nominal current is >800 A.  If thermal protection according to UL requirements for NEMA class motors is desired, the thermal time for a Class 10 trip curve is 350 s, for Class 20 trip curve 700 s and for a Class 30 trip curve 1050 s.			
unit: s	type: R	Min: 256 s	Max: 9999 s	Def: s	Integer scaling: 1 == 1s

Table 5 - 1 Motor Thermal Times for ABB HXR and AMA Motors.

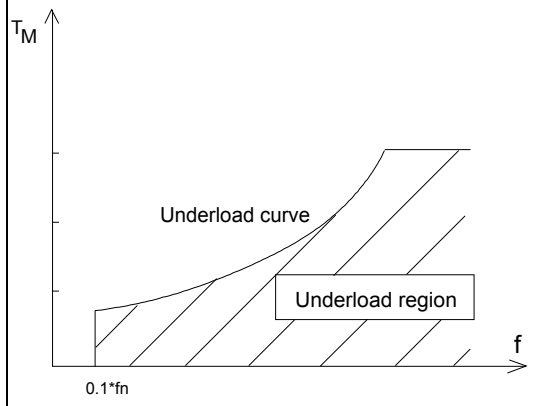
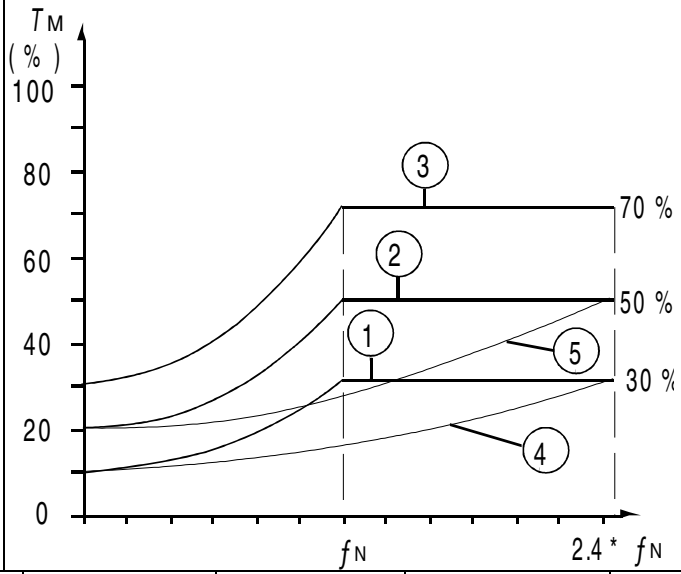
HXR motor type	Temp. rise time
400S	2700 s
400L	3600 s
450L	4200 s
500L	4800 s
560L	6000 s
AMA motor type	
all types	1500 s

30	Group name:	*FAULT FUNCTIONS*			
10 Index		**MOTOR LOAD CURVE**			
	Description:	The motor load curve sets the maximum allowable operating load of the motor. It is active when USER MODE is selected in Parameter 30.01 MOT THERM P MODE. When set to 100%, the maximum allowable load is equal to the value of Start-up Data Parameter 99.03 MOTOR NOM CURRENT. The load curve level should be adjusted if the ambient temperature differs from the nominal value. 			
unit: %	type: R	Min: 50 %	Max: 150 %	Def: 100 %	Integer scaling: 1 == 1%
11 Index		**ZERO SPEED LOAD**			
	Description:	The maximum motor load at zero speed for the load curve. A higher value can be used if the motor has an external fan motor to boost the cooling when running the drive at a low frequency. See the motor manufacturer's recommendations. This parameter is used when USER MODE is selected in parameter 30.01 MOT THERM P MODE.			
unit: %	type: R	Min: 25 %	Max: 150 %	Def: 74 %	Integer scaling: 1 == 1%
12 Index		**BREAK POINT**			
	Description:	The break point frequency for the load curve. This parameter defines the point at which the motor load curve begins to decrease from the maximum value set by Parameter 30.10 MOTOR LOAD CURVE to the value of Parameter 30.11 ZERO SPEED LOAD. Used when the USER MODE is selected in Parameter 30.01 MOT THERM P MODE.			
unit: Hz	type: R	Min: 1 Hz	Max: 300 Hz	Def: 45 Hz	Integer scaling: 100 == 1 Hz

Stall Protection

30	Group name:	*FAULT FUNCTIONS*			
13		**STALL FUNCTION**			
Index	Description:	This parameter defines the operation of the stall protection. The protection is activated if the following conditions are valid for a time longer than the period set by Parameter 30.15 STALL TIME LIM. 1. The motor torque is close to the internal momentary changing limit of the motor control program that prevents the motor and the inverter from overheating or the motor from pulling out. 2. the output frequency is below the level set by Parameter 30.14. STALL FREQ HI. 3. SPC TORQ MAX limit value must be higher than MAXIMUM TORQUE limit and SPC TORQ MIN must be lower than MINIMUM TORQUE. Operation in case of a motor stall condition. 1 = **NO** no action 2 = **WARNING** A warning Is produced**.** 3 = **FAULT** A fault is produced.			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
14		**STALL FREQ HI**			
Index	Description:	Frequency limit for the stall protection logic.  			
unit: Hz	type: R	Min: 0.5 Hz	Max: 50 Hz	Def: 20 Hz	Integer scaling: 100 == 1 Hz
15		**STALL TIME**			
Index	Description:	Time value for the stall protection logic.			
unit: s	type: R	Min: 10 s	Max: 400 s	Def: 20 s	Integer scaling: 1 == 1 s

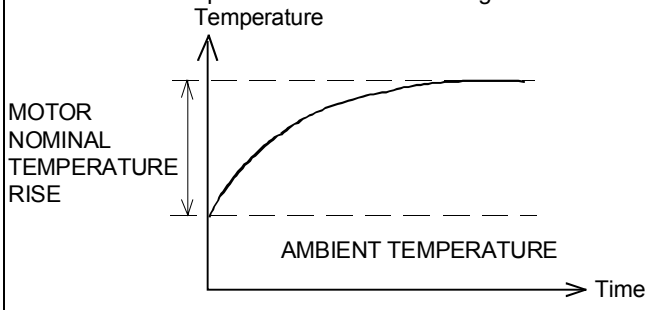
Underload Protection

30	Group name:	*FAULT FUNCTIONS*			
16 Index		**UNDERLOAD FUNC**			
	Description:		The absence of motor load may indicate a process malfunction. The protection is activated if : 1. The motor torque drops below the load curve selected by Parameter 30.18 UNDERLOAD CURVE. 2. The condition has lasted longer than the time set by Parameter 30.17 UNDERLOAD TIME. 3. Output frequency is higher than 10% of the nominal frequency of the motor. The protection function assumes that the drive is equipped with a motor of the rated power. Operation in case of the underload fault. 1 = **NO** no action 2 = **WARNING** A warning is produced. 3 = **FAULT** A fault is produced.		
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
17 Index		**UNDERLOAD TIME**			
	Description:	Time limit for underload logic.			
unit: s	type: R	Min: 0 s	Max: 600 s	Def: 600 s	Integer scaling: 1 == 1
18 Index		**UNDERLOAD CURVE**			
	Description:	One of the 5 fixed underload curves can be selected for the underload protection 			
unit:	type: I	Min: 1	Max: 5	Def: 1	Integer scaling:
19 Index		**MOTOR PHASE LOSS**			
	Description:	Operation in case a motor phase is lost. 1 = **FAULT** Enabled. 0 = **NO** Disabled.			
unit:	type: B	Min:	Max:	Def: NO	Integer scaling: 1 == 1

30	Group name:	*FAULT FUNCTIONS*			
20 Index	Description:	**EARTH FAULT** Operation in case of an earth fault condition. 1 = **FAULT** A fault is produced. 0 = **WARNING** A warning is produced.			
unit:	type: B	Min: 0	Max: 1	Def: FAULT	Integer scaling: 1 == 1
21 Index	Description:	**PANEL LOSS** Operation in case local control (control panel or Drive*Window*) is lost. 1 = **FAULT** A fault is produced. 0 = **LAST SPEED** A warning is produced.			
unit:	type: B	Min: 0	Max: 1	Def: FAULT	Integer scaling: 1 == 1
22 Index	Description:	**UNDERVOLTAGE CTL** This parameter activates the undervoltage controller. If the DC voltage level starts to decrease, the torque reference is reduced and the motor acts as a generator. 1 = **ON** Enabled. 0 = **OFF** Disabled.			
unit:	type: B	Min: 0	Max: 1	Def: OFF	Integer scaling: 1 == 1
23 Index	Description:	**OVERVOLTAGE CTL** This parameter activates the overvoltage controller. The overvoltage controller increases the torque if the DC-bus voltage exceeds the limit - typically when the motor is running as a generator and there is no regenerative incoming supply or braking chopper with resistors. 1 = **ON** Enabled. 0 = **OFF** Disabled. (This is the normal mode with regenerative supply sections.)			
unit:	type: B	Min: 0	Max: 1	Def: ON	Integer scaling: 1 == 1
24 Index	Description:	**PPCC FAULT MASK** Unwanted NINT board current measurement or communication faults can be masked in situations where the DC intermediate circuit voltage has been disconnected but the NAMC board has an external power supply and fault indication is not needed. A fault is produced only when the motor is started. See also Parameter **31.02 START INHIBIT ALM**. 0 = **NO** Fault mask disabled. 1 = **YES** Fault mask enabled.			
unit:	type: B	Min: 0	Max: 1	Def: NO	Integer scaling: 1 == 1
25 Index	Description:	**EARTH FAULT LEVEL** The earth fault trip level is set through the PPCC link by means of this parameter (non parallel connected inverters R10i, R11i and R12i only). For the parallel connected inverters this function is the current unbalance protection of the inverter output (e.g. short circuit). **0** = Disabled. **1** = 1% unbalance in the sum current. **2** = 3% unbalance in the sum current. **3** = 8% unbalance in the sum current. **4** = 13% unbalance in the sum current. **5** = 18% unbalance in the sum current. **6** = 28% unbalance in the sum current. **7** = 39% unbalance in the sum current. **8** = 62% unbalance in the sum current.			
unit:	type: R	Min: 0	Max: 8	Def: 5	Integer scaling: 1 == 1
26 Index	Description:	**COMM LOSS RO** Digital output control upon a communication fault on CH0, if controlled via ACW. **Note** that this parameter does not affect digital output DO1). 0 = **ZERO** Digital outputs are de-energised. 1 = **LAST VALUE** The states of the digital outputs before the communication fault are retained.			
unit:	type: B	Min:	Max:	Def: ZERO	Integer scaling: 1 == 1

30	Group name:	*FAULT FUNCTIONS*			
27 Index		**AI<MIN FUNC**			
	Description:	This parameter selects the action if the current signal on analogue inputs AI2 or AI3 (or NAIO input AI2) falls below 4 mA. This monitoring is valid if 4 mA is selected in Parameter 13.06 MINIMUM AI2 or 13.10 MINIMUM AI3.. 1 = **FAULT** A fault is generated. 2 = **NO** (No action) 3 = **LAST SPEED** A warning is generated. The drive continues running at the last speed before the warning.			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:

Motor Thermal Model User Mode Alarm and Fault Limits

28 Index		**THERM MOD ALM LIM**			
	Description:	An alarm temperature limit for the thermal model protection of the motor. The thermal model of the motor is activated by Parameter **30.01 MOTOR THERM PMODE** and calculated temperature is shown by the signal **1.18 MOTOR TEMP EST**.			
unit: °C	type: I	Min: 0 °C	Max: 300°C	Def: 90 °C	Integer scaling:
29 Index		**THERM MOD FLT LIM**			
	Description:	A trip temperature limit for the thermal model protection of the motor.			
unit: °C	type: I	Min: 0 °C	Max: 300 °C	Def: 110 °C	Integer scaling:
30 Index		**MOT NOM TEMP RISE**			
	Description:	Motor nominal temperature rise when loading with motor nominal current.  **Note:** If ABB motor rating plate includes the coefficient **MNTRC**, multiply its value by 80 °C and set this parameter to the result. With non-ABB motors, contact motor manufacturer for data of motor nominal temperature rise.			
unit: °C	type: R	Min: 0 °C	Max: 300 °C	Def: 80 °C	Integer scaling: 1 == 1 °C
31 Index		**AMBIENT TEMP**			
	Description:	Typical motor ambient temperature. Used only with motor thermal protection model.			
unit: °C	type: R	Min: -40 °C	Max: 100 °C	Def: 30 °C	Integer scaling: 1 == 1 °C

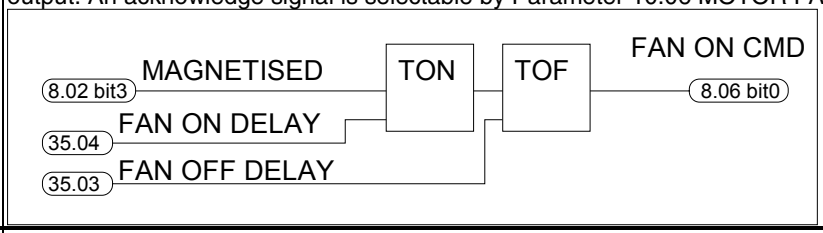
Motor Temperature Feedback to the Motor Model

32 Index		**RS TEMP SCALE**			
	Description:	Tuning coefficient for temperature dependence of stator resistance R_s based on the measured temperature with PT100 sensors or internal motor thermal protection model. The measured total resistance includes motor cable and stator resistance. With pulse encoder feedback, 100% compensation can often be used. Undercompensation decreases the starting torque at high motor temperatures.			
unit: %	type: R	Min: 0 %	Max: 200%	Def: 40 %	Integer scaling: 1 == 1 %

Group 31 Fault Functions

31	Group name:	FAULT FUNCTIONS			
01 Index		**KLIXON MOT OVER T**			
	Description:	Action when the contact of digital input **KLIXON** opens. See Parameter **10.05 KLIXON**. 0 = **FAULT** 1 = **ALARM**			
unit:	type: B	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1
02 Index		**START INHIBIT ALM**			
	Description:	Logging of the Prevention of Unexpected Start-up alarm “START INHIBI” (9.04 AW_1 bit 0) to the fault/alarm logger can be prevented using this parameter. This function has no effect on status or alarm words. 0 = **OFF** 1 = **ON** Logging disabled			
unit:	type: B	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1

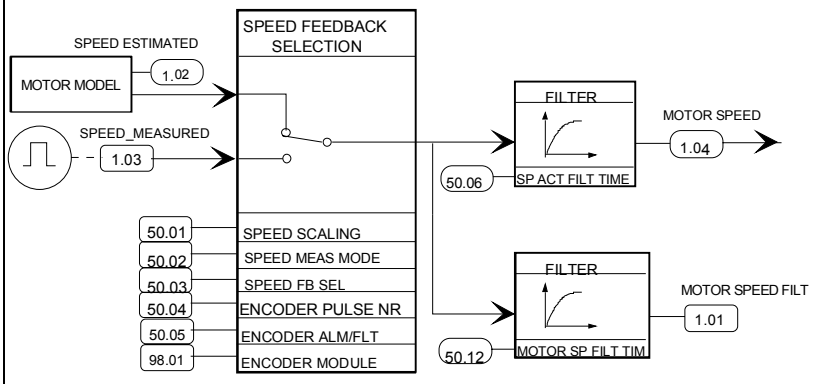
Group 35 Motor Fan Control

35	Group name:	MOTOR FAN CONTROL			
	Description:	Certain motors are equipped by an external fan. The ACS 600 System Application Program provides the control logic and diagnostics for this. The fan starter is controlled by digital output by parameter group 14. FAN ON CMD must be used as a control signal to digital output. An acknowledge signal is selectable by Parameter 10.06 MOTOR FAN ACK.  			
01 Index		**MOTOR FAN CTRL**			
	Description:	This parameter activates the motor fan diagnostics and the timer functions to signal ASW2 (8.06) bit 0. 1 = **OFF** Motor fan control and diagnostics disabled. 2 = **ALARM** Motor fan control and diagnostics enabled. If the acknowledge signal is lost, only an alarm ”MOTOR FAN” is generated. 3 = **ALARM/FAULT** Motor fan control and diagnostics enabled. If the acknowledge signal is lost, an alarm ”MOTOR FAN” is generated. If the acknowledge signal is still lost after 35.04 FAN ACK DELAY, a fault is indicated and drive is tripped.			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
02 Index		**FAN ACK DELAY**			
	Description:	An acknowledge signal delay. Delay time count starts on the activation of FAN ON CMD.			
unit: s	type: R	Min: 2 s	Max: 300 s	Def: 5 s	Integer scaling: 1 == 1s
03 Index		**FAN OFF DELAY**			
	Description:	A delay off function for the motor fan starter control. FAN ON CMD is controlled to state false when the time defined by this parameter has elapsed.			
unit: min	type: R	Min: 0 min	Max: 100 min	Def: 20 min	Integer scaling: 1 == 1 min
04 Index		**FAN ON DELAY**			
	Description:	A delay on function for the motor fan starter control, since the motor has been magnetised and FAN ON CMD is controlled to state true.			
unit: s	type: R	Min: 0 s	Max: 100 s	Def: 0 s	Integer scaling: 1 == 1 s

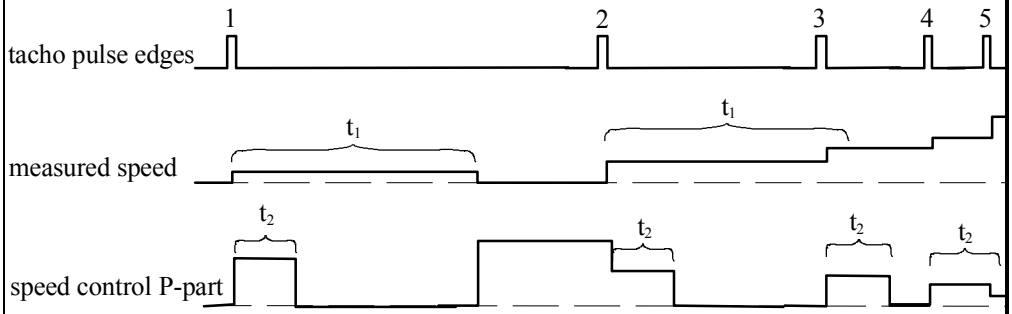
Group 36 Motor Cable Protection

36	Group name:	*MOTOR CABLE PROTECTION*			
		The motor cable can be protected in the ACS 600 application program against overload (using a thermal model). The default values never cause a trip. To activate this function, define the cable parameters. The thermal model of the motor cable is based on the current measurement and known loading data of the cable. A relative actual value of the thermal model output is shown by signal **1.27 CABLE TEMPERATURE**. The value of 100% corresponds to the trip limit.			
01 Index		**CABLE NOM CURRENT**			
	Description:	The permitted continuous current for the motor cable, including possible limitation factors due to the environment conditions (ambient temperature, distances to other cables, etc.). See the cable manufacturer's data book. **The new values become valid only on the next NAMC board power-on.**			
unit: A	type: RI	Min: 0 A	Max: 10000 A	Def: 9999.9 A	Integer scaling: 1 == 1
02 Index		**CABLE TEMP CONST**			
	Description:	Permitted loading time for the motor cable in seconds by load √2 * CABLE NOM CURRENT. See the cable manufacturer's data book. **The new values become valid only on the next NAMC board power-on.**			
unit: s	type: R	Min: 0.1 s	Max: 1000 s	Def: 8 s	Integer scaling: 10 == 1s

Group 50 Speed Measurement

50	Group name:	*SPEED MEASUREMENT*			
	Description:				
01 Index		**SPEED SCALING**			
	Description:	This parameter defines the speed reference (in rpm) that corresponds to the value of 20000 from the overriding system or I/O. This parameter has only scaling effect to speed actual signals in the scalar control mode.			
unit: rpm	type: R	Min: 0 rpm	Max: 100000 rpm	Def: 1500 rpm	Integer scaling: 15000 = 1500 rpm
02 Index		**SPEED MEAS MODE**			
	Description:	Selects the measurement type for the pulse encoder mode. 0 = **A_-B DIR** Positive edges for speed; channel B: direction 1 = **A_-_** Positive and negative edges for speed; channel B: not used 2 = **A_-_B DIR** Positive and negative edges for speed; channel B: direction 3 = **A_-_B_-_** Channels A & B: positive and negative edges for speed and direction			
unit:	type: I	Min: 0	Max: 3	Def: 3	Integer scaling: 1 == 1

