

**VACON<sup>®</sup> NX**

**AC DRIVES**

**APF1FF40**

**SYSTEM INTERFACE APPLICATION II  
APPLICATION MANUAL**

**VACON<sup>®</sup>**



# VACON SYSTEM INTERFACE APPLICATION MANUAL

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# 1. INTRODUCTION

Software APFIFF40, System Interface application

The System Interface Application is typically used in coordinated drives with overriding control system. The recommended interface to control System Interface application is a fieldbus. Communication through hardwired analogue and digital inputs is also well supported.

## 1.1 General

This application is not backwards compatible. Please read the application change note or chapter 2 Version parameter compatibility issues in this application manual to see what needs to be noted when updating the application. See also the updated parameter description in NCDriver when commissioning.

Help is available in NCDriver through selecting “Variable Text” and pressing “F1”. Below an example from Identification parameter help text from the NCDriver.

Index	Variable Text	Value	Unit	Min	Max	ID
P 2.1.1	Supply Voltage	0	V	n/a	n/a	1201
P 2.1.2	Motor Nom Voltg	400	V	n/a	n/a	110
P 2.1.3	Motor Nom Freq	50,00	Hz	n/a	n/a	111
P 2.1.4	Motor Nom Speed	1440	rpm	n/a	n/a	112
P 2.1.5	Motor Nom Currnt	5,40	A	n/a	n/a	113
P 2.1.6	Motor Cos Phi	0,85		n/a	n/a	120
P 2.1.7	Motor Nom Power	0,0	kW	n/a	n/a	116
P 2.1.8	MagnCurrent	0,00	A	n/a	n/a	612
P 2.1.9	Identification	0 / No Action		n/a	n/a	631
P 2.1.10	Motor Type	0 / Induction		n/a	n/a	650

**NCDriver**

**Identification**

0 = No Action - No action  
No identification requested.

1 = ID No Run - Identification without rotating the motor  
Current is applied to the motor but shaft will not be rotated. U/f settings are identified.

2 = ID With Run - Identification with motor rotating  
Shaft is rotated during identification. This identification must be run without load on motor shaft. U/f settings and magnetization current are identified.

3 = Enc. ID Run - Encoder identification run  
The motor shaft is rotated during identification.  
PMSM: This selection is used for PMS motor if automatic angle identification is not suitable for used motor  
This identification run will update PMSM Shaft Position parameter based on absolute position of the encoder.

4 = Ident All - Identified All  
Shaft is rotated during identification.  
All the above identification selections are made in sequence.

5 = ID Run Fails - Identification failed  
Identification has been failed in last attempt.

OK



## 1.2 Basic Features

The System Interface application provides a wide range of parameters for controlling induction motors and permanent magnet motors. It can be used for various kinds of different processes where wide flexibility of I/O signals is needed.

The main focus has been how drive can be controlled over Fieldbus. A flexible ID control possibility takes the application suitability to different process to a new level, allowing any input or actual value to be connected to any parameter with a scaling factor.

Additional functions:

- Joystick input dead zone
- Master Follower function for steering propeller and double winding motors
- Different torque limits for motoring and generating side
- Cooling monitor input from heat exchange unit with selectable response.
- Brake monitoring input and actual current monitor for immediate brake close.
- Separate speed control tuning for different speeds and loads
- Jogging function with two different references
- Possibility to connect FB Process data to any parameter and some monitoring values
- Analogue input 3 and 4 can control any parameter by ID number.
- Support for four analogue output
- Support for two PT100 board
- Condition Based Monitoring (license)

### 1.3 Condition Based Monitoring

NXP offers Condition Based Monitoring to identify motor faults at an early stage. Stator Winding, Vibration and Load Monitoring is supported in this application. The Condition Based Monitoring is license protected. Users need to buy a license key from a Danfoss supplier to make the Condition Based Monitoring effective.

#### 1.3.1 Introduction to Condition-based Monitoring

Benefits of installing the condition-based monitoring firmware are as follows:

- Reduces unexpected downtime
- Optimizes drive or motor working conditions
- Eliminates unexpected halts in production

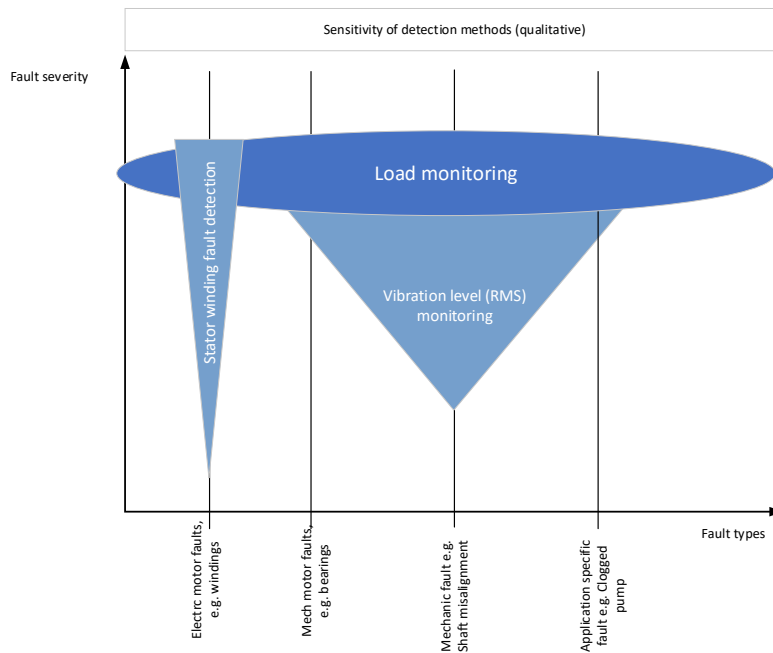
Condition-based monitoring enables to regularly check the condition and performance of the machine when the drive is in service and detects mechanical, motor, or application failures in advance. Corrective actions can be performed before the process or application is impacted. Fault or warnings are triggered in the drive to notify customers or service technicians. Some of the corrective actions include replacement of faulty motors or bearings and ensuring the motor is running within optimal conditions.

Following are the monitoring capabilities introduced:

- **Motor stator winding monitoring:** During monitoring, inter-turn short circuit or unbalance in the motor winding is detected in advance. Damages caused by motor stator winding isolation occurs over a period of time. When more winding turns are impacted, the overcurrent protection is activated due to extensive heating and stops the motor.
- **Vibration monitoring:** With the help of external sensors, the drive can monitor vibration levels in a motor. Vibrations affect motor control and can lead to motor failure. During monitoring, early detection of motor misalignment is detected and wear and tear of mechanical parts are identified earlier.

ISO10816 standard provides guidance for evaluating vibration severity for machines operating within 10-200 Hz of frequency range. The standard shall be complied with before commissioning of vibration monitoring function.
--

- **Load envelope:** Mechanical load of an application is monitored by comparing current load curve with expected load curve based on data gathered during commissioning. During monitoring, overload and under-load deviations which occur in applications are detected.



To begin condition-based monitoring a baseline must be generated. During this activity, the system captures motor stator winding speed points for each baseline. The user can define the duration, minimum and maximum speed for baseline generation. During baseline generation, 10 speed points are captured. The first and last speed point is captured based on the defined minimum and maximum speed respectively.

When speed points are not captured properly, baseline generation fails, then a new baseline has to be generated.

The baseline serves as a reference for threshold limits. Using parameters, the user can select the type of baseline measurement.

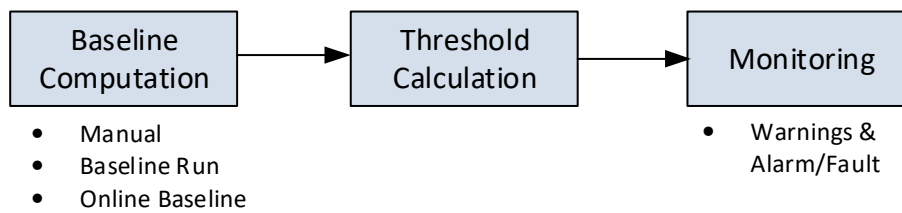
**Baseline Run:** The drive controls the motor speed and monitors required values to derive a baseline. The drive creates a speed profile for baseline measurement. The drive interrupts the application during baseline run to operate on the speed profile created for baseline measurement. The duration for baseline calculation can be specified. Baseline measurements can copy to other drive or return to same drive after factory reset.

**Online Baseline:** In this method, the baseline is created by the drive without interrupting the operation of the drive and application. For the user-specified period of time, the relevant signals are gathered by the drive. This method provides a better representation of normal variation in the application.

**Manual Baseline:** "Manual" means that the measurement points can be directly configured manually by the user through modified parameters. Manual baseline can be made before or after normal baseline.

### 1.3.2 Condition-based monitoring stages

Different stages of condition-based monitoring are as shown



**Baseline Computation:** During the initial stage, baselines for different types of condition-based monitoring are computed, based on the type of baseline mode selected by the user.

**Threshold Calculation:** Once the baseline is computed, the thresholds for warnings (stage 1 and stage 2) and alarm/fault are computed based on the warning or alarm/fault mode. The threshold and mode are set via parameters.

**Monitoring:** After the thresholds are calculated, condition-based monitoring begins. Alarm/fault and warnings are triggered during deviations to notify customers.

## 1.4 Acronyms

AC	=	Alternating Current
AI	=	Analogue Input
AIO	=	All-In-One Applications
AM	=	Asynchronous Motor
ASIC	=	Application Specific Integrated Circuit
CBM	=	Condition Based Monitoring
CL	=	Closed Loop
DC	=	Direct Current
DI	=	Digital Input
DO	=	Digital Output
DS	=	DriveSynch
FB	=	Field Bus
FFT	=	Function To Terminal
FW	=	Firmware
FWP	=	Field Weakening Point
FWPV	=	Field Weakening Point Voltage
GE	=	Greater or Equal
HW	=	Hardware
I/f	=	Current / Frequency
Id	=	Magnetization Current
IGBT	=	Insulated Gate Bipolar Transistor
INV	=	Inversion
Iq	=	Torque Producing Current
LT	=	Less Than
MF	=	Master-Follower
OL	=	Open Loop
PID	=	Proportional Integral Derivative
PM	=	Permanent Magnet
PMSM	=	Permanent Magnet Synchronous Motor
PU	=	Per Unit
RO	=	Relay Output
RS	=	Reset Set
SB	=	System Bus
Sep.Ex SM	=	Separately Excited Synchronous Motor
SM	=	Synchronous Machine
SPC	=	Speed Control
SQS	=	Sfe Quick Stop
SR	=	Set Reset
SRM	=	Synchronous Reluctance Motor
SS1	=	Safe Stop 1
STO	=	Safe Torque Off
SW	=	Software
TC	=	Torque Control
TC	=	Time Constant
TTF	=	Terminal To Function
U/f	=	Voltage / Frequency
UV	=	Under Voltage

## 2. VERSION PARAMETER COMPATIBILITY ISSUES

**Update Note 1:** This application parameters are not kept backwards compatible if new features or improvements would be difficult to implement by doing so. Read this change note and chapter “Compatibility issues in parameters between versions” from manual before updating the application.

**Update Note 2:** It's recommended to use compare function for parameter changes when updating application, especially in cases when version number change is considerably high. Application is constantly developed; this includes changing parameter default values, and if parameters are directly downloaded to drive improved default values may be lost.

### APFIFF10 vs. APFIFF40

- APFIFF40 SIA application is needed to consider as a new application when making commissioning. Old version parameters file should not be downloaded directly to the drive. Recommended action is to change parameters by using compare function of NCDriver.

Notable changes:

- DO1, DO2 and DO3 control is now in main control word instead of Aux Control Word.
- Emergency stop is now Quick stop function and operation is redesigned.

### APFIFF40 V037

- Reference selection 19 Fast Speed reference is not available anymore. Combined with reference selection 9 FB Speed Reference. See updated restrictions from Control Slot Selector parameter.
- Reference selection 11 Fast Torque reference is not available anymore. Combined with reference selection 8 FB Torque Reference. See updated restriction from Control Slot Selector parameter.

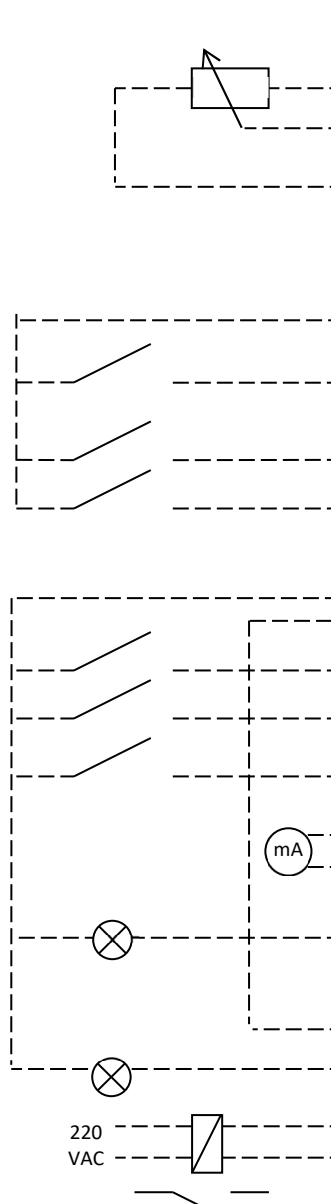
### APFIFF40 V051

- P2.14.5.1 “ID.Bit Free DO” was same with parameter as P2.5.6.6 “ID.Bit Free DO”, fixed. P2.14.5.1 “ID.Bit Free DO” ID number is now ID1217

### APFIFF40 V059

- F84 Speed Protection is by default Fault by Coasting, Limit is 120 rpm.

### 3. CONTROL I/O



NXOPTA1		
Terminal	Reference potential, Signal	Description
1	+10V <sub>ref</sub>	Reference voltage output
2	AI1+	Analogue input 1. Range 0-10V, R <sub>i</sub> = 200kΩ Range 0-20 mA R <sub>i</sub> = 250Ω
3	AI1-	I/O Ground
4	AI2+	Analogue input 2. Range 0-10V, R <sub>i</sub> = 200kΩ Range 0-20 mA R <sub>i</sub> = 250Ω
5	AI2-	I/O Ground
6	+24V	Control voltage output
7	GND	I/O ground
8	DIN1	Start forward Programmable G2.2.7
9	DIN2	Start reverse Programmable G2.2.7
10	DIN3	Fault reset Programmable G2.2.7
11	CMA	Common for DIN 1—DIN 3
12	+24V	Control voltage output
13	GND	I/O ground
14	DIN4	Run Enable Programmable G2.2.7
15	DIN5	Main Switch Ack. Programmable G2.2.7
16	DIN6	Controlled Stop Programmable G2.2.7
17	CMB	Common for DIN4—DIN6
18	AOA1+	Analogue output 1 Programmable P2.3.1.2
19	AOA1-	Analogue output 1 Programmable P2.3.1.2
20	DOA1	Digital output
NXOPTA2		
21	RO1	Relay output 1 Programmable G2.3.3
22	RO1	Relay output 1 Programmable G2.3.3
23	RO1	Relay output 1 Programmable G2.3.3
24	RO2	Relay output 2 Programmable G2.3.3
25	RO2	Relay output 2 Programmable G2.3.3
26	RO2	Relay output 2 Programmable G2.3.3

Table 3-1. System Interface application default I/O configuration and connection example.

Note: See Users Manual, chapter Control Connections, for hardware specification and configuration.

**Note:** See jumper selections below. More information in Vacon NX User's Manual, Chapter 6.2.2.2.

#### Jumper block X3: CMA and CMB grounding



CMB connected to GND  
CMA connected to GND



CMB isolated from GND  
CMA isolated from GND



CMB and CMA  
internally connected together,  
isolated from GND

= Factory default

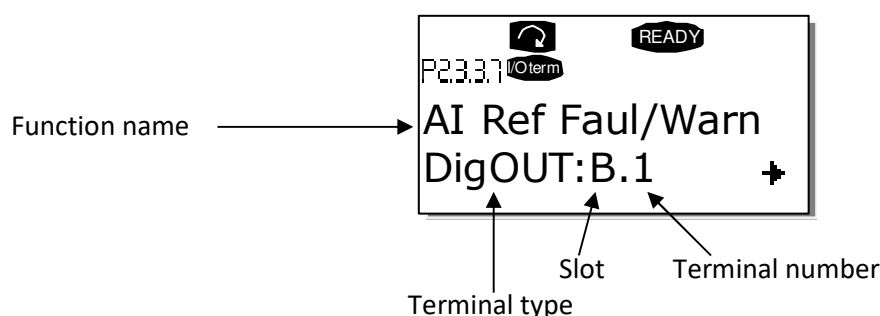
## 4. “TERMINAL TO FUNCTION” (TTF) PROGRAMMING PRINCIPLE

The programming principle of the input and output signals in the **Multipurpose Control Application NXP** as well as in the **Pump and Fan Control Application** (and partly in the other applications) is different compared to the conventional method used in other Vacon NX applications.

In the conventional programming method, *Function to Terminal Programming Method (FTT)*, you have a fixed input or output that you define a certain function for. The applications mentioned above, however, use the *Terminal to Function Programming method (TTF)* in which the programming process is carried out the other way round: Functions appear as parameters which the operator defines a certain input/output for. See *Warning* on page 17.

### 4.1 Defining an input/output for a certain function on keypad

Connecting a certain input or output with a certain function (parameter) is done by giving the parameter an appropriate value. The value is formed of the *Board slot* on the Vacon NX control board (see Vacon NX User's Manual, Chapter 6.2) and the *respective signal number*, see below.

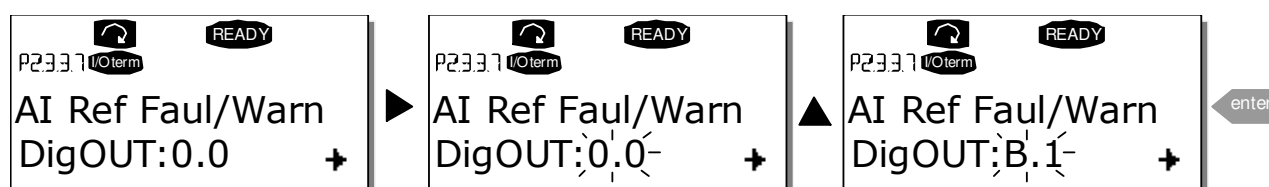


**Example:** You want to connect the digital output function *Reference fault/warning* (parameter 2.3.3.7) to the digital output DO1 on the basic board NXOPTA1 (see Vacon NX User's Manual, Chapter 6.2).

First find the parameter 2.3.3.7 on the keypad. Press the *Menu button right* once to enter the edit mode. On the *value line*, you will see the terminal type on the left (DigIN, DigOUT, An.IN, An.OUT) and on the right, the present input/output the function is connected to (B.3, A.2 etc.), or if not connected, a value (0.#).

When the value is blinking, hold down the *Browser button up* or *down* to find the desired board slot and signal number. The program will scroll the board slots starting from **0** and proceeding from **A** to **E** and the I/O selection from **1** to **10**.

Once you have set the desired value, press the *Enter button* once to confirm the change.





#### 4.2 Defining a terminal for a certain function with NCDrive programming tool

If you use the NCDrive Programming Tool for parametrizing you will have to establish the connection between the function and input/output in the same way as with the control panel. Just pick the address code from the drop-down menu in the *Value* column (see the Figure below).

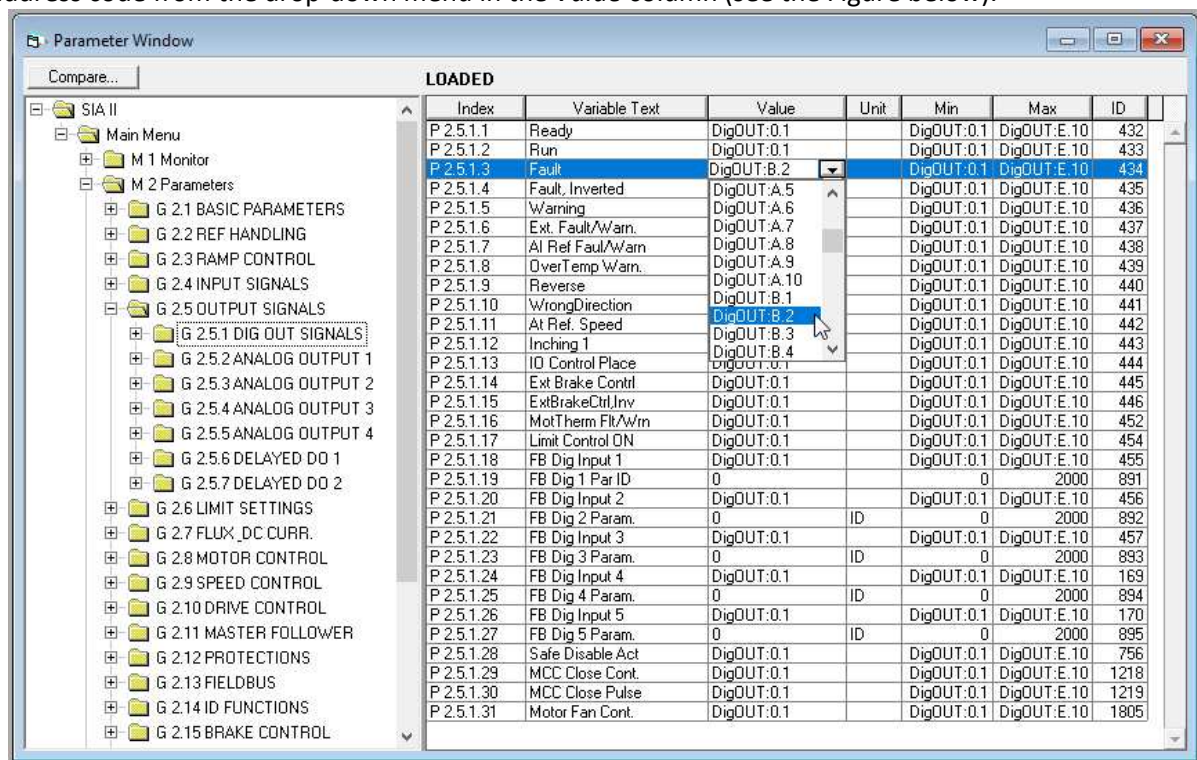


Figure 4-1. Screenshot of NCDrive programming tool; Entering the address code



**WARNING**

**Be ABSOLUTELY sure not to connect two functions to one and same output in order to avoid function overruns and to ensure flawless operation.**

**Note:** The *inputs*, unlike the *outputs*, cannot be changed in RUN state.

### 4.3 Defining unused inputs/outputs




All unused inputs and outputs must be given the board slot value **0** and the value **1** also for the terminal number. The value **0.1** is also the default value for most of the functions. However, if you want to use the **values of a digital input signal** for e.g. testing purposes only, you can set the board slot value to **0** and the terminal number to any number between 2...10 to place the input to a TRUE state. In other words, the value 1 corresponds to 'open contact' and values 2 to 10 to 'closed contact'.

In case of analogue inputs, giving the value **1** for the terminal number corresponds to 0% signal level, value **2** corresponds to 20%, value **3** to 30% and so on. Giving value **10** for the terminal number corresponds to 100% signal level.

## 5. SYSTEM INTERFACE APPLICATION – MONITORING VALUES

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given on pages 98 to 267. Parameter description includes more than is available in this application see parameter list what is available.

### Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present parameter number
Parameter	=	Name of parameter
Min	=	Minimum value of parameter
Max	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
Cust	=	Customer's own setting
ID	=	ID number of the parameter
	=	On parameter code: Parameter value can only be changed after the FC has been stopped.
	=	Apply the Terminal to Function method (TTF) to these parameters (see chapter 4)
	=	Monitoring value is possible to control from fieldbus by ID number

The manual presents signals that are not normally visible for monitoring. i.e. is not a parameter or standard monitoring signal. These signals are presented with [Letter]. e.g.

[FW]MotorRegulatorStatus

[V]	Normal monitoring signal
[P]	Normal parameter in application.
[FW]	Firmware signal, Can be monitored with NCDrive when signal type is selected Firmware
[A]	Application signal, can be monitored with NCDrive when signal type is selected Application.
[R]	Reference type parameter on keypad.
[F]	Function. Signal is received as a output of function.
[DI]	Digital input signal.

## 5.1 Monitoring values (Control keypad: menu M1)

### 5.1.1 Monitoring Values

The monitoring values are the actual values of parameters and signals as well as statuses and measurements.

Code	Parameter	Unit	Form	ID	Description
V1.1	Output frequency	Hz	#,##	1	Output frequency to motor
V1.2	Frequency reference	Hz	#,##	25	Frequency reference to motor control
V1.3	Motor speed	rpm	#	2	Motor speed in rpm
V1.4	Motor current	A	Varies	3	1 s linear filtering. Format changes depending on unit size.
V1.5	Motor torque	%	Varies	4	In % of Motor nominal torque. Format changes depending in Torque Scale parameter
V1.6	Shaft Power	%	#,.	5	Format changes depending in Torque Scale parameter
V1.7	Motor voltage	V	#,.	6	Calculated motor voltage
V1.8	DC link voltage	V	#	7	Measured DC voltage, filtered.
V1.9	Unit temperature	°C	#	8	Heatsink temperature
V1.10	Motor temperature	varies	#,.	9	Calculated motor temperature
V1.11	Analogue input 1	%	#,##	13	AI1, unfiltered.
V1.12	Analogue input 2	%	#,##	14	AI2, unfiltered.
V1.13	Analogue input 3	%	#,##	27	AI3, unfiltered.
V1.14	Analogue input 4	%	#,##	28	AI4, unfiltered.
V1.15	Analogue Out 1	%	#,##	26	AO1
V1.16	Analogue Out 2	%	#,##	31	AO2
V1.17	Analogue Out 3	%	#,##	32	AO3
V1.18	Analogue Out 4	%	#,##	1526	
V1.19	DIN1, DIN2, DIN3			15	Digital input statuses
V1.20	DIN4, DIN5, DIN6			16	Digital input statuses
V1.21	Torque reference	%		18	Used Torque Reference. Format changes depending in Torque Scale parameter
V1.22	PT-100 Temperature	°C	#,.	42	Highest temperature of OPTB8 board. 4 s filtering.
G1.23	Multimonitoring items				Displays three selectable monitoring values

Table 5-1. Monitoring values

## 5.1.2 Monitoring values 2

Code	Parameter	Unit	Form	ID	Description
V1.24.1	Current	A	Varies	1113	Unfiltered motor current. Format changes depending on unit size.
V1.24.2	Torque	%	Varies	1125	Unfiltered motor torque. Format changes depending in Torque Scale parameter
V1.24.3	DC Voltage	V	#	44	Unfiltered DC link voltage
V1.24.4	Application Status Word			43	
V1.24.5	Shaft Frequency	Hz	###	96	Filtered used for speed control
V1.24.6	Encoder 1 Frequency	Hz	###	1164	Unfiltered, directly from encoder
V1.24.7	Output Power	kw		1508	Unfiltered electrical power
V1.24.8	Measured temperature 1	C°	#, #	50	4 s filtering.
V1.24.9	Measured temperature 2	C°	#, #	51	4 s filtering.
V1.24.10	Measured temperature 3	C°	#, #	52	4 s filtering.
V1.24.11	Measured temperature 4	C°	#, #	69	4 s filtering.
V1.24.12	Measured temperature 5	C°	#, #	70	4 s filtering.
V1.24.13	Measured temperature 6	C°	#, #	71	4 s filtering.
V1.24.14	ABS Encoder Revolutions	r	#	55	
V1.24.15	ABS Encoder Position		#	54	
V1.24.16	Final Frequency Reference	Hz	###	1845	
V1.24.17	Step response	Hz	####	1846	
V1.24.18	CosPhiActual		####	68	
V1.24.19	Flux Current	%	#, #	72	
V1.24.20	ID Run Status			49	
V1.24.21	Rotor Flux	%	#, #	1158	
V1.24.22	Step Frequency	Hz	###	1871	
V1.24.23	Ident fail			98	
V1.24.24	Limit & Regulators			77	
V1.24.25	Non Ready Cause		#	1608	
V1.24.26	Prevent MC Ready		#	1609	
V1.24.27	Serial Number Key			1997	

Table 5-2. Monitoring values 2

### 5.1.3 FieldBus Monitoring values

Code	Parameter	Unit		ID	Description
V1.25.1	FB Control Word			1160	
V1.25.2	FB Speed Reference			875	
V1.25.3	FB Status Word			65	
V1.25.4	FB Actual speed			865	
V1.25.5	FB Torque Reference	%		1140	Default Control of FB PD 1. Format changes depending in Torque Scale parameter
V1.25.6	FB Limit Scaling	%	#,##	46	Default Control of FB PD 2
V1.25.7	FB Adjust Reference	%	#,##	47	Default Control of FB PD 3
V1.25.8	FB Analog Output	%	#,##	48	Default Control of FB PD 4
V1.25.9	FB Motor Current	A	#,.	45	Motor current (drive independent) given with one decimal point
V1.25.10	Fault Word 1			1172	
V1.25.11	Fault Word 2			1173	
V1.25.12	Warning Word 1			1174	
V1.25.13	AuxStatusWord			1163	
V1.25.14	Last Active Fault		#	37	
V1.25.15	AuxControlWord			1161	
V1.25.16	Din Status Word			56	
V1.25.17	Din Status Word 2			57	
V1.25.18	MC Status			64	
V1.25.19	Last Active Warning		#	74	
V1.25.20	Shaft Rounds	r	#	1170	
V1.25.21	Shaft Angle	Dec	#	1169	
V1.25.22	Fault Word 10			1202	
V1.25.23	Warning Word 10			1269	
V1.25.24	Shaft Angle P	Dec	#	1992	

Table 5-3. FieldBus Monitoring values

### 5.1.4 Master/Follower Monitoring values

Code	Parameter	Unit	ID	Description
V1.26.1	SB SystemStatus		1601	
V1.26.2	Total Current	A	80	Sum current of all drives (DS)
V1.26.3	Master CW	A	93	Control Word of Master Drive
V1.26.4	Master Freq. Ref	Hz	1842	
V1.26.5	Master Ramp Out	Hz	1843	
V1.26.6	Master Torque Ref	%	1139	
V1.26.7	Master SPC Out	%	1844	
Code	Parameter	Unit	ID	Description
V1.26.8.1	Motor Current D1	A	1616	
V1.26.8.2	Motor Current D2	A	1605	
V1.26.8.3	Motor Current D3	A	1606	
V1.26.9.4	Motor Current D4	A	1607	
Code	Parameter	Unit	ID	Description
V1.26.9.1	Status Word D1		1615	
V1.26.9.2	Status Word D2		1602	
V1.26.9.3	Status Word D3		1603	
V1.26.9.4	Status Word D4		1604	

Table 5-4. Master/Follower Monitoring values

### 5.1.5 PI Control Monitoring values

Code	Parameter	Unit	ID	Description
V1.27.1	PI Reference		20	Used PI Reference
V1.27.2	PI Actual Value		21	PI Actual value
V1.27.3	PI Output		23	PI Output before scaling
V1.27.4	PI Output Scaled		1807	Scaled PI Output This is used for ID connection

### 5.1.6 Speed reference Chain

Code	Parameter	Unit	ID	Description
V1.28.1	Speed Ref 1	rpm	1126	
V1.28.2	Speed Ref 2	rpm	1127	
V1.28.3	Speed Ref Actual	rpm	1128	
V1.28.4	Speed Ref Ramp Out	rpm	1129	
V1.28.5	Speed Ref Step	rpm	1121	
V1.28.6	Speed Ref Final	rpm	1131	
V1.28.7	Speed Ref Error	rpm	1132	
V1.28.8	Speed Drooping	rpm	1147	
V1.28.9	Speed Measured	rpm	1124	