50	Group name:	*SPEED MEASUREMENT*			
03		**SPEED FB SEL**			
Index	Description:	Source of the speed feedback to the speed controller. 1 = **INTERNAL** Internal actual speed. 2 = **ENCODER** Pulse encoder module (see also Parameter 98.01 ENCODER MODULE).			
unit:	type: I	Min: 0	Max: 2	Def: 1	Integer scaling: 1 == 1
04		**ENCODER PULSE NR**			
Index	Description:	Number of pulse encoder pulses per revolution.			
unit:	type: R	Min: 1	Max: 30000	Def: 2048	Integer scaling: 1 == 1
05		**ENCODER ALM/FLT**			
Index	Description:	Determines a if speed measurement error causes a warning or a fault. 1 = **FAULT** A drive is tripped 0 = **ALARM** A warning is generated and the drive continues running at the internal actual speed.			
unit:	type: B	Min:	Max:	Def: ALARM	Integer scaling: 1 == 1
06		**SP ACT FILT TIME**			
Index	Description:	The time constant of the first order actual speed filter.			
unit: ms	type: R	Min: 0 ms	Max: 999999 ms	Def: 4 ms	Integer scaling: 1 == 1 ms
07		**POS COUNT MODE**			
Index	Description:	The position counter is based on the pulse count from the pulse encoder. It has two different measurement modes: 0 = **PULSE EDGES** Both edges of the pulses are counted. Actual values can be read from signals 3.07 POS COUNT LOW and 3.08 POS COUNT HIGH. 1 = **ROUND&DEG** The application software counts the number of the motor shaft rounds and the shaft angle in degrees. Actual values can be read from signals 3.09 POS COUNT DEGREES and 3.10 POS COUNT ROUNDS. The position counter is controlled by means of 7.02 AUX CONTROL WORD bits 9...11. The status can be seen from 8.02 AUX STATUS WORD bit 5 (SYNC_RDY). By means of the application program in the overriding system, it is possible to create the positioning control function.			
unit:	type: I	Min: 0	Max: 1	Def: ROUND	Integer scaling: 1 == 1
08		**POS COUNT INIT LO**			
Index	Description:	Position counter initial low word value when the mode is PULSE EDGES.			
unit:	type: PB	Min: 0	Max: 65536	Def: 0	Integer scaling: 1 == 1
09		**POS COUNT INIT HI**			
Index	Description:	Position counter initial high word value when the mode is PULSE EDGES.			
unit:	type: PB	Min: 0	Max: 65536	Def: 0	Integer scaling: 1 == 1
10		**ABOVE SPEED LIMIT**			
Index	Description:	When the actual speed has reached the value of this parameter, 8.01 MAIN STATUS WORD bit 10 is set to 1.			
unit: rpm	type: R	Min: See 20.01	Max: See 20.02	Def: 0	Integer scaling: See 50.01
11		**ENCODER DELAY** (available in sw ver 5.1x)			
Index	Description:	Time of no encoder pulses received, and the drive being at the torque or current limit simultaneously, before an alarm or a fault is produced. Setting this parameter to 0 disables the function at the torque or current limit.			
unit: ms	type: R	Min: 0	Max: 50000	Def: 1000	Integer scaling: 1 == 1 ms
12		**MOTOR SP FILT TIME** (available in sw ver 5.2x)			
Index	Description:	Filter time constant for monitoring signal **1.01 MOTOR SPEED FILT**.			
unit: ms	type: R	Min: 2 ms	Max: 20000 ms	Def: 500 ms	Integer scaling: 1 == 1 ms

50	Group name:	*SPEED MEASUREMENT*
13		**ZERO DETECT DELAY**
Index:	Description:	This parameter can be adjusted for the best possible performance at the low speeds when a pulse encoder is used and pulses are not received during the 1 ms measurement cycle. The definition of “low speeds” depends on the type of the encoder used. For example if encoder pulse number is 2048 and both edges of A and B channels are calculated, there are 8192 pulses per revolution. Then at least one pulse per millisecond is received at 7.3 rpm (1 pulse / ms ⇒ 1000 pulses/s ⇒ 1000/8192 rev/s ≈ 7.3 rpm). Thus 4 ms between pulses corresponds to 1.8 rpm and 80 ms to 0.09 rpm. See the following example with parameter settings: 50.13 = 250 ms, 50.14 = 4 ms, constant speed reference. After receiving a pulse, measured speed is calculated and speed control P-part is set to a value related to speed error. When no new pulses are received within 1 ms, the measured speed and P-part (due the constant speed reference) are held. After the **SPEED HOLD TIME** P-part is forced to zero so that speed control will not be based on an absolete speed measurement value. After **ZERO DETECT DELAY,** it is assumed that speed is zero, causing clearing of measured speed and allowing use of P-part. After the next pulse, some measured speed is calculated again and P-part accordingly. P-part is cleared again after **SPEED HOLD TIME**. The measured speed is not set to zero anymore, because a new pulse comes before **ZERO DETECT DELAY**. The time between pulses 3 and 4 is still longer than **SPEED HOLD TIME** and P-part is forced to zero. The time between pulses 4 and 5 is already so short that neither P-part nor the measured speed is forced to zero.  *Figure 1:* ZERO DETECT DELAY = 250ms (t_1) and SPEED HOLD TIME = 4ms (t_2). With the configuration of figure 1 there is a long ZERO DETECT DELAY that gives accurate speed measurement. The short **SPEED HOLD TIME** keeps the speed control stable in many cases, because speed control output is not influenced by “old” speed measurement. On the other hand, if P-part is very large, forcing it to zero causes undesirable torque steps. The tuning values depends on the clearances of mechanics. Therefore after increasing these parameter values, check that the torque actual value is still smooth.

unit: ms	type: I	Min: 1 ms	Max: 2000 ms	Def: 4 ms	Integer scaling:

50	Group name:	*SPEED MEASUREMENT*			
14		**SPEED HOLD TIME**			
Index:	Description:	The time after the P-part of speed control is forced to zero, if the time has been elapsed and no new pulses have been received after the last sample. By increasing the value, it amplifies the effect of P-part at the low speeds due to the longer effect time of P-part. Oscillation can occur, if the time is too long. See description of Par. 50.13 ZERO DETECT DELAY above. **Note:** The value of SPEED HOLD TIME <= ZERO DETECT DELAY.			
Unit: ms	type: I	Min: See 50.13	Max: 2000 ms	Def: 4 ms	Integer scaling:

Group 51 Master Adapter (Field Bus Adapter)

51	Group name:	*MASTER ADAPTER*			
	Description:	This group defines the communication parameters for a fieldbus adapter module. The parameter names are copied from the module when its connection to the drive is activated using Parameter 98.02 COMM MODULE. See the module manual. **Note:** Any changes in these parameters take effect only upon the next power-up of the adapter module.			
01		**FIELDBUS PAR1** (Module type and software version)			
Index	Description:				
unit:	type: R	Min:	Max:	Def:	Integer scaling:
02...15		**FIELDBUS PAR2...15** (According to module type)			
Index	Description:				
unit:	type: R	Min:	Max:	Def:	Integer scaling:

Group 70 DDCS Control

70	Group name:	*DDCS CONTROL*			
	Description:	Parameter settings of the DDCS communication channels.			
01 Index		**CH0 NODE ADDR**			
	Description:	Node address for channel CH0. In an AC 80 DriveBus connection, the drives are addressed 1 to 12. The drive address is related to the value of the DRNR terminal of the ACSRX PC element. When using the APC2 system, the address must be 1. In an Optical ModuleBus connection, the CH0 NODE ADDR value is calculated from the value of the POSITION terminal in the DRIENG database element as follows: 1. Multiply the hundreds of the value of position by 16. 2. Add the tens and ones of the value of POSITION to the result. For example, if the POSITION terminal of the DRIENG database element has the value of 101, Parameter 70.01 must be set 16 x 1 + 1 = 17.			
unit:	type: R	Min: 0	Max: 125	Def: 1	Integer scaling: 1 == 1
02 Index		**CH0 LINK CONTROL**			
	Description:	DDCS channel 0 intensity control for transmission LEDs. This parameter can be used in special cases to optimise the communication performance of the link.			
unit:	type: R	Min: 1	Max: 15	Def: 10	Integer scaling: 1 == 1
03 Index		**CH0 BAUD RATE-**			
	Description:	Channel CH0 communication speed. This must be set to 4 Mbits/s, when FCI or FBA communication modules are used. Otherwise, the overriding system automatically sets the communication speed. 0 = **8 Mbit/s** 1 = **4 Mbit/s** 2 = **2 Mbit/s** 3 = **1 Mbit/s**			
unit: Mbit/s	type: I	Min: 1 Mbit/s	Max: 8 Mbit/s	Def: 4 Mbit/s	Integer scaling: 1 == 1
04 Index		**CH0 TIMEOUT**			
	Description:	The delay time before a communication break fault is declared. The time count starts when the link fails update the message. Setting this parameter to 0 disables the function.			
unit: ms	type: R	Min: 0 ms	Max: 60000 ms	Def: 100 ms	Integer scaling: 1 == 1 ms
05 Index		**CH0 COM LOSS CTRL**			
	Description:	This parameter defines the action after a communication fault on channel CH0. See also Parameter 30.26 COM LOSS RO. 1 = **STOP RAMPNG** The drive is stopped by ramping. The deceleration time is defined by Parameter 22.02 DECELER TIME. 2 = **STOP TORQ** The drive is stopped by torque limit. 3 = **COAST STOP** The drive is stopped by coasting. 4 = **LAST SPEED** The drive continues running on the last reference, the warning CH0 TIME OUT is activated, and 9.04 ALARM WORD 2 bit 11 is set to 1. 5 = **CNST SPEED1** The drive continues running at the speed reference defined by Parameters 23.02 CONST SPEED 1, the warning CH0 TIME OUT is activated and 9.05 ALARM WORD 2 bit 11 is set to 1.			
unit:	type: I	Min: 1	Max: 5	Def: 1	Integer scaling:
06 Index		**CH1 LINK CONTROL**			
	Description:	DDCS channel CH1 intensity control for transmission LEDs. This value is adjusted through the link including each device on the link. This parameter can be used in special cases to optimise the communication performance of the link.			
unit:	type: R	Min: 1	Max: 15	Def: 10	Integer scaling: 1 == 1

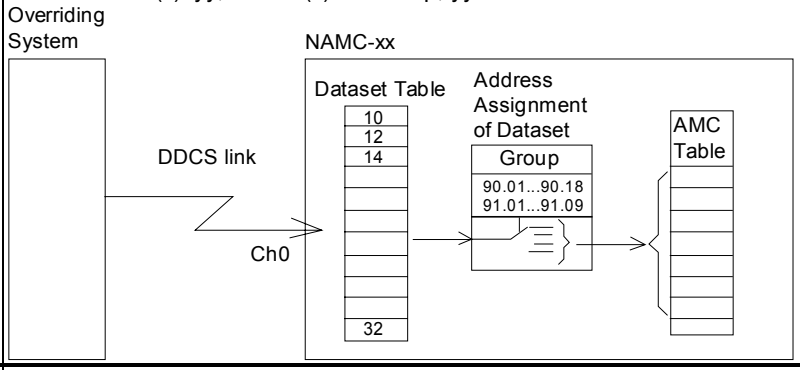
70	Group name:	*DDCS CONTROL*			
07 Index		**CH2 NODE ADDR**			
	Description:	Node address for channel CH2. This is used only in applications, with one or several point to point communications connections between the NAMC boards.			
unit:	type: R	Min: 1	Max: 125	Def: 1	Integer scaling: 1 == 1
08 Index		**CH2 M/F MODE**			
	Description:		Channel CH2 can be used to send the torque reference from the Master Drive to one or several Followers. Master/Follower is an application in which the machinery is run by several ACS 600 MultiDrives and the motor shafts are coupled to each other by gearing, a chain, a belt etc.		
		1 = **NOT IN USE**	Channel CH2 not used for M/F communication.		
		2 = **MASTER**	The drive is the master on the M/F link and broadcasts via CH2 the contents of data set 41 (defined by Parameters 70.09…70.11).		
		3 = **FOLLOWER**	The drive is a follower on the M/F link. Torque reference is read from data set 41 index 3 into TORQ REF A and from index 2 to SPEED REF. For more information, see the section "Master/Follower Link".		
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
09 Index		**MASTER SIGNAL 1**			
	Description:	Not in use. Group + Index of the signal to be sent as a broadcast message to data set 41 index 1 in the follower drives. Example: the setting 701 broadcasts 7.01 MAIN CTRL WORD.			
unit:	type: R	Min: 0	Max: 20000	Def: 0	Integer scaling: 1 == 1
10 Index		**MASTER SIGNAL 2**			
	Description:	Group + Index of the signal to be sent as a broadcast message to data set 41 index 2 in the follower drives (speed reference). Example: the setting 2301 broadcasts 23.01 SPEED REF. **Note:** This parameter is not used, if the 70.08 CH2 M/F MODE has a value FOLLOWER.			
unit:	type: R	Min: 0	Max: 20000	Def: 0	Integer scaling: 1 == 1
11 Index		**MASTER SIGNAL 3**			
	Description:	Group + Index of the signal to be sent as a broadcast message to data set 41 index 3 in the follower drives (torque reference). Example: **2.10 TORQ REF3** is typically used to send as torque reference to the **25.01 TORQUE REF A** in the follower drives. Parameter 70.11 value is then 210. **Note:** This parameter is not used, if the 70.08 CH2 M/F MODE has a value FOLLOWER.			
unit:	type: R	Min: 0	Max: 20000	Def: 0	Integer scaling: 1 == 1
12 Index		**CH2 LINK CONTROL**			
	Description:	DDCS channel CH2 intensity control for transmission LEDs. This parameter can be used in special cases to optimise the communication performance of the link.			
unit:	type: R	Min: 1	Max: 15	Def: 10	Integer scaling: 1 == 1
13 Index		**CH2 TIMEOUT**			
	Description:	The delay time before a communication break fault is declared. The time count starts when the link fails update the message. During the time elapsing, the warning CH2 TIME OUT is activated and 9.04 ALARM WORD 1 bit 6 is set to 1.			
unit: ms	type: R	Min: 0 ms	Max: 60000 ms	Def: 100 ms	Integer scaling: 1 == 1

70	Group name:	*DDCS CONTROL*				
14		**CH2 COM LOSS CTRL**				
Index	Description:		This parameter defines the action upon a communication fault on CH2 of the NAMC board.			
		1 = **FAULT**	Drive is tripped, fault M/F LINK FAULT activated and 9.01 FAULT WORD 1 bit 11 is set to 1.			
		2 = **ALARM**	The warning M/F LINK ALARM is generated and 9.04 ALARM WORD 1 bit 11 is set to 1.			
unit:	type: I	Min: 1	Max: 2	Def: 1	Integer scaling:	
15		**CH3 NODE ADDR**				
Index	Description:	Node address for channel CH3. This channel is normally used with the start-up and maintenance tools. If the CH3 channels of several drives have been connected in a ring or star (using a branching unit), each one must be given unique node address. **The new node address becomes valid only on the next NAMC board power-on**. The address range is 1…75 and 125…254. Addresses 75…124 are reserved for branching units.				
unit:	type: R	Min: 1	Max: 254	Def: 1	Integer scaling: 1 == 1	
16		**CH3 LINK CONTROL**				
Index	Description:	DDCS channel CH3 intensity control for transmission LEDs. This value is adjusted through the link including each device on the link. This parameter can be used in special cases to optimise the communication performance of the link.				
unit:	type: R	Min: 1	Max: 15	Def: 15	Integer scaling: 1 == 1	
17		**FOLL SPEED REF**				
Index	Description:	This parameter defines the source for the speed reference in the Master/Follower mode. 0 = **FOLLOWER** Speed reference is read either datasets 1, 10...24 or I/O. 1 = **MASTER** Speed reference is read from data set 41 to the follower.				
unit:	type: B	Min:	Max:	Def: FOLLOWER	Integer scaling: 1 == 1	
18		**FOLL TORQ REF**				
Index	Description:	This parameter defines the source for the torque reference in the Master / Follower mode. 0 = **FOLLOWER** Torque reference is read either datasets 1, 10...24 or I/O. 1 = **MASTER** Torque reference is read from data set 41 to the follower.				
unit:	type: B	Min:	Max:	Def: MASTER	Integer scaling: 1 == 1	
19		**CH0 HW CONNECTION**				
Index:	Description:	This parameter is used to enable or disable the regeneration of CH0 optotransmitter in DDCS mode (Par. 71.01 DRIVEBUS MODE = OFF). Regeneration means that the drive echoes all messages back. DDCS mode is typically used with APC2, AC70 and AC450 controllers. 0 = **RING** Regeneration is enabled. Used with ring-type bus topology. 1 = **STAR** Regeneration disabled. Used with star-type bus topology. Typically with configurations: AC450 – CI810 – NDBU-95 branching unit(s) – ACS 600. **Note:** This parameter has no effect in DriveBus mode. Select RING, if the CH0 channels on the NAMC boards have been connected to ring.				
unit:	type: B	Min: 0	Max: 1	Def: 1 = STAR	Integer scaling: 1 == 1	
20		**CH3 HW CONNECTION**				
Index:	Description:	This parameter is used to enable or disable the regeneration of CH3 optotransmitter. Regeneration means that the drive echoes all messages back. 0 = **RING** Regeneration is enabled. Used with ring-type bus topology. 1 = **STAR** Regeneration disabled. Used with star-type bus topology. Typically with configurations: DriveWindow (PC) – NDBU-95 branching unit(s) – ACS 600. Select RING, if the CH3 channels on the NAMC boards have been connected to ring.				
unit:	type: B	Min: 0	Max: 1	Def: 1 = STAR	Integer scaling: 1 == 1	

Group 71 DriveBus Communication

71	Group name:	*DRIVEBUS COMM*			
	Description:	Parameter settings of DriveBus communication on channel CH0. Available with sw ver. 5.2. Not available with NAMC-03/04 boards.			
01		**CH0 DRIVEBUS MODE**			
Index	Description:	Communication mode selection for channel CH0. The Drivebus mode is used with the AC 80 controller. **The new mode becomes valid only on the next NAMC board power-on**. 0 = **NO** DDCS mode 1 = **YES** DriveBus mode			
unit:	type: B	Min: 0	Max: 1	Def: 1 YES	Integer scaling: 1 == 1

Group 90 Data Set Receive Addresses

90	Group name:	*D SET REC ADDR*			
	Description:	Addresses for Received Data from the Overriding System. The format is (x)xyy, where (x)x = Group, yy = Index.  			
01		**D SET 10 VAL 1**			
Index	Description:	Data set 10 value 1 receive address (Interval: NAMC-03/-11:10 ms, NAMC-2x: 2 ms).			
Unit:	type: I	Min: 0	Max: 9999	Def: 701	Integer scaling:

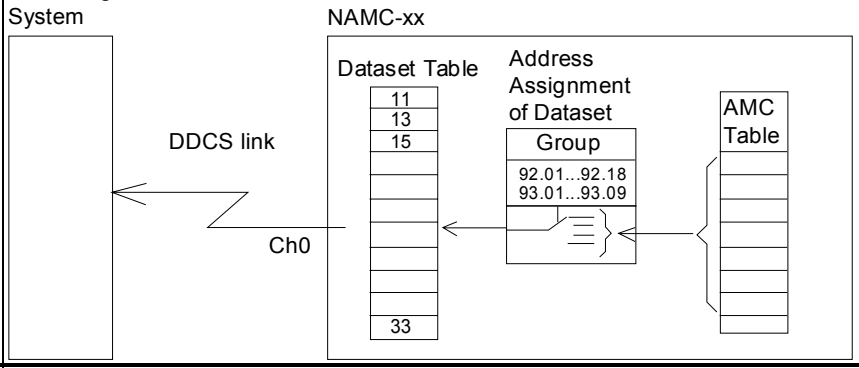
02	**D SET 10 VAL 2**	See 90.01	Interval: NAMC-03:10 ms, NAMC-2x: 2 ms
03	**D SET 10 VAL 3**	See 90.01	Interval: NAMC-03:10 ms, NAMC-2x: 2 ms
04	**D SET 12 VAL 1**	See 90.01	Interval: NAMC-03:10 ms, NAMC-2x: 4 ms
05	**D SET 12 VAL 2**	See 90.01	Interval: NAMC-03:10 ms, NAMC-2x: 4 ms
06	**D SET 12 VAL 3**	See 90.01	Interval: NAMC-03:10 ms, NAMC-2x: 4 ms
07	**D SET 14 VAL 1**	See 90.01	Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
08	**D SET 14 VAL 2**	See 90.01	Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
09	**D SET 14 VAL 3**	See 90.01	Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
10	**D SET 16 VAL 1**	See 90.01	Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
11	**D SET 16 VAL 2**	See 90.01	Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
12	**D SET 16 VAL 3**	See 90.01	Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
13	**D SET 18 VAL 1**	See 90.01	Interval: NAMC-03:100 ms, NAMC-2x: 100 ms
14	**D SET 18 VAL 2**	See 90.01	Interval: NAMC-03:100 ms, NAMC-2x: 100 ms
15	**D SET 18 VAL 3**	See 90.01	Interval: NAMC-03:100 ms, NAMC-2x: 100 ms
16	**D SET 20 VAL 1**	See 90.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
17	**D SET 20 VAL 2**	See 90.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
18	**D SET 20 VAL 3**	See 90.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms

Group 91 Data Set Receive Addresses

91	Group name:	*D SET REC ADDR*	
	Description:	Addresses for Received Data from the Overriding System. The format is (x)xyy, where (x)x = Group, yy = Index.	
01		**D SET 22 VAL 1** See 90.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
02		**D SET 22 VAL 2** See 90.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
03		**D SET 22 VAL 3** See 90.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
04		**D SET 24 VAL 1** See 90.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
05		**D SET 24 VAL 2** See 90.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
06		**D SET 24 VAL 3** See 90.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms

Group 92 Data Set Transmit Addresses

92	Group name:	*D SET TR ADDR*			
	Description:	Signal addresses for the transmitted data to the overriding system. The format is (x)xyy, where (x)x = Group, yy = Index.			
01		**D SET 11 VAL 1**			
Index	Description:	Data set 11 value 1 transmit address (Interval: NAMC-03:10 ms, NAMC-2x: 2 ms).			
unit:	type: I	Min: 0	Max: 9999	Def: 801	Integer scaling:
02		**D SET 11 VAL 2** See 92.01			Interval: NAMC-03:10 ms, NAMC-2x: 2 ms
03		**D SET 11 VAL 3** See 92.01			Interval: NAMC-03:10 ms, NAMC-2x: 2 ms
04		**D SET 13 VAL 1** See 92.01			Interval: NAMC-03:100 ms, NAMC-2x: 4 ms
05		**D SET 13 VAL 2** See 92.01			Interval: NAMC-03:100 ms, NAMC-2x: 4 ms
06		**D SET 13 VAL 3** See 92.01			Interval: NAMC-03:100 ms, NAMC-2x: 4 ms
07		**D SET 15 VAL 1** See 92.01			Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
08		**D SET 15 VAL 2** See 92.01			Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
09		**D SET 15 VAL 3** See 92.01			Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
10		**D SET 17 VAL 1** See 92.01			Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
11		**D SET 17 VAL 2** See 92.01			Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
12		**D SET 17 VAL 3** See 92.01			Interval: NAMC-03:100 ms, NAMC-2x: 10 ms
13		**D SET 19 VAL 1** See 92.01			Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
14		**D SET 19 VAL 2** See 92.01			Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
15		**D SET 19 VAL 3** See 92.01			Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
16		**D SET 21 VAL 1** See 92.01			Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
17		**D SET 21 VAL 2** See 92.01			Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
18		**D SET 21 VAL 3** See 92.01			Interval: NAMC-03:500 ms, NAMC-2x: 100 ms



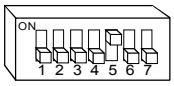
Group 93 Data Set Transmit Addresses

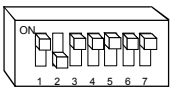
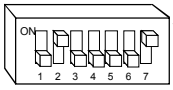
93	Group name:	D SET TR ADDR	
	Description:	Signal addresses for the transmitted data to the overriding system. The format is (x)xyy, where (x)x = Group, yy = Index.	
01		**D SET 23 VAL 1** See 92.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
02		**D SET 23 VAL 2** See 92.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
03		**D SET 23 VAL 3** See 92.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
04		**D SET 25 VAL 1** See 92.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
05		**D SET 25 VAL 2** See 92.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms
06		**D SET 25 VAL 3** See 92.01	Interval: NAMC-03:500 ms, NAMC-2x: 100 ms

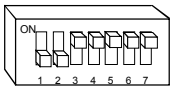
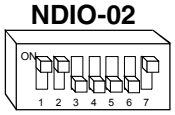
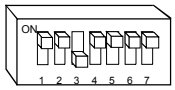
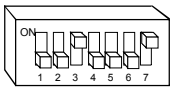
Group 97 Drive

97	Group name:	DRIVE			
	Description:				
01 Index		**DEVICE NAME**			
	Description:	The name of the drive section can be typed here by the Drive*Window* PC tool. This name is shown in the System Configuration display of Drive*Window*. The maximum number of characters is 32.			
unit:	type: String	Min: 0 char	Max: 32 char	Def: 0	Integer scaling: no

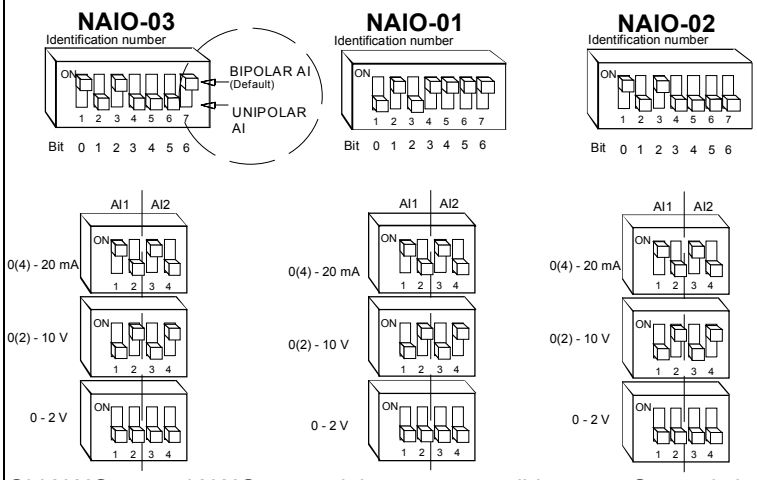
Group 98 Option Modules

98	Group name:	OPTION MODULES			
	Description:	The optional NTAC, NAIO and NDIO modules are connected in a ring (together with the NIOC board) on NAMC channel CH1. Each of these modules is given an address using the DIP switches on them. (The NIOC always has the address 1.) Fieldbus adapter modules are connected to channel CH0.			
01 Index		**ENCODER MODULE**			
	Description:	NTAC-02 pulse encoder module or NIOB-01 pulse encoder interface selection. The module is connected in series with the NIOC board on channel CH1. The module is given the address 16 by setting the DIP switches as shown below. 1 = **YES** Pulse encoder module or NIOB-01 pulse encoder interface activated. 0 = **NO** Pulse encoder module or NIOB-01 pulse encoder interface **not** activated.  **Note:** See the parameter settings in Group 50 and Par. 98.07			
unit:	type: B	Min:	Max:	Def: NO	Integer scaling: 1 == 1

98	Group name:	*OPTION MODULES*			
02 Index		**COMM MODULE**			
	Description:	This parameter defines the control mode and place in the REMOTE mode. 1 = **NO** The drive is controlled using the I/O. See settings in the parameter group 10. 2 = **FBA DSET 1** The drive is controlled through the communication link (channel CH0) using data sets 1 and 2. This is a typical setting for use with a fieldbus adapter module. 3 = **FBA DSET10** The drive is controlled through the communication link (channel CH0) using data sets 10 to 33 (for example APC2, AC 70, AC 80: also NPBA-02, NCSA-01).			
unit:	type: I	Min: 1	Max: 3	Def: 3	Integer scaling:
03 Index		**DI/O EXT MODULE 1**			
	Description:	NDIO I/O extension module 1 can be used to replace or extend the I/O. The module is connected to channel CH1 on the NAMC board. The module is given the address 2 by setting the DIP switches as shown below. 1 = **NO** No NDIO module 1 used. 2 = **REPLACE** NDIO replaces NIOC DI1, DI2, DO1 and DO2. 3 = **EXTEND** Activates extended I/O: EXT1_DI1, EXT1_DI2, EXT1_DO1 and EXT1_DO2. **NDIO-01** **NDIO-02**   S7: DI1 HW Filtering Enabled (Default) DI1 HW Filtering Disabled **Note**: DI1 HW filtering must be enabled, if AC voltage is connected to DI1.			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:

98	Group name:	*OPTION MODULES*			
04 Index		**DI/O EXT MODULE 2**			
	Description:	NDIO I/O extension module 2 can be used to replace or extend the I/O. Module is connected to channel CH1 on the NAMC board. The module is given the address 3 by setting the DIP switches as shown below. 1 = **NO** No NDIO module 2 used. 2 = **REPLACE** NDIO replaces NIOC DI3, DI4, and DO3. EXT2_DO1 is activated. 3 = **EXTEND** Activates extended I/O: EXT2_DI1, EXT2_DI2, EXT2_DO1 and EXT2_DO2 **NDIO-01** **NDIO-02**   S7: DI1 HW Filtering Enabled (Default) DI1 HW Filtering Disabled **Note:** DI1 HW filtering must be enabled, if AC voltage is connected to DI1.			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
05 Index		**DI/O EXT MODULE 3**			
	Description:	NDIO I/O extension module 3 can be used to replace or extend the I/O. Module is connected to channel CH1 on the NAMC board. The module is given the address 4 by setting the DIP switches as shown below. 1 = **NO** No NDIO module 3 used. 2 = **REPLACE** NDIO replaces NIOC DI5, DI6. EXT3_DO1 and EXT3_DO2 are activated. 3 = **EXTEND** Activates extended I/O: EXT3_DI1, EXT3_DI2, EXT3_DO1 and EXT3_DO2. **NDIO-01** **NDIO-02**   S7: DI1 HW Filtering Enabled (Default) DI1 HW Filtering Disabled **Note:** DI1 HW filtering must be enabled, if AC voltage is connected to DI1.			
Unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:

98	Group name:	*OPTION MODULES*
06		**AI/O EXT MODULE 1**
Index	Description:	This parameter configures the inputs and outputs of an NAIO analogue I/O extension module. The NAIO module is given the address 5 by setting the DIP switches as shown below. The available input type settings are also illustrated. 1 = **NO** No extension AIO board used. 2 = **UNIPOLAR AI** An NAIO module replaces NIOC-01 AI1 and AI2, and extends sw outputs AO3 and AO4. 3 = **BIPOLAR AI** An NAIO module replaces NIOC-01 AI1 and AI2, and extends sw outputs AO3 and AO4. 4 = **UNIPOL. TEMP** Motor temperature measurement (PT100 or PTC) using NAIO module, NIOB-01 board or NBIO-21 unit. 5 = **BIPOLAR TEMP** Motor temperature measurement (PT100 or PTC) using NAIO module, NIOB-01 board or NBIO-21 unit.



Old NAIO-01 and NAIO-02 modules are compatible types. See switch settings above.

unit:	type: I	Min: 1	Max: 5	Def: 1	Integer scaling:

07		**BASIC I/O BOARD**
Index	Description:	The selection and supervision of the basic I/O-board is done by means of this parameter. The address of the NIOC-01 is always 1 and with NBIO-21 or NIOB-01 address is 10 (A_{16}) set by switch S1 in the NBIO-21 I/O unit. 1 = **NIOC-01** 2 = **NBIO-21** 3 = **NO** 4 **= NIOB-01**

NBIO-21/NIOB-01:

Switch S1

unit:	type: I	Min: 1	Max: 4	Def: 1	Integer scaling:

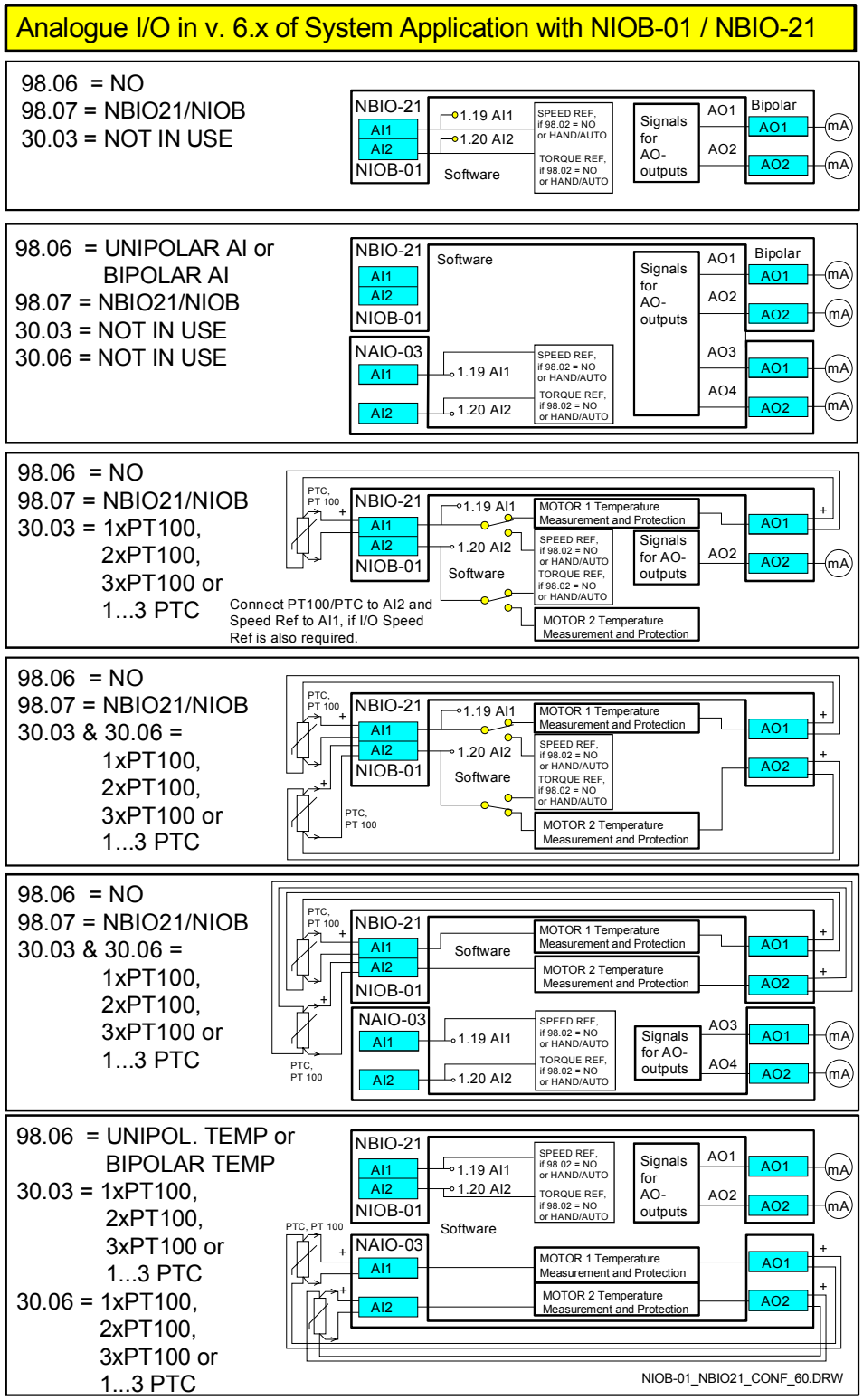


Figure 5 - 3 Analogue I/O Configuration Examples of NBIO-21or NIOB Basic I/O Board with Corresponding Parameter Selections.

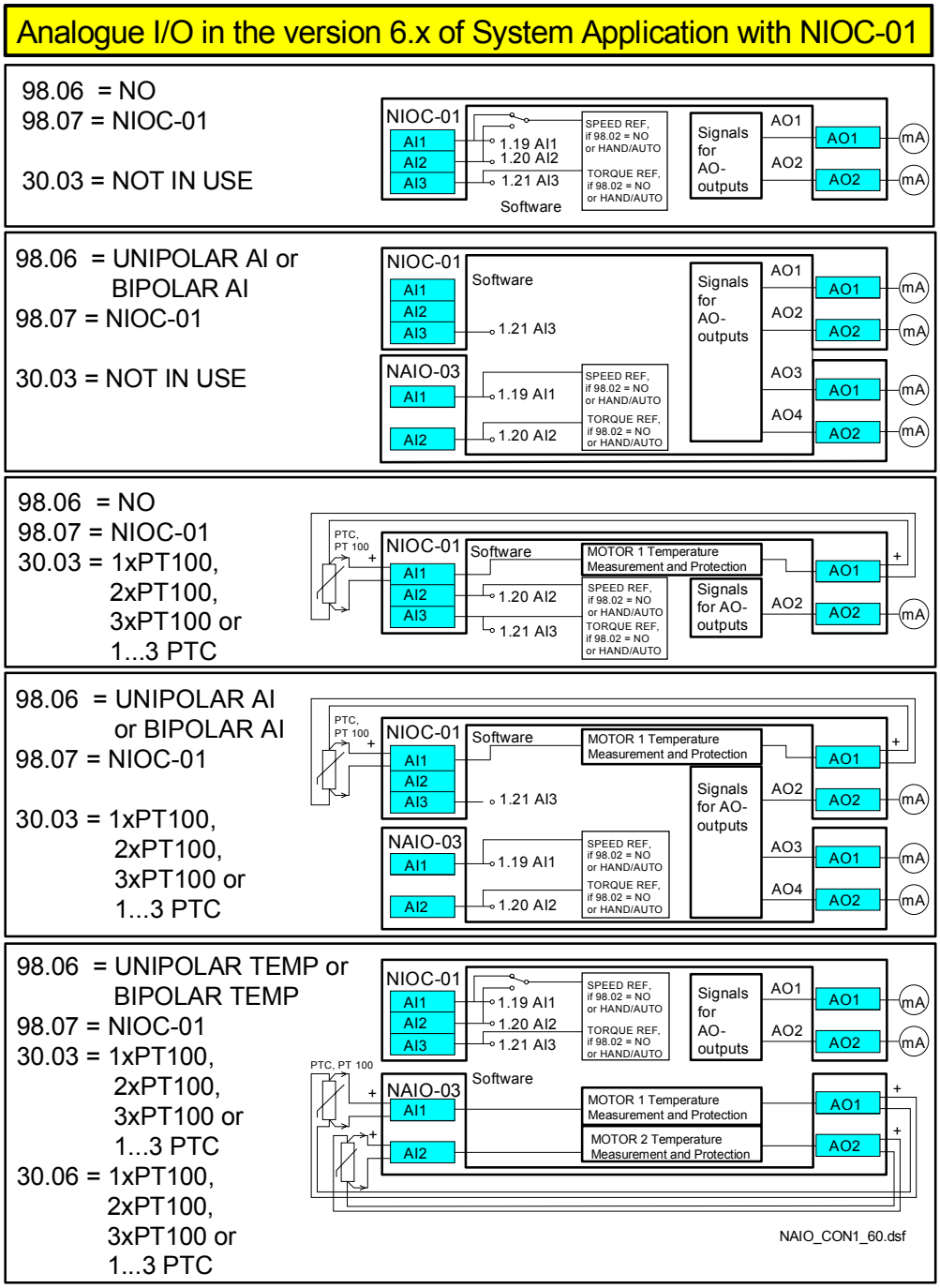


Figure 5 - 4 Analogue I/O Configuration Examples of NIOC-01 Basic I/O Board with Corresponding Parameter Selections.

Group 99 Start Up Data

Note: The drive will not start if the Start-up Data Parameters have not been changed from the factory settings, or the nominal current of the motor is too small compared to the nominal current of the inverter.

WARNING! Running the motor and the driven equipment with incorrect start-up data can result in improper operation, reduction in control accuracy and damage to equipment.

If several motors are connected to the ACS 600 drive, some additional instructions must be considered when setting the Start-up Data Parameters. Please contact your local ABB representative for more information.

Note: Changing any of the motor parameters in Group 99, causes the cancellation of all existing Motor ID Run results!

99	Group name:	*START UP-DATA*			
	Description:	Parameters for setting up the motor information.			
01 Index		**LANGUAGE**			
	Description:	If English (Am) is selected, the unit of power used is HP instead of kW. 0 = **ENGLISH** 1 = **ENGLISH AM** 2 = **DEUTSCH** available since System SW version 5.2 3 = **ITALIANO** not available 4 = **ESPAÑOL** not available 5 = **PORTUGUÊS** not available 6 = **NEDERLANDS** not available 7 = **FRANÇAIS** not available 8 = **DANSK** not available 9 = **SUOMI** not available 10 = **SVENSKA** not available			
unit:	type: I	Min: 0	Max: 12	Def: 0	Integer scaling:
02 Index		**MOTOR NOM VOLTAGE**			
	Description:	Nominal voltage from the motor rating plate. It is not possible to start the ACS 600 without setting this parameter. **Note***:* It is not allowed to connect a motor with nominal voltage less than 1/2 * UN or more than 2 * UN of the ACS 600.			
unit: V	type: R	Min: 207 V	Max: 830 V	Def: 0 V	Integer scaling: 1 == 1V
03 Index		**MOTOR NOM CURRENT**			
	Description:	Rated motor current. If several motors are connected to the inverter, enter the total current of the motors.			
unit: A	type: R	Min: 0 A	Max:	Def: 0 A	Integer scaling: 10 == 1A
04 Index		**MOTOR NOM FREQ**			
	Description:	Nominal frequency from the motor rating plate. **Note***:* If the nominal frequency of the motor is higher than 50 Hz, speed limits in DTC mode or frequency limits in scalar control mode must be set before an ID Run command. See Parameter Group 20 DTC mode or Group 29 (SCALAR control mode).			
unit: Hz	type: R	Min: 8 Hz	Max: 300 Hz	Def: 50 Hz	Integer scaling: 100 == 1 Hz
05 Index		**MOTOR NOM SPEED**			
	Description:	Nominal speed from the motor rating plate.			
unit: rpm	type: R	Min: 1 rpm	Max: 18000 rpm	Def: 1 rpm	Integer scaling: 1 == 1 rpm

99	Group name:	*START UP-DATA*			
06		**MOTOR NOM POWER**			
Index	Description:	Nominal power from the motor rating plate. If several motors are connected to the inverter, enter the total power of the motors. Set also parameter 99.12 MOTOR NOM COS FII.			
unit: kW	type: R	Min: 0 kW	Max: 9000 kW	Def: 0 kW	Integer scaling: 10 == 1 kW
07		**MOTOR ID RUN**			
Index	Description:	This parameter is used to initiate the Motor Identification Run. During the run, the drive will identify the characteristics of the motor for optimum motor control. The ID Run takes about one minute. The ID Run cannot be performed if scalar control is selected (Parameter 99.08 is set to SCALAR). **Note:** The ID Run (Standard or Reduced) should be selected if: • operation point is near zero speed • operation at torques above the motor nominal torque within a wide speed range and without a pulse encoder is required. **Note:** Check the rotation direction of the motor by first start before starting the Motor ID Run. During the run the motor will rotate in the forward direction. **Warning!** The motor will run at up to approximately 50%... 80% of nominal speed during the Motor ID Run. BE SURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE MOTOR ID RUN. 1 = **NO** The Motor ID Run is not performed. If an ID Run has not been done yet, or any of the motor parameters have been changed, the motor will start the mode **FIRST START** after the start command has been given. The DC-magnetising phase lasts much longer than the normal start because the stator resistance and other electrical losses are first identified and stored into the FPROM memory. 2 = **STANDARD** Performing the Standard Motor ID Run guarantees the best possible control accuracy. The motor must be decoupled from the driven equipment before performing the Standard ID Run. 3 = **REDUCED** Only to be selected if the motor cannot be decoupled from the driven equipment. The Reduced Motor ID Run should be selected in applications where mechanical losses are higher than 20% (i.e. the load cannot be disconnected) or where flux reduction is not allowed (i.e. there are auxiliary devices connected in parallel with the motor) while the motor is running.			
unit:	type: I	Min: 1	Max: 3	Def: 1	Integer scaling:
08		**MOTOR CTRL MODE**			
Index	Description:	Motor control mode selection. 1 = **SCALAR** Scalar control mode. 0 = **-DTC-** Direct Torque Control mode. If several motors are connected to the inverter, there are certain restrictions on the usage of DTC. Please contact your local ABB representative for more information.			
unit:	type: B	Min:	Max:	Def: DTC	Integer scaling: 1 == 1
09		**APPLIC RESTORE**			
Index	Description:	Restores either USER MACRO 1, USER MACRO 2 or FACTORY parameter values depending on the selection in Parameter 99.11 APPLICATION MACRO except parameter group 99. 1 = **YES** Values are restored. 0 = **NO**			
unit:	type: B	Min: 0	Max: 1	Def: 0	Integer scaling: 1 == 1

99	Group name:	*START UP-DATA*			
10 Index		**DRIVE ID NUMBER**			
	Description:	This parameter can be used by the overriding system to check the correct connections of the optical cables to the drive type. This parameter requires support from the overriding system.			
unit:	type: I	Min: 0	Max: 32767	Def: 0	Integer scaling:
11 Index		**APPLICATION MACRO**			
	Description:	This parameter selects the application macro to be used. In addition to the default settings (FACTORY), two user-definable parameter sets (USER) are available. In addition to the FACTORY setting there is a selection for saving the current settings as a User Macro (USER 1 SAVE or USER 2 SAVE), and recalling these settings (USER 1 LOAD or USER 2 LOAD). If User Macro 1 or 2 is in use, the parameter values are restored to the last saved values. In addition, the last saved results of the motor identification are restored. Exception: Settings of Parameters 16.05 and 99.11 remain unchanged. **Note:** The Back-Up function in Drive*Window* only saves the active User Macro if called: thus both User Macros must be backed up separately. The macro can be changed from the overriding system using AUX CTRL WORD 2 7.03 bit 12. See also Parameter 16.05 USER MACRO CHG. The status of the active macro can be seen at 8.02 AUX STATUS WORD bits 14 and 15. 1 = **FACTORY** Factory parameters (default values) are recalled and stored to the FPROM memory. 2 = **USER 1 LOAD** Parameter set 1 (User Macro 1) is loaded to the RAM memory. 3 = **USER 1 SAVE** Parameter set 1 (User Macro 1) is saved to the FPROM memory. 4 = **USER 2 LOAD** Parameter set 2 (User Macro 2) is loaded to the RAM memory. 5 = **USER 2 SAVE** Parameter set 2 (User Macro 2) is saved to the FPROM memory.			
unit:	type: I	Min: 1	Max: 5	Def: 1	Integer scaling:
12 Index		**MOTOR NOM COS FII** (available with sw version 5.1x)			
	Description:	Cos φ from the motor rating plate.			
unit:	type: R	Min: 0	Max: 1	Def: 0.7	Integer scaling: 100 == Cos φ 1
13 Index		**POWER IS GIVEN** (available with sw version 5.1x)			
	Description:	The first start/ ID run can be performed by using either power or Cos φ of the motor. Cos φ is recommended. Use power selection if Cos φ is unknown. 0 = **COSFII** 1 = **POWER**			
unit:	type: B	Min: 0	Max: 1	Def: 0 COSFII	Integer scaling: 1 == 1

Chapter 6 - Overview of the CDP 312 Control Panel

Overview

This chapter describes the programming principles of the ACS 600 using the CDP 312 Control Panel.

The user can change the configuration of the ACS 600 to meet the needs of the requirements by programming. The ACS 600 is programmable through a set of parameters. This chapter describes the operation of the CDP312 Control Panel and how to use the panel with the ACS 600 to modify the parameters, to measure the actual values and to control the drive(s).

Panel Link

The CDP312 Control Panel is connected to the drive through a Modbus-protocol communication bus. Modbus is the common bus protocol for ABB Drives products. The communication speed is 9600 bit/s. 31 drives and one panel can be connected on this bus. Each station must have a unique ID number.

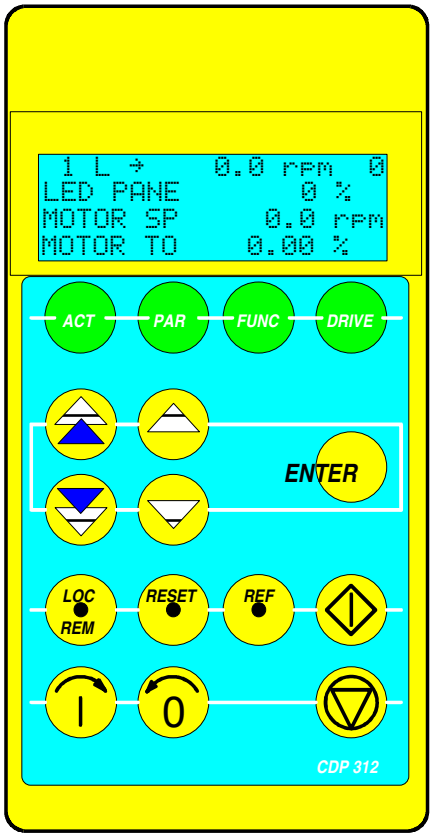


Figure 6 - 1 CDP 312 Control Panel

Display

The LCD type display has 4 lines of 20 characters.

The language selection is made at Start-up by Parameter 99.01 LANGUAGE. Depending on the customers selection, a set of four languages is loaded into the memory of the ACS 600 at the factory.

Keys

The Control Panel keys are flat, labelled, push-button keys that allow you to monitor drive functions, select drive parameters, and change settings.

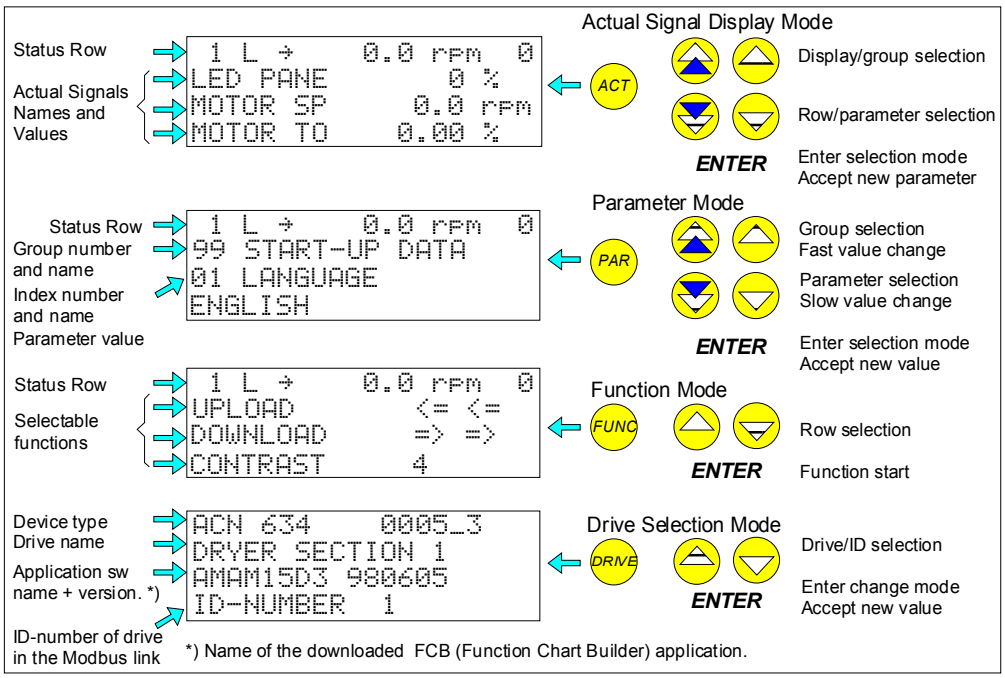


Figure 6 - 2 Control Panel Display Indications and Functions of the Control Panel Keys

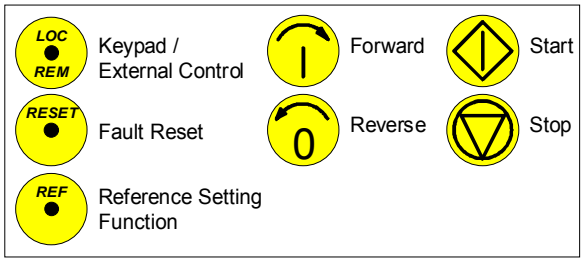


Figure 6 - 3 Operational Commands of the Control Panel Keys

Panel Operation

The following is a description of the operation of the CDP 312 Control Panel.

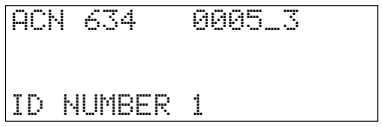
Keypad Modes

The CDP 312 Control Panel has four different keypad modes: Actual Signal Display Mode, Parameter Mode, Function Mode, and Drive Selection Mode. In addition, there is a special Identification Display, which is displayed after connecting the panel to the link. The Identification Display and the keypad modes are described briefly below.

Identification Display

When the panel is connected for the first time, or the power is applied to the drive, the Identification Display appears, showing the panel type and the number of drives connected to the Panel Link.

Note: The panel can be connected to the drive while power is applied to the drive.



After two seconds, the display will clear, and the Actual Signals of the drive will appear.

Actual Signal Display Mode

This mode includes two displays, the Actual Signal Display and the Fault History Display. The Actual Signal Display is displayed first when the Actual Signal Display mode is entered. If the drive is in a fault condition, the Fault Display will be shown first.

The panel will automatically return to Actual Signal Display Mode from other modes if no keys are pressed within one minute (exceptions: Status Display in Drive Selection Mode and Fault Display Mode).

In the Actual Signal Display Mode you can monitor three Actual Signals at a time.

The Fault History includes information on the 16 most recent faults that have occurred in your ACS 600. The name of the fault and the total power-on time are displayed. If the APC2 overriding system has been connected to the drive (DDCS channel 0), this time can be seen in the date format instead of power-on time.

The following table shows the events that are stored in the Fault History. For each event it is described what information is included.

Event	Information	Display
A fault is detected by ACS 600	Sequential number of the event. Name of the fault and a "+" sign in front of the name. Total power on time or date and time updated by overriding system.	1 L → 0.0 rpm 0 2 LAST FAULT +OVERCURRENT 12 H 49 MIN 10 S
A fault is reset by user.	Sequential number of the event. -RESET FAULT text. Total power on time or date and time updated by the overriding system.	1 L → 0.0 rpm 0 1 LAST FAULT -RESET FAULT 12 H 50 MIN 10 S
A warning is activated by ACS 600	Sequential number of the event. Name of the warning and a "+" sign in front of the name. Total power on time or date and time updated by the overriding system.	1 L → 0.0 rpm 0 1 LAST WARNING +EMESTOP 12 H 50 MIN 10 S
A warning is deactivated by ACS 600	Sequential number of the event. Name of the warning and a "-" sign in front of the name. Total power on time or date and time updated by the overriding system.	1 L → 0.0 rpm 0 1 LAST WARNING -EMESTOP 12 H 50 MIN 35 S

When a fault or warning occurs in the drive, the message will be displayed immediately, except in the Drive Selection Mode. From the fault display, it is possible to change to other displays without resetting the fault. If no keys are pressed the fault or warning text is displayed as long as the fault exists.

Table 6 - 1 How to Display the Full Name of the three Actual Signals

Step	Function	Press key	Display after key is pressed
1.	To display the full name of the three actual signals	**Hold** ACT	1 L → 0.0 rpm 0 LED PANEL OUTP MOTOR SPEED FILT MOTOR TORQUE FILT
2.	To return to the Actual Signal Display Mode.	**Release** ACT	1 L → 0.0 rpm 0 LED PANE 0 % MOTOR SP 0.0 rpm MOTOR TO 0.00 %

Table 6 - 2 How to Select Actual Signals to the Display

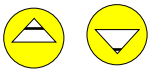
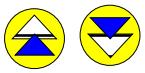
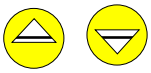
Step	Function	Press key	Display after key is pressed
1.	To enter the Actual Signal Display Mode	ACT	1 L → 0.0 rpm 0 LED PANE 0 % MOTOR SP 0.0 rpm MOTOR TO 0.00 %
2.	To select the desired row.		1 L → 0.0 rpm 0 LED PANE 0 % MOTOR SP 0.0 rpm MOTOR TO 0.00 %
3.	To enter the Actual Signal Selection Mode.	ENTER	1 L → 0.0 rpm 0 1 ACTUAL SIGNALS 01 MOTOR SPEED FILT 0.0 rpm
4.	To select a different group.		1 L → 0.0 rpm 0 2 ACTUAL SIGNALS 01 SPEED REF 2 0 rpm
5.	To select a index.		1 L → 0.0 rpm 0 2 ACTUAL SIGNALS 02 SPEED REF 3 0 rpm
6.	To accept the selection and to return to the Actual Signal Display Mode.	ENTER	1 L → 0.0 rpm 0 LED PANE 0 % SPEED RE 0.0 rpm MOTOR TO 0.00 %

Table 6 - 3 How to Display a Fault and Reset the Fault History

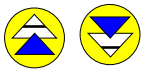
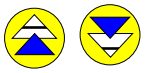
Step	Function	Press key	Display after key is pressed
1.	To enter the Actual Signal Display Mode	ACT	1 L → 0.0 rpm 0 LED PANE 0 % MOTOR SP 0.0 rpm MOTOR TO 0.00 %
2.	To enter the Fault History Display. The time of occurrence can be seen either as total power-on time or in the date format if an overriding system (eg. APC2) has been connected to control the drive.		1 L → 0.0 rpm 0 1 LAST FAULT +PANEL LOST 20 H 49 MIN 56 S 1 L → 0.0 rpm 0 1 LAST FAULT +PANEL LOST 980621 10:26:19.3043 s = fault or alarm logged into the fault logger r = fault or alarm reset
3.	To clear all the faults from the Fault History Buffer. A view of cleared fault logger.	RESET	1 L → 0.0 rpm 0 2 LAST FAULT +OVERCURRENT 12 H 49 MIN 10 S 1 L → 0.0 rpm 0 2 LAST FAULT H MIN S
4.	To return to the Actual Signal Display Mode.		1 L → 0.0 rpm 0 LED PANE 0 % MOTOR SP 0.0 rpm MOTOR TO 0.00 %

Table 6 - 4 How to Display and Reset an Active Fault

Step	Function	Press key	Display after key is pressed
1.	To enter the Actual Signal Display Mode.	ACT	1 L → 0.0 rpm 0 ACS 600 75 kW *** FAULT *** PANEL LOST
2.	To reset the fault. The Reset button functions also in the REMOTE mode.	RESET	1 L → 0.0 rpm 0 LED PANE 0 % MOTOR SP 0.0 rpm MOTOR TO 0.00 %

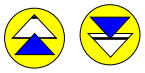
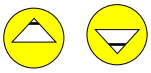
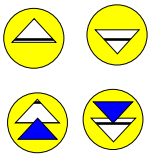
Parameter Mode

The Parameter Mode is used for making changes to the ACS 600 parameters. When this mode is entered for the first time after power up, the display will show the first parameter of the first group. The next time, the Parameter Mode is entered, the previously selected parameter is shown.