### 5.1.7 Torque Reference Chain

Code	Parameter	Unit	ID	Description
V1.29.1	Torque Reference	%	18	
V1.29.2	Torque Ref. 3	%	1144	
V1.29.3	Torque Ref Final	%	1145	
V1.29.4	Speed Control Out	%	1134	
V1.29.5	Accell Compensation	%	1146	
V1.29.6	Torque Ref. Actual	%	1180	

### 5.1.8 SM Excitation

Code	Signal	Unit	ID	Description
------	--------	------	----	-------------

V1.30.1	Magnetization Reference	%	1767	
V1.30.2	Magn Ref AO	%	1768	
V1.30.3	Magnetization Actual	%	1816	
V1.30.4	Magn Act AI	%	1817	

### 5.1.9 Functional Safety Monitoring

Code	Signal	Unit	ID	Description
V1.31.1	Safety App Status		1653	
V1.31.2	Integrity Level		1640	
V1.31.3	Acknowledge Mode		1641	
V1.31.4	Safety Encoder Speed	rpm	1642	
V1.31.5	Ramp Selection		1643	
V1.31.6	Function Reached		1644	
V1.31.7	Request DIN		1645	
V1.31.8	Request PLC		1646	
V1.31.9	Function In Use		1647	
V1.31.10	Safety Status Word		1648	
V1.31.11	Safety General Status Word		1649	
V1.31.12	Safety Status		1650	
V1.31.13	Safety Zero Speed		1651	
V1.31.14	SBC Speed	rpm	1652	



## 5.1.10 Condition Based Monitoring

Code	Parameter	Unit	ID	Description
V1.32.1.1	Baseline Status		3622	0=Not Started 1=Running 2=Running 10% 3=Running 20% 4=Running 30% 5=Running 40% 6=Running 50% 7=Running 60% 8=Running 70% 9=Running 80% 10=Running 90% 11=Completed 12=Run Failed 13=Manual Before Baseline 14=Manual After Baseline
V1.32.1.2	Baseline Data 1	Hz or %	3601	
V1.32.1.3	Baseline Data 2	Hz or %	3602	
V1.32.1.4	Baseline Data 3	Hz or %	3603	
V1.32.1.5	Baseline Data 4	Hz or %	3604	
V1.32.1.6	Baseline Data 5	Hz or %	3605	
V1.32.1.7	Baseline Data 6	Hz or %	3606	
V1.32.1.8	Baseline Data 7	Hz or %	3607	
V1.32.1.9	Baseline Data 8	Hz or %	3608	
V1.32.1.10	Baseline Data 9	Hz or %	3609	
V1.32.1.11	Baseline Data 10	Hz or %	3610	
Code	Parameter	Unit	ID	Description
V1.32.2.1	Current Unbalance	%	3617	
V1.32.2.2	Current Threshold Value	%	3620	
V1.32.2.3	Current Warning S1 High	%	3611	
V1.32.2.4	Current Warning S2 High	%	3612	
V.1.32.2.5	Current Alarm/Fault High	%	3613	
V1.32.2.6	Voltage Unbalance	%	3618	
V1.32.2.7	Voltage Threshold Value	%	3621	
V1.32.2.8	Voltage Warning S1 High	%	3614	
V1.32.2.9	Voltage Warning S2 High	%	3615	
V.1.32.2.10	Voltage Alarm/Fault High	%	3616	
Code	Parameter	Unit	ID	Description
V1.32.3.1	Vibration	%	3623	
V1.32.3.2	Vibration Threshold Value	%	3624	
V1.32.3.3	Vibration Warning S1 High	%	3625	
V1.32.3.4	Vibration Warning S2 High	%	3626	
V.1.32.3.5	Vibration Alarm/Fault High	%	3627	
Code	Parameter	Unit	ID	Description
V1.32.4.1	Motor Torque	%	4	
V1.32.4.2	Load Threshold Value	%	3628	
V1.32.4.3	Load Warning S1 High	%	3629	
V1.32.4.4	Load Warning S2 High	%	3630	
V.1.32.4.5	Load Alarm/Fault High	%	3631	
V1.32.4.6	Load Threshold Value Low	%	3635	

V1.32.4.7	Load Warning S1 Low	%	3632	
V1.32.4.8	Load Warning S2 Low	%	3633	
V.1.32.4.9	Load Alarm/Fault Low	%	3634	
Code	Parameter	Unit	ID	Description
V.1.32.5	Condition Based Status		3619	<b>B0</b> = Stator current warning S1 <b>B1</b> = Stator voltage warning S1 <b>B2</b> = Vibration warning S1 <b>B3</b> = Load warning S1 <b>B5</b> = Stator current warning S2 <b>B6</b> = Stator voltage warning S2 <b>B7</b> = Vibration warning S2 <b>B8</b> = Load warning S2 <b>B10</b> = Stator current alarm/fault <b>B11</b> = Stator voltage alarm/fault <b>B12</b> = Vibration alarm/fault <b>B13</b> = Load alarm/fault

## 5.2 Monitoring values description

### 5.2.1 Monitoring values

#### **V1.1 Output frequency [# Hz] ID1**

Output frequency to motor, updated at 10 ms time level.

#### **V1.2 Frequency reference [# Hz] ID 25**

Frequency reference to motor control, after speed share function. updates at 1 ms time level.

#### **V1.3 Motor speed [# rpm] ID 2**

Motor speed in rpm

#### **V1.4 Motor current [Unit size dependent A] ID 3**

##### **Open loop:**

1 s linear filtering.

##### **Closed Loop:**

32 ms filtering

##### **Drive Synch Operation Master drive**

This value is the total current of the system divided by number of drives in the system (SbLastID). SbLastID cannot be changed; it needs to be set according to how many drives are linked with system bus.

##### **Drive Synch Operation Follower drive**

This value is the current of the drive's own power unit.

##### **Current scaling in different size of units**

Note: ID45, usually in Process data OUT 3 is scaled to be with one decimal always.

Voltage	Size	Scale
208 – 240 Vac	NX0001 – NX0011	100 – 0,01A
208 – 240 Vac	NX0012 – NX0420	10 – 0,1A
208 – 240 Vac	NX0530	1 – 1A
380 – 500 Vac	NX0003 – NX0007	100 – 0,01A
380 – 500 Vac	NX0009 – NX0300	10 – 0,1A
380 – 500 Vac	NX0385 – NX2643	1 – 1A
525 – 690 Vac	NX0004 – NX0013	100 – 0,01A
525 – 690 Vac	NX0018 – NX0261	10 – 0,1A
525 – 690 Vac	NX0325 – NX1500	1 – 1A

#### **V1.5 Shaft Power [Torque Scale Dependent %] ID 5**

Calculated motor power

#### **V1.6 Motor torque [Torque Scale Dependent %] ID 4**

In % of Motor nominal torque

**Open loop**

1 s linear filtering

**Closed Loop**

32 ms filtering

**Drive Synch Operation Follower drive**

This value is the torque of the drive's own power unit related to set motor nominal current.

**V1.7      Motor voltage      [#,# V]      ID 6**

Calculated motor voltage

**V1.8      DC link voltage      [# V]      ID 7**

Measured DC voltage, filtered.

**V1.9      Unit temperature      °C      ID 8**

Heatsink temperature

**V1.10      Motor temperature      % or °C ID 9**

Calculated motor temperature. 105 % is tripping limit if response is fault.

Motor temperature is calculated in Celsius when motor nom temp rise parameter (ID 1922) is activated.

$$T[°C] = \text{MotorTemperatureRise}[\%] * \text{MotorNomTempRise}[°C] / 100\% + T_{amb}[°C]$$

**V1.11      Analogue input 1      [#,## %]      ID 13**

**V1.12      Analogue input 2      [      #,## %] ID 14**

Unfiltered analogue input level.

0 % = 0 mA / 0 V, -100 % = -10 V, 100 % = 20 mA / 10 V.

Monitoring scaling is determined by the option board parameter.

**V1.13      Analogue input 3      [#,## %]      ID 27**

**V1.14      Analogue input 4      [#,## %]      ID 28**

It is possible to adjust this input value from fieldbus when the input terminal selection is 0.1. This way it is possible to adjust the free analogue input from fieldbus and have all analogue input functions available for fieldbus process data.

**V1.15      Analogue Out 1      [#,## %]      ID 26**

**V1.16      Analogue Out 2      [#,## %]      ID 31**

**V1.17      Analogue Out 3      [#,## %]      ID 32**

**V1.18      Analogue Out 4      [#,## %]      ID 1526**

Analogue Output value 0 % = 0 mA / 0 V, 100 % = 20 mA / 10 V

**V1.19**      **DIN1, DIN2, DIN3**      **ID 15**

**V1.20**      **DIN4, DIN5, DIN6**      **ID 16**

	DIN1/DIN2/DIN3 status	DIN4/DIN5/DIN6 status
<b>b0</b>	DIN3	DIN6
<b>b1</b>	DIN2	DIN5
<b>b2</b>	DIN1	DIN4

**V1.21**      **Torque reference %**      **ID 18**

Torque reference value before load share.

**V1.22**      **PT-100 Temperature**      **C°**      **ID 42**      **[#, #]**

Highest temperature of OPTB8 board. 4 s filtering.

### 5.2.2 Monitoring values 2

#### V1.24.1 **Current A ID 1113**

Unfiltered motor current, recommended signal for NCDrive monitoring.

##### **Drive Synch Operation Master drive**

This value is the total current of the system divided by number of drives in the system (SbLastID). SbLastID cannot be changed; it needs to be set according to how many drives are linked with system bus.

##### **Drive Synch Operation Follower drive**

This value is current of drive own power unit.

#### V1.24.2 **Torque % ID 1125**

Unfiltered motor torque, recommended signal for NCDrive monitoring.

#### V1.24.3 **DC VoltageV ID 44**

Unfiltered DC link voltage, recommended signal for NCDrive monitoring.

#### V1.24.4 **Application Status Word ID 43 "Status Word"**

Application Status Word combines different drive statuses to one data word.  
Recommended signal for NCDrive monitoring.

Application Status Word ID43		
	FALSE	TRUE
b0	Flux not ready	Flux ready (>90 %)
b1	Not in Ready state	Ready
b2	Not Running	Running
b3	No Fault	Fault
b4	Direction Forward	Direction Reverse
b5	Emergency Stop Active	Emergency Stop NOT Active
b6	Run Disabled	Run Enable
b7	No Warning	Warning
b8		
b9		
b10		
b11	No DC Brake	DC Brake is active
b12	No Run Request	Run Request
b13	No Limit Controls Active	Limit control Active
b14	External Brake Control OFF	External Brake Control ON
b15		

#### V1.24.5 **Shaft Frequency Hz ID96**

Filtered Encoder frequency, used for speed control

#### V1.24.6 **Encoder 1 Frequency Hz ID 1164**

Unfiltered encoder frequency, directly from encoder.

**V1.24.7    Output Power    kw    ID 1508**

Unfiltered electrical drive output power.

**V1.24.8    Measured temperature 1    C°    ID 50**

**V1.24.9    Measured temperature 2    C°    ID 51**

**V1.24.10    Measured temperature 3    C°    ID 52**

**V1.24.11    Measured temperature 4    C°    ID 69**

**V1.24.12    Measured temperature 5    C°    ID 70**

**V1.24.13    Measured temperature 6    C°    ID 71**

Separate measurement from two PT100 board. The signal has 4 s filtering time.

**V1.24.14    ABS Encoder Revolutions    ID55**

Absolute encoder revolution information.

**V1.24.15    ABS Encoder Position    ID54**

Absolute encoder position within one rotation. See encoder manual for scaling.

**V1.24.16    Final Frequency Reference Hz    ID 1845**

Final reference to speed controller. After ramp generator and after Speed Step function, used for closed loop speed tuning when used together with Encoder 1 frequency.

**V1.24.17    Step response    Hz    ID 1846**

Frequency error. Compares ramp output to actual encoder frequency with 0,001 Hz accuracy. Can be used for speed control tuning in closed loop control.

**V1.24.18    CosPhiiActual    ID 68**

Estimated Cos Phii.

**V1.24.19    Flux Current    %    ID 72**

Flux current part of the total current. 100 % = Motor Nominal Current.

**V1.24.20    ID Run Status    ID49**

When bit is zero identification has not been done.

ID Run Status ID49		
Bit		
0	Rs identification, programmable U/f curve	
1	Tr/Lm identification at stand still	
2	Magnetization current identification run	
3	Saturation curve identification run	
4	PMSM encoder zero-position identification run	
5	Magnetization current default initialisation	
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

#### V1.24.21 Rotor Flux ID1158

Calculated Rotor Flux

#### V1.24.22 Step Frequency ID1871

Frequency reference from NCDriver when making the speed controller tuning. Used together with Step Response monitoring variable.

#### V1.24.23 Ident Failure Code [Ident Fail. Code] ID 98

Failure code for failed identification:

- 1 = Current measurement offset
- 2 = Identification current level
- 3 = Acceleration time too long
- 4 = Identification frequency reference not reached
- 5 = Too low or high magnetization current
- 6 = Flux curve outside expected levels
- 7 = PMSM, Encoder zero position
- 8 = Too low maximum frequency limit
- 9 = PMSM, encoder zero pulse not found.
- 10 = Ls Identification timeout
- 11 = Ls Identification current

#### V1.24.24 Limits and Regulators ID77

	Limit & Regulators ID77
--	-------------------------



	Signal	
b0	Motoring Current Limit	
b1	Generator Current Limit	
b2	Motoring Torque Limit	
b3	Generator Torque Limit	
b4	Over Voltage Regulator	
b5	Under Voltage Regulator	
b6	Positive Speed Controller Limit	
b7	Negative Speed Controller Limit	
b8	Positive Iq Limit	
b9	Negative Iq Limit	
b10		
b11		
b12		
b13		
b14		
b15		

**V1.24.25 Non Ready Cause ID 1608**

	Non Ready Cause ID1608	
	Signal	
b0	Fault is Active	
b1	Prevent MC Ready is set	
b2	Charge switch is open	
b3	DC Voltage not OK	
b4	Power unit state not OK	
b5	Start-up Wizard is active	
b6	Run Enable is not set	
b7	Ready state prevented by STO	
b8		
b9		
b10		
b11		
b12		
b13		
b14		
b15		

**V1.24.26 Prevent MC Ready ID 1609**

	Prevent MC Ready ID1609	
	Signal	

b0	Endat option board (OPTBB, OPTBE) communication is not initialized after power-up.
b1	Drive sync master has wrong modulator or 1000ms task parameters are not initialized
b2	Drive sync follower delay is active
b3	Drive sync failure in sw modulator double period mode
b4	Charge switch delay is active
b5	AFE fast run disable through ENC C1 is active
b6	100ms task not executed
b7	
b8	
b9	
b10	
b11	
b12	
b13	
b14	
b15	

**V1.24.27 Serial Number Key****ID 1997**

### 5.2.3 FieldBus Monitoring values

#### V1.25.1 FB Control Word ID1160

Control word used in bypass mode. See P2.13.22 and option board ByPass.

Bit	Description	
	Value = 0	Value = 1
0	OFF	ON, Reset after Fault or b1 and b2
1	Coasting Stop	ON, On normal operation: Keep TRUE
2	Quick Stop	ON, On normal operation: Keep TRUE
3	STOP REQUEST	RUN REQUEST
4	Force ramp to Zero	Enable Ramp,
5	Freeze Ramp	Enable Ramp,
6	Force Ref to Zero	Enable Ramp,
7	No Action	FAULT RESET (0 -> 1)
8	No Action	Jogging 1
9	No Action	Jogging 2
10	Disable Profibus control	Enable Profibus control
11	Watchdog pulse (Fieldbus DIN1=OFF)	Watchdog pulse (Fieldbus DIN1=ON)
12	Fieldbus DIN2=OFF	Fieldbus DIN2=ON
13	Fieldbus DIN3=OFF	Fieldbus DIN3=ON
14	Fieldbus DIN4=OFF	Fieldbus DIN4=ON
15	<u>For internal use</u> : FB Fault	FB Communication fault. Always zero with fast profibus mode.

#### V1.25.2 FB Speed Reference ID 875

Speed reference from fieldbus

**V1.25.3    FB Status Word                    ID65**

PROFIdrive type status word. Generated in the application level.  
 Selected by P2.13.17 GSW, to be used. When needed with profibus board, operation mode needs to be set to ByPass in option board and with P2.13.19 ProfiBus Mode select: 2 / ProfiDrive.

Bit	Description	
	Value = 0	Value = 1
0	Not ready to switch on	Ready to switch on
1	Not ready to operate	Ready to operate
2	Not Running	Running
3	No Fault	Fault
4	Coast stop Active	Coast stop not active
5	Quick stop active	Quick stop not active
6	Switch not inhibited	Switch on inhibit
7	No Warning	Warning
8	Speed error	Speed At Reference
9	No FB Control request	FB Control Active
10	Fout < P2.6.4.5 Above Speed Lim	Fout > P2.6.4.5 Above Speed Lim
11	SW ID.BIT Selection 1	Updated at 100 ms time level
12	SW ID.BIT Selection 2	Updated at 100 ms time level
13	SW ID.BIT Selection 3	Updated at 100 ms time level
14	SW ID.BIT Selection 4	Updated at 100 ms time level
15	Fieldbus DIN1=OFF	Fieldbus DIN1=ON (Watchdog pulse)

**V1.25.4    FB Actual Speed                    ID 865**

Actual speed of the drive. Scaled with process speed and FB Reference Scale parametes.

**V1.25.5    FB Torque Reference            %            ID 1140**

Torque reference value from fieldbus  
 Default Control of FB PD 1

**V1.25.6    FB Limit Scaling            %            ID 46**

Limit scaling input value from fieldbus.  
 Default Control of FB PD 2.

**V1.25.7    FB Adjust Reference            %            ID 47**

Reference adjustment value from fieldbus.  
 Default Control of FB PD 3.

**V1.25.8    FB Analog Output            %            ID 48**

Fieldbus value to control analogue output.  
 Default Control of FB PD 4.

**V1.25.9    FB Motor Current            A            ID 45**

Motor current (drive independent) given with one decimal point.

**V1.25.10 Fault Word 1 ID 1172**

Different faults are collected to two words that can be read from fieldbus or with NCDrive PC software.

	<b>Fault Word 1 ID1172</b>
Bit	Fault(s)
B0	F1 Over current, F31 IGBT, F41 IGBT
B1	F2 Over Voltage
B2	F9 Under Voltage
B3	F15 Motor Stalled
B4	F3 Earth Fault
B5	F17 Motor Underload
B6	F14 Unit Over Temperature
B7	F16 Motor Temperature, F29 Thermistor,
B8	F10 Input line fault
B9	
B10	
B11	F52 Keypad or F52 PC communication fault
B12	F53 FieldBus fault
B13	F59 System Bus fault
B14	F54 Slot Communication fault
B15	F50 4mA fault

**V1.25.11 Fault Word 2 ID 1173**

	<b>Fault Word 2 ID1173</b>
Bit	Fault(s)
B0	F11 Output phase
B1	F5 Charge Switch
B2	F43 Encoder Fault
B3	
B4	
B5	
B6	F51 External fault
B7	F12 Brake Chopper
B8	
B9	F31 IGBT, F41 IGBT
B10	F58 Brake Fault
B11	F60 Cooling Failure
B12	
B13	F8 System Fault
B14	F64 Main Switch
B15	

**V1.25.12 Warning Word 1 ID 1174**

	<b>Warning Word 1 ID1174</b>
--	------------------------------

Bit	Warning(s)
B0	W15 Motor Stalled
B1	W16 Motor Over Temperature, W29 Thermistor
B2	W17 Motor Under Load
B3	W10 Input Phase Loss
B4	W11 Output Phase Loss
B5	W30 Safe Torque Off
B6	
B7	
B8	W14 Unit Over Temperature
B9	W50 4 mA warning
B10	W59 Motor Fan
B11	W63 Quick Stop
B12	W62 Run Disabled
B13	Inching Enabled, no warning indication
B14	W58 Brake Warning
B15	W52 Keypad or W52 PC Communication

### V1.25.13 **AuxStatusWord** ID 1163

Aux Status Word ID1163		
	Function	Comment
b0	Data Logger triggered	Reserved
b1		Window control active and speed outside of widow
b2	Motoring or Generator side limits active	
b3	Under or over voltage regulator	
b4	Reversing	
b5	IO Control active	
b6	Reserved	
b7	Brake Open Command	
b8	DC Ready, Pulse	Pulse
b9	Charge SW State	
b10	Drive in torque control mode	
b11	Speed zero	
b12	Reserved	Reserved
b13	Reserved	Reserved
b14	Reserved	Reserved
b15	Reserved	Reserved

### V1.25.14 **Fault History** ID 37

Fault number of the last active fault.

### V1.25.15 **AuxControlWord** ID 1161

Aux Control Word ID1161	
-------------------------	--

	Function	Comment
b0	Reserved	Reserved
b1	Reserved	Reserved
b2	Bypass ramp	Reserved
b3	Force reference from I/O Ref 2	Reference is taken from I/O Reference 2
b4	Reserved	Reserved
b5	Reserved	Reserved
b6	Reserved	Reserved
b7	Ext brake is forced open	Command to open external brake unconditionally
b8	Force Ramp Out to zero	Reserved
b9	Reset encoder position	
b10	Reserved	Reserved
b11	Reserved	Reserved
b12	Reserved	Reserved
b13	Reserved	Reserved
b14	Reserved	Reserved
b15	Reserved	Quick Stop Acknowledge

**V1.25.16 Din Status Word ID 56**

**V1.25.17 Din Status Word 2 ID 57**

	DIN StatusWord 1	DIN StatusWord 2
<b>b0</b>	DIN: A.1	DIN: C.5
<b>b1</b>	DIN: A.2	DIN: C.6
<b>b2</b>	DIN: A.3	DIN: D.1
<b>b3</b>	DIN: A.4	DIN: D.2
<b>b4</b>	DIN: A.5	DIN: D.3
<b>b5</b>	DIN: A.6	DIN: D.4
<b>b6</b>	DIN: B.1	DIN: D.5
<b>b7</b>	DIN: B.2	DIN: D.6
<b>b8</b>	DIN: B.3	DIN: E.1
<b>b9</b>	DIN: B.4	DIN: E.2
<b>b10</b>	DIN: B.5	DIN: E.3
<b>b11</b>	DIN: B.6	DIN: E.4
<b>b12</b>	DIN: C.1	DIN: E.5
<b>b13</b>	DIN: C.2	DIN: E.6
<b>b14</b>	DIN: C.3	
<b>b15</b>	DIN: C.4	

**V1.25.18 MC Status ID 64**

This is the value that is also send to fieldbus on those fieldbus that do not use own state machine.

Motor Control Status Word		
	FALSE	TRUE
b0	Not in Ready state	Ready
b1	Not Running	Running
b2	Direction Clockwise	Counter clockwise
b3	No Fault	Fault
b4	No Warning	Warning
b5		At reference speed
b6		At Zero Speed
b7		Flux Ready
b8		TC Speed Limiter Active
b9	Encoder Direction	Counter clockwise
b10		Under Voltage Fast stop
b11	No DC brake	DC Brake is active
b12		
b13		Restart delay active
b14		
b15		

**V1.25.19    Warning                    ID 74**

Last active warning.

**V1.25.20    Shaft Rounds                ID 1170**

Rounds information from incremental encoder. The value is reset when 24 Vdc is removed from the drive.

**V1.25.21    Shaft Angle                    ID 1169**

Angle information from incremental encoder. The value is reset when 24 Vdc is removed from the drive.

**V1.25.22    Fault Word 10                    ID1202**

Fault Word 10 ID1202	
Bit	Warning(s)
B0	W61 Speed Error



B1	
B2	
B3	
B4	W56 PT100 Warning
B5	
B6	
B7	
B8	
B9	
B10	
B11	
B12	
B13	
B14	
B15	

**V1.25.23      Warning Word 10      ID1269**

	<b>Warning Word 10 ID1269</b>
Bit	Warning(s)
B0	W61 Speed Error
B1	
B2	
B3	
B4	W56 or W65 PT100 Warning
B5	
B6	
B7	
B8	
B9	
B10	
B11	
B12	
B13	
B14	
B15	

**V1.25.23      Shaft Angle Precision      ID1992**  
 Same as ID 1169 but with one additional decimal.

**5.2.4 Master / Follower**

**V1.26.1      SB SystemStatus      ID 1601**

**D1:** Status of all (max 4) drives status in system bus.

**D2, D3 and D4:** Drive own status B0-B3

	<b>System Bus Status Word ID1601</b>	
	FALSE	TRUE
b0		Drive 1 in synch
b1		Drive 1 Ready
b2		Drive 1 Running
b3		Drive 1 Fault
b4		Drive 2 in synch
b5		Drive 2 Ready
b6		Drive 2 Running
b7		Drive 2 Fault
b8		Drive 3 in synch
b9		Drive 3 Ready
b10		Drive 3 Running
b11		Drive 3 Fault
b12		Drive 4 in synch
b13		Drive 4 Ready
b14		Drive 4 Running
b15		Drive 4 Fault

#### **V1.26.2    Total Current    A    ID 80**

**D1:** This value is the current of whole drive synch system.

**D2, D3 and D4:** This value is the sum current of the drive's own power unit and that of the drives with smaller system bus identification number starting from master drive.

**If D2 Master:** This value is the current of whole drive synch system.

**V1.26.3 Master Control Word ID93**

Master Drive Control Word. Master Sending, Follower receiving.

Master Control Word		
	Standard Master Follower	Drive Sync operation
b0	Ready Status	
b1	Run Enable Command	
b2	Final Run Request	
b3	Fault Reset	Fault Reset
b4	Running	Running
b5	Fault active	
b6	External Brake Control	External Brake Control
b7	Communication WD	Communication WD
b8	Ramp Hold Command	
b9	Data logger trig Command	Data logger trig Command
b10	Master in Ramp Stop	
b11	Master in Start Delay	
b12	Force Ramp out to zero	
b13	Emergency Stop Active	
b14	Disable MF Diagnostic	Disable MF Diagnostic
b15	Freeze Reference	

**V1.26.4 Master Freq Ref Hz ID1842**

Reference before ramp generator. When drive is in follower mode this is reference send by master drive. If master or a single drive this is the drive own reference before ramp generator

**V1.26.5 Master Ramp Out Hz ID1843**

Final frequency reference, after the ramp generator but before speed controller. When drive is in follower mode this is the reference send by master drive, used when drive is a ramp follower. If master or a single drive this is the drive own reference after ramp generator but before speed controller.

**V1.26.6 Master Torque Ref % ID1139**

Final torque reference after speed controller and torque reference chain. When drive is in follower mode this is reference send by master drive. If master or a single drive this is the drive own.

**V1.26.7 Master SPC Out % ID1844**

Speed Controller output. When drive is in follower mode this is reference send by master drive. If master or a single drive this is drive own reference.

**V1.26.8.1    Motor Current D1   A        ID 1616**

**D1, D2, D3 and D4:** This value is the current of drive own power unit.

**V1.26.8.2    Motor Current D2   A        ID 1605**

**D1:** This value is the current of drive number two power unit.

**D2,D3 and D4:** Not updated.

**V1.26.8.3    Motor Current D3   A        ID 1606**

**D1:** This value is the current of drive number three power unit.

**D2,D3 and D4:** Not updated.

**V1.26.8.4    Motor Current D4   A        ID 1607**

**D1:** This value is the current of drive number four power unit.

**D2,D3 and D4:** Not updated.

**V1.26.9.1 Status Word D1 ID 1615****D1:** Status Word for D1 without B15**D2,D3 and D4:** Status Word that is send to D1.**V1.26.9.2 Status Word D2 ID 1602****D1:** D2 Status Word**D2,D3 and D4:** Not updated.**V1.26.9.3 Status Word D3 ID 1603****D1:** D3 Status Word**D2,D3 and D4:** Not updated.**V1.26.9.4 Status Word D4 ID 1604****D1:** D4 Status Word**D2,D3 and D4:** Not updated.

	Follower Drive status word	
	FALSE	TRUE
b0	Flux not ready	Flux ready (>90 %)
b1	Not in Ready state	Ready
b2	Not Running	Running
b3	No Fault	Fault
b4		ChargeSwState
b5		
b6	Run Disabled	Run Enable
b7	No Warning	Warning
b8		
b9		
b10		SB Communication OK
b11	No DC Brake	DC Brake is active
b12	No Run Request	Run Request
b13	No Limit Controls Active	Limit control Active
b14	External Brake Control OFF	External Brake Control ON
b15		Heard Beat

### 5.2.5 PI Control monitoring

This PI control uses ID numbers for input and output signal. See detail in PI Control chapter.

**V1.27.1      *PI Reference*                                      *ID20***

Used PI Reference, reference is selected by ID number.

**V1.27.2      *PI Actual Value*                                      *ID21***

PI Actual value. Actual input is selected by ID number.

**V1.27.3      *PI Output*    *ID23***

PI Output before scaling. This value uses PI Out High and Low for limiting.

**V1.27.3      *PI Output Scaled*                                      *ID1807***

Scaled PI Output.

This is used for ID connection. Scaling function is used to scale value more suitable for connected signal. e.g. when output is connected to torque limit actual value need to be -1000 ...+1000 (-100,0 %..+100,0 %) But PI Out High and Low can be from -30000...+30000 to have more accurate PI control.

### 5.2.6 Speed Reference Chain

Monitoring points for speed reference chain in actual order

<b>V1.28.1</b>	<b>Speed Ref 1</b>	<b>rpm</b>	<b>ID1126</b>	Speed reference after reference selector, before speed share.
<b>V1.28.2</b>	<b>Speed Ref 2</b>	<b>rpm</b>	<b>ID 1127</b>	Speed reference after speed share, before interpolator and filtering
<b>V1.28.3</b>	<b>Speed Ref Actual</b>	<b>rpm</b>	<b>ID 1128</b>	Speed reference input for ramp controller.
<b>V1.28.4</b>	<b>Speed Ref Ramp Out</b>	<b>rpm</b>	<b>ID 1129</b>	Speed reference output from ramp controller.
<b>V1.28.5</b>	<b>Speed Ref Step</b>	<b>rpm</b>	<b>ID 1121</b>	Speed step scaled to rpm.
<b>V1.28.6</b>	<b>Speed Ref Final</b>	<b>rpm</b>	<b>ID 1131</b>	Speed reference for speed controller.
<b>V1.28.7</b>	<b>Speed Ref Error</b>	<b>rpm</b>	<b>ID 1132</b>	Speed error, used for speed controller tuning with Speed Ref Step.
<b>V1.28.8</b>	<b>Speed Drooping</b>	<b>rpm</b>	<b>ID 1147</b>	Rpm value of the drooping function.
<b>V1.28.9</b>	<b>Speed Measured</b>	<b>rpm</b>	<b>ID 1124</b>	Unfiltered actual speed, directly from encoder.

### 5.2.7 Torque Reference Chain

Monitoring points for torque reference chain in actual order

**V1.29.1    Torque Reference    %    ID18**

Torque reference after reference selector, before load share.

**V1.29.2    Torque Ref. 3    %    ID 1144**

Torque reference after load share, before filtering and interpolator.