Note: If you try to write to a write-protected parameter, the following warning will be displayed.

```
**WARNING**
WRITE ACCESS DENIED
PARAMETER SETTING
NOT POSSIBLE
```

Table 6 - 5 How to Select a Parameter and Change the Value

Step	Function	Press key	Display after key is pressed
1.	To enter the Parameter Mode.	PAR	1 L → 0.0 rpm 0 13 ANALOGUE INPUTS 01 AI1 HIGH VALUE 10000
2.	To select another parameter group. While holding the arrow down, only the group name and number are displayed. When the key is released, name, number and value of the first parameter in the group are displayed.		1 L → 0.0 rpm 0 14 DIGITAL OUTPUTS 1 L → 0.0 rpm 0 14 DIGITAL OUTPUTS 01 DO1 CONTROL OFF
3.	To select an index number. While holding the arrow down, only the parameter name and number are displayed. When the key is released the value of the parameter is also displayed.		1 L → 0.0 rpm 0 14 DIGITAL OUTPUTS 01 DO1 GROUP+INDEX 1 L → 0.0 rpm 0 14 DIGITAL OUTPUTS 02 DO1 GROUP+INDEX 801
4.	To enter the parameter value.	ENTER	1 L → 0.0 rpm 0 14 DIGITAL OUTPUTS 02 DO1 GROUP+INDEX [801]
5.	To change the parameter value. (slow change) (fast change)		1 L → 0.0 rpm 0 14 DIGITAL OUTPUTS 02 DO1 GROUP+INDEX [901]
6a. 6b.	To send a new value to the drive. To cancel the new setting and keep the original value. The selected Keypad Mode is entered.	ENTER ACT PAR FUNC DRIVE	1 L → 0.0 rpm 0 14 DIGITAL OUTPUTS 02 DO1 GROUP+INDEX 901 1 L → 0.0 rpm 0 14 DIGITAL OUTPUTS 02 DO1 GROUP+INDEX 801

Function Mode

The Function Mode is used to select special functions. These functions include Parameter Upload, Parameter Download and setting the contrast of the CDP 312 Panel Display.

Parameter Upload will copy existing parameters from Groups 10 to 98 from the drive to the panel. The upload function can be performed while the drive is running. Only the STOP command can be given during the uploading process.

Parameter Download will copy existing parameter Groups 10 to 97 stored in the panel to the drive.

Note: Parameters in Groups 98 and 99 concerning options, language and motor data are not copied.

If downloading is attempted before uploading, the following warning will be displayed:

```
**WARNING**
NOT UPLOADED
DOWNLOADING
NOT POSSIBLE
```

The parameters can be uploaded and downloaded only if the DTC software version and application software version (see Signals 4.02 DTC SW VERSION and 4.03 APPL SW VERSION) of the destination drive are the same as the software versions of the source drive. Otherwise the following warning will be displayed:

```
**WARNING**
DRIVE INCOMPATIBLE
DOWNLOADING
NOT POSSIBLE
```

The drive must be stopped during the downloading process. If the drive is running and downloading is selected, the following warning is displayed:

```
**WARNING**
DRIVE IS RUNNING
DOWNLOADING
NOT POSSIBLE
```

Table 6 - 6 How to Select and Perform a Function

Step	Function	Press key	Display after key is pressed
1.	To enter the Function Mode	FUNC	1 L → 0.0 rpm 0 UPLOAD <= <= DOWNLOAD => => CONTRAST 0
2.	To select a function.	▲ ▼	1 L → 0.0 rpm 0 UPLOAD <= <= DOWNLOAD => => CONTRAST 0
3.	To activate the selected function.	ENTER	1 L → 0.0 rpm 0 => => => => => => => DOWNLOAD
4.	Loading completed.		1 L → 0.0 rpm 0 LED PANE 0 % MOTOR SP 0.0 rpm MOTOR TO 0.00 %

Table 6 - 7 How to Set the Contrast of the Panel Display.

Step	Function	Press key	Display after key is pressed
1.	To enter the Function Mode.	FUNC	1 L → 0.0 rpm 0 UPLOAD <= <= DOWNLOAD => => CONTRAST 0
2.	To select a function.	▲ ▼	1 L → 0.0 rpm 0 UPLOAD <= <= DOWNLOAD => => CONTRAST 0
3.	To enter the contrast setting function.	ENTER	1 L → 0.0 rpm 0 CONTRAST [0]
4.	To set the contrast. (0...7)	▲ ▼	1 L → 0.0 rpm 0 CONTRAST [7]
5a.	To accept the selected value. To cancel the new setting and keep the original value, press any of the Mode keys. The selected Keypad Mode is entered.	ENTER ACT PAR FUNC DRIVE	1 L → 0.0 rpm 0 UPLOAD <= <= DOWNLOAD => => CONTRAST 7 1 L → 0.0 rpm 0 UPLOAD <= <= DOWNLOAD => => CONTRAST 0

Copying Parameters from One Unit to Other Units

You can copy parameters in Groups 10...97 from one drive to another by using the Parameter Upload and Parameter Download functions in the Function Mode. Typically this kind of function can be used if the processes and the motor types are same. This procedure is permitted only if the DTC SW and APPL SW versions are the same on both units. Follow the procedure below:

1. Select the correct options (Group 98) and language (Group 99) **for each drive**.
2. Set the rating plate values for the motors (Group 99) and perform the identification run for each motor if required.
3. Set the parameters in Groups 10 to 97 as preferred in one ACS 600 drive.
4. Upload the parameters from the ACS 600 to the panel (see Table 6-6).
5. Disconnect the panel and reconnect it to the next ACS 600 unit.
6. Download the parameters from the panel to the ACS 600 unit. (see Table 6-6).
7. Repeat steps 5 and 6 for the rest of the units.

Note: Parameters in Groups 98 and 99 concerning options, language and motor data are not copied.

Setting the Contrast

If the Control Panel Display is not clear enough, set the contrast according to the procedure explained in Table 6-7.

Drive Selection Mode

In normal use, the features available in the Drive Selection Mode are not needed; these features are reserved for applications where several drives are connected to one Modbus Link.

Modbus Link is the communication link connecting the Control Panel and the ACS 600. Each on-line station must have an individual identification number (ID).

Caution: The default ID number setting of the ACS 600 must not be changed unless it is to be connected to the Modbus Link with other drives on-line.

Table 6 - 8 How to Select a Drive

Step	Function	Press key	Display after key is pressed
1.	To enter the Drive Selection Mode.	DRIVE	ACN 634 0005_3 DRIVE NAME AMAM1050 980612 ID NUMBER 1
2.	To select the drive. The drive connected to the panel is selected with the arrow buttons. Selected ID number is shown on the bottom row in the display. The Status Display of all devices connected to the Panel Link is shown after the last individual station. If all stations do not fit on the display at once, press to view the rest of them.		ACN 634 0005_3 DRIVE NAME AMAM1050 980612 ID NUMBER 1 ACN 634 0005_3 DRIVE NAME AMAM1050 980612 ID NUMBER 2 1 2 3 4 5 6 7F 8 9 10
3.	To connect to the last displayed drive and to enter another mode, press one of the Mode keys. The selected Keypad Mode is entered.	ACT PAR FUNC	1 L → 0.0 rpm 0 LED PANE 0 % MOTOR SP 0.0 rpm MOTOR TO 0.00 %

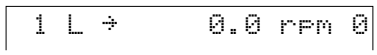
Table 6 - 9 How to Change ID Number of the Drive

Step	Function	Press key	Display after key is pressed
1.	To enter the Drive Selection Mode	DRIVE	ACN 634 0005_3 DRIVE NAME AMAM1050 980612 ID NUMBER 1
2.	To select the next view. The ID number of the station is changed by first pressing ***ENTER*** (the brackets round the ID number appear) and then adjusting the value with the arrow buttons. The new value is accepted with ***ENTER***. The power of the ACS 600 must be switched off to validate its new ID number setting (the new value is not displayed until the power is switched off and on). The Status Display of all devices connected to the Panel Link is shown after the last individual station. If all stations do not fit on the display at once, press to view the rest of them.		ACN 634 0005_3 DRIVE NAME AMAM1050 980612 ID NUMBER 1 1→ 2↑ 3↓ 4↑ 5↑ 6→ 7F 8↑ 9↑ 10↑ → = Drive stopped, direction forward ↑ = Drive running, direction reverse F = Drive has tripped on a fault
3.	To connect to the last displayed drive and to enter another mode, press one of the Mode keys. The selected Keypad Mode is entered.	ACT PAR FUNC	1 L → 0.0 rpm 0 LED PANE 0 % MOTOR SP 0.0 rpm MOTOR TO 0.00 %

Operational Commands

Operational commands control the operation of the ACS 600. They include starting and stopping the drive, changing the direction of rotation and adjusting the reference. The reference value is used for controlling motor speed (Local Reference 1), motor torque (Local Reference 2) or frequency in scalar control (Local Reference 3).

Operational commands can be given from the CDP 312 Control Panel always when the status row is displayed and the control location is the panel. This is indicated by L (Local Control) on the display. See the following figure.

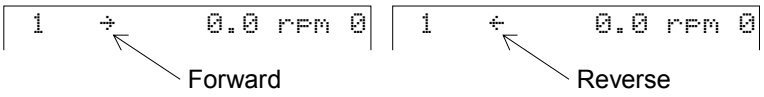


Remote Control (control from the overriding system or I/O is indicated by an empty field).

Operational commands cannot be given from this panel when in Remote Control. Only monitoring actual signals, setting parameters, uploading and changing ID numbers is possible.

The control is changed between Local and External control locations by pressing the ***LOC / REM*** key. Only one of the Local Control devices (CDP 312 or Drive*Window*) can be used as the local control location at a time.

Direction of actual rotation is indicated by an arrow.



Start, Stop, Direction and Reference

Start, Stop and Direction commands are given from the panel by pressing the keys

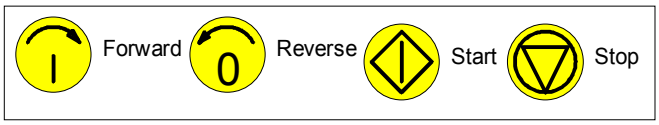
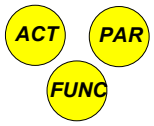
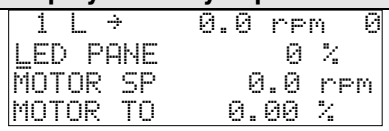
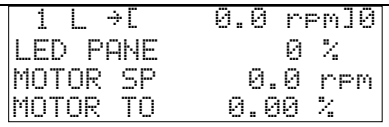
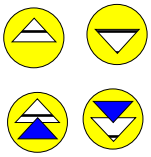
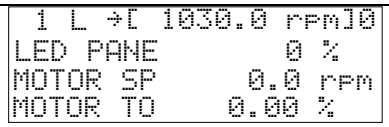
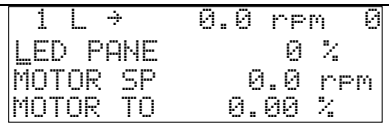


Table 6 - 10 How to Set the Reference

Step	Function	Press key	Display after key is pressed
1.	To display enter a Keypad Mode displaying the status row.		
2.	To enter the Reference Setting Mode		
3.	To change the reference. (slow change) (fast change)		
4.	To escape the Reference Setting Mode. The selected Keypad Mode is entered.		

Chapter 7 – Fault Tracing

Overview

This chapter describes the protections and fault tracing of ACS 600 drive.

Protections

I/O- Monitoring

If the Application and Motor Control Board (NAMC) cannot communicate with the I/O Control Board (NIOC), or with an I/O Extension Module connected to the I/O Extension Link, the following alarms are given:

DIO ALARM	bit 7 in ALARM WORD_1 (9.04)
AIO ALARM	bit 8 in ALARM WORD_1 (9.04)
EXT DIO ALM	bit 9 in ALARM WORD_1 (9.04)
EXT AIO ALM	bit 10 in ALARM WORD_1 (9.04)

Communication Monitoring

Messages received from the overriding system are monitored in the NAMC diagnostics program. The monitoring function is activated by parameter **70.4 CH0 TIME OUT**. This parameter defines the delay before the communication fault is indicated. By entering a value of zero, this function is disabled. The action in case of communication fault is defined in the parameter **CH0 COM LOSS CTRL (70.05)**. On a communication fault, bit 12 (fault **"CH0 COM LOS"**) in **FAULT WORD 2 (9.02),** is set to 1.

Note: If updating interval to the data set 10 is slower than 2 s, an alarm and fault is activated.

Inverter Overtemperature Fault

The ACS 600 drive supervises the inverter power plate module temperature. If it exceeds 115 °C, a warning "**ACS 600 TEMP**" is given and **AW_1 (9.04)** bit 4 is set to 1.

If the power plate module temperature exceeds 125°C, a fault "**ACS 600 TEMP**" is given and **FW_1 (09.01)** bit 3 is set to 1.

Ambient Temperature

The ACS 600 measures the ambient temperature on the surface of the NIOC board. The drive will not start if the temperature is below -5°C or above 73 to 82°C (depending on converter type). Also a fault "**CABIN TEMP F**" is given and **FW_2 (9.02)** bit 7 is set to1.

Overcurrent

The Overcurrent trip limit is 3.5 * I_{hd} (nominal motor current for heavy duty use). There are several sources of the overcurrent trip:

- Software trip (time level 100 µs, level = 97 % of measurement scale)
- Hardware level trip (97 % of measurement scale for 35 µs)
- Hardware derivative trip (12.5 % of measurement scale for 75 µs)

- Hardware level trip in parallel connected units by PBU logic (94 % of measurement scale for 75 μs)

A fault "**OVERCURRENT**" is given and **FW_1 (09.01)** bit 1 is set to 1.

The current measurement is calibrated automatically during the start procedure.

DC Overvoltage

The DC Overvoltage trip limit is 1.3 * 1.35 * U_{1max}, where U_{1max} is the maximum value of the mains voltage range.

Nominal Voltage of Inverter Unit	U_{1max}(AC)	U_{DC} Overvoltage Trip Limit
400 V	415 V	730 V
500 V	500 V	880 V
690 V	690 V	1210 V

A fault **"DC OVERVOLT"** is given and **FW_1 (09.01)** bit 2 is set to 1.

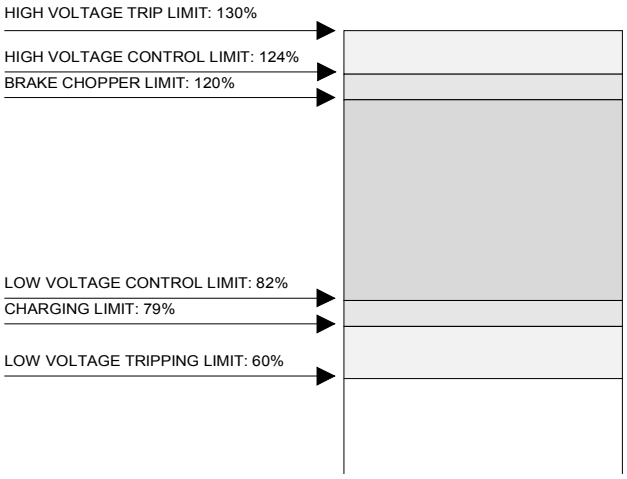


Figure 7 - 1 DC Voltage Control and Tripping Limits

DC Undervoltage

The DC Undervoltage trip limit is 0.60 * 1.35 * U_{1min}, where U_{1min} is the minimum value of the mains voltage range.

Nominal Voltage of Inverter Unit	U_{1min} (AC)	U_{DC} Undervoltage Trip Limit
400 V	380 V	307 V
500 V	380 V	307 V
690 V	525 V	425 V

A fault "**DC UNDERVOLT**" is given and **FW_2 (09.02)** bit 2 is set to 1.

Local Control Lost Function

The Local Control Lost function defines the operation of the ACS 600 drive when, while in local control mode, the communication between the local control device (control panel or Drive*Window*) and the ACS 600 stops.

RUN ENABLE Interlocking Function

Digital input DI2 state ”0” activates the RUN ENABLE function, used for external RUN interlocking and for internal charging logic, when the optional load switch is used at the input DC circuit of the inverter unit. When the state of DI2 switches to 0, the drive stops by coasting, a fault “**RUN DISABLD**” is given and **FW_2 (9.02)** bit 4 and **ASW (08.02)** bit 4 are set to 1.

START INHIBITION Interlocking Function

START INHIBIT DI function is used to control and monitor the prevention of unexpected start-up function. Inverter IGBT pulses are first blocked directly by this digital input, when the safety relay -A40 or -K14 contact opens in the prevention of Unexpected start-up circuit. Selected digital input effects as an AND interlocking for the bit 3 (RUN) of Main Control Word. Status of both signals “**START INHIBIT DI**” digital input and “**START INHIBIT**” **ASW (8.02)** bit 8 from the PPCC link must follow each other within 3 seconds. If contact of “**START INHIBIT DI**” opens but still the status of “**START INHIBIT**” indicates different status, a fault “**START INH HW**” is given and bit 9.06 **FW_3 (9.06)** bit 1 is set. This diagnostics indicates incorrect HW and faulty NGPS board power supply. If there is no Prevention of Unexpected start-up circuit in use, selection NO must be selected.

Short Circuit

There are separate protection circuits for supervising the motor cable and the inverter short circuits. If a short circuit occurs, the drive will not start and a fault “**SHORT CIRC**” is given and **FW_1 (09.01)** bit 0 is set to “1”.

Intermediate DC Link Current Ripple Fault

Input phase loss protection circuits supervise the status of the mains in the supply section by detecting the intermediate current ripple. If an input phase is lost, the intermediate circuit current ripple increases. If the ripple exceeds 13% the drive is stopped and a fault “**SUPPLY PHASE**” is given. **FW_2 (09.02)** bit 0 is set to 1.

Overspeed Fault

If the ACS 600 drive output frequency exceeds the preset level (eg. in the case of overshooting in speed control), the drive is stopped and a fault “**OVER FREQ**” is given. **FW_1 (09.01)** bit 9 is set to 1.
The trip level frequency margin is adjustable by Parameter **FREQ TRIP MARGIN (20.11)**.

Earth/Fault Logics

This section describes how to track the cause of earth fault in ACS 600 MultiDrive R2i-R12i, 2xR11i/R12i and 4xR11i/R12i modules.

Earth fault notification of **inverter module** does not always indicate actual earth fault. Failure can sometimes be in IGBTs or NGDRs.