**V1.29.3    Torque Ref Final    %    ID 1145**

Final torque reference from torque reference chain.

**V1.29.4    Speed Control Out    %    ID 1134**

Torque reference from speed controller.

**V1.29.5    Acceleration Compensation    %    ID 1146**

Torque reference from acceleration compensation.

**V1.29.6    Torque Ref. Actual    %    ID 1180**

Final torque reference from speed control and torque control. Also includes torque step and acceleration compensation factors.

### 5.2.8 SM Excitation Monitor

**V1.30.1    Magnetization Reference    %    1767**

Excitation reference 100 % = No load magnetization.

**V1.30.2    Magn Ref AO    %    1768**

Magnetization reference in analogue output scale. 100 % = 20 mA.

**V1.30.3    Magnetization Actual    %    1816**

Actual Excitation 100 % = No load magnetization

**V1.30.4    Magn Act AI    %    ID1817**

Magnetization actual in analogue input scale. 100 % = 20 mA.



## 5.2.9 Functional Safety Monitoring

**V1.31.1      Safety App Status      ID1653**

	FALSE	TRUE
b0	Drive ack not accepted	Advanced safety option board will accept ack from drive
b1	Drive reset not accepted	Advanced safety option board will accept reset from drive
b2		
b3		
b4		
b5		
b6		
b7		
b8		
b9		
b10		
b11		
b12		
b13		
b14		
b15		

**V1.31.2      Integrity Level      ID1640**

Safety integrity level (SIL) of drive. Considers presence of OPTAF, control board version and power unit topology.

Possible values: 0 (no safety), 2 (SIL2), 3 (SIL3). \*)

**V1.31.3 Acknowledge Mode ID1641**

Bits indicate whether specific safety functions are acknowledged automatically by advanced safety option board or require acknowledge from outside.

0 = automatic, 1 = manual

	FALSE	TRUE
b0	B0 = Start up (STO active) [ACK-STO-Boot]	
b1	B1 = STO [ACK-STO]	
b2	B2 = SS1 [ACK-SS1]	
b3	B3 = SS2 [ACK-SS2]	
b4	B4 = SQS [ACK-SQS]	
b5	B5 = SLS [ACK-SLS]	
b6	B6 = SSR [ACK-SSR]	
b7	B7 = SMS [ACK-SMS]	
b8	B8 = SSM [ACK-SSM]	
b9	B9 = SAR [ACK-SAR]	
b10	B10 = SDI [ACK-SDI]	
b11		
b12		
b13		
b14		
b15		

**V1.31.4 Safety Encoder Speed ID1642**

Encoder speed in RPM reported by advanced safety option board.

**V1.31.5 Ramp Selection ID1643**

B1,B0 = SLS ramp

B3,B2 = SSR ramp

00 = none, 01 = ramp 1, 10 = ramp 2. \*)

**V1.31.6      Function Reached      ID1644**

Advanced safety option board -> Control board safety function status word. For active functions, indicates if a safety function is reached

	FALSE	TRUE
b0	STO	
b1	SS1	
b2	SS2	
b3	SQS	
b4	SSR	
b5	SLS1	
b6	SLS2	
b7	SLS3	
b8	SDI+	
b9	SDI-	
b10	SSM	
b11	SMS	
b12	SAR	
b13	SOS	
b14	SBC	
b15		

**V1.31.7      Request DIN      ID1645**

Advanced safety option board -> Control board safety function request word. Indicates if a function is requested by Digital input of the advanced safety option board.

	FALSE	TRUE
b0	STO	
b1	SS1	
b2	SS2	
b3	SQS	
b4	SSR	
b5	SLS1	
b6	SLS2	
b7	SLS3	
b8	SDI+	
b9	SDI-	
b10	SSM	
b11	SMS	
b12	SAR	
b13		
b14		
b15		

**V1.31.8      Request PLC      ID1646**

Advanced safety option board -> Control board safety function request word. Indicates if a function is requested by safe PLC.

	FALSE	TRUE
b0	STO	
b1	SS1	
b2	SS2	
b3	SQS	
b4	SSR	
b5	SLS1	
b6	SLS2	
b7	SLS3	
b8	SDI+	
b9	SDI-	
b10	SSM	
b11	SMS	
b12	SAR	
b13		
b14		
b15		

#### V1.31.9 *Function In Use* **ID1647**

Indicates which safety functions have been enabled by configuration

	FALSE	TRUE
b0	STO	
b1	SS1	
b2	SS2	
b3	SQS	
b4	SOS	
b5	SBC	
b6	SLS	
b7	SSR	
b8	SMS	
b9	SSM	
b10	SAR	
b11	SDI	
b12		
b13		
b14		
b15		

#### V1.31.10 *Safety Status Word* **ID1648**

Advanced safety option board -> Control board safety function status word. Indicates if a safety function is active (being executed). 1 = active, 0 = not active

	FALSE	TRUE
b0	STO	
b1	SS1	
b2	SS2	
b3	SQS	
b4	SSR	
b5	SLS1	
b6	SLS2	
b7	SLS3	
b8	SDI+	
b9	SDI-	
b10	SSM	
b11	SMS	
b12	SAR	
b13		
b14		
b15		

#### V1.31.11 Safety General Status Word

ID1649

Indicates states of the advanced safety option board input & outputs.

	FALSE	TRUE
b0	DIN1	
b1	DIN2	
b2	SIN3	
b3	SIN4	
b4	DOUT1	
b5	DOUT2	
b6	SSM_Above_Max_Limit	
b7	SSM_Below_Max_Limit	
b8	Acknowledge_Requested_DIN	
b9	Acknowledge_Requested_PLC	
b10	Acknowledge_Requested_Drive	
b11	SS1_Ramp_Select	
b12	SS2_Ramp_Select	
b13	Reset_Requested_DIN	
b14	Reset_Requested_PLC	
b15	Reset_Requested_Drive	

#### V1.31.12 Safety Status

ID1650

	FALSE	TRUE
b0	StoAtexBoardDetected	
b1	StoLinesActivated	
b2	StoFault	
b3	StoConfigureError	
b4	StoDiagnosticFault	
b5	StoThermistorActivated	
b6	StoThermistorFaultActive	
b7	StoThermistorDiagnosticFault	
b8	StoThermistorShortCircuitFault	
b9	StoChannel1State	
b10	StoChannel2State	
b11	StartUpPreventActivated	
b12		
b13		
b14		
b15		

#### **V1.31.13    *Safety Zero Speed*            ID1651**

Speed value the advanced safety option board uses for determining motor stoppage.

#### **V1.31.14    *SBC Speed rpm*            ID1652**

Indicates the speed the brake is intended to be activated.

If SBC Order = 1 (SBC activated after STO/SOS), SBC will be activated at SBC Speed or after SBC t1.

If SBC Order = 0 (SBC activated before STO/SOS), SBC Speed is neglected.

### 5.2.10 Condition Based Monitoring

#### V1.32.1.1 Baseline Status

**ID 3622**

	Baseline Status ID 3622
0	Not Started
1	Running
2	Running 10%
3	Running 20%
4	Running 30%
5	Running 40%
6	Running 50%
7	Running 60%
8	Running 70%
9	Running 80%
10	Running 90%
11	Completed
12	Run Failed
13	Manual run before baseline run completed
14	Manual run after baseline run completed
15	

Monitoring points for the baseline data. The baseline data is chosen using the baseline data selector ID 3509.

**V1.32.1.2 Baseline Data 1** **Hz or % ID 3601**

**V1.32.1.3 Baseline Data 2** **Hz or % ID 3602**

**V1.32.1.4 Baseline Data 3** **Hz or % ID 3603**

**V1.32.1.5 Baseline Data 4** **Hz or % ID 3604**

**V1.32.1.6 Baseline Data 5** **Hz or % ID 3605**

**V1.32.1.7 Baseline Data 6** **Hz or % ID 3606**

**V1.32.1.8 Baseline Data 7** **Hz or % ID 3607**

**V1.32.1.9 Baseline Data 8** **Hz or % ID 3608**

**V1.32.1.10 Baseline Data 9** **Hz or % ID 3609**

**V1.32.1.11 Baseline Data 10** **Hz or % ID 3610**

**V1.32.2.1 Current Unbalance** **%** **ID 3617**

Current unbalance value in the stator winding monitoring

**V1.32.2.2 Current Threshold Value** **%** **ID 3620**

Current threshold value after interpolating

<b>V1.32.2.3</b>	<b>Current Warning S1 High</b>	<b>%</b>	<b>ID 3611</b>
	The warning S1 high threshold value		
<b>V1.32.2.4</b>	<b>Current Warning S2 High</b>	<b>%</b>	<b>ID 3612</b>
	The warning S2 high threshold value		
<b>V1.32.2.5</b>	<b>Current Alarm/Fault High</b>	<b>%</b>	<b>ID 3613</b>
	The alarm/fault high threshold value		
<b>V1.32.2.6</b>	<b>Voltage Unbalance</b>	<b>%</b>	<b>ID 3618</b>
	Voltage unbalance value in the stator winding monitoring		
<b>V1.32.2.7</b>	<b>Voltage Threshold Value</b>	<b>%</b>	<b>ID 3621</b>
	Voltage threshold value after interpolating		
<b>V1.32.2.8</b>	<b>Voltage Warning S1 High</b>	<b>%</b>	<b>ID 3614</b>
	The warning S1 high threshold value		
<b>V1.32.2.9</b>	<b>Voltage Warning S2 High</b>	<b>%</b>	<b>ID 3615</b>
	The warning S2 high threshold value		
<b>V1.32.2.10</b>	<b>Voltage Alarm/Fault High</b>	<b>%</b>	<b>ID 3616</b>
	The alarm/fault high threshold value		
<b>V1.32.3.1</b>	<b>Vibration</b>	<b>%</b>	<b>ID 3623</b>
	Vibration value in the condition based monitoring		
<b>V1.32.3.2</b>	<b>Vibration Threshold Value</b>	<b>%</b>	<b>ID 3624</b>
	Vibration threshold value after interpolating		
<b>V1.32.3.3</b>	<b>Vibration Warning S1 High</b>	<b>%</b>	<b>ID 3625</b>
	The warning S1 high threshold value		
<b>V1.32.3.4</b>	<b>Vibration Warning S2 High</b>	<b>%</b>	<b>ID 3626</b>
	The warning S2 high threshold value		
<b>V1.32.3.5</b>	<b>Vibration Alarm/Fault High</b>	<b>%</b>	<b>ID 3627</b>
	The alarm/fault high threshold value		
<b>V1.32.4.1</b>	<b>Motor Torque</b>	<b>%</b>	<b>ID 4</b>
	In % of Motor nominal torque		
<b>V1.32.4.2</b>	<b>Load Threshold Value</b>	<b>%</b>	<b>ID 3628</b>
	Load threshold value after interpolating		



**V1.32.4.3 Load Warning S1 High % ID 3629**

The warning S1 high threshold value

**V1.32.4.4 Load Warning S2 High % ID 3630**

The warning S2 high threshold value

**V1.32.4.5 Load Alarm/Fault High % ID 3631**

The alarm/fault high threshold value

**V1.32.4.6 Load Threshold Value Low % ID 3628**

Load threshold value low after interpolating

**V1.32.4.7 Load Warning S1 Low % ID 3632**

The warning S1 low threshold value

**V1.32.4.8 Load Warning S2 Low % ID 3633**

The warning S2 low threshold value

**V1.32.4.9 Load Alarm/Fault Low % ID 3634**

The alarm/fault low threshold value

**V1.32.5 Condition Based Status****ID 3619**

Condition Based Status ID 3619	
Bit	
B0	Stator Winding Current Warning S1
B1	Stator Winding Voltage Warning S1
B2	Vibration Warning S1
B3	Load Warning S1
B4	
B5	Stator Winding Current Warning S2
B6	Stator Winding Voltage Warning S2
B7	Vibration Warning S2
B8	Load Warning S2
B9	
B10	Stator Winding Current Alarm/Fault
B11	Stator Winding Voltage Alarm/Fault
B12	Vibration Warning Alarm/Fault
B13	Load Warning Alarm/Fault
B14	
B15	

## 6. SIA-II APPLICATION – PARAMETER LIST

### 6.1 Basic parameters

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.1.1	Supply Voltage	Varies	Varies	V	0		1201	0 = Drive internal logic
P2.1.2	Motor nominal voltage	20	690	V	NX2: 230V NX5: 400V NX6: 690V		110	Check the rating plate of the motor. Note also used connection Delta/Star
P2.1.3	Motor nominal frequency	4,00	320,00	Hz	50,00		111	Check the rating plate of the motor
P2.1.4	Motor nominal speed	5	20 000	rpm	1440		112	The default applies for a 4-pole motor and a nominal size frequency converter.
P2.1.5	Motor nominal current	0,1 x I <sub>H</sub>	2 x I <sub>H</sub>	A	I <sub>H</sub>		113	Check the rating plate of the motor.
P2.1.6	Motor cosφ	0,30	1,00		0,85		120	Check the rating plate of the motor
P2.1.7	Motor Nominal Power	0,0	3200,0	kW	0,0		116	Check the rating plate of the motor
P2.1.8	Magnetizing current	0,00	100,00	A	0,00		612	0,00 A = Drive uses estimated value from motor name plate values
P2.1.9	Identification	0	11		0		631	<b>0</b> =No action <b>1</b> =Identification w/o run <b>2</b> =Identification with run <b>3</b> =Encoder ID Run <b>4</b> =Ident All <b>5</b> =Absolute encoder, locked rotor <b>6</b> =U/f and Magnetization <b>7</b> =DTC Identification <b>NOTE:</b> Set motor control mode to Freq Control before identification!
P2.1.10	Motor type	0	4		0		650	<b>0</b> =Induction Motor <b>1</b> =PMS Motor <b>2</b> =Sep.Ex SM <b>3</b> =Reserved <b>4</b> =SRM

Table 6-1. Basic parameters G2.1

## 6.2 Reference Handling

### 6.2.1 Basic Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.1	<a href="#">Process Speed</a>	0,0	6000,0	rpm	1500,0		1203	
P2.2.2	<a href="#">FB Ref Scale</a>	0	32000		20000		899	
P2.2.3	<a href="#">Torque Scale</a>	0	1		0		1247	0=100,0 % 1=100,00 %
P2.2.4	<a href="#">I/O Reference</a>	0	18		0		117	0=AI1 1=AI2 2=AI1+AI2 3=AI1-AI2 4=AI2-AI1 5=AI1xAI2 6=AI1 Joystick 7=AI2 Joystick 8=Keypad 9=Fieldbus 10=Motor potentiometer 11=AI1, AI2 minimum 12=AI1, AI2 maximum 13=Process Speed 14=AI1/AI2 selection 15=Encoder 1 16=Encoder 2 17=Master Ref 18=Master Ramp
P2.2.5	<a href="#">Keypad reference selector</a>	0	9		8		121	See par.2.2.4
P2.2.6	<a href="#">Fieldbus control reference</a>	0	9		9		122	See par.2.2.4
P2.2.7	<a href="#">I/O Reference 2</a>	0	16		1		131	See <a href="#">ID117</a> & <a href="#">ID422</a>
P2.2.8	<a href="#">Speed Share</a>	-300,00	300,00	%	100,00		1241	
P2.2.9	<a href="#">Load Share</a>	0,0	500,0	%	100,0		1248	
P2.2.10	<a href="#">Minimum Speed</a>	0	1500	rpm	0		101	

### 6.2.2 Constant Reference

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.11.1	<a href="#">Inching speed reference</a>	0	32000	rpm	150		124	
P2.2.11.2	<a href="#">Jogging Reference 1</a>	-32000	32000	rpm	-60		1239	
P2.2.11.3	<a href="#">Jogging Reference 2</a>	-32000	32000	rpm	60		1240	
P2.2.11.4	<a href="#">Preset speed 1</a>	0.00	320.00	Hz	10.00		105	Multi-step speed 1
P2.2.11.5	<a href="#">Preset speed 2</a>	0.00	320.00	Hz	15.00		106	Multi-step speed 2
P2.2.11.6	<a href="#">Preset speed 3</a>	0.00	320.00	Hz	20.00		126	Multi-step speed 3
P2.2.11.7	<a href="#">Preset speed 4</a>	0.00	320.00	Hz	25.00		127	Multi-step speed 4
P2.2.11.8	<a href="#">Preset speed 5</a>	0.00	320.00	Hz	30.00		128	Multi-step speed 5
P2.2.11.9	<a href="#">Preset speed 6</a>	0.00	320.00	Hz	40.00		129	Multi-step speed 6
P2.2.11.10	<a href="#">Preset speed 7</a>	0.00	320.00	Hz	50.00		130	Multi-step speed 7

### 6.2.3 Torque Reference

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.12.1	<a href="#">Torque reference selection</a>	0	10		0		641	0=Not used 1=AI1

								2=AI2 3=AI3 4=AI4 5=AI1 joystick (-10 – 10 V) 6=AI2 joystick (-10 – 10 V) 7=Torque reference from keypad, R3.5 8=FB Torque Reference 9=Master Torque 10=Master SPC
P2.2.12.2	Torque reference max.	-300,0	300,0	%	100		642	
P2.2.12.3	Torque reference min.	-300,0	300,0	%	0,0		643	
P2.2.12.4	Torque reference filtering time	0	32000	ms	0		1244	
P2.2.12.5	Torque Reference Dead Zone	0,0	300,0	%	0,00		1246	
P2.2.12.6	Torque Reference Hysteresis	-300,0	300,0	%	0,0		1245	
P2.2.12.7	Window negative	0	5000	rpm	2,00		1305	
P2.2.12.8	Window positive	0	5000	rpm	2,00		1304	
P2.2.12.9	Window negative off	0	P2.2.12.7	rpm	0,00		1307	
P2.2.12.10	Window positive off	0	P2.2.12.8	rpm	0,00		1306	
P2.2.12.11	Torque Ref Ramp Time	0	30000	ms	0		1249	
P2.2.12.12	Torque step	-100,0	100,0	%	0,0		1253	
P2.2.12.13	Torque Reference Add	-100,0	100,0	%	0,0		1264	

#### 6.2.4 Torque Reference OL Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
2.2.12.14.1	Open loop torque control minimum speed	0,00	32000	rpm	100		636	
2.2.12.14.2	Open loop torque controller P gain	0	32000		150		639	
2.2.12.14.3	Open loop torque controller I gain	0	32000		10		640	

### 6.2.5 Prohibit Speed parameters

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.13.1	Prohibit Speed range 1 low limit	-100	32000	rpm	0,00		509	0=Not used
P2.2.13.2	Prohibit Speed range 1 high limit	0,00	32000	rpm	0,00		510	0=Not used
P2.2.13.3	Ramp time factor	0,1	10,0	x	1,0		518	Multiplier of the currently Selected ramp time between prohibit speed limits.

Table 6-2. Prohibit Speed (G2.2.12)

### 6.2.6 Motor Potentiometer

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.14.1	Motor potentiometer ramp rate	0,10	200,00	Hz/s	1,00		331	Ramp rate for motor potentiometer
P2.2.14.2	Motor potentiometer reference memory reset	0	2		1		367	0=No reset 1=Reset in stop state 2=Reset in powered down
P2.2.14.3	Motor potentiometer reference copy	0	2		0		366	0=No copy 1=Copy Reference 2=Copy output frequency

Table 6-3. Motor potentiometer (G2.2.13)

### 6.2.7 Adjust Reference

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.15.1	Adjust input	0	5		0		493	0=Not used 1=AI1 2=AI2 3=AI3 4=AI4 5=Fieldbus
P2.2.15.2	Adjust minimum	0,0	100,0	%	0,0		494	Adjust limit to decrease ref.
P2.2.15.3	Adjust maximum	0,0	100,0	%	0,0		495	Adjust limit to increase ref.
P2.2.15.4	Speed Step	-20000	20000		0		1252	Same scaling as in Fieldbus reference.

## 6.2.8 Follower

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.2.16.1	Follower Speed Reference Select	0	18		17		1081	0=AI1 1=AI2 2=AI1+AI2 3=AI1-AI2 4=AI2-AI1 5=AI1xAI2 6=AI1 Joystick 7=AI2 Joystick 8=Keypad 9=Fieldbus 10=Motor potentiometer 11=AI1, AI2 minimum 12=AI1, AI2 maximum 13=Process Speed 14=AI1/AI2 selection 15=Encoder 1 16=Encoder 2 17=Master Reference 18=Master Ramp Out
P2.2.16.2	Follower Torque Reference Select	0	10		10		1083	0=Not used 1=AI1 2=AI2 3=AI3 4=AI4 5=AI1 joystick (-10 – 10 V) 6=AI2 joystick (-10 – 10 V) 7=Torque reference from keypad, R3.5 8=FB Torque Reference 9=Master Torque 10=Master SPC

## 6.3 Ramp Control

### 6.3.1 Basic Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.1	Start function	0	1		0		505	0=Ramp 1=Flying start
P2.3.2	Stop function	0	1		0		506	0=Coasting 1=Ramp
P2.3.3	Acceleration time 1	0,0	3270,0	s	3,0		103	zero speed to Process Speed
P2.3.4	Deceleration time 1	0,0	3270,0	s	3,0		104	Process Speed to zero speed
P2.3.5	Ramp 1 shape	0	100	%	2		500	0=Linear >0=S-curve ramp time
P2.3.6	Acceleration time 2	0,0	3270,0	s	10,0		502	
P2.3.7	Deceleration time 2	0,0	3270,0	s	10,0		503	
P2.3.8	Ramp 2 shape	0	100	%	4		501	0=Linear >0=S-curve ramp time
P2.3.9	Jogging Inc Ramp	0, 1	320,0	s	1,0		1257	
P2.3.10	Jogging Dec Ramp	0,1	320,0	s	1,0		1258	
P2.3.11	Jogging Ramp Shape	0	100	%	0		1259	
P2.3.12	Jogging Stop Function	0	1		0		1810	0=Coasting 1=Ramp
P2.3.13	Disable Speed Ramp						1815	

### 6.3.2 Quick Stop

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.13.1	Quick Stop Mode	0	5		0		1276	0=Coasting 1= Ramp 2=Fast Stop 3= Power/Torque Stop 4= Power/Torque and SPC limit stop 5=Ramp stop with Power/Torque and SPC limits.
P2.3.13.2	Quick Stop Ramp Time	0,1	3200,0	s	5,0		1256	
P2.3.13.3	Quick Stop Power Limit	0,0	300,0	%	300,0		1293	
P2.3.13.4	Quick Stop Torque Limit	0,0	300,0	%	300,0		1294	
P2.3.13.5	IO Quick Stop Delay	0,00	320,00	s	0,00		1254	
P2.3.13.6	Quick stop acknowledge time	0,00	10,00	s	0,00		1263	
P2.3.13.7	Quick Stop Monitoring	0	3		0		1759	

### 6.3.3 Ramp Control Options

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.3.14.1	Ramp: Skip S2	0	1		0		1900	0=No 1= Yes
P2.3.14.2	CL Ramp Follower Encoder speed	0	1		0		1902	0=No 1= Yes
P2.3.14.3	RampIn Interpolator TC	0	200	ms	20		1184	

## 6.4 Input Signals

### 6.4.1 Basic Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note		
P2.4.1.1	Start/Stop logic selection	0	7		5		300		Start signal <b>1</b> (Default: DIN1)	Start signal <b>2</b> (Default: DIN2)
								<b>0</b>	Start fwd	Start rvs
								<b>1</b>	Start/Stop	Reverse
								<b>2</b>	Start/Stop	Run enable
								<b>3</b>	Start pulse	Stop pulse
								<b>4</b>	Start	Mot.Pot UP
								<b>5</b>	Start fwd*	Start rvs*
								<b>6</b>	Start*/Stop	Reverse
								<b>7</b>	Start*/Stop	Run Enable

Table 6-4. Input signals: basic settings, G2.2.1

\* = Rising edge required to start



## 6.4.2 Digital inputs

Code	Parameter	Min	Default	Cust	ID	Note
P2.4.2.1	Start signal 1	0.1	A.1		403	Forward, See ID300
P2.4.2.2	Start signal 2	0.1	A.2		404	Reverse. See ID300
P2.4.2.3	Run enable	0.1	0.2		407	Motor start enabled (cc)
P2.4.2.4	Reverse	0.1	0.1		412	Direction forward (oc) Direction reverse (cc)
P2.4.2.5	Motor potentiometer reference DOWN	0.1	0.1		417	Mot.pot. reference decreases (cc)
P2.4.2.6	Motor potentiometer reference UP	0.1	0.1		418	Mot.pot. reference increases (cc)
P2.4.2.7	Fault reset	0.1	0.1		414	All faults reset (cc)
P2.4.2.8	External fault 1	0.1	0.1		405	Ext. fault displayed
P2.4.2.9	External fault 2	0.1	0.2		406	Ext. fault displayed
P2.4.2.10	Acc/Dec time selection	0.1	0.1		408	Acc/Dec time 1 (oc) Acc/Dec time 2 (cc)
P2.4.2.11	Acc/Dec prohibit	0.1	0.1		415	Acc/Dec prohibited (cc)
P2.4.2.12	DC braking	0.1	0.1		416	DC braking active (cc)
P2.4.2.13	Inching speed	0.1	0.1		413	Inching speed selected for reference (cc)
P2.4.2.14	IO reference 1 / 2 selection	0.1	0.1		422	IO reference selection:14 ID117
P2.4.2.15	Control from I/O terminal	0.1	0.1		409	Force control place to I/O terminal (cc)
P2.4.2.16	Control from keypad	0.1	0.1		410	Force control place to keypad (cc)
P2.4.2.17	Control from fieldbus	0.1	0.1		411	Force control place to fieldbus (cc)
P2.4.2.18	Parameter set 1/set 2 selection	0.1	0.1		496	Closed cont.=Set 2 is used Open cont.=Set 1 is used
P2.4.2.19	External Brake Acknowledge	0.1	0.2		1210	Monitoring signal from mechanical brake
P2.4.2.20	Cooling Monitor	0.1	0.2		750	Used when water cooled unit
P2.4.2.21	Enable Jogging	0.1	0.1		532	Enables Jogging function
P2.4.2.22	Jogging 1	0.1	0.1		531	Jogging reference 1 <b>This will start the drive.</b>
P2.4.2.23	Jogging 2	0.1	0.1		532	Jogging reference 2 <b>This will start the drive.</b>
P2.4.2.24	Reset Position	0.1	0.1		1090	
P2.4.2.25	Quick Stop	0.1	A.6		1213	
P2.4.2.26	Input Switch Acknowledge	0.1	A.5		1209	
P2.4.2.27	Max Speed 2	0.1	0.1		1511	
P2.4.2.28	PI Activations	0.1	0.1		1804	
P2.4.2.29	Motor Fan Acknowledge	0.1	0.1		1211	
P2.4.2.30	Disable Positive Speed	0.1	0.2		1813	
P2.4.2.31	Disable Negative Speed	0.1	0.2		1814	
P2.4.2.32	Preset speed 1	0.1	0.1		419	See preset speeds in basing parameter group G2.2.11
P2.4.2.33	Preset speed 2	0.1	0.1		420	
P2.4.2.34	Preset speed 3	0.1	0.1		421	

Table 6-5. Digital input signals, G2.2.4

cc = closing contact  
oc = opening contact

## 6.4.3 Analogue input 1

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.4.3.1	AI1 signal selection	0.1	E.10		A.1		377	Slot . Board input No.
P2.4.3.2	AI1 filter time	0,000	32,000	s	0,000		324	0=No filtering
P2.4.3.3	AI1 signal range	0	3		0		320	0=0...100%* 1=20...100%* 4 mA Fault 2= -10V...+10V* 3= Custom range*
P2.4.3.4	AI1 custom minimum setting	-160,00	160,00	%	0,00		321	Custom Range: Minimum input
P2.4.3.5	AI1 custom maximum setting	-160,00	160,00	%	100,00		322	Custom Range: Maximum input
P2.4.3.6	AI1 reference scaling, minimum value	0,00	32000	rpm	0,00		303	Selects the speed that corresponds to the min. reference signal
P2.4.3.7	AI1 reference scaling, maximum value	0,00	32000	rpm	0,00		304	Selects the speed that corresponds to the max. reference signal
P2.4.3.8	AI1 joystick Dead Zone	0,00	20,00	%	0,00		384	Dead Zone for joystick input
P2.4.3.9	AI1 sleep limit	0,00	100,00	%	0,00		385	Drive goes to stop if input is below this limit for this time.
P2.4.3.10	AI1 sleep delay	0,00	320,00	s	0,00		386	
P2.4.3.11	AI1 joystick offset	-100,00	100,00	%	0,00		165	Press enter for 1s to set offset

Table 6-6. Analogue input 1 parameters, G2.2.2

\*Remember to place jumpers of block X2 accordingly. See NX User's Manual, chapter 6.2.2.2

## 6.4.4 Analogue input 2

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.4.4.1	AI2 signal selection	0.1	E.10		A.2		388	Slot . Board input No.
P2.4.4.2	AI2 filter time	0,000	32,000	s	0,000		329	0=No filtering
P2.4.4.3	AI2 signal range	0	3		1		325	0=0...100%* 1=20...100%* 4 mA Fault 2= -10V...+10V* 3= Custom range*
P2.4.4.4	AI2 custom minimum setting	-160,00	160,00	%	0,00		326	Custom Range: Minimum input
P2.4.4.5	AI2 custom maximum setting	-160,00	160,00	%	100,00		327	Custom Range: Maximum input
P2.4.4.6	AI2 reference scaling, minimum value	0,00	32000	rpm	0,00		393	Selects the speed that corresponds to the min. reference signal
P2.4.4.7	AI2 reference scaling, maximum value	0,00	32000	rpm	0,00		394	Selects the speed that corresponds to the max. reference signal
P2.4.4.8	AI2 joystick Dead Zone	0,00	20,00	%	0,00		395	Dead Zone for joystick input
P2.4.4.9	AI2 sleep limit	0,00	100,00	%	0,00		396	Drive goes to stop if input is below this limit for this time.
P2.4.4.10	AI2 sleep delay	0,00	320,00	s	0,00		397	
P2.4.4.11	AI2 joystick offset	-100,00	100,00	%	0,00		166	Press enter for 1s to set offset

Table 6-7. Analogue input 2 parameters, G2.2.3

## 6.4.5 Analogue input 3

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.4.5.1	AI3 signal selection	0.1	E.10		0.1		141	Slot . Board input No.

								If 0.1 ID27 can be controlled from FB
P2.4.5.2	AI3 filter time	0,000	32,000	s	0,000		142	0=No filtering
P2.4.5.3	AI3 custom minimum setting	-160,00	160,00	%	0,00		144	Custom range always active.
P2.4.5.4	AI3 custom maximum setting	-160,00	160,00	%	100,00		145	Custom range always active.
P2.4.5.5	AI3 signal inversion	0	1		0		151	0=Not inverted 1=Inverted
P2.4.5.6	AI3 reference scaling, minimum value	-32000	32000		0		1037	Selects the value that corresponds to the min. reference signal
P2.4.5.7	AI3 reference scaling, maximum value	-32000	32000		0		1038	Selects the value that corresponds to the max. reference signal
P2.4.5.8	AI3 Controlled ID	0	10000		0		1509	Select parameter that you want to control by ID number.

Table 6-8. Analogue input 3 parameters, G2.2.4

\*\*Remember to place jumpers of block X2 accordingly. See NX User's Manual, chapter 6.2.2.2

#### 6.4.6 Analogue input 4

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.4.6.1	AI4 signal selection	0.1	E.10		0.1		152	Slot . Board input No. If 0.1 ID28 can be controlled from FB
P2.4.6.2	AI4 filter time	0,000	32,000	s	0,000		153	0=No filtering
P2.4.6.3	AI4 custom minimum setting	-160,00	160,00	%	0,00		155	Custom range always active.
P2.4.6.4	AI4 custom maximum setting	-160,00	160,00	%	100,00		156	Custom range always active.
P2.4.6.5	AI4 signal inversion	0	1		0		162	0=Not inverted 1=Inverted
P2.4.6.6	AI3 reference scaling, minimum value	-32000	-32000		0		1039	Selects the value that corresponds to the min. reference signal
P2.4.6.7	AI3 reference scaling, maximum value	-32000	32000		0		1040	Selects the value that corresponds to the max. reference signal
P2.4.6.8	AI4 Controlled ID	0	10000		0		1510	Select parameter that you want to control by ID number.

Table 6-9. Analogue input 4 parameters, G2.2.5

#### 6.4.7 Options

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.4.7.1	Input signal inversion Control	0	65535				1091	

### 6.5 Output Signals

#### 6.5.1 Digital output signals

Code	Parameter	Min	Default	Cust	ID	Note
P2.5.1.1	Ready	0.1	0.1		432	Ready to Run
P2.5.1.2	Run	0.1	0.1		433	Running

P2.5.1.3	Fault	0.1	0.1		434	Drive in fault state
P2.5.1.4	Inverted fault	0.1	0.1		435	Drive not in fault state
P2.5.1.5	Warning	0.1	0.1		436	Warning active
P2.5.1.6	External fault	0.1	0.1		437	External fault active
P2.5.1.7	Reference fault/warning	0.1	0.1		438	4 mA fault active
P2.5.1.8	Over temperature warning	0.1	0.1		439	Drive over temperature active
P2.5.1.9	Reverse	0.1	0.1		440	Output speed < 0 rpm
P2.5.1.10	Unrequested direction	0.1	0.1		441	Reference <> Speed
P2.5.1.11	At speed	0.1	0.1		442	Reference = Speed
P2.5.1.12	Inching speed	0.1	0.1		443	Inching speed command active
P2.5.1.13	External control place	0.1	0.1		444	IO control active
P2.5.1.14	External brake control	0.1	0.1		445	See explanations on page <b>Error! Bookmark not defined..</b>
P2.5.1.15	External brake control, inverted	0.1	0.1		446	
P2.5.1.16	Motor thermal protection	0.1	0.1		452	Thermistor fault or warning
P2.5.1.17	Motor regulator activation	0.1	0.1		454	One of limit controller is active
P2.5.1.18	Fieldbus digital input 1	0.1	0.1		455	FB CW B11
P2.5.1.19	FB Dig 1 Parameter	ID0	ID0		891	Select parameter to control
P2.5.1.20	Fieldbus digital input 2	0.1	0.1		456	FB CW B12
P2.5.1.21	FB Dig 2 Parameter	ID0	ID0		892	Select parameter to control
P2.5.1.22	Fieldbus digital input 3	0.1	0.1		457	FB CW B13
P2.5.1.23	FB Dig 3 Parameter	ID0	ID0		893	Select parameter to control
P2.5.1.24	Fieldbus digital input 4	0.1	0.1		169	FB CW B14
P2.5.1.25	FB Dig 4 Parameter	ID0	ID0		894	Select parameter to control
P2.5.1.26	Fieldbus digital input 5	0.1	0.1		170	FB CW B15
P2.5.1.27	FB Dig 5 Parameter	ID0	ID0		895	Select parameter to control
P2.5.1.28	Safe Disable Active	0.1	0.1		756	
P2.5.1.29	MCC Close Cont	0.1	0.1		1218	
P2.5.1.30	MCC Close Pulse	0.1	0.1		1219	
P2.5.1.31	Motor Fan Control	0.1	0.1		1805	

### 6.5.2 Analogue output 1

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.2.1	Analogue output 1 signal selection	0.1	E.10		A.1		464	TTF programming See chapter 3.1 and 3.2
P2.5.2.2	Analogue output 1 function	0	18		0		307	<b>0</b> =Not used (4 mA / 2 V) <b>1</b> =Output freq. (0— $f_{max}$ ) <b>2</b> =Freq. reference (0— $f_{max}$ ) <b>3</b> =Motor speed (0—Motor nominal speed) <b>4</b> =Motor current (0— $I_{nMotor}$ ) <b>5</b> =Motor torque (0— $T_{nMotor}$ ) <b>6</b> =Motor power (0— $P_{nMotor}$ ) <b>7</b> =Motor voltage (0— $U_{nMotor}$ ) <b>8</b> =DC-link volt (0—1000V) <b>9</b> =AI1 <b>10</b> =AI2

								<b>11</b> =Output freq. ( $f_{\min} - f_{\max}$ ) <b>12</b> =-2xTorque...+2xTorque <b>13</b> =-2xPower...+2xPower <b>14</b> =PT100 temperature <b>15</b> =FB Analog Output <b>16</b> = -2xSpeed...+2xSpeed <b>17</b> = Encoder speed (0— Motor nominal speed) <b>18</b> =Unit Temperature
P2.5.2.3	Analogue output 1 filter time	0,00	10,00	s	1,00		308	<b>0</b> =No filtering
P2.5.2.4	Analogue output 1 inversion	0	1		0		309	<b>0</b> =Not inverted <b>1</b> =Inverted
P2.5.2.5	Analogue output 1 minimum	0	1		0		310	<b>0</b> =0 mA (0 %) <b>1</b> =4 mA (20 %)
P2.5.2.6	Analogue output 1 scale	10	1000	%	100		311	
P2.5.2.7	Analogue output 1 offset	-100,00	100,00	%	0,00		375	

Table 6-10. Analogue output 1 parameters, G2.3.5

### 6.5.3 Analogue output 2

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.3.1	Analogue output 2 signal selection	0.1	E.10		0.1		471	TTF programming See chapter 3.1 and 3.2
P2.5.3.2	Analogue output 2 function	0	18		0		472	See P2.5.2.2
P2.5.3.3	Analogue output 2 filter time	0,00	10,00	s	1,00		473	<b>0</b> =No filtering
P2.5.3.4	Analogue output 2 inversion	0	1		0		474	<b>0</b> =Not inverted <b>1</b> =Inverted
P2.5.3.5	Analogue output 2 minimum	0	1		0		475	<b>0</b> =0 mA (0 %) <b>1</b> =4 mA (20 %)
P2.5.3.6	Analogue output 2 scale	10	1000	%	100		476	
P2.5.3.7	Analogue output 2 offset	-100,00	100,00	%	0,00		477	

Table 6-11. Analogue output 2 parameters, G2.3.6

## 6.5.4 Analogue output 3

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.4.1	Analogue output 3 signal selection	0.1	E.10		0.1		478	TTF programming See chapter 3.1 and 3.2
P2.5.4.2	Analogue output 3 function	0	18		0		479	See P2.5.2.2
P2.5.4.3	Analogue output 3 filter time	0,00	10,00	s	1,00		480	0=No filtering
P2.5.4.4	Analogue output 3 inversion	0	1		0		481	0=Not inverted 1=Inverted
P2.5.4.5	Analogue output 3 minimum	0	1		0		482	0=0 mA (0 %) 1=4 mA (20 %)
P2.5.4.6	Analogue output 3 scale	10	1000	%	100		483	
P2.5.4.7	Analogue output 3 offset	-100,00	100,00	%	0,00		484	

Table 6-12. Analogue output 3 parameters, G2.3.7

## 6.5.5 Analogue output 4

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.5.1	Analogue output 4 signal selection	0.1	E.10		0.1		1527	TTF programming See chapter 3.1 and 3.2
P2.5.5.2	Analogue output 4 function	0	18		0		1520	See P2.5.2.2
P2.5.5.3	Analogue output 4 filter time	0,00	10,00	s	1,00		1521	0=No filtering
P2.5.5.4	Analogue output 4 inversion	0	1		0		1522	0=Not inverted 1=Inverted
P2.5.5.5	Analogue output 4 minimum	0	1		0		1523	0=0 mA (0 %) 1=4 mA (20 %)
P2.5.5.6	Analogue output 4 scale	10	1000	%	100		1525	
P2.5.5.7	Analogue output 4 offset	-100,00	100,00	%	0,00		1524	

Table 6-13. Analogue output 4 parameters, G2.3.8

## 6.5.6 Delayed digital output 1

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
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P2.5.6.1	Digital output 1 signal selection	0.1	E.10		0.1		486	Possibility to invert by ID1091 INV Commands
P2.5.6.2	Digital output 1 function	0	28		1		312	0=Not used 1=Ready 2=Run 3=Fault 4=Fault inverted 5=FC overheat warning 6=Ext. fault or warning 7=Ref. fault or warning 8=Warning 9=Reverse 10=Jogging or inching 11=At speed 12=Mot. regulator active 13=Not used 14= Not used 15= Not used 16= Not used 17=External brake control 18=I/O control place act. 19= Not used 20=Reference inverted 21=Ext. brake control inverted 22=Therm. fault or warn. 23= Not used 24=Fieldbus input data 1 25=Fieldbus input data 2 26=Fieldbus input data 3 27=Warning Set Reset 28=ID.Bit Select
P2.5.6.3	Digital output 1 on delay	0,00	320,00	s	0,00		487	0,00 = On delay not in use
P2.5.6.4	Digital output 1 off delay	0,00	320,00	s	0.00		488	0,00 = Off delay not in use
P2.5.6.5	Invert delayed DO1	0	1		0		1587	0=No 1=Yes
P2.5.6.6	ID.Bit Free DO	0,00	2000,15		0,00		1216	
P2.5.6.7	DDO1 Feed Back	0.1	E.10		0.1		1326	
P2.5.6.8	Feed Back Delay	0,00	320,00	s	0,00		1808	

Table 6-14. Delayed digital output 1 parameters, G2.3.1

## 6.5.7 Delayed digital output 2

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.5.7.1	Digital output 2 signal selection	0.1	E.10		0.1		489	Possibility to invert by ID1091 INV Commands
P2.5.7.2	Digital output 2 function	0	28		0		490	See P2.5.6.2
P2.5.7.3	Digital output 2 on delay	0,00	320,00	s	0,00		491	0,00 = On delay not in use
P2.5.7.4	Digital output 2 off delay	0,00	320,00	s	0,00		492	0,00 = Off delay not in use
P2.5.7.5	Invert delayed DO2						1588	0=No 1=Yes
P2.5.7.6	ID.Bit Free DO	0,00	2000,15		0,00		1385	
P2.5.7.7	DDO2 Feed Back	0.1	E.10		0.1		1277	
P2.5.7.8	Feed Back Delay	0,00	320,00	s	0,00		1809	

Table 6-15. Delayed digital output 2 parameters, G2.3.2

## 6.6 Limit Settings

### 6.6.1 Current handling

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.1.1	<a href="#">Current limit</a>	0	2 x I <sub>H</sub>	A	I <sub>L</sub>		107	Limit will lower frequency
P2.6.1.2	Current Limit Kp	1	32000				1451	
P2.6.1.3	Current Limit Ki	1	32000				1452	

### 6.6.2 Power Handling

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.2.1	<a href="#">Power Limit</a>	0,0	300,0	%	300,0		1722	General power limit
P2.6.2.2	<a href="#">Generator Power Limit</a>	0,0	300,0	%	300,0		1290	
P2.6.2.3	<a href="#">Motoring Power Limit</a>	0,0	300,0	%	300,0		1289	

### 6.6.3 Torque Handling

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.3.1	Torque Limit	0,0	300,0	%	300,0		609	General maximum limit
P2.6.3.2	<a href="#">Motoring Torque Limit</a>	0,0	300,0	%	300,0		1287	Motoring side torque limit
P2.6.3.3	<a href="#">Generator Torque Limit</a>	0,0	300,0	%	300,0		1288	Generator side torque limit
P2.6.3.4	Pull Out Slip Limit	0,0	3270,0	%	500,0		1291	

#### 6.6.3.1 Torque Handling OL Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.3.5.1	<a href="#">Torque limit control P-gain</a>	0,0	32000		3000		610	
P2.6.3.5.2	<a href="#">Torque limit control I-gain</a>	0,0	32000		200		611	

#### 6.6.3.2 Torque Handling CL Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.3.6.1	SPC Out Limit	0,0	300,0	%	300,0		1382	
P2.6.3.6.2	<a href="#">SPC Pos Limit</a>	0,0	300,0	%	300,0		646	
P2.6.3.6.3	<a href="#">SPC Neg Limit</a>	0,0	300,0	%	300,0		645	

### 6.6.4 Speed Handling

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.4.1	<a href="#">Negative speed limit</a>	-30000	P2.6.4.2	rpm	0		1286	Alternative limit for negative direction
P2.6.4.2	<a href="#">Positive speed limit</a>	P2.6.4.1	30000	rpm	1500		1285	Alternative limit for positive direction
P2.6.4.3	<a href="#">Zero speed limit</a>	0	30000	rpm	5		1283	
P2.6.4.4	<a href="#">Max speed 2</a>	0	320,00	Hz	750		1512	Maximum speed limit that is activated by digital input.
P2.6.4.5	Above Speed Lim	0	32000	rpm	1500		1251	Will set FB SW B10



### 6.6.5 DC-Link Handling

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.5.1	Overvoltage controller	0	2		1		607	0=Not used 1=Used (no ramping) 2=Used (ramping)
P2.6.5.2	Over Voltage Reference selector	0	2		1		1262	0=High Voltage 1=Normal Voltage 2=BrakeChopperLevel
P2.6.5.3	Over Voltage Kp	0	32765		2000		1468	
P2.6.5.4	Over Voltage Ki	0	32765		50		1409	
P2.6.5.5	Over Voltage Kp Add	0	32765		2000		1425	
P2.6.5.6	Brake chopper	0	4		0		504	0=Disabled 1=Used when running 2=External brake chopper 3=Used when stopped/running 4=Used when running (no testing)
P2.6.5.7	Brake Chopper Level	0	1267	V	Varies		1267	500 V unit: 567 Vdc 6690 V unit: 836 Vdc
P2.6.5.8	Brake Resistor Torque Limit	0,0	300,0	%	300,0		1268	
P2.6.5.9	Undervoltage controller	0	2		1		608	0=Not used 1=Used (no ramping) 2=Used (ramping to zero)
P2.6.5.10	Under Voltage Kp	0	32765		4000		1415	
P2.6.5.11	Under Voltage Ki	0	32765		400		1416	

#### 6.6.5.1 DC-Link Handling CL Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.5.12.1	Over voltage reference	513	1210	V	Varies		1528	
P2.6.5.12.2	Over voltage motoring side torque limit	0,0	300,0	%	10,0		1623	Maximum motoring torque when over voltage controller is active.
P2.6.5.12.3	Under Voltage Ref	425	931	V	Varies		1567	

#### 6.6.5.2 Limit Settings Options

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.6.6.1	Limit Total Current In Closed Loop	0	1		0		1901	0=No 1=Yes

### 6.7 Flux and DC Current handling

#### 6.7.1 Flux and DC Current handling OL Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.7.1.1	DC braking current	0,00	I <sub>L</sub>	A	0,00		507	
P2.7.1.2	DC braking time at start	0,00	600,00	s	0,00		516	0=DC brake is off at start
P2.7.1.3	DC braking time at stop	0,00	600,00	s	0,00		508	0=DC brake is off at stop
P2.7.1.4	Speed to start DC braking during	0	1000	rpm	1		515	

	ramp stop							
P2.7.1.5	Scaling of DC-braking current	0	5		0		400	Scaling from 0 to ID507 0=Not used 1=AI1 2=AI2 3=AI3 4=AI4 5=FB Limit Scaling
P2.7.1.6	DC-Brake Current in Stop	0,00	I <sub>L</sub>	A	Varies		1080	
P2.7.1.7	Flux brake	0	1		0		520	0=Off 1=On
P2.7.1.8	Flux braking current	0,00	I <sub>L</sub>	A	I <sub>H</sub>		519	

### 6.7.2 Flux and DC Current handling CL Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.7.2.1	Magnetizing current at start	0	I <sub>L</sub>	A	0,00		627	
P2.7.2.2	Magnetizing time at start	0,0	600,0	s	0,0		628	
P2.7.2.3	Flux Reference	0,0	500,0	%	100,0		1250	
P2.7.2.4	Flux Off Delay	-1	32000	s	0		1402	-1=forever
P2.7.2.5	Stop State Flux	0,0	150,0	%	100,0		1401	

## 6.8 Motor Control

### 6.8.1 Motor Control Basic Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.1	Motor control mode	0	4		0		600	0=Frequency control 1=Speed control 2=Speed/Torque control 3=Closed loop speed ctrl 4=Closed loop Speed/torque ctrl
P2.8.2	Torque Select	1	5		1		1278	1=Speed Control 2=Torque 3=Min 4=Max 5=Window

### 6.8.2 Open Loop

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.3.1	U/f optimisation	0	1		0		109	0=Not used 1=Automatic torque boost
P2.8.3.2	U/f ratio selection	0	3		0		108	0=Linear 1=Squared 2=Programmable 3=Linear with flux optim.
P2.8.3.3	Field weakening point	4,00	320,00	Hz	50,00		602	
P2.8.3.4	Voltage at field weakening point	10,00	200,00	%	100,00		603	n% x U <sub>nmot</sub>
P2.8.3.5	U/f curve midpoint frequency	0,00	P2.6.4	Hz	50,00		604	

P2.8.3.6	U/f curve midpoint voltage	0,00	100,00	%	100,00		605	n% x U <sub>nmot</sub> Parameter max. value = P2.6.5
P2.8.3.7	Output voltage at zero frequency	0,00	40,00	%	0,00		606	n% x U <sub>nmot</sub>
P2.8.4.8	I/f Start	0	1		0		534	0=Disabled 1=Enabled
P2.8.4.9	I/f Current	0.0	150.0	%	50.0		1693	
P2.8.4.10	I/f Control Limit	0.0	300.0	%	10.0		1790	
P2.8.3.11	MakeFluxTime	0	32000	ms	200		660	

### 6.8.3 Closed Loop Control Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.4.1	Current control P gain	0,00	100,00	%	40,00		617	
P2.8.4.2	Current control I Time	0,0	3200,0	ms	1,5		657	
P2.8.4.3	Encoder Selection	0	1		0		1595	0=Encoder Input 1 1=Encoder Input 2
P2.8.4.4	Motor Temperature Compensation mode	0	2		0		1426	0=Not used 1=Internal 2=Measured Temperature
P2.8.4.5	Slip adjust	0	500	%	75		619	
P2.8.4.6	Slip Adjust Cold	0	500	%	75		1183	
P2.8.4.7	SC Torque Chain Select	0	65535		0		1557	Default 96 after identification.
P2.8.4.8	TC Speed Limit Select	0	65535		0		1568	
P2.8.4.9	TCDunDampGain	0,00	100,00	%	0,00		1576	
P2.8.4.10	TCDynDampTC	0	32000	ms	0		1577	
P2.8.4.11	CL MC Mode	0	1		0		691	0=Flux Model 1 1=Flux Model 2

## 6.8.4 PMSM Control settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.5.1	PMSM Shaft Position	0	65535		0		649	
P2.8.5.2	Start Angle Identification mode	0	10		0		1691	0=Automatic 1=Forced 2=After Power Up 3=Disabled
P2.8.5.3	Start Angle Identification DC Current	0,0	150,0	%	0,0		1756	
P2.8.5.4	Polarity Pulse Current	-10,0	200,0	%	0,0		1566	
P2.8.5.5	Start Angle ID Time	0	32000	ms	0		1755	
P2.8.5.6	I/f Current	0,0	150,0	%	50,0		1693	
P2.8.5.7	I/f Control Limit	0,0	300,0	%	10,0		1790	
P2.8.5.8	Flux Current Kp	0	32000		5000		651	
P2.8.5.9	Flux Current Ti	0	1000		25		652	
P2.8.5.10	External Id Reference	-150,0	150,0	%	0,0		1730	
P2.8.5.11	Enable Rs Identification	0	1		1		654	0=No 1=Yes
P2.8.5.12	Lsd Voltage Drop	-32000	32000		0		1757	
P2.8.5.13	Lsq Voltage Drop	-32000	32000		0		1758	
P2.8.6.14	EnclDCurrent	0.0	150.0	%	90.0		1734	
P2.8.6.15	Polarity ID Mode	0	1				1737	
P2.8.6.16	Polarity Pulse Length	0	1000	ms	200		1742	
P2.8.6.17	Polarity Detection Angle	0.0	360.0	Deg	1.5		1748	
P2.8.6.18	Angle Identification Mode	0	2				1749	
P2.8.6.19	Current Control Kp d	0	32000	%			1761	
P2.8.6.20	Voltage Margin	0.0	120.0	%			1759	
P2.8.6.21	Encoder ID Run Mode	0	2		0		680	
P2.8.6.22	Start Angle Offset	-360,0	360,0	Dec	0,0		696	
P2.8.6.23	VoltageCorr. Kp	0,000	32,000		0,100		1783	
P2.8.6.24	VoltageCorr. Ki	0	32000		5000		1784	

### 6.8.5 Stabilizers

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.6.1	<a href="#">Torque Stabilator Damping</a>	0	999		800		1413	With PMSM use 980
P2.8.6.2	<a href="#">Torque Stabilator Gain</a>	0	1000		100		1412	
P2.8.6.3	<a href="#">Torque Stabilator Gain in FWP</a>	0	1000		50		1414	
P2.8.6.4	Torque Stabilator Limit	0	1500		150		1720	
P2.8.6.5	Flux Circle Stabilator Gain	0	32767		10000		1550	
P2.8.6.6	Flux Stabilator Gain	0	32000		500		1797	
P2.8.6.7	Flux Circle Stabilator TC	0	32700		900		1551	
P2.8.6.8	Voltage Stabilator TC	0	1000		900		1552	
P2.8.6.9	Voltage Stabilator Gain	0	100,0	%	10,0		1738	
P2.8.6.10	Voltage Stabilator Limit	0	320,00	Hz	1,50		1553	

### 6.8.6 Tuning parameters

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.7.1	<a href="#">Fly Start Options</a>	0	65535		0		1610	
P2.8.7.2	MC Options	0	65535		0		1740	
P2.8.7.3	Resonance Damping Select	0	11		0		1760	0=Not in Use 1=BandPass (Speed) 2=BandStop+BandPass. (Speed) 11=BandPass (Iq Actual)
P2.8.7.4	Damping Frequency	0,0	450,0	Hz	0,0		1763	
P2.8.7.5	Damping Gain	0	32000		0		1764	
P2.8.7.6	Damping Phase	0	360		0,00		1765	
P2.8.7.7	Damping Activation Frequency	0	320,00	%	0		1770	
P2.8.7.8	Damping Filter Time Constant	0	32700		105		1771	
P2.8.7.9	<a href="#">Over Modulation Limit</a>	50	120	%	105		1515	Use P6.7.5 if sine filter is used
P2.8.7.10	<a href="#">Modulator Index Limit</a>	0	200	%	100		655	
P2.8.7.11	DC Voltage Filter	0,0	500,0	Hz	0,0		1591	
P2.8.7.12	Process Frequency	0,00	320,00	Hz	0,00		1811	Keep zero if Process Speed is used
P2.8.7.13	GearRatioMultipl	0	32000		1		1558	
P2.8.7.14	GearRatioDivider	0	32000		1		1559	

## 6.8.7 Identification parameters

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.8.1	Flux 10 %	0	2500	%	10		1355	
P2.8.8.2	Flux 20 %	0	2500	%	20		1356	
P2.8.8.3	Flux 30 %	0	2500	%	30		1357	
P2.8.8.4	Flux 40 %	0	2500	%	40		1358	
P2.8.8.5	Flux 50 %	0	2500	%	50		1359	
P2.8.8.6	Flux 60 %	0	2500	%	60		1360	
P2.8.8.7	Flux 70 %	0	2500	%	70		1361	
P2.8.8.8	Flux 80 %	0	2500	%	80		1362	
P2.8.8.9	Flux 90 %	0	2500	%	90		1363	
P2.8.8.10	Flux 100 %	0	2500	%	100		1364	
P2.8.8.11	Flux 110 %	0	2500	%	110		1365	
P2.8.8.12	Flux 120 %	0	2500	%	120		1366	
P2.8.8.13	Flux 130 %	0	2500	%	130		1367	
P2.8.8.14	Flux 140 %	0	2500	%	140		1368	
P2.8.8.15	Flux 150 %	0	2500	%	150		1369	
P2.8.8.16	Rs voltage drop	0	30000		Varies		662	Used for torque calculation in open loop
P2.8.8.17	Ir add zero point voltage	0	30000		Varies		664	
P2.8.8.18	Ir add generator scale	0	30000		Varies		665	
P2.8.8.19	Ir add motoring scale	0	30000		Varies		667	
P2.8.8.20	Ls Voltage Dropp	0	3000		0		673	
P2.8.8.21	Motor BEM Voltage	0,00	320,00	%	0		674	
P2.8.8.22	Iu Offset	-32000	32000		0		668	
P2.8.8.23	Iv Offset	-32000	32000		0		669	
P2.8.8.24	Iw Offset	-32000	32000		0		670	
P2.8.8.25	Estimator Kp	0	32000		400		1781	
P2.8.8.26	Estimator Ki	0	32000				1782	
P2.8.8.27	Voltage Drop	0	2000				671	
P2.8.8.28	ID Run Current Kp						695	
P2.8.8.29	DeadTimeComp.						1751	
P2.8.8.30	DeadTieContCurL						1752	

Table 6-16. Identification parameters, G2.6.4

### 6.8.8 Fine tuning parameters

These parameters are for special cases.

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P 2.8.9.1	DeadTHWCompDisab						1750	
P 2.8.9.2	CurrMeasFCompTC						1554	
P 2.8.9.3	CurrLimOptions						1702	
P 2.8.9.4	AdConvStartShift						1701	
P 2.8.9.5	DCVoltageBalGain						1519	

### 6.8.9 SM Excitation

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.10.1	No Load Magnetization Current	0,0	3200	A	0,0		1966	
P2.8.10.2	Magnetization Current Limit	0,0	3200	A	0,0		1973	

#### 6.8.9.1 SM Tuning

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.10.3.1	Magnetization Reference offset	-100,0	100,0	%	0,0		1872	
P2.8.10.3.2	CosPhi Kp	0,0	3200,0	%	50,0		1975	
P2.8.10.3.3	CosPhi Ti	0,0	3200,0	ms	50,0		1976	
P2.8.10.3.4	Flux Control Kp	0,0	3000,0	%	400,0		1772	

#### 6.8.9.2 SM Reference AO

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.10.4.1	Magnetization Reference AO	0.1	E.10	AnOUT	0.1		1963	
P2.8.10.4.2	20 mA Reference	0,0	500,0	%	330,0		1971	

#### 6.8.9.3 SM Actual AI

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.10.5.1	Magnetization Actual AI	0.1	E.10	AnIN	0.1		1964	
P2.8.10.5.2	Magn AI Nom Level	0	320	%	44,25		1974	
P2.8.10.5.3	20 mA Actual	0,0	3200,0	A	0,0		1965	
P2.8.10.5.4	Magn Act AI Filt TC	0	1000	Ms	5		1972	

## 6.8.9.4 SM Magn DO / DI

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.8.10.6.1	MgnReadyToStart	0.1	E.10		DigIN:0.1		1956	
P2.8.10.6.2	MgnReadyForLoad	0.1	E.10		DigIN:0.1		1957	
P2.8.10.6.3	StartMgnSystem	0.1	E.10		DigOUT:0.1		1958	
P2.8.10.6.4	StartMagnetizatn	0.1	E.10		DigOUT:0.1		1959	

## 6.9 Speed Control

## 6.9.1 Speed Control CL Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.9.1.1	Speed control P gain	0	1000		30		613	
P2.9.1.2	Speed control I time	-3200,0	32000	ms	100		614	Negative value uses 0,1 ms format instead of 1 ms
P2.9.1.3	0-speed time at start	0	32000	ms	100		615	
P2.9.1.4	0-speed time at stop	0	32000	ms	100		616	
P2.9.1.5	SPC f1 Point	0,00	320,00	Hz	0,00		1301	
P2.9.1.6	SPC f0 Point	0,00	320,00	Hz	0,00		1300	
P2.9.1.7	SPC Kp f0	0	1000	%	100		1299	
P2.9.1.8	SPC Kp FWP	0	1000	%	100		1298	
P2.9.1.9	SPC Torque minimum	0	400,0	%	0,0		1296	
P2.9.1.10	SPC Torque minimum Kp	0	1000	%	100		1295	
P2.9.1.11	SPC Kp TC Torque	0	1000	ms	0		1297	
P2.9.1.12	Acceleration compensation	0,00	300,00	s	0,00		626	
P2.9.1.13	Speed Error Filter TC	0	1000	ms	0		1311	
P2.9.1.14	Encoder filter time	0	1000	ms	0		618	

## 6.9.2 Speed Control Basic settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.9.2	Load drooping	0,00	100,00	%	0,00		620	
P2.9.3	Load Drooping Time	0	32000	ms	0		656	For dynamic changes
P2.9.4	Load Drooping Removal	0	2		0		1534	0=Normal 1= At zero Freq Lim 2=Linear zero to Fnom

## 6.9.3 Speed Control OL Settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.9.5.1	Speed controller P gain (open loop)	0	32767		3000		637	
P2.9.5.1	Speed controller I gain (open loop)	0	32767		300		638	

## 6.10 Drive Control

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.10.1	Switching frequency	1,0	Varies	kHz	Varies		601	
P2.10.2	Modulator Type	0	3		0		1516	
P2.10.3	Control Options	0	65535		64		1084	



P2.10.4	Control Options 2	0	65535		0		1798	
P2.10.5	Advanced Options 1	0	65535		0		1560	
P2.10.6	Advanced Options 2	0	65535		0		1561	
P2.10.7	Advanced Options 4	0	65535		0		1563	
P2.10.8	Advanced Options 5	0	65535		0		1564	
P2.10.9	Advanced Options 6	0	65535		0		1565	
P2.10.10	Advanced Options 7	0	65535		0		1589	
P2.10.11	Restart Delay	0	65535	s	Varies		1424	
P2.10.12	Reverse VW Phases	0	1		0		1062	

### 6.11 Master Follower Control Parameters

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.11.1	Master Follower Mode	0	4		0		1324	0=Not Used 1=Master 2=Follower 3=Drive Synch Master 4=Drive Synch Follower
P2.11.2	Follower Stop Function	0	2		2		1089	0=Coasting 1=Ramping 2=As Master
P2.11.3	Follower phase shift	0,0	360,0	Dec	0,0		1518	Phase shift between multiple wind motors.