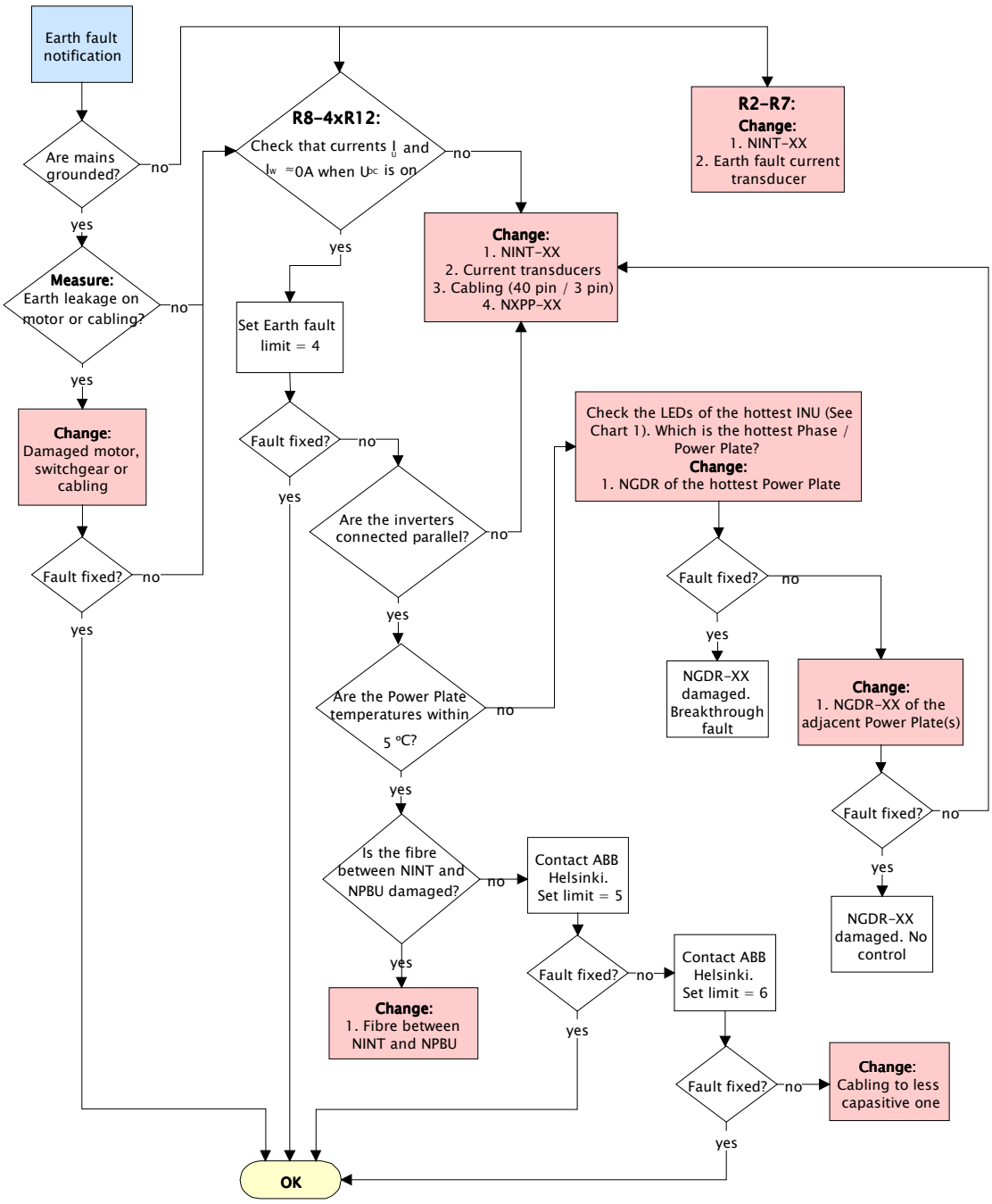


Figure 7 - 2 This Flowchart can be used to Trace the Cause of Earth Fault and to Find Faulty Parts.

Indicator LEDs in the NINT Board

Following figure describes how to find the hottest phase or power plate by checking the LEDs of NINT-XX and NXPP-0X boards. This applies only to parallel connected phase modules and power plates of R8i – R12i modules.

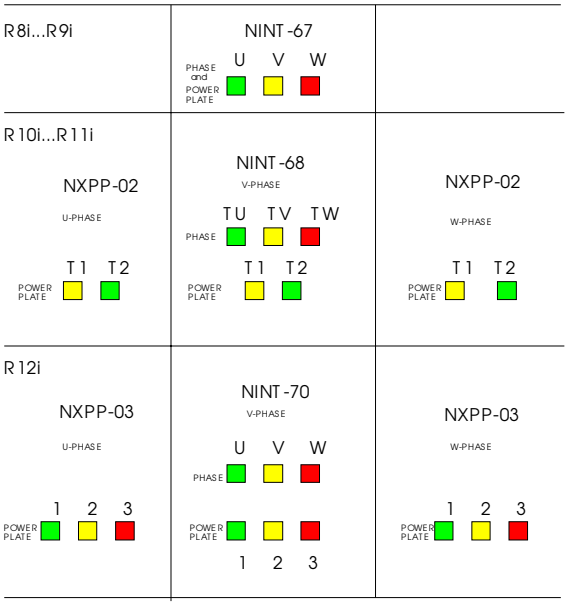


Figure 7 - 3 LED Indicators of NINT Boards.

Interpretation of the LEDs

All LEDs are unlit on NINT-XX or NXPP-0X board:

- No DC-voltage connected.
- Possibly burned fuse on the NPOW-62 board.
- Connection between NRED-61 and NPOW-62 is faulty.
- Connection between NPOW-62 (X32) and NINT-XX (X42) is faulty.

Only one LED is lit on NINT-XX or NXPP-0X board: That phase or power plate is hotter than the other ones.

One LED is brighter than other ones on NINT-XX or NXPP-0X board: That phase or power plate is hotter than the other ones.

All LEDs are lit on NINT-XX or NXPP-0X board: That phase or power plate is hotter than the other ones.

R8i – R9i modules: The *three LEDs of NINT-XX* tell the hottest *phase* and also the hottest *power plate*, because on each phase there is only one power plate.

R10i – R11i modules: The *upper three LEDs of NINT-XX* board show, which *phase* is the hottest. The *lower two LEDs of NINT-XX* indicate the hottest *power plate on V-phase* and the *two LEDs of NXPP-0X* indicate the hottest *power plate on U-phase* (left NXPP-0X) and *W-phase* (right NXPP-0X). Two power plates are connected parallel in each phase module.

R12i module: The *upper three LEDs of NINT-XX* board show, which *phase* is the hottest. The *lower three LEDs of NINT-XX* tell the hottest *power plate on V-phase* and the *three LEDs of NXPP-0X* tell the hottest *power plate on U-phase* (left NXPP-0X) and *W-phase* (right NXPP-0X). Three parallel connected power plates are placed in each phase module.

The causes of overheated power plate are usually faulty NGDR-XX boards, damaged power plates or badly installed power plates (greasing or quality of the surface).

The colors of the three LEDs and the matching phases or power plates are:

U-phase / power plate 1	Green (left)
V-phase / power plate 2	Yellow (middle)
W-phase / power plate 3	Red (right)

For two power plates per phase (R10i – R11i):

Power plate T1	Yellow (left)
Power plate T2	Green (right)

Speed Measurement Fault

Speed Measurement Fault is activated, if

- no pulses are received within the time of Parameter **(50.11) ENCODER DELAY** and the drive is simultaneously at the current or torque limit.
- measured and estimated speed differ 20 % from nominal speed of motor.
- there is no communication between the pulse encoder module and NAMC board.
- there is observed big change in the pulse frequency of the pulse encoder during 1 ms.

The Fault/Alarm function is activated by Parameter **(50.05) ENCODER ALM/FLT**. In case of a fault, **FW_2 (09.02)** bit 5 is set to 1 and a fault "**ENCODER FLT**" is given.

Switching from Measured Speed to Estimated Speed

In case of an alarm, **AW_1 (9.04)** bit 5 is set to 1 and an alarm "**ENCODER ERR**" is given. If an alarm function has been selected and the speed measurement error is detected based on derivation term the drive automatically turns to use estimated speed. Drive uses estimated speed as long as the difference between estimated and measured speed is bigger than 1%. The difference is checked every five seconds. When the difference is smaller than 1% drive turns back to use measured speed. The status of the used actual speed can be seen from the **ASW (802)** bit 12.

Overswitching Frequency Fault

If the inner control loop exceeds the maximum switching frequency, a fault "**OVER SWFREQ**" is given and **FW_2 (9.02)** bit 9 is set to 1.

System Fault

If the program on the NAMC board has failed and causes an interruption, **FW_1 (09.01)** bit 7 (SYSTEM_FAULT) is set to 1.

Short Time Overloading

The inverter section of the ACS 600 MultiDrive incorporates an IGBT-transistor power stage. Duty Cycles A and B are presented for each inverter type in the ACS 600 MultiDrive catalogue (code 3BFE 63981915). See also the environmental limits.

$I_{AC\_NOMINAL}$ = nominal current (continuous)

$I_{AC\_4/5\ min}$ = I_2 base current for Duty Cycle A

$I_{AC\_1/5\ min}$ = I_2 max current for Duty Cycle A (150% of the base current $I_{AC\_4/5\ min}$)

$I_{AC\_50/60\ s}$ = I_2 base current for Duty Cycle B

$I_{AC\_10/60\ s}$ = I_2 max current for Duty Cycle B (200% of the base current $I_{AC\_50/60\ s}$)

If the overload cycle is longer than described for Duty Cycle A or B, the inverter section is protected against the overload with a temperature measurement sensor and a software algorithm.

Overloading between $I_{AC\_Nominal}$ and $I_{AC\_1/5\ min}$

If the load current is continuously between $I_{AC\_Nominal}$ and $I_{AC\_1/5\ min}$, the temperature of the IGBT power plate(s) and the heat sink will increase further. The overloading time is limited by means of the temperature sensor.

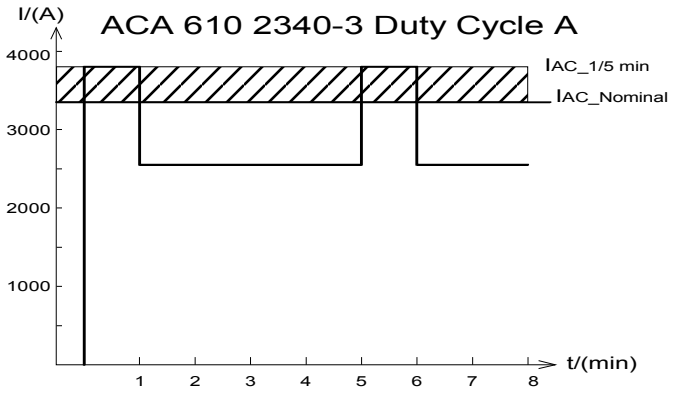


Figure 7 - 4 Overloading Range between $I_{AC\_Nominal}$ and $I_{AC\_1/5\ min}$ in ACA 610 2340-3

If the measured temperature exceeds 115 °C, a warning "**ACS 600 TEMP**" is given and **Alarm Word 1 (AW1)** bit 4 is set to 1.

If the power plate module temperature exceeds 125 °C, a fault "**ACS 600 TEMP**" is given and **Fault Word 1 (FW1)** bit 3 is set 1. The inverter pulses are blocked and the drive stops by coasting (zero torque).

Overloading between the $I_{AC\_1/5\ min}$ and Maximum Current

The maximum current is limited by parameter 20.04 **MAXIMUM CURRENT**. If the actual current exceeds the $\mathbf{I_{AC\_1/5\ min}}$ level, a software algorithm is also activated. The load cycle between $\mathbf{I_{AC\_1/5\ min}}$ and the maximum current is time-limited as a function of current by means of a software integrator and thus the areas of the A1, A2 and A3 are equal.

$A1 = 10\ s * (\mathbf{I_{AC\_10/60s}} - \mathbf{I_{AC\_1/5\ min}})$.

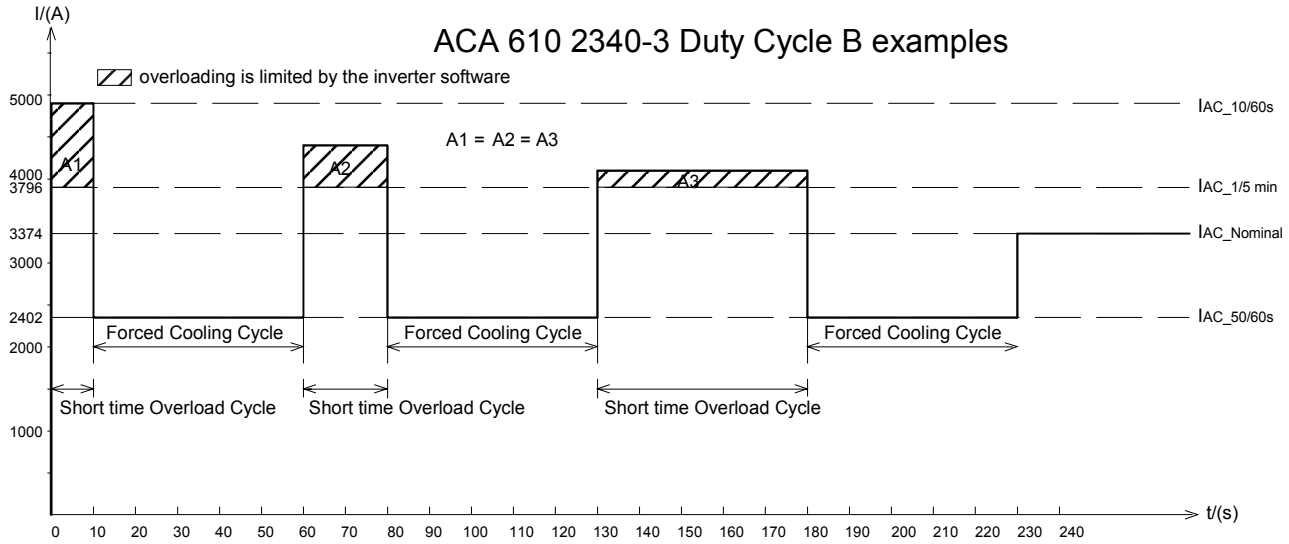


Figure 7 - 5 Overloading example when the Load Current is > $I_{AC\_1/5\ min}$

At the beginning of a forced cooling cycle, **AW_2 (9.05)** bit 2 is set to 1 and an alarm "**INV OVERLOAD**" is given.

Motor Protections

Motor Thermal Protection Functions

The motor can be protected against overheating by:

- activating the DTC motor thermal model or User Mode.
- measuring motor temperature by PT 100 or PTC sensors (1 or 2 separate measurement channels).
- by detecting the state of a thermal switch (KLIXON) inside the motor by the digital input DI6. See Parameter Group 10, selection KLIXON. If the contact opens, fault "**KLIXON**" is activated and **FW_1 (09.01)** bit 5 is set to 1

The motor thermal model can be used parallel with other temperature protections (PTC, PT100, KLIXON).

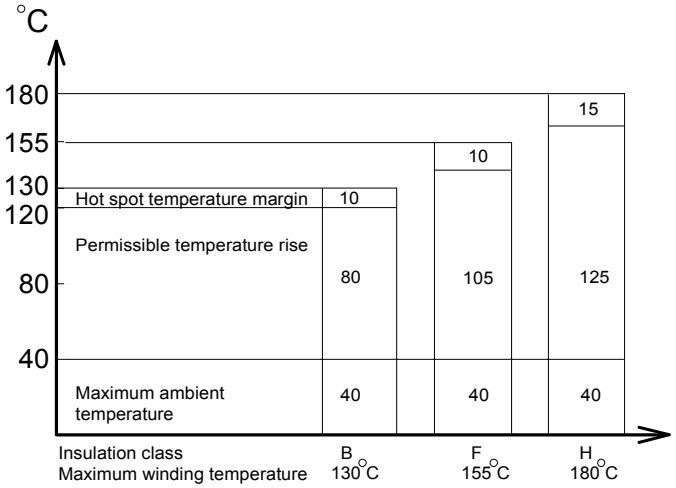


Figure 7 - 6 Motor Insulation Classes According to IEC 85

Motor Thermal Model

The ACS 600 drive calculates the temperature of the motor based on the following assumptions:

1. The motor ambient temperature is 30 °C.
2. Motor temperature is calculated using either the user-adjustable or automatically calculated Motor Thermal Time and Motor Load Curve. The load curve should be adjusted in case the ambient temperature is higher than 30 °C.

The thermal model provides protection equivalent to standard class 10, 20, or 30 overload relays by setting the Motor Thermal Time to 350, 700, or 1050 seconds respectively and parameter **30.29 THERM MOD FLT L** to value 110 °C.

There are two levels of temperature monitoring:

- alarm "**MOTOR TEMP**" is activated when the alarm temperature limit defined by Parameter **30.28 THERM MOD ALM L** is reached and **AW_1 (09.04)** bit 3 is set to 1.
- fault "**MOTOR TEMP**" is activated when the trip temperature limit defined by Parameter **30.29 THERM MOD FLT L** is reached, **FW_1 (09.01)** bit 6 is set to 1.

Usage of PT100, PTC or KTY84-1xx Temperature Sensors

Motor temperature can be measured by using the analogue inputs and outputs of the drive. The System Application program supports two measurement channels: AI1 and AI2 for motor 1 and motor 2 temperature measurements.

WARNING! According to IEC 664, the connection of the thermistor to the analogue I/O (NIOC-01 or NAIO) or to digital input DI6 of the NIOC-01 requires double or reinforced insulation between motor live parts and the thermistor. Reinforced insulation entails a clearance and creepage of 8 mm (400/500 VAC equipment). If the thermistor assembly does not fulfil the requirement, the other I/O terminals of ACS 600 must be protected against contact, or a thermistor relay must be used to isolate the thermistor from the digital input.

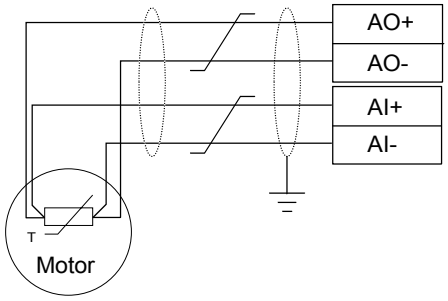


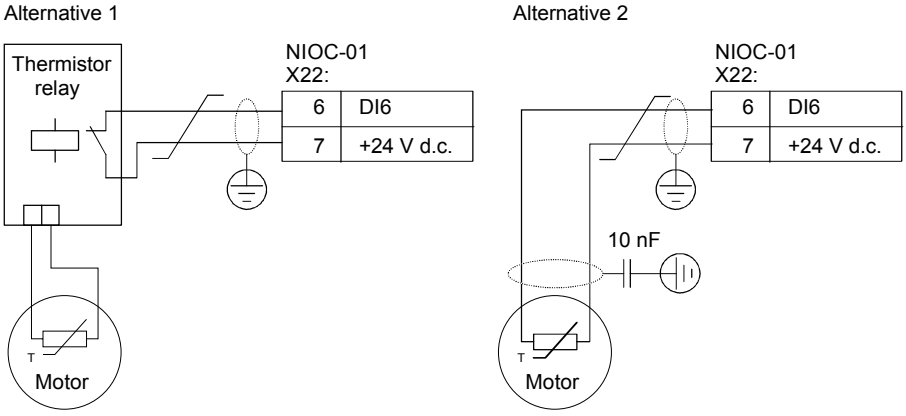
Figure 7 - 7 Thermistor Connection example using Analogue I/O.

Motor overtemperature can be detected by connecting 1...3 PTC thermistors, 1...3 PT100 elements or silicon temperature sensor

KTY84-1xx (1000Ω at 100 °C). The purpose of the analogue output is to supply a constant current to the temperature element, the analogue input measures the voltage across the element. The application program sets the correct constant current according to the sensor type selection. Alarm and trip limits are defined by Parameters 30.04 and 30.05 for the motor 1 and 30.07 and 30.08 for the motor 2.

- alarm "**MOTOR TEMP M**" is activated when the alarm temperature limit is reached. **AW_1 (09.04)** bit 2 is set to 1.
- fault "**MOTOR TEMP M**" is activated when the trip temperature limit is reached and the **FW_1 (09.01)** bit 5 is set to 1.

- **Note:** The thermistor can also be connected to digital input DI6 on the NIOC board according to the following figure. If direct thermistor connection is used, digital input DI6 goes to 0 false when resistance rises higher than 4 kΩ. As a result, the drive is tripped, fault "KLIXON" is activated and appended to the fault logger, and **FW_1 (09.01)** bit 5 is set to 1.



Alternative 2: At the motor end, the cable shield should be earthed through a 10 nF capacitor. If this is not possible, the shield is to be left unconnected.

Stall Function

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

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

1. The ACS 600 output frequency is below the Stall Frequency limit set by the user.
2. The motor torque has risen to the maximum allowed value (the value $T_{m.a}$ in the figure) calculated by the ACS 600 application program. This limit is continuously changing depending on variables such as the motor temperature calculated by the frequency converter software.
3. Conditions 1 and 2 have been fulfilled longer than the period set by the user (Stall Time Limit).

An alarm or fault function can be selected by Parameter **30.13 STALL FUNCTION**. If FAULT is selected, a stall situation produces a fault **"MOTOR STALL"** and sets **FW_2 (9.02)** bit 14 to 1. If WARNING is selected, a stall situation produces a warning **"MOTOR STALL"** and sets **AW_2 (9.05)** bit 9 to 1.