Table 6-17. Master Follower Control parameters, G2.5

## 6.12 Protections

## 6.12.1 General settings

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.1.1	Input phase supervision	0	3		0		730	0=No response 1=Warning 2=Fault, 3=Fault,stop by coasting
P2.12.1.2	Response to undervoltage fault	0	1		0		727	0=Fault stored in history 1=Fault not stored
P2.12.1.3	Output phase supervision	0	3		2		702	0=No response 1=Warning 2=Fault, 3=Fault,stop by coasting
P2.12.1.4	Response to slot fault	0	3		2		734	0=No response 1=Warning 2=Fault, 3=Fault,stop by coasting
P2.12.1.5	Safe Disable Response	0	2		1		755	0=No response 1=Warning 2=Fault, 3=Fault,stop by coasting
P2.12.1.6	Keypad and PC Communication fault mode	1	2		2		1329	1=Warning (Stopping) 2=Fault,

## 6.12.2 Temperature sensor protections

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.2.1	No. of PT100 inputs	0	5		0		739	0=Not used (ID Write) 1=PT100 input 1 2= PT100 input 1 & 2 3= PT100 input 1 & 2 & 3 4= PT100 input 2 & 3 5= PT100 input 3
P2.12.2.2	Response to PT100 fault	0	3		2		740	0=No response 1=Warning 2=Fault,stop 3=Fault,stop by coasting
P2.12.2.3	PT100 warning limit	-30,0	200,0	C°	120,0		741	
P2.12.2.4	PT100 fault limit	-30,0	200,0	C°	130,0		742	
P2.12.2.5	No. of PT100 2 inputs	0	5		0		743	See ID739
P2.12.2.6	PT100 warning limit	-30,0	200,0	C°	120,0		745	
P2.12.2.7	PT100 fault limit	-30,0	200,0	C°	130,0		746	
P2.12.2.8	PT100 AI In	0	6		0		1222	0=Not used 1=AI1 1 Sensor 2= AI1 2 Sensor 3= AI1 3 Sensor 4= AI2 1 Sensor 5= AI2 2 Sensor 6= AI2 3 Sensor
P2.12.2.9	KTY AI In	0	6		0		1224	0=Not used 1=AI1 1 Sensor 2= AI1 2 Sensor 3= AI1 3 Sensor 4= AI2 1 Sensor 5= AI2 2 Sensor 6= AI2 3 Sensor
2.12.2.10.1	Channel 1B Warn	-30,0	200,0	C°	0,0		764	

2.12.2.10.2	Channel 1B Fault	-30,0	200,0	C°	0,0		765	
2.12.2.10.3	Channel 1C Warn	-30,0	200,0	C°	0,0		768	
2.12.2.10.4	Channel 1C Fault	-30,0	200,0	C°	0,0		769	
2.12.2.10.5	Channel 2B Warn	-30,0	200,0	C°	0,0		770	
2.12.2.10.6	Channel 2B Fault	-30,0	200,0	C°	0,0		771	
2.12.2.10.7	Channel 2C Warn	-30,0	200,0	C°	0,0		772	
2.12.2.10.8	Channel 2C Fault	-30,0	200,0	C°	0,0		773	

### 6.12.3 Stall Protection

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.3.1	Stall protection	0	3		0		709	0=No response 1=Warning 2=Fault, stop 3=Fault, stop by coasting
P2.12.3.2	Stall current	0,1	2 x I <sub>H</sub>	A	I <sub>H</sub>		710	
P2.12.3.3	Stall RPM limit	1,0	P2.1.2	Hz	25,0		712	
P2.12.3.4	Stall time limit	1,00	120,00	s	15,00		711	

### 6.12.4 Speed error monitoring

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.4.1	Speed Error Mode	0	3		0		752	0=No response 1=Warning 2=Fault, stop 3=Fault, stop by coasting
P2.12.4.2	Speed Error Limit	0,0	100,0	%	5,0		753	
P2.12.4.3	Speed Fault Delay	0,00	100,00	s	0,1		754	
P2.12.4.4	Over Speed Fault Response	0	2		2		1812	0=No response 1=Warning 2=Fault, stop by coasting

### 6.12.5 Motor thermal protections

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.5.1	Thermal protection of the motor	0	3		2		704	
P2.12.5.2	Motor ambient temperature factor	– 100,0	100,0	%	0,0		705	
P2.12.5.3	Motor cooling factor at zero speed	0,0	150,0	%	40,0		706	
P2.12.5.4	Motor thermal time constant	1	200	min	45		707	
P2.12.5.5	Motor duty cycle	0	100	%	100		708	
P2.12.5.6	Response to thermistor fault	0	3		2		732	0=No response 1=Warning 2=Fault, stop 3=Fault, stop by coasting
P2.12.5.7	Motor Fan Off Delay	0	32000	s	0		1320	
P2.12.5.8	MotorNomTempRise	0	300,0	C°	0		1922	

### 6.12.6 Living Zero monitoring (i.e. 4 mA fault)

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.6.1	Response to 4mA reference fault	0	5		0		700	0=No response 1=Warning 2=Warning+Previous speed 3=Wrng+Preset speed 4=Fault,stop 5=Fault,stop by coasting
P2.12.6.2	4mA reference fault speed	0	1500	rpm	0		728	

### 6.12.7 Underload protection

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.7.1	Underload protection	0	3		0		713	0=No response 1=Warning 2=Fault,stop 3=Fault,stop by coasting
P2.12.7.2	Field weakening area load	10,0	150,0	%	50,0		714	
P2.12.7.3	Zero speed load	5,0	150,0	%	10,0		715	
P2.12.7.4	Underload protection time limit	2,00	600,00	s	20,00		716	

### 6.12.8 Earth Fault protection

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.8.1	Earth fault protection	0	3		2		703	0=No response 1=Warning 2=Fault,stop 3=Fault,stop by coasting
P2.12.8.2	Eart fault current limit	0,0	100,0	%	50,0		1333	

### 6.12.9 Cooling protection

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.9.1	Cooling Fault Response	1	2		2		762	1=Warning 2= Fault,stop by coasting
P2.12.9.2	Cooling Fault delay	0,00	7,00	s	2,00		751	

### 6.12.10 Fieldbus protection

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.10.1	Fieldbus Communication response	0	3		2		733	0=No Action 1=Warning 2= Fault 3= Fault,stop by coasting 4=Warning; Prev speed 5=Quick Stop
P2.12.10.2	FB Fault Delay	0,00	60,00	s	0,50		1850	Delay to fault when FB Response is 4
P2.12.10.3	FB Watchdog Delay	0,00	30,00	s	0,00		1354	Delay when WD pulse is missing. 0,00 s = Disabled

## 6.12.11 Master Follower

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.11.1	System Bus Fault	0	3		1		1082	0=No response 1=Warning 2=Fault,stop 3=Fault,stop by coasting
P2.12.11.2	System Bus Fault Delay	0,00	320,00	s	3,00		1352	
P2.12.11.3	Follower Fault	0	3		0		1536	0=No response 1=Warning 2=Fault,stop 3=Fault,stop by coasting
P2.12.11.4	Drive Synch Follower fault	0	2		2		1531	0=No response 1=Warning 2=Fault,stop

## 6.12.12 Mechanical Brake

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.12.1	Brake Fault Action	1	3		1		1316	1=Warning 2=Fault,stop 3=Fault,stop by coasting
P2.12.12.2	Brake Fault Delay	0,00	320,00	s	0,20		1317	

## 6.12.13 External Fault

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.13.1	Response to external fault 1	0	3		2		701	0=No response 1=Warning 2=Fault,stop 3=Fault,stop by coasting
P2.12.13.2	Response to external fault 2	0	3		2		747	0=No response 1=Warning 2=Fault,stop 3=Fault,stop by coasting

## 6.12.14 Encoder fault

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.14.1	Encoder fault mode	1	3		2		1353	1=Warning 2=Fault,stop 3=Warning, Change to Open Loop
P2.12.14.2	Iq Fault Limit	0	300	%	100		1800	
P2.12.14.3	Fast Hz Limit	0,00	320,00	Hz	10,00		1801	

## 6.12.15 Signal Monitoring Function

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.15.1	Monitored ID	0	10000		0		1431	
P2.12.15.2	Monitored Level	0	1		0		1432	0=High Level 1=Low Level
P2.12.15.3	Warning Level	-32000	32000		0		1433	
P2.12.15.4	Fault Level	-32000	32000		0		1437	

## 6.12.16 Options

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.12.16	Disable Stop Lock	0	1		0		1086	
P2.12.17	Reset Datalogger	0	4		0		1857	0 = Auto 1 = Reset to Auto 2 = SW Default 3 = Auto Fast 4 = No Change

## 6.13 Fieldbus parameters

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.13.1	Fieldbus process data out 1 selection	0	10000		1		852	Choose monitoring data with parameter ID Def: Output Frequency
P2.13.2	Fieldbus process data out 2 selection	0	10000		2		853	Def: Motor Speed
P2.13.3	Fieldbus process data out 3 selection	0	10000		3		854	Def: Motor Current to FB
P2.13.4	Fieldbus process data out 4 selection	0	10000		4		855	Def: Motor Torque
P2.13.5	Fieldbus process data out 5 selection	0	10000		5		856	Def: Motor Power
P2.13.6	Fieldbus process data out 6 selection	0	10000		6		857	Def: Motor Voltage
P2.13.7	Fieldbus process data out 7 selection	0	10000		7		858	Def: DC-Link Voltage
P2.13.8	Fieldbus process data out 8 selection	0	10000		37		859	Def: Last Active Fault
P2.13.9	Fieldbus process data out 9 selection	0	10000		0		558	Visible with correct hardware and software
P2.13.10	Fieldbus process data out 10 selection	0	10000		0		559	Visible with correct hardware and software
P2.13.11	Fieldbus process data out 11 selection	0	10000		0		560	Visible with correct hardware and software
P2.13.12	Fieldbus process data out 12 selection	0	10000		0		561	Visible with correct hardware and software
P2.13.13	Fieldbus process data out 13 selection	0	10000		0		562	Visible with correct hardware and software
P2.13.14	Fieldbus process data out 14 selection	0	10000		0		563	Visible with correct hardware and software
P2.13.15	Fieldbus process data out 15 selection	0	10000		0		564	Visible with correct hardware and software
P2.13.16	Fieldbus process data out 16 selection	0	10000		0		565	Visible with correct hardware and software
P2.13.17	Fieldbus process data in 1 selection	0	10000		1140		876	Choose controlled data with parameter ID. Def: FB Torque Reference
P2.13.18	Fieldbus process data in 2 selection	0	10000		46		877	Def: FB Limit Scaling
P2.13.19	Fieldbus process data in 3 selection	0	10000		47		878	Def: FB Adjust Reference
P2.13.20	Fieldbus process data in 4 selection	0	10000		48		879	Def: FB Analogue Output.
P2.13.21	Fieldbus process data in 5 selection	0	10000		0		880	Choose controlled data with parameter ID
P2.13.22	Fieldbus process data in 6 selection	0	10000		0		881	Choose controlled data with parameter ID
P2.13.23	Fieldbus process data in 7 selection	0	10000		0		882	Choose controlled data with parameter ID
P2.13.24	Fieldbus process data in 8 selection	0	10000		0		883	Choose controlled data with parameter ID

P2.13.25	Fieldbus process data in 9 selection	0	10000		0		550	Visible with correct hardware and software
P2.13.26	Fieldbus process data in 10 selection	0	10000		0		551	Visible with correct hardware and software
P2.13.27	Fieldbus process data in 11 selection	0	10000		0		552	Visible with correct hardware and software
P2.13.28	Fieldbus process data in 12 selection	0	10000		0		553	Visible with correct hardware and software
P2.13.29	Fieldbus process data in 13 selection	0	10000		0		554	Visible with correct hardware and software
P2.13.30	Fieldbus process data in 14 selection	0	10000		0		555	Visible with correct hardware and software
P2.13.31	Fieldbus process data in 15 selection	0	10000		0		556	Visible with correct hardware and software
P2.13.32	Fieldbus process data in 16 selection	0	10000		0		557	Visible with correct hardware and software
P2.13.33	General Status Word ID	0	10000		67		897	Choose monitoring data in General Status Word
P2.13.34	Control Slot Selector	0	9		0		1440	0=All 4=Slot D 5=Slot E 6=Slot D Fast 7=Slot E Fast 8=Slot D 16 Data 9=Slot E 16 Data
P2.13.35	State Machine	0	2		2		896	0 = Echo 1 = Standard 2 = ProfiDrive
P2.13.36	FB Reference Filter TC	0	32000	ms	0		863	
P2.13.37	Enable FB Monitoring	0	1		0		1629	0 = Disable 1 = Enable
P2.13.38	SW ID.Bit 11 selection	0	2000,00		0		1625	
P2.13.39	SW ID.Bit 12 selection	0	2000,00		0		1626	
P2.13.40	SW ID.Bit 13 selection	0	2000,00		0		1627	
P2.13.41	SW ID.Bit 14 selection	0	2000,00		0		1628	

Table 6-18. Fieldbus parameters

## 6.14 ID Functions

### 6.14.1 Value Control

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.14.1.1	Control Input Signal ID	0	10000	ID	0		1580	
P2.14.1.2	Control Input Off Limit	-32000	32000		0		1581	
P2.14.1.3	Control Input On Limit	-32000	32000		0		1582	
P2.14.1.4	Control Output Off Value	-32000	32000		0		1583	
P2.14.1.5	Control Output On Value	-32000	32000		0		1584	
P2.14.1.6	Control Output Signal ID	0	10000	ID	0		1585	
P2.14.1.7	Control Mode	0	5		0		1586	0=SR ABS 1=Scale ABS



								2=Scale INV ABS 3=SR 4=Scale 5=Scale INV
P2.14.1.8	Control Output Filtering time	0,000	32,000	s	0,000		1721	

Table 6-19. Power reference input signal selection, G2.2.8

## 6.14.2 DIN ID Control 1

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.14.2.1	ID Control DIN	0.1	E.10		0.1		1570	Slot . Board input No.
P2.14.2.2	Controlled ID	0	10000	ID	0		1571	Select ID that is controlled by digital input
P2.14.2.3	False value	-32000	32000		0		1572	Value when DI is low
P2.14.2.4	True value	-32000	32000		0		1573	Value when DI is high

Table 6-20. DIN ID Control parameters, G2.2.8

## 6.14.3 DIN ID Control 2

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.14.3.1	ID Control DIN	0.1	E.10		0.1		1590	Slot . Board input No.
P2.14.3.2	Controlled ID	0	10000	ID	0		1575	Select ID that is controlled by digital input
P2.14.3.3	False value	-32000	32000		0		1592	Value when DI is low
P2.14.3.4	True value	-32000	32000		0		1593	Value when DI is high

Table 6-21. DIN ID Control parameters, G2.2.8

## 6.14.4 DIN ID Control 3

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.14.4.1	ID Control DIN	0.1	E.10		0.1		1578	Slot . Board input No.
P2.14.4.2	Controlled ID	0	10000	ID	0		1579	Select ID that is controlled by digital input
P2.14.4.3	False value	-32000	32000		0		1594	Value when DI is low
P2.14.4.4	True value	-32000	32000		0		1596	Value when DI is high

Table 6-22. DIN ID Control parameters, G2.2.8

## 6.14.5 ID Controlled Digital Output

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.14.5.1	ID.Bit Free DO	0,00	2000,15		0,00		1217	
P2.14.5.2	Free DO Sel	0,1	E.10		0,1		1574	

Table 6-23. ID Controlled Digital Output parameters, G2.14.5

## 6.15 Brake Control

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.15.1	BrakeMechDelay	0,00	320,00	s	0,00		1544	Time that is required to open the brake
P2.15.2	Brake OFF FreqLim Open Loop	0,00	32000	rpm	1,50		1535	Opening limit and maximum reference limit when brake is closed.
P2.15.3	Brake OFF RPM Lim Closed Loop	0,00	32000	rpm	0,00		1555	Opening limit and maximum reference limit when brake is closed.
P2.15.4	Brake ON RPM Lim +	0,00	32000	rpm	1,00		1539	Close frequency from positive direction
P2.15.5	Brake ON RPM Lim -	0,00	32000	rpm	1,50		1540	Close frequency from negative direction
P2.15.6	Brake On/Off Current Limit	0,00	320,00	A	0,00		1085	Brake is closed immediately if current goes below this value.
P2.15.7	Generator Torque limit increase speed level	0,00	32000	rpm	0,00		1547	Function disabled when zero. Point where Generator torque limit starts to increase.
P2.15.8	Generator Torque limit increase maximum speed limit	0,00	32000	rpm	100,00		1548	Point where torque value of ID1549 is added to base generator torque limit.
P2.15.9	Generator Torque limit increase maximum addition	0,0	300,0	%	300,0		1549	

Table 6-24. Brake control parameters, G2.15.8

## 6.15.1.1 Brake Control Start up torque for CL

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.15.10.1	Start-up torque	0	3		0		621	0=Not used 1=Torque memory 2=Torque reference 3=Start-up torque fwd/rev 4=Start-up torque Ref
P2.15.10.2	Start-up torque FWD	-300,0	300,0	s	0,0		633	
P2.15.10.3	Start-up torque REV	-300,0	300,0	s	0,0		634	
P2.15.10.4	Start Up Torque Time	-1	10000	ms	-1		1371	-1 = Automatic
P2.15.10.5	Start Up Torque Ref	-300,0	300,0	%	0,0		1375	

## 6.15.1.2 Functions

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.15.11.1	Stop Torque Release Time	0	500	ms	0		1858	

Table 6-25. Functions parameters, G2.15.14

## 6.16 Auto Reset parameters

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.16.1	Wait time	0,10	10,00	s	0,50		717	
P2.16.2	Trial time	0,00	60,00	s	0,10		718	
P2.16.3	Start function	0	2		2		719	0=Ramp 1=Flying start 2=According to Start Function
P2.16.4	Number of tries after undervoltage trip	0	10		0		720	
P2.16.5	Number of tries after overvoltage trip	0	10		0		721	
P2.16.6	Number of tries after overcurrent trip	0	3		0		722	
P2.16.7	Number of tries after reference trip	0	10		0		723	
P2.16.8	Number of tries after motor temperature fault trip	0	10		0		726	
P2.16.9	Number of tries after external fault trip	0	10		0		725	
P2.16.10	Number of tries after underload fault trip	0	10		0		738	
P2.16.11	Fault Simulation	0	65535		0		1569	

Table 6-26. Auto reset parameters, G2.16

## 6.17 PI Control Parameters

Code	Parameter	Min	Max	Unit	Step	Default	ID	Note
P2.17.1	PI controller gain	0,0	1000,0	%		100,0	118	
P2.17.2	PI controller I-time	0,00	320,00	s		1,00	119	
P2.17.3	PI Reference	-32000	32000			0	167	
P2.17.4	PI controller reference signal ID	0	10000			167	332	Default P2.17.3
P2.17.5	PI Actual value ID	0	10000			0	333	
P2.17.6	PI Controller output ID	0	10000			0	1802	
P2.17.7	PI Controller Scale	-32000	32000			1	340	>= 1 = No inversion <=-1 = Inverted 0 = Illegal value
P2.17.8	PI Low limit	-32000	32000				359	
P2.17.9	PI High limit	-32000	32000	%		10000	360	
P2.17.10	PI Controller Output scale	-3200,0	3200,0	%		100,0	1803	
P2.17.11	PI Stop state value	-32000	32000			0	1806	

Table 27. PI Controller parameters, G2.17

## 6.18 Functional Safety

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.18.1	SQS Reaction	0	1		1		545	0=No Action 1=Quick Stop
P2.18.2	SS1 Reaction	0	1		1		542	0=No Action 1=Stop 2=Quick Stop
P2.18.3	SS2 Reaction	0	1		1		546	0=No Action 1=Zero Speed 2=Quick Stop
P2.18.4	SLS Reaction	0	1		1		543	0=No Action 1=Limit Reference
P2.18.5	SSR Reaction	0	1		1		547	0=No Action 1= Limit Reference
P2.18.6	Safety Options	0	65535		2		548	

## 6.19 Condition Based Monitoring

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.1.1	Baseline Type	0	3		0		3501	0=No Action 1=Baseline Run 2=Online Baseline 3=Baseline Finished
P2.19.1.2	Baseline Min Freq	0	320,00	Hz	0		3502	
P2.19.1.3	Baseline Max Freq	0	320,00	Hz	50,00		3503	
P2.19.1.4	Baseline Duration	1	300 000	min	2		3504	
P2.19.1.5	Modified Array	0	16		0		3506	0=Freq Points 1=Current Max Steady 2=Current Min Steady 3=Current Mean Steady 4=Current Std Steady 5= Voltage Max Steady 6= Voltage Min Steady 7= Voltage Mean Steady 8= Voltage Std Steady 9=Vibration Max Ramp 10= Vibration Min Ramp 11= Vibration Mean Ramp 12= Vibration Std Ramp 13= Load Max Steady 14= Load Min Steady 15= Load Mean Steady 16= Load Std Steady
P2.19.1.6	Modified Point	0	9		0		3507	
P2.19.1.7	Modified Value	-300,00	320,00	Hz or %	0		3508	
P2.19.1.8	Modified Activation	0	1		0		3505	0=No Action 1=Set Modified Value
P2.19.1.9	Baseline Data Selector	0	16		0		3509	0=Freq Points 1=Current Max Steady 2=Current Min Steady 3=Current Mean Steady 4=Current Std Steady 5= Voltage Max Steady 6= Voltage Min Steady 7= Voltage Mean Steady 8= Voltage Std Steady 9=Vibration Max Ramp 10= Vibration Min Ramp 11= Vibration Mean Ramp 12= Vibration Std Ramp 13= Load Max Steady 14= Load Min Steady 15= Load Mean Steady 16= Load Std Steady 17= Current Counter 18= Voltage Counter 19= Vibration Counter 20= Load Counter
P2.19.1.10	Speed Band	0,00	10,00	%	5,00		3510	

### 6.19.1 Stator Winding

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.2.1	Stator Winding Fault Mode	0	2		1		3540	0=No response 1=Warnings 2=Fault + Warnings
P2.19.2.2	Line Frequency	0	100,00	Hz	50,00		1913	
P2.19.2.3	Line Frequency Hysteresis	0	10,00	Hz	1,00		1914	

#### 6.19.1.1 Current Unbalance Threshold Value

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.2.4.1	Mean Factor	-10	10		1		3511	
P2.19.2.4.2	Min Factor	-10	10		0		3512	
P2.19.2.4.3	Max Factor	-10	10		0		3513	
P2.19.2.4.4	Std Factor	-10	10		0		3514	
P2.19.2.4.5	Interpolation Type	0	1		1		3515	0=Constant 1=Linear

#### 6.19.1.2 Current Unbalance Limits

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.2.5.1	Warning S1 Mode	0	2		0		3516	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.2.5.2	Warning S1 High	0	300,0	%	0		3517	
P2.19.2.5.3	Warning S1 Delay	0	3600	s	0		3518	
P2.19.2.5.4	Warning S2 Mode	0	2		0		3519	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.2.5.5	Warning S2 High	0	300,0	%	0		3720	
P2.19.2.5.6	Warning S2 Delay	0	3600	s	0		3721	
P2.19.2.5.7	Alarm/fault Mode	0	2		0		3522	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.2.5.8	Alarm/fault High	0	300,0	%	0		3523	
P2.19.2.5.9	Alarm/fault Delay	0	3600	s	0		3524	

#### 6.19.1.3 Voltage Unbalance Threshold Value

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.2.6.1	Mean Factor	-10	10		1		3526	
P2.19.2.6.2	Min Factor	-10	10		0		3527	
P2.19.2.6.3	Max Factor	-10	10		0		3528	
P2.19.2.6.4	Std Factor	-10	10		0		3529	
P2.19.2.6.5	Interpolation Type	0	1		1		3530	0=Constant 1=Linear

#### 6.19.1.4 Voltage Unbalance Limits

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.2.7.1	Warning S1 Mode	0	2		0		3531	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.2.7.2	Warning S1 High	0	300,0	%	0		3532	
P2.19.2.7.3	Warning S1 Delay	0	3600	s	0		3533	
P2.19.2.7.4	Warning S2 Mode	0	2		0		3534	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.2.7.5	Warning S2 High	0	300,0	%	0		3535	
P2.19.2.7.6	Warning S2 Delay	0	3600	s	0		3536	
P2.19.2.7.7	Alarm/fault Mode	0	2		0		3537	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.2.7.8	Alarm/fault High	0	300,0	%	0		3538	
P2.19.2.7.9	Alarm/fault Delay	0	3600	s	0		3539	

#### 6.19.2 Vibration

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.3.1	Vibration Fault Mode	0	2		1		3588	0=No response 1=Warnings 2=Fault + Warnings
P2.19.3.2	Vibration Input	0	4		0		3587	0 = Not Used 1 = A1 2 = A2 3 = A3 4 = A4

##### 6.19.2.1 Vibration Threshold Value

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.3.3.1	Mean Factor	-10	10		0		3550	
P2.19.3.3.2	Min Factor	-10	10		0		3551	
P2.19.3.3.3	Max Factor	-10	10		1		3552	
P2.19.3.3.4	Std Factor	-10	10		0		3553	
P2.19.3.3.5	Interpolation Type	0	1		0		3554	0=Constant 1=Linear

##### 6.19.2.2 Vibration Limits

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.3.4.1	Warning S1 Mode	0	2		0		3555	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.3.4.2	Warning S1 High	0	300,0	%	0		3556	
P2.19.3.4.3	Warning S1 Delay	0	3600	s	0		3557	
P2.19.3.4.4	Warning S2 Mode	0	2		0		3558	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.3.4.5	Warning S2 High	0	300,0	%	0		3559	
P2.19.3.4.6	Warning S2 Delay	0	3600	s	0		3560	
P2.19.3.4.7	Alarm/fault Mode	0	2		0		3561	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.3.4.8	Alarm/fault High	0	300,0	%	0		3562	

P2.19.3.4.9	Alarm/fault Delay	0	3600	s	0		3563	
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### 6.19.3 Load

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.4.1	Load Fault Mode	0	2		1		3589	0=No response 1=Warnings 2=Fault + Warnings

#### 6.19.3.1 Load Threshold Value

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.4.2.1	Mean Factor	-10	10		1		3567	
P2.19.4.2.2	Min Factor	-10	10		0		3568	
P2.19.4.2.3	Max Factor	-10	10		0		3569	
P2.19.4.2.4	Std Factor	-10	10		0		3570	
P2.19.4.2.5	Interpolation Type	0	1		1		3571	0=Constant 1=Linear

#### 6.19.3.2 Load Limits

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P2.19.4.3.1	Warning S1 Mode	0	2		0		3572	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.4.3.2	Warning S1 Low	-300,0	300,0	%	0		3584	
P2.19.4.3.3	Warning S1 High	-300,0	300,0	%	0		3573	
P2.19.4.3.4	Warning S1 Delay	0	3600	s	0		3574	
P2.19.4.3.5	Warning S2 Mode	0	2		0		3575	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.4.3.6	Warning S2 Low	-300,0	300,0	%	0		3585	
P2.19.4.3.7	Warning S2 High	-300,0	300,0	%	0		3576	
P2.19.4.3.8	Warning S2 Delay	0	3600	s	0		3577	
P2.19.4.3.9	Alarm/fault Mode	0	2		0		3578	0=Abs. value 1=Baseline offset 2=Baseline factor
P2.19.4.3.10	Alarm/fault Low	-300,0	300,0	%	0		3586	
P2.19.4.3.11	Alarm/fault High	-300,0	300,0	%	0		3579	
P2.19.4.3.12	Alarm/fault Delay	0	3600	s	0		3580	



### 6.20 Keypad control (Control keypad: Menu M3)

The parameters for the selection of control place and direction on the keypad are listed below. See the Keypad control menu in the Vacon NX User's Manual.

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P3.1	Control place	1	4		2		125	0=PC Control 1=I/O terminal 2=Keypad 3=Fieldbus 4=MF Master
R3.2	Keypad reference	P2.1.1	P2.1.2	rpm				
P3.3	Direction (on keypad)	0	1		0		123	0=Forward 1=Reverse
P3.4	Stop button	0	1				114	0=Limited function of Stop button 1=Stop button always enabled
R3.5	Torque reference	0,0	100,0	%	0,0			
P3.6	License	0	65535		0		1995	

Table 6-28. Keypad control parameters, M3

### 6.21 System menu (Control keypad: Menu M6)

For parameters and functions related to the general use of the frequency converter, such as application and language selection, customised parameter sets or information about the hardware and software, see Chapter 7.3.6 in the Vacon NX User's Manual.

### 6.22 Expander boards (Control keypad: Menu M7)

The **M7** menu shows the expander and option boards attached to the control board and board-related information. For more information, see Chapter 7.3.7 in the Vacon NX User's Manual.

## 7. SIA-II APPLICATION - DESCRIPTION OF PARAMETERS

### 7.1 Basic Parameters

#### **P2.1.1      *Supply Voltage*                      *ID1201      “Supply Voltage”***

This parameter sets the incoming line voltage for the drive. The maximum value is 760 V. Set this parameter to the nominal line voltage at the installation site. Leave to zero for drive internal logic to determine supply voltage.

#### **P2.1.2      *Motor Nominal Voltage*                      *ID110      “Motor Nom Voltg”***

Find this value  $U_n$  on the rating plate of the motor.  
This parameters defines nominal voltage at field weakening point.

#### **P2.1.3      *Motor Nominal Frequency* *ID111      “Motor Nom Freq”***

Find this value  $f_n$  on the rating plate of the motor. This parameter sets the field weakening point to the same value in “G: Motor Control \ U/f Settings”.

#### **P2.1.4      *Motor nominal speed*                      *ID112      “Motor Nom Speed”***

Find this value  $n_n$  on the rating plate of the motor. Note also nominal frequency.

Some cases motor nominal speed is shown with one decimal. In this case the practice is to give nearest integer number and adjust motor nominal frequency so that drive will calculate correct [FW]PolePairNumber.

#### **P2.1.5      *Motor nominal current*                      *ID113      “Motor Nom Currnt”***

Find this value  $I_n$  on the rating plate of the motor. If magnetization current is provided set also Magnetization current P2.1.8 before identification run.

##### **DriveSynch Operation**

Motor Nominal current from the motor name plate / Number of drives in parallel using Vacon Drive Synch.

#### **P2.1.6      *Motor cos phi*                      *ID120      “Motor Cos Phi”***

Find this value “cos phi” on the rating plate of the motor.

#### **P2.1.7      *Motor Nominal Power*                      *ID116      “Motor Nom Power”***

Find this value on the rating plate of the motor.

##### **Drive Synch Operation**

Motor Nominal power from the motor name plate / Number of drives in parallel using Vacon Drive Synch.

**P2.1.8 Magnetizing current ID612 "MagnCurrent"**

Set here the motor magnetizing current (no-load current) at 2/3 of motor nominal speed.

When value is zero the magnetization current is calculated from motor nominal parameters

$$\text{Motor Magnetization Current} = \frac{5 * \sin \varphi - 1}{5 - \sin \varphi} * \text{Motor Nominal Current}$$

$$[FW]\text{RotorFlux} = \left( \frac{f(\text{MotorNomFreq})}{f(\text{Out})} \right)^2, \text{ when } f(\text{Out}) > f(\text{MotorNomFreq})$$

If given before identification run this is used as reference for U/f tuning when making identification without rotating the motor.

**DriveSynch Operation**

Motor Nominal magnetization current / Number of drives in parallel using Vacon Drive Synch.

**P2.1.9 Identification ID631 "Identification"**

Identification Run is a part of tuning the motor and the drive specific parameters. It is a tool for commissioning and service of the drive with the aim to find as good parameter values as possible for motors. The automatic motor identification calculates or measures the motor parameters that are needed for optimum motor and speed control.

**NOTE:** Set motor control mode to Frequency Control before identification.

**NOTE:** During identification drive will not open mechanical brake for safety reasons. If motor rotation requires that brake is opened this needs to be achieved externally.

**NOTE:** During identification run torque and power limits should be above 100 %. Also current limit should be above motor nominal current.

**NOTE:** During identification run acceleration time should be below 20 second.

**NOTE:** If switching frequency is changed after identification it's recommended to do identification run again.

**NOTE:** Small motor with long motor cabled may require reduction of switching frequency if identification is not successful.

**NOTE:** To use sensorless motor control mode DTC Identification or Ident All option must be performed.

**0 = "No Action" No action**

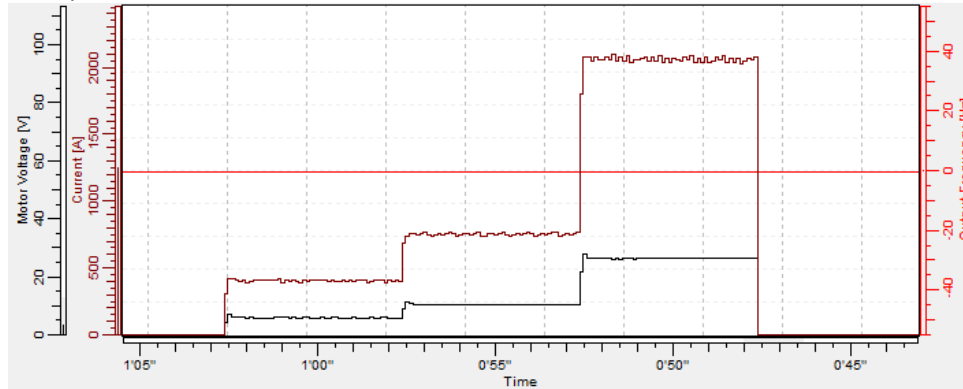
No identification requested.

### 1 = "ID No Run" - Identification without rotating the motor

Current is applied to the motor but shaft will not be rotated. U/f settings are identified.

This identification is minimum requirement if motor is only to be used in open loop control. it is however recommended to make always identification with rotating motor if need for closed loop control comes after mechanics are connected to shaft.

#### Example of behaviour



#### Parameters updated during this identification

##### AM:

P2.1.8 MagnCurrent  
 P2.8.3.2 U/f Ratio Select  
 P2.8.3.5 U/f Mid Freq  
 P2.8.3.6 U/f Mid Voltg  
 P2.8.3.7 Zero Freq Voltg  
 P2.8.8.16 RsVoltageDrop  
 P2.8.8.17 IrAddZeroPVoltg  
 P2.8.8.22-24 Ix Offset

##### PM:

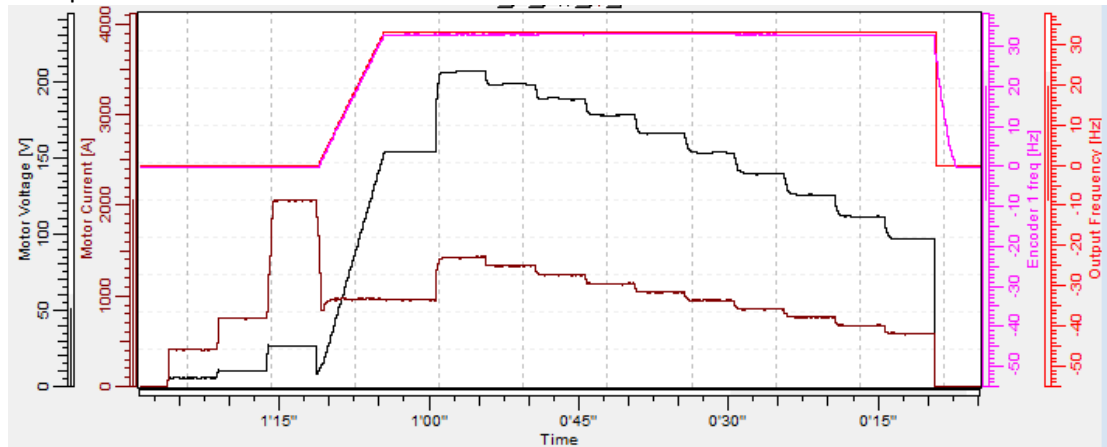
P2.8.3.2 U/f Ratio Select  
 P2.8.3.5 U/f Mid Freq  
 P2.8.3.6 U/f Mid Voltg  
 P2.8.3.7 Zero Freq Voltg  
 P2.8.4.1 CurrentControlKp  
 P2.8.5.12 LsdVoltageDrop  
 P2.8.5.13 LsqVoltageDrop  
 P2.8.8.16 RsVoltageDrop  
 P2.8.8.17 IrAddZeroPVoltg  
 P2.8.8.20 LsVoltageDrop  
 P2.8.8.22-24 Ix Offset  
 P2.8.8.25 Estimator Kp

## 2 = "ID With Run" - Identification with motor rotating

Shaft is rotated during identification.

This identification must be run without load on motor shaft. U/f settings and magnetization current are identified. This identification should be run regardless of the final operation mode (closed loop or open loop) to get the best performance from the motor.

Example of behaviour



Parameters updated during this identification

AM:

P2.1.8 MagnCurrent  
 P2.8.3.2 U/f Ratio Select  
 P2.8.3.5 U/f Mid Freq  
 P2.8.3.6 U/f Mid Voltg  
 P2.8.3.7 Zero Freq Voltg  
 P2.8.8.16 RsVoltageDrop  
 P2.8.8.17 IrAddZeroPVoltg  
 P2.8.8.22-24 Ix Offset  
 P2.8.8.1-15 Flux X %

PM:

P2.8.3.2 U/f Ratio Select  
 P2.8.3.3 Field WeakngPnt  
 P2.8.3.5 U/f Mid Freq  
 P2.8.3.6 U/f Mid Voltg  
 P2.8.3.7 Zero Freq Voltg  
 P2.8.4.1 CurrentControlKp  
 P2.8.5.12 LsdVoltageDrop  
 P2.8.5.13 LsqVoltageDrop  
 P2.8.8.16 RsVoltageDrop  
 P2.8.8.17 IrAddZeroPVoltg  
 P2.8.8.20 LsVoltageDrop  
 P2.8.8.21 MotorBEMVoltage  
 P2.8.8.22-24 Ix Offset  
 P2.8.8.25 Estimator Kp

**3 = "Enc. ID Run" - Encoder identification run**

The motor shaft is rotated during identification.

**IM:** If performed for induction motor encoder pulse number and direction are identified. Can be used if there is no encoder information available, correct result can be achieved only when motor is unloaded.

**PMSM:** This selection is used for PMS motor if automatic angle identification is not suitable for used motor (angle is identified automatically in every start if PMSM Shaft Position parameter is zero).

This identification run will update PMSM Shaft Position parameter based on absolute position of the encoder or Z pulse position of incremental type encoder.

**Note:** Identification needs to be remade if encoder position related to motor is changed e.g. due to maintenance.

Parameters updated during this identification

AM:

P2.1.8 MagnCurrent  
 P2.8.3.2 U/f Ratio Select  
 P2.8.3.5 U/f Mid Freq  
 P2.8.3.6 U/f Mid Voltg  
 P2.8.3.7 Zero Freq Voltg  
 P2.8.8.16 RsVoltageDrop  
 P2.8.8.17 IrAddZeroPVoltg  
 P2.8.8.22-24 lx Offset  
 P2.8.8.1-15 Flux X %  
 P7.3.1.2 Pulse revolution  
 P7.3.1.3 Invert direction

PM:

P2.8.5.1 PMSMShaftPositio  
 P2.8.8.22-24 lx Offset  
 P2.8.8.25 Estimator Kp

**4 = “Ident All” - Identified All**

Shaft is rotated during identification.

All the above identification selections are made in sequence.

Parameters updated during this identification

AM:

P2.1.8 MagnCurrent  
P2.8.3.2 U/f Ratio Select  
P2.8.3.5 U/f Mid Freq  
P2.8.3.6 U/f Mid Voltg  
P2.8.3.7 Zero Freq Voltg  
P2.8.8.16 RsVoltageDrop  
P2.8.8.17 IrAddZeroPVoltg  
P2.8.8.22-24 Ix Offset  
P2.8.8.1-15 Flux X %

PM:

P2.8.3.2 U/f Ratio Select  
P2.8.3.3 Field WeakngPnt  
P2.8.3.5 U/f Mid Freq  
P2.8.3.6 U/f Mid Voltg  
P2.8.3.7 Zero Freq Voltg  
P2.8.4.1 CurrentControlKp  
P2.8.5.12 LsdVoltageDrop  
P2.8.5.13 LsqVoltageDrop  
P2.8.8.16 RsVoltageDrop  
P2.8.8.17 IrAddZeroPVoltg  
P2.8.8.20 LsVoltageDrop  
P2.8.8.21 MotorBEMVoltage  
P2.8.8.22-24 Ix Offset  
P2.8.8.25 Estimator Kp  
P2.8.5.1 PMSMShaftPositio

**5 = “Enc.ABS.Lock” – Absolute encoder when locked rotor**

Absolute encoder zero position identification when rotor is locked while using permanent magnet motor.

It's recommended to have shaft locked during this identification mode.

Parameters updated during this identification

PM:

P2.8.5.1 PMSMShaftPositio  
P2.8.8.22-24 Ix Offset  
P2.8.8.25 Estimator Kp

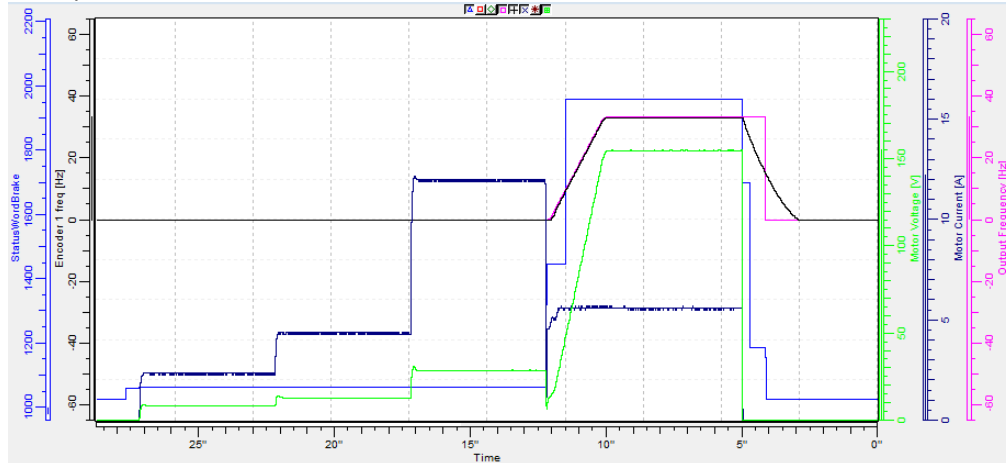
## 6 = "U/f + Magn.Curr" – U/f Curve and magnetization current

Shaft is rotated during identification.

This identification selection will not make a saturation curve identification and will open the brake when the start rotation begins.

Because saturation curve run is not made, the running time is shorter and gives possibility to make even if lifting hook is connected.

Example of behaviour



Parameters updated during this identification

- P2.1.8 MagnCurrent
- P2.8.3.2 U/f Ratio Select
- P2.8.3.5 U/f Mid Freq
- P2.8.3.6 U/f Mid Voltg
- P2.8.3.7 Zero Freq Voltg
- P2.8.8.16 RsVoltageDrop
- P2.8.8.17 IrAddZeroPVoltg
- P2.8.8.22-24 Ix Offset

## 7 = "DTC Identification" – Dead Time Compensation

Shaft is not rotated during this identification

Parameters updated during this identification

- P2.1.8 MagnCurrent
- P2.8.3.2 U/f Ratio Select
- P2.8.3.5 U/f Mid Freq
- P2.8.3.6 U/f Mid Voltg
- P2.8.3.7 Zero Freq Voltg
- P2.8.8.16 RsVoltageDrop
- P2.8.8.17 IrAddZeroPVoltg
- P2.8.8.20 LsVoltageDrop
- P2.8.8.22-24 Ix Offset
- P2.8.8.25 Estimator Kp
- P2.8.8.27 Voltage Drop
- P2.8.8.29 DeadTimeComp.
- P2.8.8.30 DeadTieContCurL

## 10 = "ID Run Fails" - Identification failed



Identification failed in last attempt.

The basic motor name plate data has to be set correctly before performing the identification run:

- P2.1.2 – P2.1.7. Motor basic data.
- P2.1.8 Magnetization current can also be given if available if given before identification without rotating motor; U/f curve will be tuned according to given magnetization current.
- P2.1.10 Motor Type.

When in closed loop and with an encoder installed, also the parameter for pulses / revolutions (in Menu M7) has to be set.

The automatic identification is activated by setting this parameter to the appropriate value followed by a start command in the requested direction. The start command to the drive has to be given within 20 s. If no start command is given within 20 s the identification run is cancelled and the parameter will be reset to its default setting. The identification run can be stopped any time with normal stop command and the parameter is reset to its default setting. In case identification run detects fault or other problems, the identification run is completed if possible. After the identification is finished, warning will be given if not all requested identification types has been completed successfully.

During Identification Run, the brake control is disabled.

**Note:** After identification is made drive requires rising edge of start command.

**Note:** System Interface application has all identified values stored to parameters, no need to redo identification if previous parameters are loaded back to the drive if e.g. control board is changed.

**DriveSynch operation:** Activate identification only from the master drive:

#### **P2.1.10    Motor Type        ID650    “Motor Type”**

Select used motor type with this parameter

##### **0    “Induction” - Induction motor**

-Asynchronous motor

##### **1    “PMSM” - Permanent magnet synchronous motor**

- Contact factory before using with externally magnetized motor.

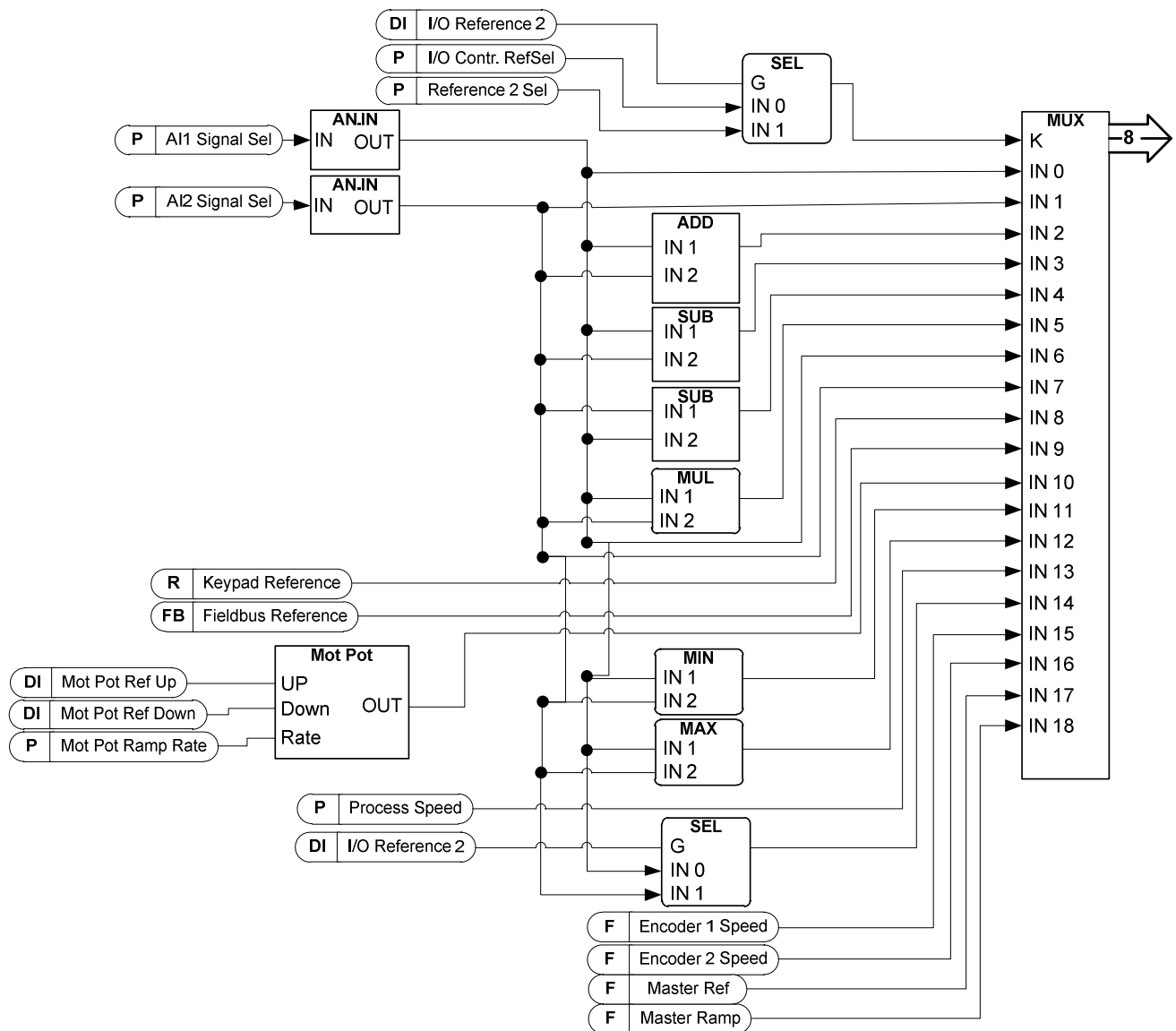
See related parameter in “G2.8.5: Motor Control \ PMSM Control”.

## 7.2 Reference Handling – “Ref Handling”

Upper level reference selections for all dynamically used reference.

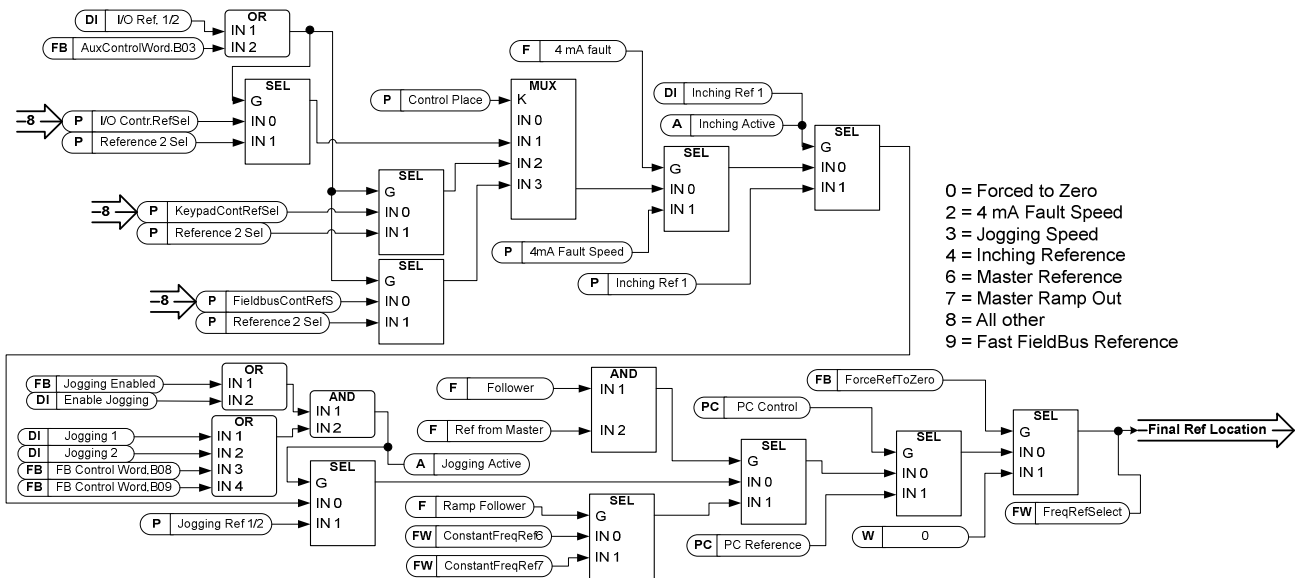
[P]Control Place is determinative for the reference parameter. Control place will determine where the start and stop commands are received, reference signal are freely selectable and has own reference selection for each control place.

Below block diagram present where speed reference signals are possible to receive and are common for Keypad Control place, IO Control place and Fieldbus Control place. Arrow presents jump to next page where reference selection is presented for each control place.



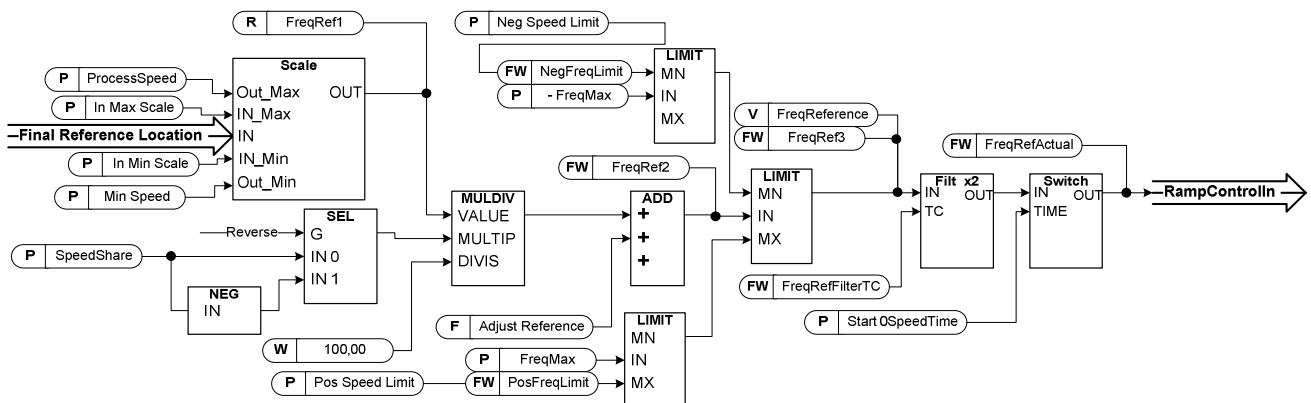
Priority order of System Interface application speed reference chain.

Control Place: 0 = PC, 1 = IO, 2 = Panel, 3 = Fieldbus.



Speed reference chain before ramp control

[FW]FreqRefFilterTC comes from selected reference filtering.

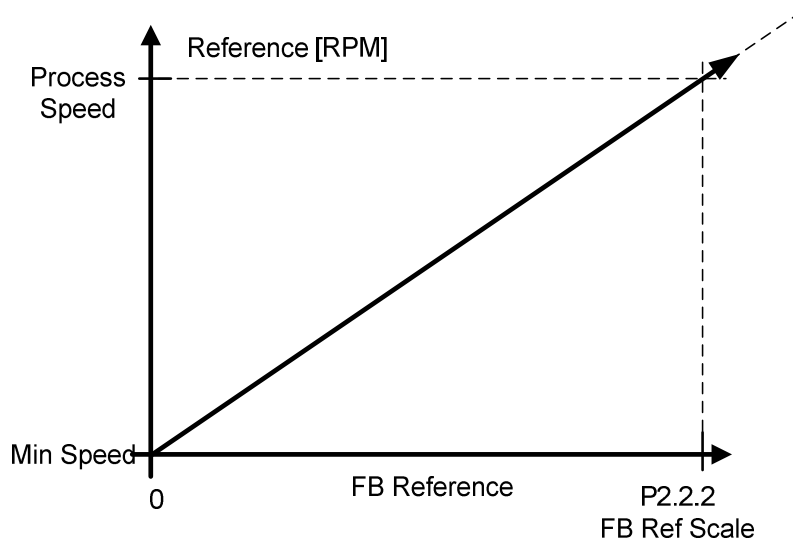


**NOTE:** For Jogging Reverse command is not used. Jogging reference parameter is bidirectional.

### 7.2.1 Basic Parameters

#### P2.2.1 Process speed ID1203 "ProcessSpeed"

This parameter is used to scale the speed signal in terms of the process speed. This speed value corresponds to value of the parameter FB Ref Scale (P2.2.3) for the speed reference written from the fieldbus. For e.g. If P2.2.2= 20000 and P2.2.1= 1600 then drive will run with the speed reference of 1600 rpm when the speed reference from fieldbus is written as 20000. Reference is not limited to P2.2.3 but continues linearly.



Process Speed is also reference point for ramp times. Set ramp time will correspond from zero speed to process speed.

**Note:** If process speed higher than 6500,0 rpm is needed see parameter Process Frequency.

#### Limits for Process Speed in Hz:

- 1 pole pair = 108 Hz
- 2 pole pair = 216 Hz
- 3 pole pair = 325 Hz,

#### P2.2.2 Fieldbus reference scale ID899 "FB Ref Scale"

The speed reference range from fieldbus is from –32767 to 32767. It can be scaled to the Process speed (P2.2.1) with this parameter. The value of this parameter corresponds to the RPM value in Process speed (P2.2.1). The default value is 20000. Hence the speed reference of 20000 from fieldbus corresponds to Process speed (P2.2.1) rpm reference. This is not limiting factor for reference.

**Note:** Full accuracy of fieldbus reference scale is available only when using fast fieldbus communication. In normal mode accuracy is 0,01 Hz regardless of FB Ref Scale. With fast fieldbus communication and FB Ref Scale 20000, accuracy is 0,0025 Hz.

### **P2.2.3      Torque reference scale      ID1247      “Torque Scale”**

With this parameter the default resolution of torque reference 1000 = motor nominal torque can be changed to 10000 = motor nominal torque.

**NOTE!** This function is available for closed loop control only.

**0** 1000: (100,0 %)

**1** 10000: (100,00 %)

All the torque related signals and parameters are changed and displayed automatically in the same scale.

Parameters affected by this are presented below, and values should be checked before starting the drive, values are not automatically changed when torque format is changed:

**P2.2.12.2      Torque Ref Max**

**P2.2.12.3      Torque Ref Min**

**P2.2.12.5      TorqueRefDeadZone**

**P2.2.12.6      Torque Ref. Hyst**

**P2.2.12.12 Torque Step**

**P2.2.12.13 Torque Ref. Add**

**P2.3.13.4      Quick Stop T Lim**

**P2.6.3.1      Torque Limit**

**P2.6.3.2      MotorTorqueLimit**

**P2.6.3.3      GenerTorqueLimit**

**P2.6.3.6.1      SPC Out Limit**

**P2.6.3.6.2      SPC Pos Limit**

**P2.6.3.6.3      SPC Neg Limit**

**P2.6.5.8      BrakeResTorqLim**

**P2.6.5.12.2 CL OV ConMotTLim**

**P2.9.5.9      SPC Torq Min**

**P2.12.7.2      UP F0 Torque**

**P2.12.7.3      UP Fnom Torque**

**P2.15.9      MaxTorqLim**

**P2.2.4 I/O Control Reference selection ID117 "I/O Contr.RefSel"**

Defines which speed reference source is used when control place is I/O terminal P3.1

**0="AI1" - Analogue Input 1.**

Signal scaling in "G2.4.2: Input Signals \ Analogue Input 1"

**1="AI2" - Analogue Input 2.**

Signal scaling in "G2.4.3: Input Signals \ Analogue Input 2"

**2="AI1+AI2" - Analogue Input 1 + Analogue Input 2.**

With alternative reference scaling in Analogue Input group 100 % input values can be set to correspond 25 Hz thus when both are at 100 % final reference will be 50 Hz.

**3="AI1-AI2"**

Analogue Input 1 - Analogue Input 2.

**4="AI2-AI1"**

Analogue Input 2 - Analogue Input 1.

**5="AI1xAI2"**

Analogue Input 1 x Analogue Input 2

**6="AI1 Joystick"**

Analogue input 1, -10 Vdc... +10 Vdc

**NOTE:** Use of 0-10 Vdc signal or 4-20 mA signal will make drive run to full speed if broken wire.

**7="AI2 Joystick"**

Analogue input 2, -10 Vdc... +10 Vdc

**NOTE:** Use of 0-10 Vdc signal or 4-20 mA signal will make drive run to full speed if broken wire.

**8="Keypad Ref"**

Reference from keypad R3.2

**9="Fieldbus"**

Reference is taken from Fieldbus, alternative scaling can be selected in "G: Fieldbus"

**10="Motor Pot" - Motor potentiometer.**

Reference handled with two digital input "G: Input Signals \ Digital Inputs" (increase and decrease). Behaviour adjusted in "G: Ref Handling \ Motor Poten.mete".

**11="AI1, AI2 min"**

The minimum of Analogue Input 1 and Analogue Input 2 is used as reference.

**12="AI1, AI2 max"**

The maximum from Analogue Input 1 and Analogue Input 2 is used as reference.

**13="Process Speed" –**

P2.2.1 Process Speed is used as reference.

**14="AI1/AI2 Sel" – AI1/AI2 Selection**

Digital Input "I/O Ref 1/2" is used to select between Analogue Input 1 and Analogue Input 2 reference. "I/O Ref 1/2" is used to select between "I/O Reference" and "I/O Reference 2" if selection is different than 14 (this one).

**15="Encoder 1"**

Reference is read from encoder input 1.

**16="Encoder 2"**

Reference is read from encoder input 2. This selection is usable with double encoder boards. Could be used e.g. for speed synchronization where two motor needs to run at same speed but not necessarily same angle.

**17="Master Ref"**

Drive reads master drive reference and uses own ramp time.

**18="Master Ramp"**

Drive reads master drive final reference and uses master drive ramp. Drive own ramp times are bypassed.

**P2.2.5      Keypad Control speed reference selection      ID121      "KeypadContRefSel"**

Defines which speed reference source is used when control place is keypad P3.1

**0="AI1" - Analogue Input 1.**

Signal scaling in "G2.4.3: Input Signals \ Analogue Input 1"

**1="AI2" - Analogue Input 2.**

Signal scaling in "G2.4.4: Input Signals \ Analogue Input 2"

**2="AI1+AI2" - Analogue Input 1 + Analogue Input 2.**

With alternative reference scaling in Analogue Input group 100 % input values can be set to correspond 25 Hz. That is, when both are at 100 % final reference will be 50 Hz.

**3="AI1-AI2"**

Analogue Input 1 - Analogue Input 2.

**4="AI2-AI1"**

Analogue Input 2 - Analogue Input 1.

**5="AI1xAI2"**

Analogue Input 1 x Analogue Input 2

**6="AI1 Joystick"**

Analogue input 1, -10 Vdc... +10 Vdc

**7="AI2 Joystick"**

Analogue input 2, -10 Vdc... +10 Vdc

**8="Keypad Ref"**

Reference from keypad R3.2

**9="Fieldbus"**

Reference is taken from Fieldbus, alternative scaling can select in "G: Fieldbus"

**10="Motor Pot" - Motor potentiometer.**

Reference handled with two digital input "G: Input Signals \ Digital Inputs" (increase and decrease). Behaviour adjusted in "G: Ref Handling \ Motor Poten.mete".

**11="AI1, AI2 min"**

The minimum of Analogue Input 1 and Analogue Input 2 is used as reference.

**12="AI1, AI2 max"**

The maximum from Analogue Input 1 and Analogue Input 2 is used as reference.

**13="ProcessSpeed" – Process Speed**

P2.2.1 Process Speed is used as reference.

**14="AI1/AI2 Sel" – AI1/AI2 Selection**

Digital Input "I/O Ref 1/2" is used to select between Analogue Input 1 and Analogue Input 2 reference. "I/O Ref 1/2" is used to select between "I/O Reference" and "I/O Reference 2" if selection is different than 14 (this one).

**15="Encoder 1"**

Reference is read from encoder input 1.

**16="Encoder 2"**

Reference is read from encoder input 2. This selection is usable with double encoder boards. Could be used e.g. for speed synchronization where two motor needs to run at same speed but not necessarily same angle.