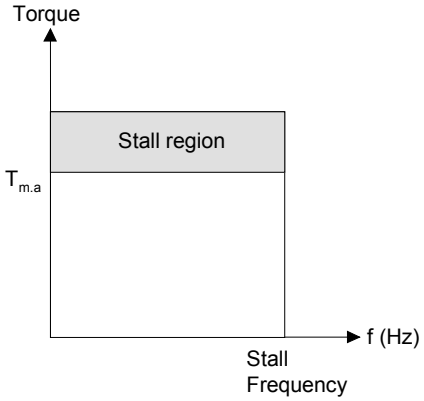


Figure 7 - 8 Stall Protection Area

Underload Function

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

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

1. The motor load is below the Underload Curve selected by the user.
2. The motor load has been below the selected Underload Curve longer than the time set by the user (Underload Time).
3. The ACS 600 drive output frequency is more than 10 % of the motor nominal frequency.

An alarm or fault function can be selected by Parameter **30.16 UNDERLOAD FUNC**. If FAULT is selected, an underload situation produces a fault **"UNDERLOAD"** and sets **FW_1 (9.01)** bit 8 to 1. If WARNING is selected, an underload situation produces a warning **"UNDERLOAD"** and sets **AW_2 (9.05)** bit 1 to 1.

Motor Phase Loss Function

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

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

The fault indication is "**MOTOR PHASE**". **FW_2 (09.02)** bit 15 is simultaneously set to a 1.

Earth Fault Protection Function

The Earth Fault protection detects earth faults in the motor, the motor cable or the inverter. The Earth Fault protection is based on earth leakage current measurement with a summation current transformer at the input of the converter. Depending on the user's selection, the Earth Fault function stops the drive and gives a fault indication, or the drive continues operation and gives an alarm.

The tripping level of inverter sizes R10i…R12i can be selected by parameter **30.25 EARTH FAULT LEVEL**. The parameter defines the unbalance trip level of sum current measured by the NINT board.

A fault function can be selected by selecting **FAULT** at parameter **30.20 EARTH FAULT**. In case of fault, "**EARTH FAULT**" is indicated and **FW_1 (09.01)** bit 4 is set to 1. If NO is selected, an alarm "**EARTH FAULT**" is given and **AW_1 (09.04)** bit 14 is set to 1.

Motor Fan Diagnostics

If the motor has an external cooling fan motor, it is possible to control the starter of the fan motor by digital output. See Parameter group 14 and 35. The diagnostics is activated by Parameter **35.01 MOTOR FAN CTRL**. The acknowledge signal to the digital input from the motor starter is selected by Parameter **10.06 MOTOR FAN ACK**.

Diagnostics

1. When first starting the motor, if the motor fan acknowledge signal is not received within the time defined by parameter **35.02 FAN ACK DELAY**, a fault is generated and the drive is tripped.
2. While running the motor:
   If the acknowledge signal is lost, an alarm "**MOTOR FAN**" is generated. If the acknowledge signal is still lost after **35.02 FAN ACK DELAY**, a fault is indicated and drive is tripped. If the acknowledge time is zero, only alarm is indicated.
3. **AW_2** bit 0 is set to 1 in case of motor fan alarm.
4. **FW_3** bit 0 is set to 1 in case of motor fan fault, if **35.01 MOTOR FAN CTRL** has selection ALARM/FAULT.

Fault and Alarm Messages

Fault Message Table

FAULT MESSAGES (in alphabetical order)		
Alarm / Fault Text	**Cause**	**What to do**
ACS 600 TEMP 9.01 FW_1, bit 3	The ACx 600 internal temperature is excessive. A warning is given if inverter module temperature exceeds 115 °C.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
AI<MIN FUNC 9.02 FW_2, bit 10	I/O reference 4…20 mA is below 4mA level. (programmable fault or alarm, see Parameter 30.27).	Check for proper analogue control signal levels. Check the control wiring. Check AI < MIN FUNC Fault Function parameters.
CABIN TEMP F 9.02 FW_2, bit 7	Cabinet over- or undertemperature detected on the NIOC-01 I/O board (thermistor). Environment temperature is too high (>73 °C) or too low (<5 °C).	Boost the cooling of air.
CABLE TEMP 9.02 FW_2 bit 3	Motor cable overtemperature trip. Thermal model of cable has reached 100% temperature level.	Check the motor load. Check the motor cable and its type. Verify with the cable thermal model parameters in Parameter Group 36.
CH0 COM LOS 9.02 FW_2, bit 12	Communication break detected on CH0 receive. (programmable fault, see Parameter 70.04)	Check the optical fibres between the NAMC board and overriding system (or fieldbus adapter). Test with new optical fibres. Check that the node address is correct in the drive. Check the status of the fieldbus adapter. See appropriate fieldbus adapter manual. Check parameter settings of Group 51, if a fieldbus adapter is present. Check the connections between the fieldbus and the adapter. Check that the bus master is communicating and correctly configured.
CH2 COM LOS 9.01 FW_1, bit 11	Communication break detected on CH2 receive. (programmable fault or alarm, see parameter 70.13)	Check the optical fibres between the NAMC boards. Check that the optical fibre loop is closed. Test with new optical fibres.

FAULT MESSAGES (in alphabetical order)		
Alarm / Fault Text	**Cause**	**What to do**
DC OVERVOLT 9.01 FW_1, bit 2	Intermediate circuit DC voltage is excessive. This can be caused by 1. Static or transient overvoltages in the mains. 2. Faulty braking chopper or resistor (if used). 3. Deceleration time being too short, if there is no braking chopper or regenerative incoming section. 4. Internal fault in the inverter unit.	Check the functioning of the braking chopper. If using a regenerative incoming section check that the diode mode is not forced during deceleration. Check the level of DC voltage and inverter nominal voltage. Replace the NINT-xx board (its voltage measurement circuit is faulty).
DC UNDERVOLT 9.02 FW_2, bit 2	Intermediate circuit DC voltage is not sufficient. This can be caused by a missing mains phase in the diode rectifying bridge.	Checks mains supply and inverter fuses. If Standard HW is used, check that digital input DI2 is on 1, when the inverter is powered.
DDF FORMAT 9.03 SFW, bit 3	File error in FLASH memory.	Replace the NAMC board.
EARTH FAULT 9.01 FW_1, bit 4	The load on the incoming mains system is out of balance. This can be caused by a fault in the motor, motor cable or an internal malfunction. (programmable fault, see parameter 30.20) Tripping level setting is too sensitive in the non parallel connected R10i…R12i inverters. Check Parameter 30.25.	Check motor. Check motor cable. Check that there are no power factor correction capacitors or surge absorbers in the motor cable.
ENCODER FLT 9.02 FW_2 bit 5	Speed measurement fault detected. This can be caused by loose cable connection, communication time-out, faulty pulse encoder, or too great a difference between the internal and measured actual speeds. (programmable fault or alarm, see Parameter 50.05)	Check settings of Parameter Group 50. Check pulse encoder and its cabling including Ch A and Ch B phasing. The sign of the signal **1.03 SPEED MEASURED** must be same as internal actual speed **1.02 MOTOR SPEED** when rotating the motor. If not, exchange channels A and B. Check fibre optic connection between the NAMC board and the NTAC-0x module. Check the proper earthing of equipment. Check for highly emissive components nearby.
FACTORY FILE 9.03 SFW bit 0	Factory macro parameter file error.	Replace the NAMC board.
FLT (xx) 8.01 MSW bit 3	There is an internal fault in the ACS 600.	Check for loose connections inside of frequency converter cabinet. Write down the Fault code (in brackets). Contact ABB Service.

FAULT MESSAGES (in alphabetical order)		
Alarm / Fault Text	**Cause**	**What to do**
ID RUN FLT 8.01 MSW bit 3	Motor ID Run not possible due to the limits or locked rotor.	Check that no overriding system is connected to the drive. Switch off the auxiliary voltage supply from the NAMC board and power up again. Check the parameter values in Group 20. - Check that no limits prevent the ID Run. Restore factory settings and try again. Check that the motor shaft is not locked.
IO FAULT 9.02 FW_2 bit 6	I/O communication fault or error detected on CH1. This can be caused by a fault in the I/O unit, a fibre optic cable connection problem or incorrect module identification number (if I/O extension modules are present).	Check for loose connections between the NIOC-01 or extension module and NAMC board. Measure that every I/O unit receives +24 V DC auxiliary voltage. Test with new optic fibre cables. Check the identification numbers of extension I/O modules. If the fault is still active, replace the I/O board/extension unit(s).
KLIXON 9.01 FW_1 bit 5	Motor 1 or 2 overtemperature fault. A thermal switch or thermistor connected to DI6 has opened. Also PTC thermistor connected to DI6 of NIOC-01detects motor overtemperature.	Check motor ratings and load. Check cable. Check thermistor (only to DI6 of NIOC-01) or thermal switch connections to digital inputs. If the resistance of the thermistor is over 4 kΩ, real overtemperature occurs in the motor. Wait until the motor has cooled. The state of DI6 returns back to 1 when the resistance of the thermistor is between 0...1.5 kΩ. Replace the I/O board if the voltage in the selected KLIXON digital input is correct, but the state of DI6 is 0 in **1.15 DI6-1 STATUS** or **8.03 DI STATUS WORD**. Check Parameter **10.05 KLIXON**.
MOTOR TEMP M 9.01 FW_1 bit 5	Motor 1 or 2 overtemperature fault. (PT100 or PTC measurement to analogue I/O). Motor temperature has exceeded the tripping level. (programmable fault or alarm, see Parameter 30.02)	Check motor ratings, load and cooling. Check start-up data. Check MOTOR TEMP Fault Function parameters. If an NAIO module is used for temperature measurement, check its DIP switch settings as well as Parameter **98.06 AIO EXT MODULE 1**.

FAULT MESSAGES (in alphabetical order)		
Alarm / Fault Text	**Cause**	**What to do**
MOTOR FAN 9.06 FW_3 bit 0	Acknowledge signal is missing from the external motor fan starter.	Check the acknowledge circuit connection to the selected digital input. Check Parameter 35.02. Check the overload protection device of the fan motor. If it has tripped, reset it. Check the condition of the bearings of the fan motor by rotating fan motor manually. Replace the spare part fan if faulty. Replace the spare part fan if overload trippings continue and the bearings are OK.
MOTOR PHASE 9.02 FW_2 bit 15	Fault in the motor circuit. One of the motor phases is lost. This can be caused by a fault in the motor, the motor cable, a thermal relay (if used), or an internal fault. (programmable fault or alarm, see Parameter 30.19).	Check motor and motor cable. If the motor is disconnected, this fault is activated. Check thermal relay (if used). Check MOTOR PHASE Fault Function parameters. Disable this protection. If the cable and motor is ok, this fault can appear with small motors (<30 kW) in low speed. Deactivate protection in this case.
MOTOR STALL 9.02 FW_2 bit 14	Motor or process stall. Motor is operating in the stall region. This can be caused by excessive load or insufficient motor power. (programmable fault or alarm, see Parameter 30.13)	Check motor load and the ACx 600 ratings. Check MOTOR STALL Fault Function parameters (30.13 ... 30.15).
MOTOR TEMP 9.01 FW_1 bit 6	Overtemperature fault (thermal model). Temperature has exceeded the tripping level of the thermal model. (programmable fault or alarm, see parameter 30.02)	Check motor ratings, load and cooling. Check start-up data. Check MOTOR TEMP Fault Function parameters.
NVOS ERROR 9.03 SFW bit 2	Non-volatile operating system error.	Replace the NAMC board.
OVER SWFREQ 9.02 FW_2 bit 9	Over switching frequency fault. This may be due to a hardware fault in the electronics boards.	Replace the NAMC board. Replace the NINT board. On units with parallel connected inverters, replace the NPBU board.

FAULT MESSAGES (in alphabetical order)		
Alarm / Fault Text	**Cause**	**What to do**
OVERCURRENT 9.01 FW_1 bit 1	Overcurrent has been detected.	If the drive tripped during flying start, check that Parameter **21.01 START FUNCTION** is set to AUTO. (Other modes do not support flying start). Check motor load. Check acceleration time. Check motor and motor cable (including phasing). Check pulse encoder and pulse encoder cable. Check that there are no power factor correction capacitors or surge absorbers in the motor cable. Check the nominal motor values from Group 99 to confirm that the motor model is correct.
OVERFREQ 9.01 FW_1 bit 9	Motor is turning faster than the highest allowed speed. This can be caused by an incorrect setting of parameters, insufficient braking torque or changes in the load when using torque reference.	Check the minimum and maximum speed settings. Check the adequacy of motor braking torque. Check the applicability of torque control. Check the need for a Braking Chopper and Braking Resistor if the drive has a Diode Supply Unit DSU. Check Parameter **20.11 FREQ TRIP MARGIN**.
PANEL LOST 9.02 FW_2 bit 13	A Local Control device (CDP 312 or Drive*Window)* has ceased communicating. This can be caused by the disconnetion of the selected local control device during local control or an internal fault in the local controlling device. (programmable fault or alarm, see parameter 30.21)	Check Control Panel connector. Replace Control Panel in the mounting platform. Check PANEL LOST Fault Function parameters.
PPCC LINK 9.02 FW_2 bit 11	NINT board current measurement or communication fault between the NAMC and NINT boards. (This fault can be masked, if the DC intermediate circuit voltage has been disconnected, but the NAMC board has an external power supply and fault indication is not needed. The Fault appears only if the motor is start. See Parameter 30.24)	Check the fibre optic cables connected between the NAMC and NINT boards. In parallel connected inverters, also check the cabling on the NPBU-xx board. If the fault is still active, replace the NPBU board (only with parallel connected inverters), NAMC and NINT board (in this order) until the fault disappears. Test with new fibre optic cables in the PPCC link. Check that there is no short circuit in the power stage. The short circuit or over current can cause this message due to the possible faulty power plate. It can causes possible overloading for auxiliary power and as a result PPCC link communication failure.

FAULT MESSAGES (in alphabetical order)		
Alarm / Fault Text	**Cause**	**What to do**
RUN DISABLD 9.02 FW_2 bit 4	External interlocking (DI2=0) circuit is open. There is a fault in the external devices.	Check the circuit connected to digital input DI2.
SAFETY SWITC	The motor is running and safety switch is opened.	Close the safety switch. Reset the fault and start the motor again.
SC (INU 1) 9.01 FW_1 bit 12	Short Circuit in (parallel connected) inverter unit 1	Short circuit detected in parallel connected inverter unit 1. Check the optic fibre connection from the NPBU-xx board channel CH1 (INT1) to the inverter. Check the motor and motor cable. Check all power plates in inverter unit 1. If a faulty power plate is detected, replace the whole phase module by another.
SC (INU 2) 9.01 FW_1 bit 13	Short Circuit in (parallel connected) inverter unit 2	Short circuit detected in the parallel connected inverter unit 2. Check the optic fibre connection from the NPBU-xx board channel CH2 (INT2) to the inverter. Check the motor and motor cable. Check all power plates in inverter unit 2. If a faulty power plate is detected, replace the whole phase module by another.
SC (INU 3) 9.01 FW_1 bit 14	Short Circuit in (parallel connected) inverter unit 3	Short circuit detected in the parallel connected inverter unit 3. Check the optic fibre connection from the NPBU-xx board channel CH3 (INT3) to the inverter. Check the motor and motor cable. Check all power plates in inverter unit 3. If a faulty power plate is detected, replace the whole phase module by another.
SC (INU 4) 9.01 FW_1 bit 15	Short Circuit in (parallel connected) inverter unit 4	Short circuit detected in the parallel connected inverter unit 4. Check the optic fibre connection from the NPBU-xx board channel CH4 (INT4) to the inverter. Check the motor and motor cable. Check all power plates in inverter unit 4. If a faulty power plate is detected, replace the whole phase module by another.
SHORT CIRC 9.01 FW_1 bit 0	Short circuit has been detected. The output current is excessive.	Check the motor and motor cable. Measure the resistances of the power plate(s). If a faulty power plate is detected, replace the power plate and the NINT and NGDR boards or the whole inverter phase module. Check that the prevention of unexpected start-up circuit has not opened during the run.

FAULT MESSAGES (in alphabetical order)		
Alarm / Fault Text	**Cause**	**What to do**
START INH HW 9.06 FW_3 bit 1	Start Inhibit HW fault has been detected in the Prevention of Unexpected Start-Up circuit.	Check that the LED indicator is ON in the NGPS-xx power supply, when powered. If not, change the NGPS-xx power supply. Check the digital input connection in the START INHIB DI circuit according to parameter selection 10.08. Check the status of START INHIB DI in the HW by measuring the voltage between the input terminals. Check the SW status from the signal DI STATUS WORD (8.05). If there is a voltage in the input terminals of START INHIB DI, but the DI STATUS WORD (8.05) indicates state FALSE, change the I/O board / module.
SUPPLY PHASE 9.02 FW_2 bit 0	Ripple voltage in the DC link is too high. This can be caused by a missing mains phase in the diode rectifier bridge, or DC voltage oscillation by a thyristor rectifying bridge (if used in the incoming section).	Check for mains supply imbalance. Check the mains fuses.
UNDERLOAD 9.01 FW_1 bit 8	Process underload situation detected. Motor load is too low. This can be caused by a release mechanism in the driven equipment. (programmable fault or alarm, see Parameter 30.16.)	Check the driven equipment. Check UNDERLOAD Fault Function parameters.
USER MACRO 9.03 SFW bit 1	User Macro parameter file error. There is no User Macro saved or the file is defective.	Create the User Macro again.

Alarm Message Table

ALARM MESSAGES (in alphabetical order)		
Alarm Message	***Cause***	***Action***
ACS 600 TEMP 9.04 AW_1 bit 4	Power plate overtemperature alarm. The ACS 600 internal temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
AI<MIN FUNC 9.05 AW_2 bit 10	I/O reference 4…20 mA is below 4 mA. (programmable fault or alarm, see parameter 30.27).	Check for proper analogue control signal levels. Check the control wiring. Check AI < MIN FUNC Fault Function parameters.
AIO ALARM 9.04 AW_1 bit 8	Analogue I/O error detected on the Standard I/O board NIOC-01.	Replace the NIOC-01 board. Test with new fibre optic cables on CH1.
ALM (xx) 8.01 MSW bit 7	There is an internal alarm in the ACS 600.	Check for loose connections inside of frequency converter cabinet. Write down the Alarm code (in brackets). Contact ABB Service.
CABLE TEMP 8.05 AW_2 bit 3	Motor cable overtemperature alarm. Thermal model of the cable has reached 90% temperature level.	Check the motor load. Check the motor cable and its type and verify the cable thermal model parameters from the parameter group 36.
CH0 TIMEOUT 9.05 AW_2 bit 11	Communication break detected on CH0 receive. CONSTANT SPEED1 mode selected with Par. 70.05. (can be deactivated: see Parameter 70.04)	Check the fibre optic cables between the NAMC board and the overriding system (or fieldbus adapter). Test with new fibre optic cables on CH0. Check that the node address is correct for the drive. Check the status of the fieldbus adapter. See appropriate fieldbus adapter manual. Check parameter settings of Group 51 in case of FBA module and connections between control system and adapter module. Check if the bus master is not communicating or configured.
CH2 COM LOS 9.04 AW_1 bit 11	Communication break detected on CH2 receive. (programmable fault or alarm; see Parameter 70.13)	Check the fibre optic cables on CH2 between the NAMC boards. Check that the fibre optic loop is closed. Test with new fibre optic cables on CH2. Check that there is one master drive and the remainder are followers in the M/F link. See Parameter **70.08 CH2 M/F MODE**.

ALARM MESSAGES (in alphabetical order)		
Alarm Message	***Cause***	***Action***
DC UNDERVOLT 9.05 AW_2 bit 14	An undervoltage trip has been detected with the Auto Restart function. This is indicated to the AW2 diagnostics.	n.a. Only indication.
DIO ALARM 9.04 AW_1 bit 7	Digital input malfunction detected in the I/O board NIOC-01.	Check the fibre optic cables. Test with new fibre optic cables on CH1. Replace the NIOC-01 board.
EARTH FAULT 9.04 AW_1 bit 14	The load on the incoming mains system is out of balance. This can be caused by a fault in the motor, motor cable or an internal malfunction. (programmable fault or alarm; see Parameter 30.20) Tripping level setting is too sensitive in the R10i…R12i inverters. See Parameter 30.25.	Check motor. Check motor cable. Check that there are no power factor correction capacitors or surge absorbers in the motor cable.
EM STOP 9.04 AW_1 bit 1	Emergency Stop has been activated either by digital input DI1(= 0) or MAIN CONTROL WORD 7.01 bit 2 (= 0).	Emergency stop push buttons must be returned to their normal position after the emergency stop situation is over. Check that the overriding system keeps sending the MAIN CONTROL WORD to drive. See bit 2 of MCW. To get drive to ready status, the MCW bit 0 must be set to state FALSE and back to TRUE.
ENCODER ERR 9.04 AW_1 bit 5	Speed measurement alarm detected. This can be caused by a loose cable connection or faulty pulse encoder. (programmable fault or alarm, see parameter 50.05)	Check settings of Parameter Group 50. Check the pulse encoder and its cabling (including CH A and CH B phasing). The sign of signal **1.03 SPEED MEASURED** must be the same as internal actual speed **1.02 SPEED ESTIMATED**. If it is not, reverse the channels A and B. Check fibre optic connection between the NAMC board and the NTAC-0x module. Check the proper earthing of equipment. Check for highly emissive components nearby.
EXT AIO ALM 9.04 AW_1 bit 10	Analogue I/O error detected in the NAIO I/O Extension module	If the alarm is continuously active, replace the NAIO module.
EXT DIO ALM 9.04 AW_1 bit 9	Digital input error detected in the NDIO I/O Extension module.	If the alarm is continuously active, replace the NDIO module.
INV OVERLOAD 9.05 AW2_ bit 2	Forced cooling cycle for inverter is active after the overloading cycle 10/60s.	Load is too high. Check the dimensioning and process.

ALARM MESSAGES (in alphabetical order)		
Alarm Message	***Cause***	***Action***
M/F CONNECT Fault Logger	Wrong data type has been selected at parameters MASTER REF 1, 2 or 3 (70.09...70.11)	Select zero or correct data type at the following parameters: 70.09 packed boolean 70.10 real or integer 70.11 real or integer
MOTOR TEMP M 9.04 AW_1 bit 2	Motor 1 or 2 overtemperature alarm (PT100 or PTC measurement to Analogue I/O) (programmable fault or alarm; see Parameter (30.01, 30.03...30.05)	Check motor ratings and load. Check start-up data. Check PT100 or thermistor connections for AI and AO of the NIOC-01 board or NAIO extension module according to the hardware configuration. Check the DIP switches and selection of parameter **98.06 AIO EXT MODULE 1**, if an NAIO extension module is used for temperature measurement.
MOTOR FAN 9.05 AW_2 bit 0	Acknowledge signal is missing from the external motor fan and an alarm is present the time defined by Parameter 35.03 FAN ACK DELAY.	Check the acknowledge circuit on the selected digital input. See Parameter 35.02. Check the overload protection device of the fan motor. If it has tripped, reset it. Check the condition of the bearings of the fan motor by rotating the fan motor manually. Replace the spare part fan if faulty. Replace the spare part fan if overload trippings continue and the bearings are OK.
MOTOR STALL 9.05 AW_2 bit 9	Motor or process stall. Motor operating in the stall region. This can be caused by excessive load or insufficient motor power. (programmable fault or alarm; see Parameter 30.13)	Check motor load and the ACx 600 ratings. Check MOTOR STALL Fault Function parameters.
MOTOR STARTS	Motor ID Run has been selected and the drive started in the Local control mode.	Wait until the Motor ID Run is complete.
MOTOR TEMP 9.04 AW_1 bit 3	Overtemperature alarm (thermal model). Temperature has exceeded the alarm level of the thermal model. (programmable fault or alarm; see Parameter 30.02)	Check motor ratings, load and cooling. Check Parameter **30.28 THERM MOD ALM L**. If USER MODE is selected, check that Parameters 30.09 ... 30.12 are set correctly.
NO MOTOR DATA 9.02 FW_2 bit 1	Motor data is not given or motor data does not match with inverter data.	Check the motor data given by Parameters 99.02...99.06.

ALARM MESSAGES (in alphabetical order)		
Alarm Message	***Cause***	***Action***
PANEL LOST 9.05 AW_2 bit 13	A Local Control device (CDP 312 or Drive*Window)* has ceased communicating. This can be caused by the disconnection of the selected local control device during local control or an internal fault in the local controlling device. (programmable fault or alarm, see parameter 30.21)	Check Control Panel connector. Replace Control Panel in the mounting platform. Check PANEL LOST Fault Function parameters.
POWDOWN FILE 9.05 AW_2 bit 8	Error in restoring powerdown.ddf file	If the alarm keeps reappearing, replace the NAMC-xx board.
POWFAIL FILE 9.05 AW_2 bit 7	Error in restoring powerfail.ddf file.	If the alarm keeps reappearing, replace the NAMC-xx board.
RESTARTED 9.05 AW_2 bit 15	The motor has been restarted after the short net break with AUTO RESTART function. See parameter 21.09.	n.a.
SAFETY SWITC	The motor has been stopped and safety switch is opened.	Close the safety switch.
START INHIBI 9.04 AW_1 bit 0	Prevention of unexpected start-up activated from the hardware typically by operator for equipment maintenance.	The Operator must close the prevention of unexpected start-up switch. If the switch is closed and the alarm is still active, check that the “Power On” LED is lit on the NGPS board. If the LED is off but there is a voltage at the input terminals of the NGPS, replace the board.
T MEAS ALM 9.04 AW_1 bit 6	Motor temperature measurement circuit is faulty. This can be caused by a broken temperature sensor or cable.	Check the motor temperature sensor connections.
UNDERLOAD 9.05 AW_2 bit 1	Process underload situation detected. Motor load is too low. This can be caused by a release mechanism in the driven equipment. (programmable fault or alarm; see Parameter 30.16)	Check for a problem in the driven equipment. Check UNDERLOAD Fault Function parameters.

Event Messages

EVENT MESSAGES (in alphabetical order)		
Event Message	***Cause***	***Action***
SYSTEM START	Inverter Software has been started. This indicates normally an auxiliary voltage on connection.	

Other Messages

OTHER MESSAGES (in alphabetical order)		
Alarm Message	***Cause***	***Action***
NO COMMUNICATION	Control Panel CDP 312 message. The selected drive is not present on the link. The link does not work because of a hardware malfunction or problem in the cabling.	Check the fibre optic cable connections in the I/O-link.
SWC ON INHIB 8.01 MSW bit 6	Drive is in the ON INHIBIT state. See ABB Drive Profile description.	Set MAIN CONTROL WORD bit 0 first to 0, then back to 1 to proceed into the next state.
ID N CHANGED	Modbus ID number of the drive has been changed from 1 in Drive Selection Mode of CDP 312 panel (the change is not shown on the display).	To change the Modbus ID number back to 1 go to Drive Selection Mode by pressing ***DRIVE***. Press ***ENTER***. Set the ID number to 1. Press ***ENTER.***
MACRO CHANGE	A Macro is being restored or a user Macro is being saved.	Please wait.
ID MAGN REG	The ACx 600 is ready to start identification magnetisation.	This warning belongs to the normal start-up procedure. Press PAR and check Parameter 99.07.
ID MAGN	The ACx 600 is performing identification magnetisation.	Please wait 20 to 60 seconds.
ID DONE	The ACx 600 has performed the identification magnetisation and is ready to start.	-
I/O SP REF	AI1 of NIOC-01 has been selected incorrectly for speed reference and motor temperature measurement when I/O control (98.02 = NO) or HAND/AUTO function has been selected.	Use AI2 of NIOC-01 for speed reference by setting Par. 11.01 to value STD AI2 or use an NAIO Analogue I/O Extension Module. See Par. 98.06.

Chapter 8 - Terms

TERMS	FULL NAME	DESCRIPTION
ACS	AC Standard	ABB standard frequency converter family. E.g. ACS 600.
ACS 600		ACS 600 frequency converter family.
ACS 600 MultiDrive		System drive; a member of ACS 600 product family.
ACU	Auxiliary Control Unit	
AI	Analogue Input	Interface for an analogue input signal.
NAMC	Application and Motor Control	E.g. NAMC table. The interface between application SW and motor control SW in ACS 600.
NAMC Control Board	Application and Motor Controller board	Control board for ACS 600 and ACS 600 MultiDrive.
AO	Analogue Output	Interface for an analogue output signal.
APC2	Application Program Controller	System drives application controller (board).
AC 80	Application Program Controller	System drives application controller.
ASIC	Application Specific Integrated Circuit	Non-standard IC circuits. Allow more compact and cheaper PCB design than using standard circuits.
BJT	Bipolar Junction Transistor	Semiconductor type.
CAD	Computer Aided Design	
CDC	Common Drive Control	APC 2, DDC and optional boards.
CDP 311	Common Drives Panel 311	Control panel is used to parametrise and monitor ACS 600 using CDI-protocol.
CDP 312	Common Drives Panel 312	Control panel is used to parametrise and monitor ACS 600 using Modbus-protocol.
CE Marking	Communauté Européenne Marking	CE marking: The product complies with the requirements of relevant European Directives.
CMOS	Complementary MOS	Semiconductor type.
DC Busbar		Direct Current supply for inverter units.
DDC	Digital Drive Controller	Standard control functions, torque and speed control loops, internal start/stop logic, internal fault diagnostic, motor and cable protection.
DDCC	Distributed Drives Communication Circuit	Communication ASIC used in ACS 600 products.
DDCS	Distributed Drives Communication System	Communication protocol used in ACS 600 products.

TERMS	FULL NAME	DESCRIPTION
DDCTool	Digital Drive Controller Tool	Window based PC tool. Optically connected to the DDC, setting/monitoring DDC's parameters local control of DDC, monitoring actual values, testing DDC I/O's.
DI	Digital Input	Interface for a digital input signal.
DO	Digital Output	Interface for a digital output signal.
Drive*Size*		Dimensioning PC tool for optional selection of ACS 600 and motors.
Drive*Support*		Servicing, maintaining and troubleshooting tool for ACS 600 product family.
Drive*Window*		PC tool for operating, controlling, parametrising and monitoring ABB drives (ACS 600).
DSP	Digital Signal Processor	Processor type used in NAMC board of ACS 600 product family.
DSU	Diode Supply Unit	Diode rectifying type of incoming supply.
DTC	Direct Torque Control	Revolutionary motor and inverter control method utilised first in ACS 600 product family.
EEPROM	Electrically Erasable Programmable ROM	Non volatile memory. Look abbreviation: ROM.
EMC	Electromagnetic Compatibility	The ability of electrical equipment to operate problem-free in electromagnetic environment. Likewise, the equipment must not disturb other products/systems.
EMI	Electromagnetic Interference	
EPROM	Erasable Programmable ROM	See: ROM.
ESD	ElectroStatic Discharge	
FCB	Function Chart Builder	SW tool to make application programs (for ACS 600 and APC2).
FCE	Function Chart Editor	Editor of FCB used to draw application blocks.
FET	Field Effect Transistor	Semiconductor type.
Flash EEPROM	Electrically Sector erasable EEPROM memory	Non volatile memory type.
FSR	Full Scale Range	E.g. the error is 0.01 % FSR (from maximum value).
GTO	Gate Turn-Off Thyristor	Semiconductor type.
HW	Hardware	Physical device or equipment.
I/O	Input/Output	Control Input/Output signal (E.g. DI, DO, AI, AO).
IC	Integrated Circuit	
IC	International Cooling	International cooling standard.

TERMS	FULL NAME	DESCRIPTION
ICMC	Integrated Control Motor Circuit	Motor and inverter control ASIC used in ACS 600.
ICU	Incoming Unit	Section through which the ACS 600 MultiDrive connects to the mains.
ID	Identification	E.g. ID run of ACS 600 to get initial motor parameters.
ID-run	Identification run	Start-up run to identify characteristics of a motor for optimum motor control.
IEC	International Electrotechnical Commission	Organisation for Electrical and Electronic Engineering Standards.
IEEE	Institute of Electrical and Electronic Engineers	US professional society that takes part in standardisation. E.g. IEEE Conference Reviews.
IGBT	Insulated Gate Bipolar Transistor	Power semiconductor used widely in frequency converters.
IM	International Mounting	International mounting standard.
IOCC	Input Output Control Circuit	I/O ASIC used in ACS 600 products.
IP	International Protection	Degree of protection provided by enclosures.
IR	IR stands for voltage. I(Current)x R(Resistance) = U(Voltage))	E.g. IR compensation: An extra voltage (torque) boost for a motor at low speeds.
ISO	International Organisation for Standardisation	E.g. ISO 9000 series quality standards.
KLIXON switch	Temperature switch	Overtemperature monitoring sensor.
LCD	Liquid Crystal Display	Electronic display type used e.g. in CDP 312 Control Panel of ACS 600.
LCI	Load Commutated Inverter	Some ABB Megadrive products are equipped with LCI (large synchronous motor drives).
LED	Light Emitting Diode	Semiconductor type.
LMD-0X	Led Monitoring Display	Led display for monitoring ACS 600 Drive status and one signal.
Modbus		Fieldbus communication protocol.
NAC	Next AC drive	Common platform or basis for drives R&D projects. ACS 600, MultiDrive, XT are based on NAC for example.
NAFA	NAC AF100 Adapter	Fieldbus option module of ACS 600.
NAIO	NAC Analogue Input/Output	Option module for ACS 600 to replace or extend analogue I/O channels.
NAMC	NAC NAMC Board	Motor and inverter control board of ACS 600.
NBRA	NAC Braking Chopper	Option device of ACS 600 for efficient braking with no regenerative input bridge.
NBRC	NAC Braking Chopper Controller Board	Board controlling the operation of braking chopper NBRA.
NCPC	NAC Control Panel Cable	Option cable for remote connection of the CDP 312 control panel.
NCSA	NAC CS 31 Adapter	Fieldbus option module of ACS 600.

TERMS	FULL NAME	DESCRIPTION
NDIO	NAC Digital Input/Output	Option module for ACS 600 to replace or extend digital I/O channels.
NDNA	NAC DeviceNet Adapter	Fieldbus option module of ACS 600.
NDSC	NAC Diode Supply Unit Controller	Control board for half controlled diode/thyristor input bridge.
NECG	NAC EMC Cable Glands	Optional add-on kit of ACS 601 (R3 to R6) for 360° cable shield earthing.
NED	Next Engineered Drive	R&D project to develop engineered drive based on NAC platform. ACS 600 MultiDrive.
NGDR	NAC Gate Driver Board	PCB of ACS 600 for controlling the inverter IGBTs.
NIBA	NAC Interbus-S Adapter	Fieldbus option module of ACS 600.
NINP	NAC Input Bridge Board	PCB of ACS 600 for controlling the rectifier.
NINT	NAC Interface Electronics Board	PCB of ACS 600 for interfacing NAMC and Main Circuit.
NIOC	NAC Input Output Control Board	PCB of ACS 600 for connecting I/O and CDP 312 control panel to the drive.
NISA	NAC ISA/DDCS Adapter	Optional device of ACS 600. Placed to a PC's ISA board slot. Connects via fibres to NAMC.
NLWC	NAC Ligth Wave Cable	Optional add-on kit of ACS 600 (2 additional fibre optic cables).
NMBA	NAC Modbus Adapter	Fieldbus option module of ACS 600.
NMFA	NAC Master Fieldbus Adapter	Fieldbus option module of ACS 600.
NPBA	NAC Profibus Adapter	Fieldbus option module of ACS 600.
NPBU	NAC PPCS Branching Unit	Optical PPCS branching unit used when paralleling inverter modules.
NPMP	NAC Panel Mounting Platform	Optional add-on kit of ACS 600: A base onto which the control panel can be attached.
NPOW	NAC Power Supply Board	PCB of ACS 600 for powering other boards and option modules.
NPSM	NAC Power Supply Option	Option module of ACS 600 to power external devices.
NSNA	NAC SucoNet Adapter	Fieldbus option module of ACS 600.
NTAC	NAC Tacho (Encoder)	Option pulse encoder interface for ACS 600.
NTC	Negative Temperature Coefficient resistor	
NVAR	NAC Varistor Board	PCB of ACS 600 for input bridge protection.
OSI	Open System Interconnection	A standard layer model for open telecommunication systems.
PCB	Printed Circuit Board	Wiring boards used in electronic devices.
PCMCIA	Personal Computer Memory Card International Association	DDCS/PCMCIA interface enables connecting PC and Drives Window tool to ACS 600 series drive.
PE	Protective Earth	Terminal for grounding e.g. ACS 600.

TERMS	FULL NAME	DESCRIPTION
PFC	Pump and Fan Control (Macro)	The macro of ACS 600 for controlling pump or fan sections.
PI	Proportional, Integral	Controller type.
PID	Proportional, Integral and Derivate	Controller type which allows to control customer's process'.(e.g. used in ACS 600 speed controller).
PLC	Programmable Logic Controller	
PP	Power Plate	Inverter IGBTs, sensors and control circuits integrated into one component.
PPCC	Power Plate Control Circuit	ASIC of NINT board used for controlling PPs.
PPCS	Power Plate Communication System	Optical serial link for inverter control.
ppm	parts per million	$1/10^{-6}$
ppr	pulses per revolution	Number of pulses given by incremental encoder per one revolution.
PROM	Programmable ROM	See: ROM.
PT100	Platinum Wire Resistance Element 100	Temperature dependent resistor used e.g. in AC-motors to indicate motor temperature. R = 100 ohm at 0°.
PTC	Positive Temperature Coefficient resistor	PTC thermistor is a semi-conductor used to indicate exceeded temperature limit.
PWM	Pulse Width Modulation	The traditional control method of inverter.
R&D	Research and Development	
R2, ..., R9	Frame size 2 - 9	ACS 600/500 series: Size of the frame inside which the converter unit is assembled.
RAM	Random Access Memory	Volatile memory.
RFI	Radio Frequency Interference	
RMS	Rated Mean Squareroot	For sini wave the RMS value is maximum value divided by squareroot of 2. E.g. 4 A RMS: Effective value is four amperes.
RO	Relay Output	Interface for a digital output signal. Implemented with a relay.
ROM	Read Only Memory	Non volatile memory component type used e.g. in NAMC of ACS 600.
RS 232		Standard for data transmission physical interface (signal usage & other electrical parameters).
RS 485		Standard for data transmission physical interface (signal levels & other electrical parameters).
SCR	Silicon Controlled Rectifier	Semiconductor type similar to thyristor.
SDCS UCM-1	UC-resistor board	Used in TSU.
SDCS-COM-1	Communication board	Used in TSU.
SDCS-CON-1	Control board	Used in TSU.
SDCS-IOB-22	Digital connection card (115V)	Used in TSU.
SDCS-IOB-23	Digital connection card (230V)	Used in TSU.

TERMS	FULL NAME	DESCRIPTION
SDCS-IOE-2	UC-measurement board	Used in TSU.
SDCS-PIN-41	Pulse transformer board	Used in TSU.
SDCS-PIN-51	Measurement board	Used in TSU.
SDCS-POW-1	Power supply board	Used in TSU.
SW	Software	Computer programs.
TSU	Thyristor Supply Unit	Full controlled thyristor input bridge.
UART	Universal Asynchronous Receiver Transmitter	Communication controlled circuit used in asynchronous communication protocols.
UPS	Uninterrupted Power Supply	Power supply equipment with battery to maintain output voltage during power failure.
UR fuse	Ultra Rapid fuse	Fuse type used to protect semiconductors.
VSD	Variable Speed Drives	Speed controlled electrical motor.
XT	Extension	R&E project name. It stands for power range extension of ACS 600 product family by paralleling inverter modules.
YPQ112A/B		DDCS Interface board for CDC system.

3BFE 63700177 R0425
EFFECTIVE: 02.05.2001

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