**17="Master Ref"**

Drive reads master drive reference and uses own ramp time.

**18="Master Ramp"**

Drive reads master drive final reference and uses master drive ramp. Drive own ramp times are bypassed.



**P2.2.6      *Fieldbus Control Speed reference selection ID122      "FieldbusContRefs"***

Defines which speed reference source is selected when control place is Fieldbus P3.1.

**0="AI1" - Analogue Input 1.**

Signal scaling in "G2.4.3: Input Signals \ Analogue Input 1"

**1="AI2" - Analogue Input 2.**

Signal scaling in "G2.4.4: Input Signals \ Analogue Input 2"

**2="AI1+AI2" - Analogue Input 1 + Analogue Input 2.**

With alternative reference scaling in Analogue Input group 100 % input values can be set to correspond 25 Hz thus when both are at 100 % final reference will be 50 Hz.

**3="AI1-AI2"**

Analogue Input 1 - Analogue Input 2.

**4="AI2-AI1"**

Analogue Input 2 - Analogue Input 1.

**5="AI1xAI2"**

Analogue Input 1 x Analogue Input 2

**6="AI1 Joystick"**

Analogue input 1, -10 Vdc... +10 Vdc

**7="AI2 Joystick"**

Analogue input 2, -10 Vdc... +10 Vdc

**8="Keypad Ref"**

Reference from keypad R3.2

**9="Fieldbus"**

Reference is taken from Fieldbus, alternative scaling can select in "G: Fieldbus"

**10="Motor Pot" - Motor potentiometer.**

Reference handled with two digital input "G: Input Signals \ Digital Inputs" (increase and decrease). Behaviour adjusted in "G: Ref Handling \ Motor Poten.mete".

**11="AI1, AI2 min"**

The minimum of Analogue Input 1 and Analogue Input 2 is used as reference.

**12="AI1, AI2 max"**

The maximum from Analogue Input 1 and Analogue Input 2 is used as reference.

**13="ProcessSpeed" – Process Speed**

P2.2.1 Process Speed is used as reference.

**14="AI1/AI2 Sel" – AI1/AI2 Selection**

Digital Input "I/O Ref 1/2" is used to select between Analogue Input 1 and Analogue Input 2 reference. "I/O Ref 1/2" is used to select between "I/O Reference" and "I/O Reference 2" if selection is different than 14 (this one).

**15="Encoder 1"**

Reference is read from encoder input 1.

**16="Encoder 2"**

Reference is read from encoder input 2. This selection is usable with double encoder boards. Could be used e.g. for speed synchronization where two motor needs to run at same speed but not necessarily same angle.

**17="Master Ref"**

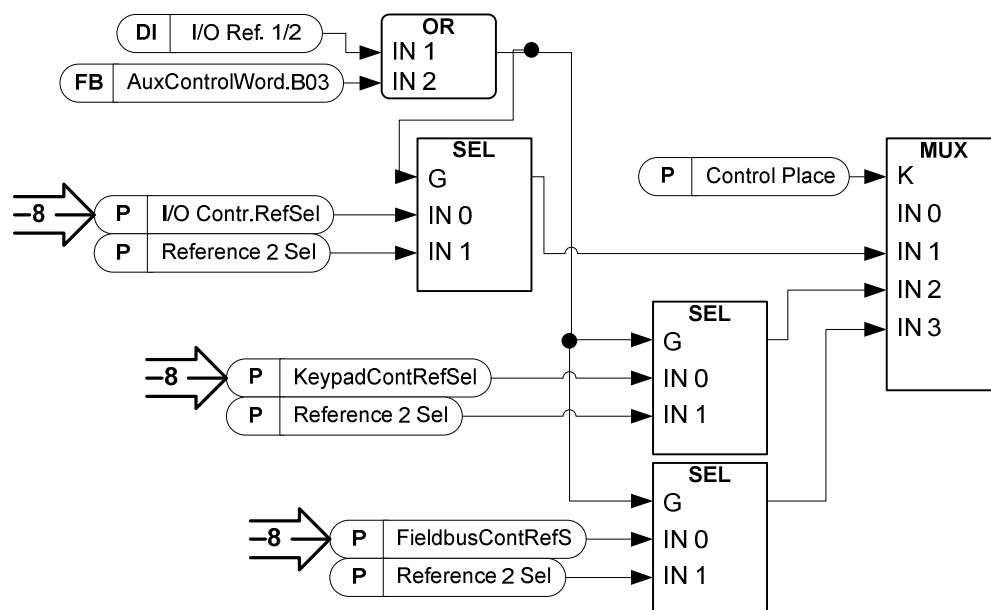
Drive reads master drive reference and uses own ramp time.

**18="Master Ramp"**

Drive reads master drive final reference and uses master drive ramp. Drive own ramp times are bypassed.

**P2.2.7 Reference 2 selection ID131 “Reference 2 Sel”**

This parameter is used to select different reference input location with digital input P2.4.2.14 I/O Ref. 1/2. Selections for this are the same as for the I/O speed reference selection 1.



Other parameters related to function

- Digital input P2.4.2.14 I/O Ref. 1/2, reference location when activated.
- AuxControlWord.B3, same command from fieldbus.

**P2.2.8 Speed share ID1241 “Speed Share”**

Defines speed reference percentage ratio after final reference location but before ramp control. Monitoring value “FreqReference” shows reference after speed share function. Used to adjust reference ration e.g. in line drive that PLC can give same reference to all drives while speed share compensate gear ratio affect to the line speed.

**P2.2.9 Load Share ID1248 “Load Share”**

Defines torque reference percentage ratio. After final torque reference location selection but before the torque reference step function and torque reference dead zone and reference filtering.

**P2.2.10 Minimum Speed ID101 “Min Speed”**

Defines minimum speed of any adjustable reference input (i.e. reference is not a parameter). Minimum speed is bypassed when jogging speed or inching reference is used.

### 7.2.2 Constant Reference

#### P2.2.11.1 Inching speed reference ID124 "Inching Ref 1"

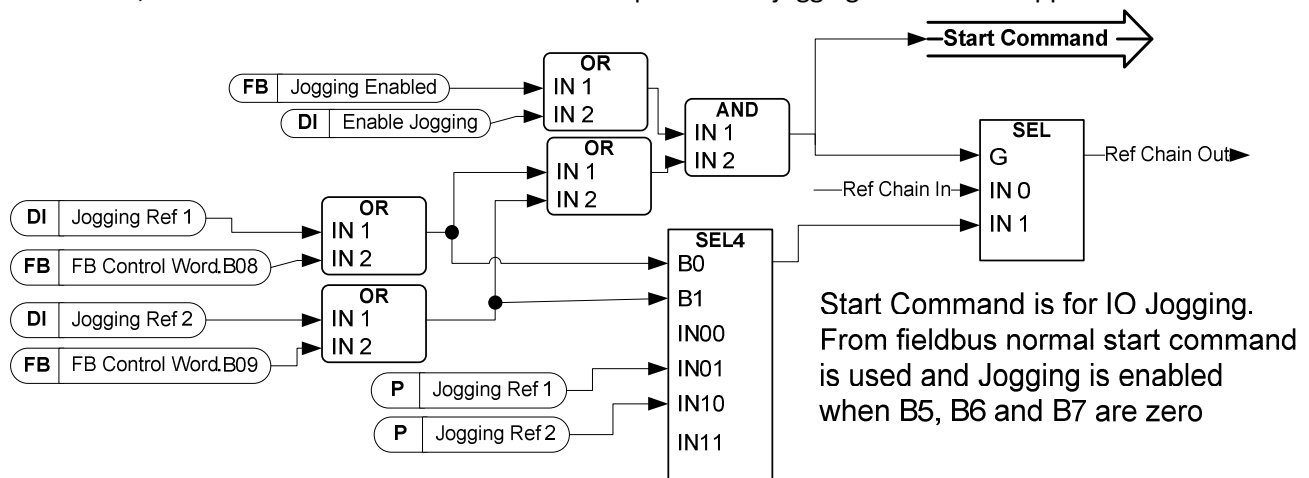
Defines the inching speed reference when activated by a digital input. This reference will follow the reverse command if given. Related parameters

- Digital Input P2.4.2.13 Inching Speed

#### 7.2.2.1 Jogging function

**I/O Jogging Command:** Jogging function will start the drive to reference without additional start command regardless of control place when given from IO. Jogging function requires enabling from digital input before command is accepted. Inching is also disabled if there is start command active from active control place. If both inching references are active at the same time drive will stop.

**Fieldbus Jogging Command:** Jogging command is activated by CW.B7 or CW.B8 command but the ramp control bits CW.B4, B5 & B6 needs to be zero. Drive needs to be at zero speed before command is accepted and CW.B4, B5 & B6 are active after drive is at zero speed when jogging function is stopped.



#### P2.2.11.2 Jogging reference 1 ID1239 "Jogging Ref 1"

#### P2.2.11.3 Jogging reference 2 ID1240 "Jogging Ref 2"

These parameters define the reference for the Jogging function. The references are bidirectional and the reverse command does not affect the direction of the jogging reference.

Other parameters for Jogging function

- Digital input selection: Enable Jogging
- Digital input selection: Jogging 1
- Digital input selection: Jogging 2
- Parameter: Jogging Ramp

#### P2.2.11.4 Preset speed 1 ID105 "Preset Speed 1"

#### P2.2.11.5 Preset speed 2 ID106 "Preset Speed 2"

#### P2.2.11.6 Preset speed 3 ID126 "Preset Speed 3"

#### P2.2.11.7 Preset speed 4 ID127 "Preset Speed 4"

#### P2.2.11.8 Preset speed 5 ID128 "Preset Speed 5"

#### P2.2.11.9 Preset speed 6 ID129 "Preset Speed 6"

#### P2.2.11.10 Preset speed 7 ID130 "Preset Speed 7"

Parameter values define the Preset speeds references activated by digital inputs. These references will follow reverse command if given.

Speed	Digital Input Preset speed 1	Digital Input Preset speed 2	Digital Input Preset speed 3
Basic speed	0	0	0
Preset Speed 1	1	0	0
Preset Speed 2	0	1	0
Preset Speed 3	1	1	0
Preset Speed 4	0	0	1
Preset Speed 5	1	0	1
Preset Speed 6	0	1	1
Preset Speed 7	1	1	1

Table 7-1. Preset speeds 1 to 7

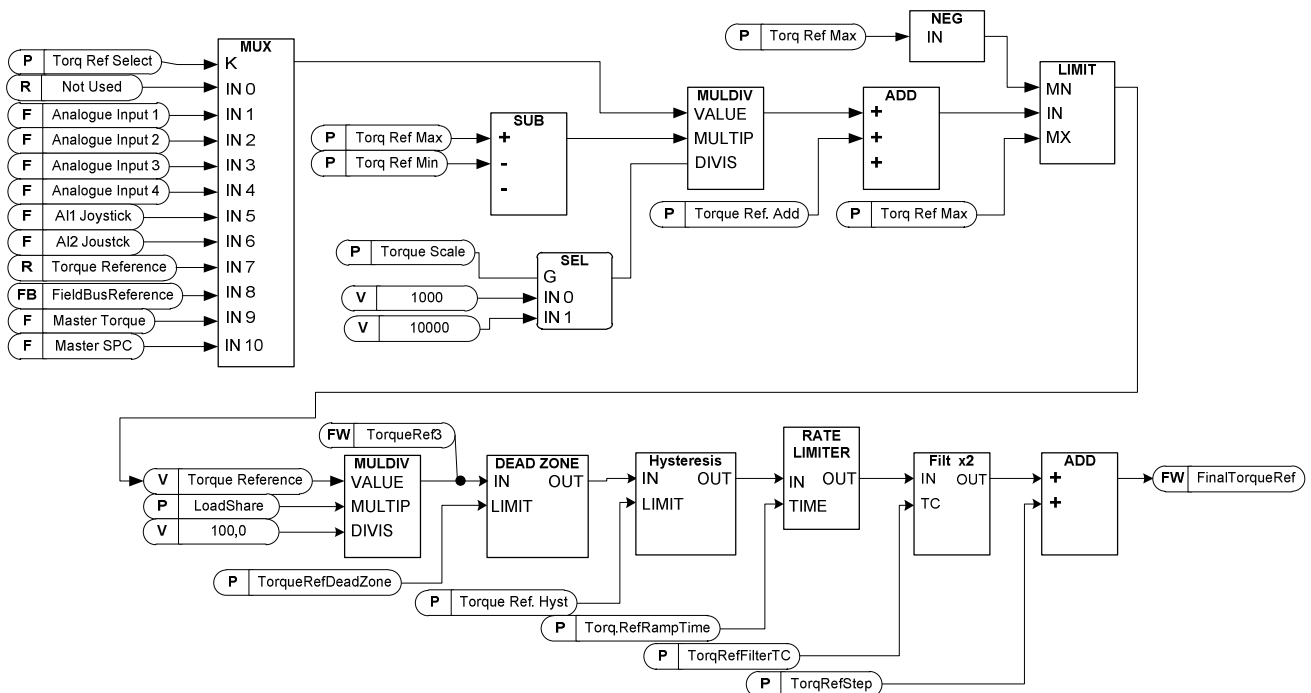
Related parameters

Digital inputs P2.4.2.5-7 Preset Speed 1-3

### 7.2.3 Torque Reference

Motor torque is controlled which allows the motor speed to change depending on the actual load on the motor shaft. Speed limit behaviour is controlled by P2.2.9.6 TorqSpeedLimit parameter.

For joystick inputs maximum negative reference is negated "Torq Ref Max". The minimum is used only for analogue input selections 1 to 4. Also the maximum negative torque reference maximum is negated "Torq Ref Max".



#### P2.2.12.1 Torque reference selection

#### ID641 "Torq Ref Select"

**0="Not Used"**

**1="AI1" - Analogue Input 1.**

Signal scaling in "G: Input Signals \ Analogue Input 1"

**2="AI2" - Analogue Input 2.**

Signal scaling in "G: Input Signals \ Analogue Input 2"

**3="AI3"**

Signal scaling in "G: Input Signals \ Analogue Input 3"

**4="AI4"**

Signal scaling in "G: Input Signals \ Analogue Input 4"

**5="AI1 Joystick"**

Analogue input 1, -10 Vdc... +10 Vdc. For joystick inputs the maximum negative reference is negated "Torq Ref Max".

**6="AI2 Joystick"**

Analogue input 2, -10 Vdc... +10 Vdc For joystick inputs the maximum negative reference is negated "Torq Ref Max".

**7="Keypad Ref"**

Torque reference from keypad R3.5.

**8="Fieldbus"**

Reference is taken from Fieldbus. When this reference location is used reference is not scaled. Scaling parameters works as a reference limits.

**9="Master Torque"**

Reference is taken from Master drive when using Master Follower function. When this reference location is used reference is not scaled. Scaling parameters do not have any affect

**10="Master SPC."**

Torque reference is taken from master drive speed controller output. E.g. Acceleration compensation is not included in this reference. When this reference location is used reference is not scaled. Scaling parameters do not have any affect

**P2.2.12.2 Torque reference scaling, maximum value ID641 "Torq Ref Max"**

Maximum allowed torque reference for positive and negative values. This is also used for joystick input for negative maximum limit.

**P2.2.12.3 Torque reference scaling, minimum value ID642 "Torq Ref Min"**

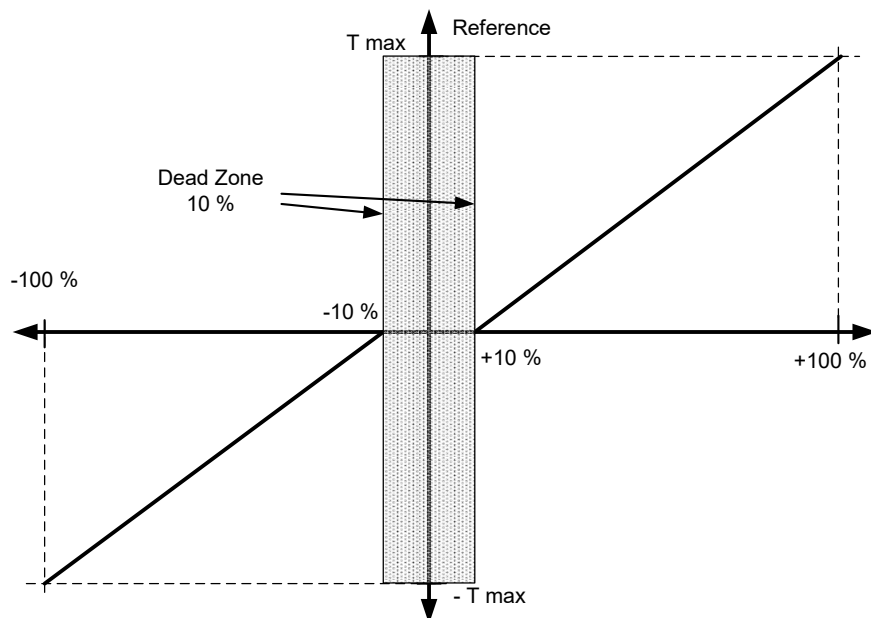
Minimum torque reference for analogue input reference selections 1-4.

**P2.2.12.4 Torque reference filtering time ID1244 "TorqRefFilterTC"**

Filtering time for torque reference. Filtering is after load share function and before torque step function.

**P2.2.12.5 Torque reference dead zone ID1246 "TorqRefDeadZone"**

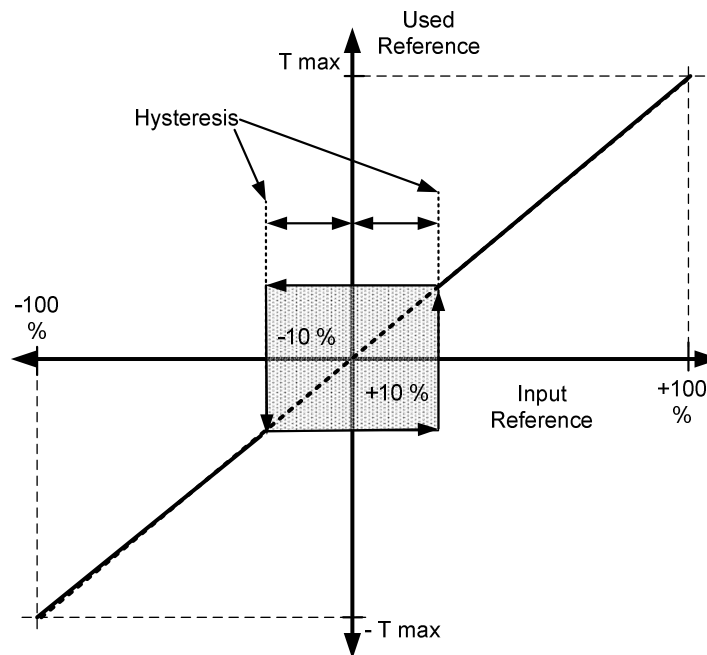
The small values of the torque reference around zero can be ignored by setting this value greater than zero. When reference is between zero to plus/minus this parameter, the reference is forced to zero.





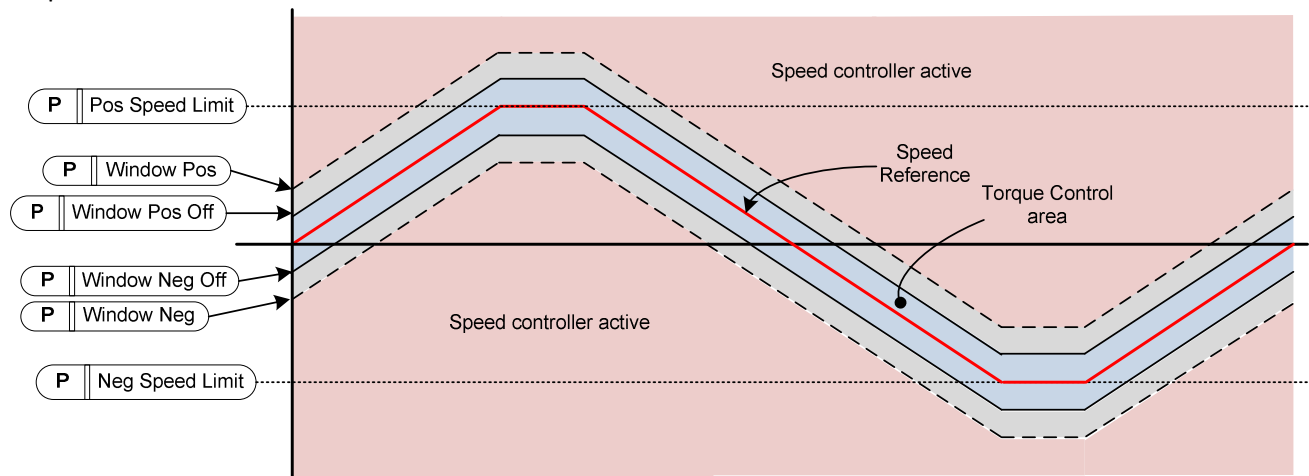
### P2.2.12.6 Torque reference Hysteresis ID1245 “Torque Ref. Hyst”

Torque Reference Hysteresis determines hysteresis band around the zero torque reference value. If a torque reference is between zero to plus / minus Torque Reference Hysteresis, the output is set to plus / minus Torque Reference Hysteresis, depending on the value before hysteresis band. If the value of the Torque Reference Hysteresis is negative, or smaller than the absolute value of the Torque Reference Dead Zone, then the hysteresis operation is bypassed.



### 7.2.3.1 Window Control

In the window control the drive is torque controlled in defined speed window. The drive operates in torque control mode until actual speed is out of window. When the actual speed is out of window the drive operates in speed control.



#### P2.2.12.7 Window negative ID1305 "Window Neg"

Defines the size of window to negative direction from the final speed reference. If both windows off limits are zero this parameter is also the speed limit from the "FinalFreqRef". Otherwise this is the speed control activation limit.

#### P2.2.12.8 Window positive ID1304 "Window Pos"

Defines the size of window to positive direction from the final speed reference. If both windows off limits are zero this parameter is also the speed limit from the "FinalFreqRef". Otherwise this is the speed control activation limit.

#### P2.2.12.9 Window negative Off limit ID1307 "Window Neg Off"

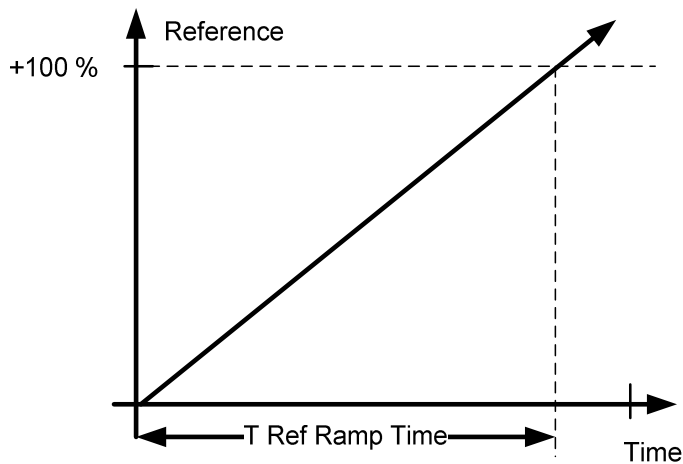
Defines the speed controller negative off limit when the speed controller brings the speed back to window.

#### P2.2.12.10 Window positive Off limit ID1306 "Window Pos Off"

Defines speed controller positive off limit when speed controller brings speed back to window.

**P2.2.12.11 Torque Reference Ramp time ID1249 "Torq.RefRampTime"**

Defines time when reference from 0 % to 100 % is completed.

**P2.2.12.12 Torque step ID1253 "Torque Step"**

Step torque reference in percentage of motor nominal torque. Added after the filtering function and ramp function.

This step reference is normally used for the inertia/friction compensation of the drive system through fieldbus in fieldbus control. E.g. the inertia compensation for winder or unwinder roll can be written from fieldbus to this parameter.

**P2.2.12.13 Torque Reference Add ID1264 "Torque Ref. Add"**

Step torque reference in percentage of motor nominal torque. Added before the filtering function and ramp function.

This step reference is normally used for the inertia/friction compensation of the drive system through fieldbus in fieldbus control. E.g. the inertia compensation for winder or unwinder roll can be written from fieldbus to this parameter.

.

**7.2.3.2 Torque reference OL settings****P2.2.12.14.1 Open loop torque control minimum speed ID636 "OL TC Min RPM"**

Defines the speed limit below which the drive operates in *speed control mode*. i.e. drive speed will not go below this value while speed limit itself is not below this value.

**P2.2.12.14.2 Open loop torque controller P gain ID639 "OL TorqCtrl P"**

Defines the gain for open loop torque control.

**P2.2.12.14.3 Open loop torque controller I gain ID640 "OL TorqCtrl I"**

Defines the integration gain for open loop torque control.

### 7.2.4 Prohibited speed

In some systems it may be necessary to avoid certain speeds because of mechanical resonance problems. With these parameters it is possible to set limits for the prohibited speed region and ramp rate factor to use when speed is going above this area. When the input reference is increased the internal reference is kept at the low limit until the input reference is above the high limit.

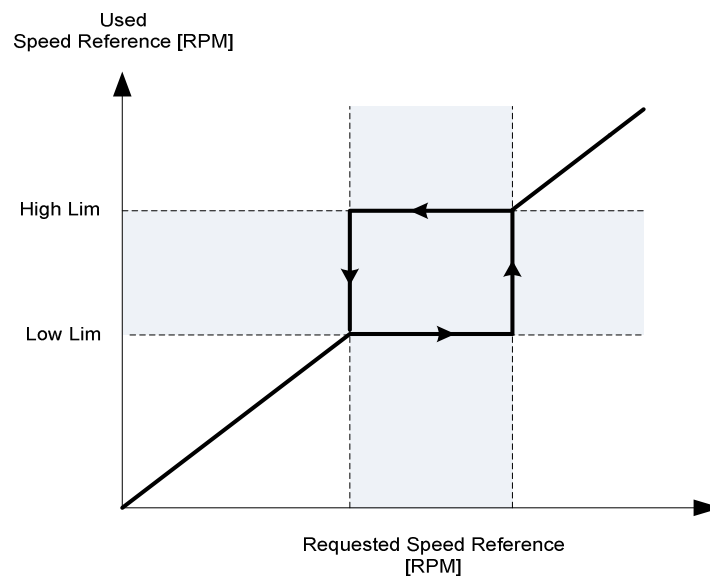
**P2.2.13.1 Prohibit speed area 1; Low limit**

**ID509 "Range 1 Low Lim"**

**P2.2.13.2 Prohibit speed area 1; High limit**

**ID510 "Range 1 High Lim"**

Range definition where a different ramp time defined by "RampTimeFactor" is used.



**P2.2.13.3 Ramp time factor for prohibited range**

**ID518 "RampTimeFactor"**

Multiplier of the currently selected ramp time between prohibit speeds limits.

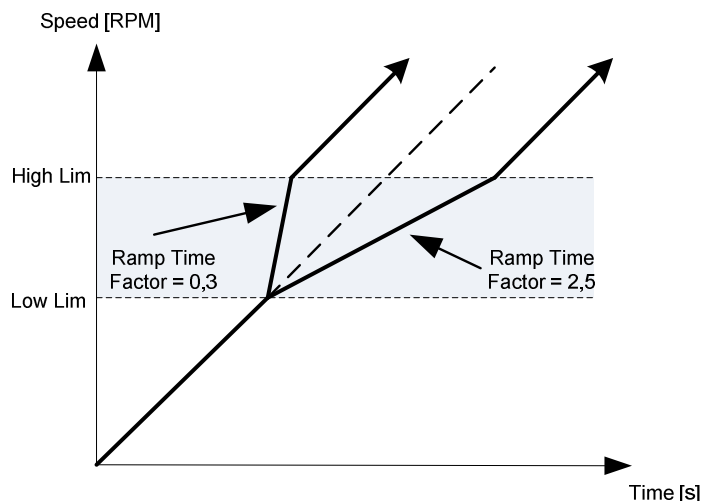
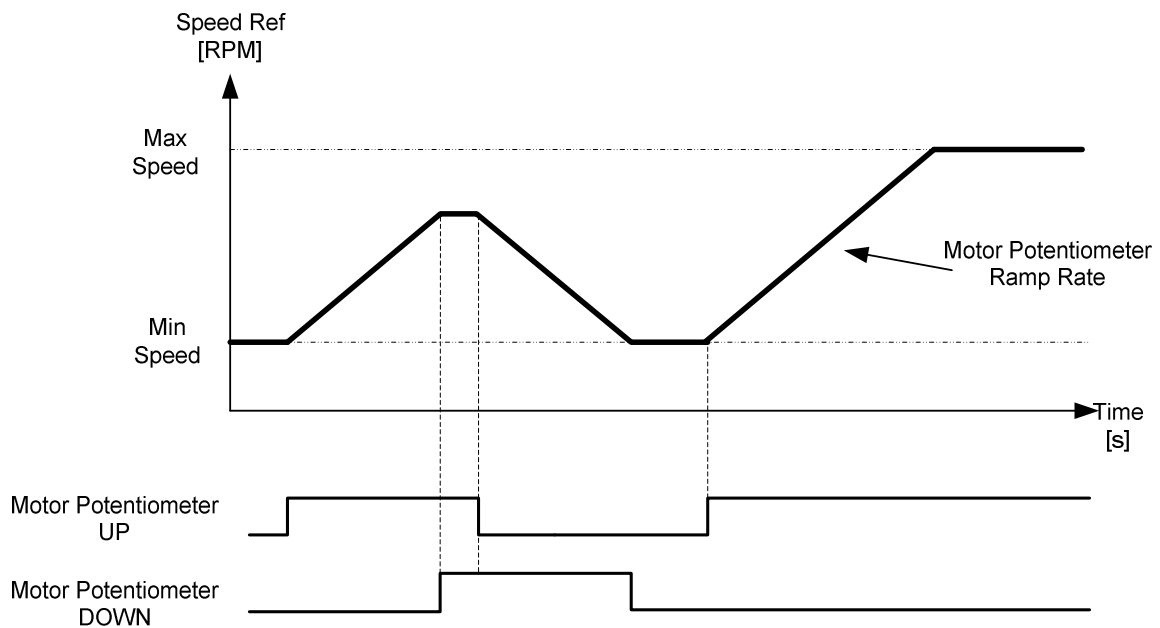


Figure 7-1. Ramp rate scaling between prohibit speeds

### 7.2.5 Motor potentiometer

Motor potentiometer is used to control the reference with two digital inputs, one increasing the reference and the other decreasing the reference. The reference change rate can be set by parameter [Hz/s]. Motor

potentiometer reference is available in I/O control only. It can be changed only when the drive is in running state.



#### **P2.2.14.1 Motor potentiometer ramp rate ID331 “MotPot Ramp Rate”**

Defines the rate of change of the motor potentiometer reference value in Hz/s. Normal ramp times are still active and determine how fast the actual speed increases.

#### **P2.2.14.2 Motor potentiometer reference reset ID367 “MotPotRef Reset”**

##### **0 “No reset”**

Reference is kept past the stop state and stored to memory in case of a powerdown.

##### **1 “Stop State”**

Reference is set to zero when the drive is in stop state. This selection includes powerdown situations.

##### **2 “Power Down”**

Reference is reset only in a powerdown situation.

Other parameters related to function

- P2.4.2.5 Motor potentiometer DOWN ID417 “Mot Pot Ref Down”
- P2.4.2.6 Motor potentiometer UP ID418 “Mot Pot Ref Up”

**P2.2.14.3 Motor potentiometer reference copy ID366 "MotPotRefCopy"**

This parameter defines how reference is handled when reference input is changed to motor potentiometer in I/O control.

**0 "No copy"**

Reference is not copied. Depending on "MotPot Reset" function, the drive may start from minimum speed or from reference that was last used when the drive was run with motor potentiometer.

**1 "Reference"**

The drive's active reference is copied. If the drive is ramping when the value of motor potentiometer is changed the drive will continue ramping after the change.

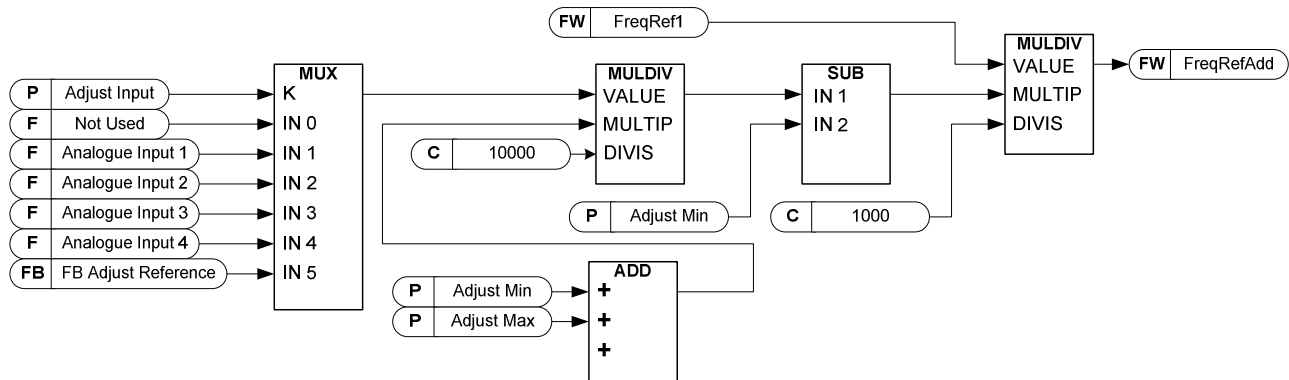
This allows the reference copy in stop state unless the "MotPot Reset" function overruns it (e.g. reset in stop state is not selected).

**2 "Freq. Output"**

Speed at the time of change is copied to reference. If the drive is ramping when the change is made the drive will stop ramping and keep the present speed.

### 7.2.6 Adjust Reference

Adjust reference function is used to fine tune the main reference. Adjust reference is added to main reference after “Speed Share” function.



#### P2.2.15.1 Adjust input ID493 “Adjust Input”

With this parameter you can select the signal according to which the speed reference to the motor is fine adjusted.

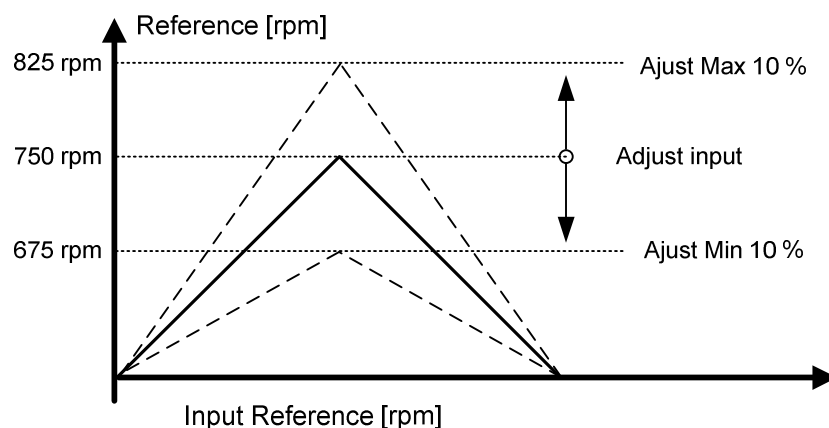
- 0 Not used
- 1 Analogue input 1
- 2 Analogue input 2
- 3 Analogue input 3
- 4 Analogue input 4
- 5 FB Adjust Reference ID47 Monitoring Signal

#### P2.2.15.2 Adjust minimum ID494 “Adjust minimum”

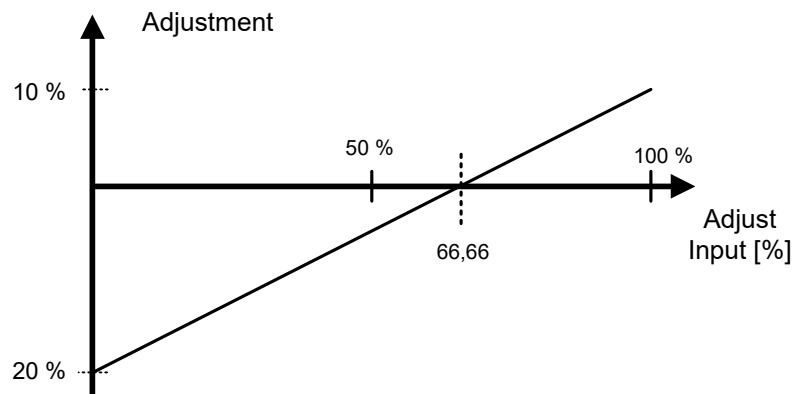
Percentage that is subtracted from the main reference when adjust input is at minimum.

#### P2.2.15.3 Adjust maximum ID495 “Adjust Maximum”

These parameters define the minimum and maximum of adjusted signals.



If minimum and maximum are not equal, adjustment is not at the middle point of analogue input or at zero point if -10...+10 Vdc input is used. Below picture minimum is 20 % and maximum 10 %.



#### **P2.2.15.4** *Speed step ID1252* **"Speed Step"**

This step reference is normally used to give speed steps during the speed controller tuning in closed loop motor control operation and can also be used as a fast speed correction from fieldbus. This parameter uses P2.2.2 Fieldbus reference scaling. Reference step is given after ramp controller.



### 7.2.7 Follower Reference

#### P2.2.16.1 Follower reference selection ID1081 "Follower Ref Sel"

Select where the follower drive receives its speed reference from.

##### 0="AI1" - Analogue Input 1.

Signal scaling in "G: Input Signals \ Analogue Input 1"

##### 1="AI2" - Analogue Input 2.

Signal scaling in "G: Input Signals \ Analogue Input 2"

##### 2="AI1+AI2" - Analogue Input 1 + Analogue Input 2.

With alternative reference scaling in Analogue Input group, 100 % input values can be set to correspond 25 Hz. In other words, when both are 100% the final reference will be 50 Hz.

##### 3="AI1-AI2"

Analogue Input 1 minus Analogue Input 2.

##### 4="AI2-AI1"

Analogue Input 2 minus Analogue Input 1.

##### 5="AI1xAI2"

Analogue Input 1 x Analogue Input 2

##### 6="AI1 Joystick"

Analogue input 1, -10 Vdc... +10 Vdc

##### 7="AI2 Joystick"

Analogue input 2, -10 Vdc... +10 Vdc

##### 8="Keypad Ref"

Reference from keypad R3.2

##### 9="Fieldbus"

Reference is taken from fieldbus. Alternative scaling can be selected in "G: Fieldbus"

##### 10="Motor Pot" - Motor potentiometer

Reference handled with two digital inputs "G: Input Signals \ Digital Inputs" (increase and decrease). Behaviour adjusted in "G: Ref Handling \ Motor Poten.mete".

##### 11="AI1, AI2 min"

The smaller of Analogue Input 1 and Analogue Input 2 is used as reference.

##### 12="AI1, AI2 max"

The greater of Analogue Input 1 and Analogue Input 2 is used as reference.

##### 13="ProcessSpeed" – Process Speed

P2.2.1 Process Speed is used as reference.

##### 14="AI1/AI2 Sel" – AI1/AI2 Selection

The digital input "I/O Ref 1/2" is used to select between Analogue Input 1 and Analogue Input 2 reference. "I/O Ref 1/2" is used to elect between "I/O Reference" and "I/O Reference 2" if selection of this parameter is different from 14 (this one).

**15="Encoder 1"**

Reference is read from encoder input 1.

**16="Encoder 2"**

Reference is read from encoder input 2. This selection is usable with double encoder boards. Could be utilized e.g. for speed synchronization.

**17 "Master Ref"**

Master reference before ramp generator. When this is selected the follower drive's own ramp times are active and used.

**18 "Master Ramp"**

Master reference after ramp generator, before speed controller. When this is selected the follower drive will use the ramp times defined by the Master drive.

**P2.2.16.2 Follower torque reference selection ID1083 "FollowerTorq Sel"**

Select the source of torque reference for the follower drive.

**0="Not Used"**

**1="AI1" - Analogue Input 1.**

Signal scaling in "G: Input Signals \ Analogue Input 1"

**2="AI2" - Analogue Input 2.**

Signal scaling in "G: Input Signals \ Analogue Input 2"

**3="AI3"**

Signal scaling in "G: Input Signals \ Analogue Input 3"

**4="AI4"**

Signal scaling in "G: Input Signals \ Analogue Input 4"

**5="AI1 Joystick"**

Analogue input 1, -10 Vdc... +10 Vdc. For joystick inputs, the maximum negative reference is the negative of "Torq Ref Max".

**6="AI2 Joystick"**

Analogue input 2, -10 Vdc... +10 Vdc For joystick inputs maximum negative reference is the negative of "Torq Ref Max".

**7="Keypad Ref"**

Torque reference from keypad R3.5

**8="Fieldbus"**

Reference is taken from fieldbus. Alternative scaling can be selected in "G: Fieldbus"

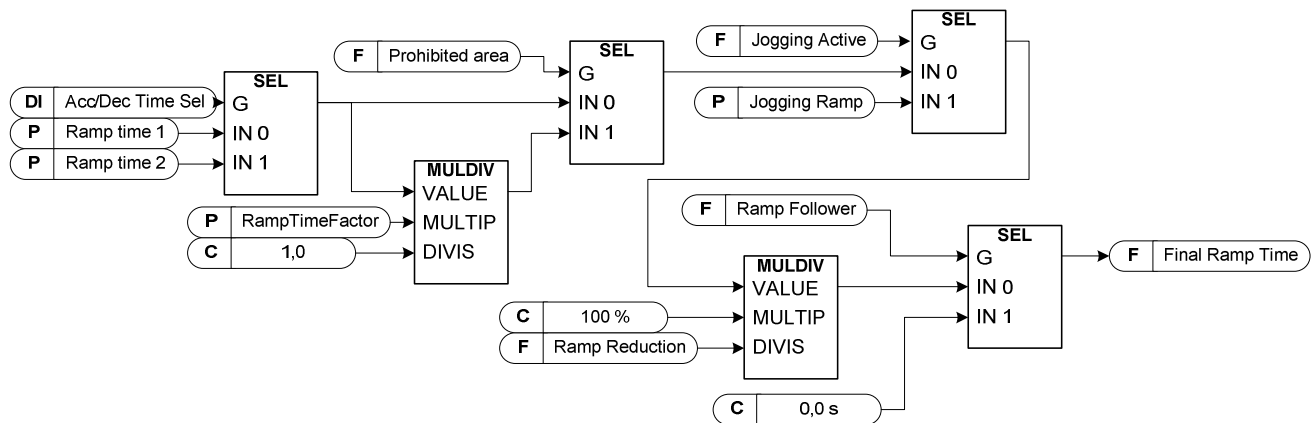
**9="Master Torque"**

Reference is taken from Master drive when using the Master Follower function.

**10="Master SPC"**

Reference is taken from Master speed controller output i.e. reference do not include master drive acceleration compensation.

### 7.3 Ramp control



#### P2.3.1 Start function ID505 "Start Function"

Ramp:

- 0** The frequency converter starts from 0 Hz and accelerates to the set reference frequency within the set acceleration time.

Flying start:

- 1** The frequency converter is able to start with motor running by applying current to motor and searching for the frequency corresponding to the speed the motor is running at. When activated in closed loop control drive will not wait 90 % flux level before releasing reference, reference is released immediately.

Use this mode if the motor is coasting when the start command is given. With the flying start it is possible to start motor from actual speed without forcing the speed to zero before ramping to reference.

Closed loop control will always start like flying start because exact speed of the motor is known from encoder feedback.

#### P2.3.2 Stop function ID506 "Stop Function"

Coasting:

- 0** Drive stops controlling the motor immediately and let's motor rotate freely.

Ramp:

- 1** After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters to zero speed. DI "Run Enable" will make coasting stop regardless of selected stop function.

#### P2.3.3 Acceleration time 1 ID103 "Accel Time 1"

This parameter defines the time required for the speed to increase from the zero speed to Process Speed.

#### P2.3.4 Deceleration time 1 ID104 "Decel Time 1"

This parameter defines the time required for the speed to decrease from the process speed to zero speed.

### P2.3.5 Acceleration/Deceleration ramp 1 shape ID500 "Ramp 1 Shape"

The start and end of acceleration and deceleration ramps can be smoothed with these parameters. Setting value **0 %** gives a linear ramp shape which causes acceleration and deceleration to act immediately to the changes in the reference signal. Setting value 1...100 % for this parameter produces an S-shaped acceleration/deceleration.

Used to reduce mechanical erosion and current spikes when reference is changed.

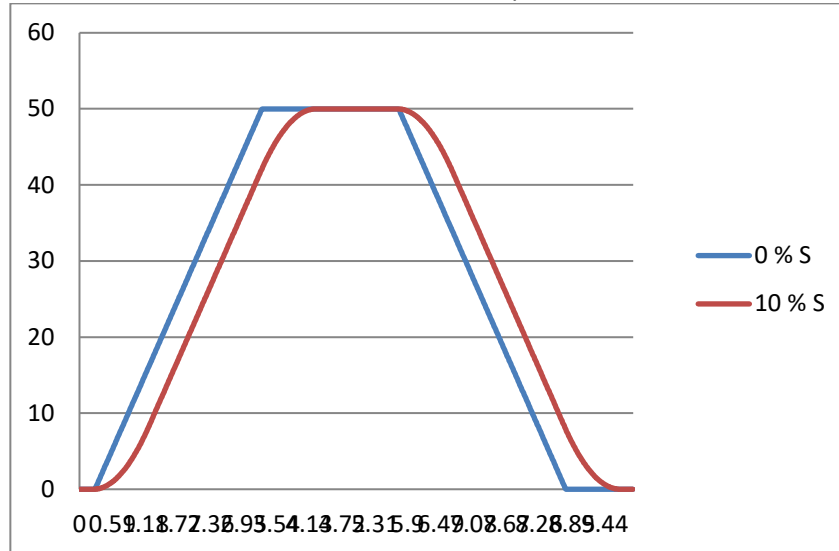


Figure 7-2. 10 % S ramp with 3 s ramp time compared to without S ramp

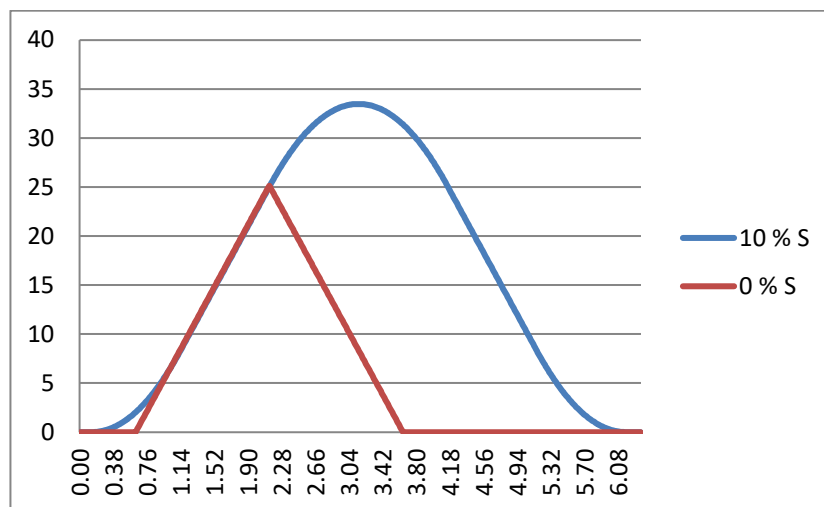


Figure 7-3. 10 % S ramp with 3 s ramp time when reference set to zero at 25 Hz

### P2.3.6 Acceleration time 2

ID502 "Accel Time 2"

### P2.3.7 Deceleration time 2

ID503 "Decel Time 2"

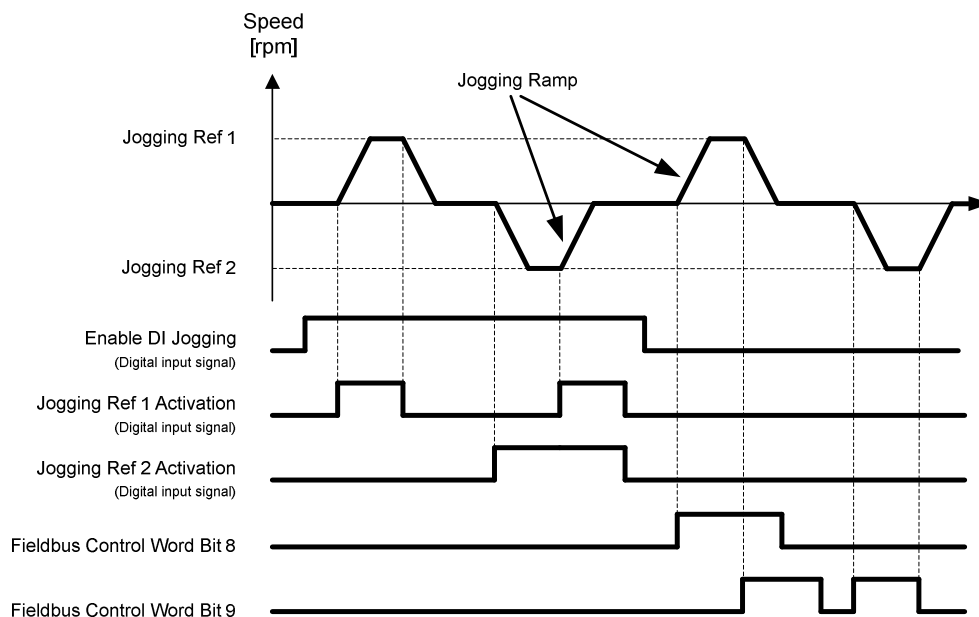
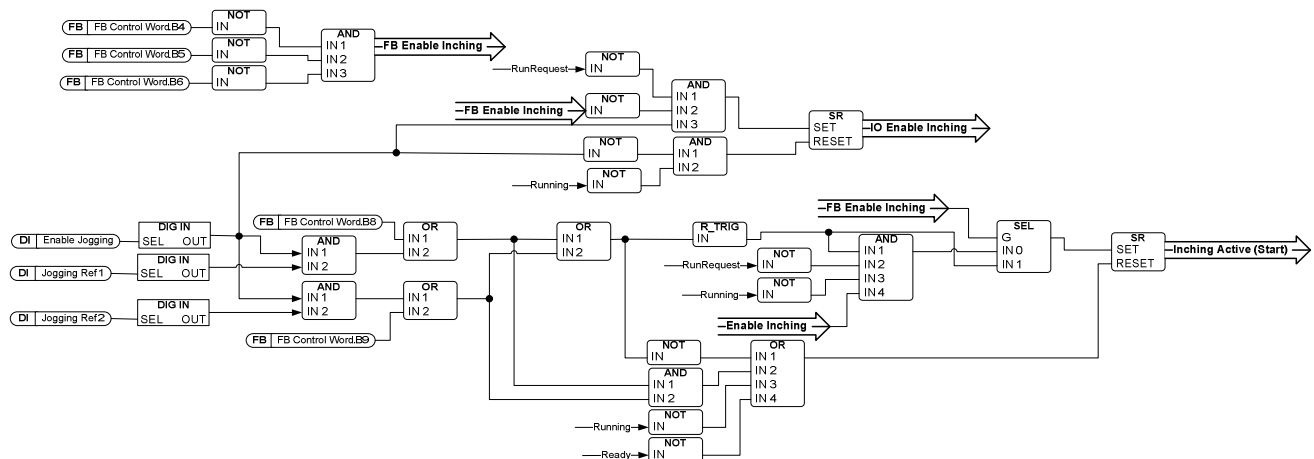
### P2.3.8 Acceleration/Deceleration ramp 2 shape ID501 "Ramp 2 Shape"

These ramp times and ramp shapes are used when the second ramp time is activated by digital input "Acc/Dec Time Sel"

### 7.3.1 Jogging function

**I/O Jogging Command:** Jogging function will start the drive to reference without additional start command regardless of control place when given from IO. Jogging function requires enabling from digital input before command is accepted. Inching is also disabled if there is start command active from active control place. If both inching references are active at the same time drive will stop.

**Fieldbus Jogging Command:** Jogging command is activated by B7 or B8 command but the ramp control bits CW.B4, B5 & B6 needs to be zero. Drive needs to be at zero speed before command is accepted and CW.B4, B5 & B6 are active after drive is at zero speed when jogging function is stopped.



**P2.3.9 Jogging Inc ramp ID1257 “Jogging Inc Ramp”**

**P2.3.10 Jogging Dec ramp ID1258 “Jogging Dec Ramp”**

This parameter defines acceleration and deceleration times when jogging is active. Jogging function will start the drive to reference without additional start command regardless of control place. Jogging function requires enabling from digital input before command is accepted. Jogging is also disabled if there is a start command active on the active control place.

**P2.3.11 Jogging ramp shape ID1259 “JoggingRampShape”**

The start and end of acceleration and deceleration ramp can be smoothed with this parameter. Setting value 0 gives a linear ramp shape which causes acceleration and deceleration to act immediately to the changes in the reference signal.

This parameter is used when jogging function is used from the fieldbus or constant speed operation is used in I/O control.

**P2.3.12    Jogging Stop Function    ID1810    “JoggingStopFunct”**

Coasting:

- 0** Drive stops controlling the motor immediately and let's motor rotate freely.

Ramp:

- 1** After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters to zero speed. DI “Run Enable” will make coasting stop regardless of selected stop function.

Other parameters for jogging:

- Parameter: Jogging Reference 1
- Parameter: Jogging Reference 2
- Digital input selection: Enable Jogging
- Digital input selection: Jogging 1
- Digital input selection: Jogging 2

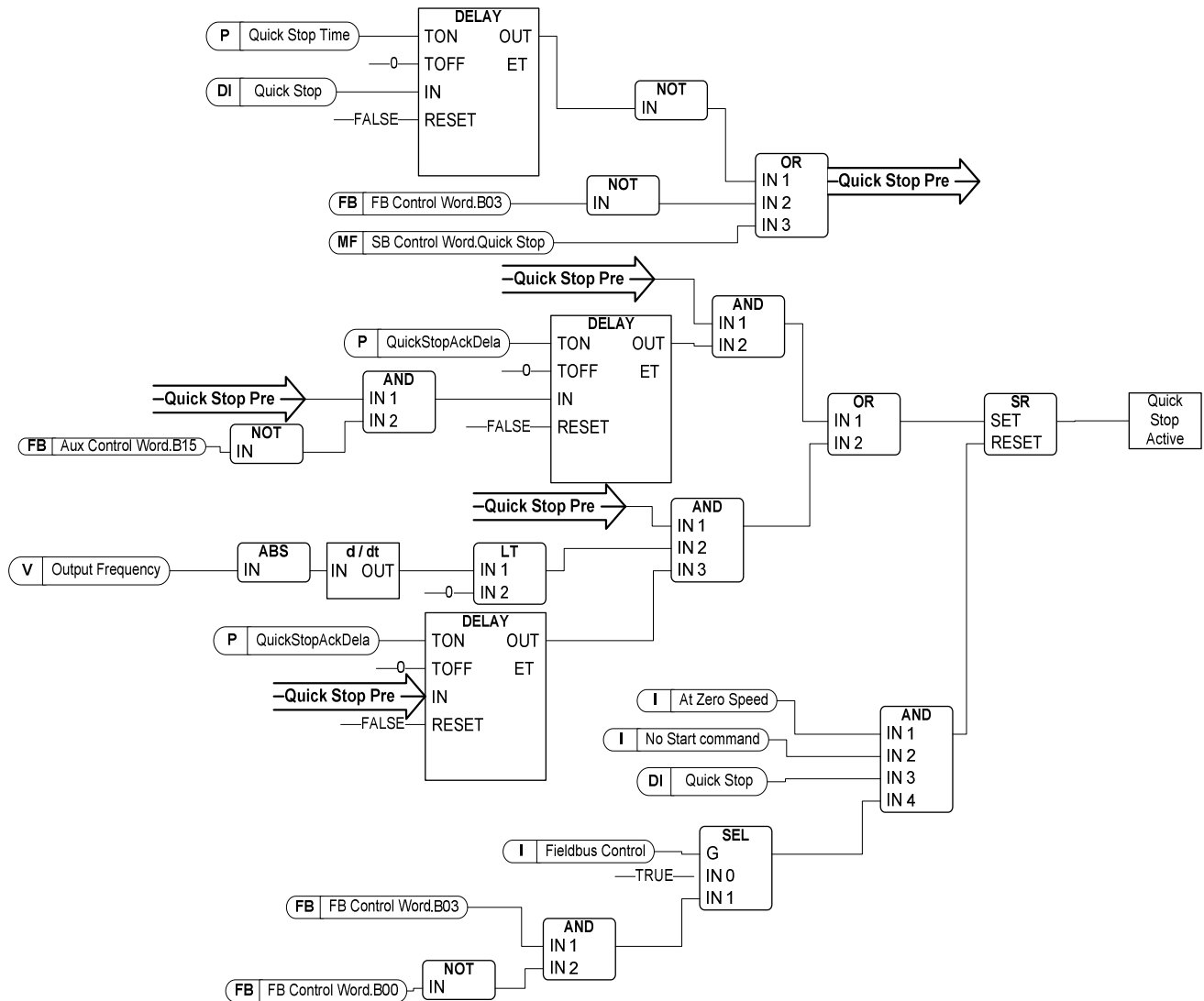
**P2.3.13    Disable Speed Ramp    ID1815**

Deceleration ramp time when motor is running in disabled direction. See also Functional Safety functions.

### 7.3.2 Quick Stop

Quick stop function is used for purposes where drive is needed to stop certain way e.g. for emergency purposes.

Upper system can over write drive quick stop functionality when certain conditions has been met. See detail from P2.3.13.7 Quick Stop Monitoring,





### **P2.3.13.1 Quick stop mode ID1276 “Quick Stop Mode”**

Selects the mode of stopping the drive when quick stop is active.

- It is recommended to use same stop function in follower drives.
  - It is recommended to use same ramp time in follower drives
- 0** Coast stop. The motor is allowed to stop on its own inertia.
  - 1** Ramp stop. The motor is stopped by the deceleration ramp time selected by Quick stop Time.
  - 2** Fast Stop. The speed ramp generator output is forced to zero and the drive is allowed to stop against its torque limits.
  - 3** Power/Torque limit stop. Drive can be stopped by torque and power limit values selected for the quick stop.
  - 4** Power/Torque and SPC limit stop. Drive can be stopped by torque and power limit values selected for the quick stop. Also Speed Control Output will be limited by set torque limit.
  - 5** Ramp stop with Power/Torque and SPC limits. Drive will stop by set ramp time but limited by set Power/Torque and SPC limits.

Follower drive operation rules on quick stop:

1. Master/Single drive will remain in torque control if there is a acknowledge from upper system [V]Aux Control Word B15. and speed is slowing down. If acknowledge is missing and speed is not slowing down drive will take control of quick stop.
2. Follower will not change to speed control mode, this control needs to come from upper system if speed controlled stop is required.
3. Follower will not stop in speed control until its own speed is below zero speed level even if master is already in stop state.
4. Follower needs to stop by coasting after defined ramp time has been passed in torque control mode.
  - a. Torque reference may come from upper system and zero speed would not be reached if torque reference is not controlled to reach zero speed level.

Mode	Master	Follower
<b>0</b> Coasting	<b>Speed and Torque control:</b>	<b>Speed and Torque control:</b> Drive will stop by coasting immediately

	Drive will stop by coasting immediately	
<b>1</b> Ramping	<p><b>Speed Control:</b> Drive will stop by set ramp time.</p> <p><b>Torque Control:</b> Drive will remain in torque control while there is a acknowledgement from PLC that quick stop has been given and actual speed is slowing down.</p>	<p><b>Speed Control</b> Drive will stop by set ramp time. If follower has a different speed reference (higher) follower will make ramping stop to below zero speed level even if master drive is already in stop state.</p> <p><b>Torque Control; Master Torque</b> Drive will follow torque reference of the master drive. Follower will stop by coasting if master has reached zero speed level before follower has.</p> <p><b>Torque Control; Own torque reference</b> Drive will follow set torque reference until internal ramp time (in pure torque control) has reached zero, when reached drive will make coasting stop.</p>
<b>2</b> Fast stop	<p><b>Speed Control:</b> Drive will stop as fast as possible against normal limit functions.</p> <p><b>Torque Control</b> Drive will remain in torque control while there is a acknowledgement from PLC that quick stop has been given and actual speed is slowing down.</p>	<p><b>Speed Control</b> Drive will stop as fast as possible against normal limit functions.</p> <p><b>Torque Control; Master Torque</b> Drive will follow torque reference of the master drive. Follower will stop by coasting if master has reached zero speed level before follower has.</p>
<b>3</b> Quick stop limits	<p><b>Speed Control</b> Drive will stop as fast as possible against quick stop power and torque limits. SPC Limits remains unchanged.</p> <p><b>Torque Control</b> Drive will remain in torque control while there is a acknowledgement from PLC that quick stop has been given and actual speed is slowing down.</p>	<p><b>Speed Control</b> Drive will stop as fast as possible against normal limit functions.</p> <p><b>Torque Control; Master Torque</b> Drive will follow torque reference of the master drive. Follower will stop by coasting if master has reached zero speed level before follower has .</p>
<b>4</b> Quick stop limits with SPC Limit	<p><b>Speed Control</b> Drive will stop as fast as possible against quick stop power and torque limits. SPC Limits are also set.</p> <p><b>Torque Control</b></p>	<p><b>Speed Control</b> Drive will stop as fast as possible against normal limit functions.</p> <p><b>Torque Control; Master Torque</b> Drive will follow torque reference of the master drive. Follower will stop by coasting if master has reached zero speed level before follower has.</p>

	Drive will remain in torque control while there is a acknowledgement from PLC that quick stop has been given and actual speed is slowing down.	
<b>5</b> Ramping with Quick Stop limits with SPC Limits	<p><b>Speed Control:</b> Drive will stop by set ramp time. but limited by quick stop power and torque limits. SPC Limits are also set.</p> <p><b>Torque Control:</b> Drive will remain in torque control while there is a acknowledgement from PLC that quick stop has been given and actual speed is slowing down.</p>	<p><b>Speed Control</b> Drive will stop by set ramp time. If follower has a different speed reference (higher) follower will make ramping stop to below zero speed level even if master drive is already in stop state.</p> <p><b>Torque Control; Master Torque</b> Drive will follow torque reference of the master drive. Follower will stop by coasting if master has reached zero speed level before follower has.</p> <p><b>Torque Control; Own torque reference</b> Drive will follow set torque reference until internal ramp time (in pure torque control) has reached zero, when reached drive will make coasting stop.</p>

**P2.3.13.2 Quick stop ramp time ID1256 “Quick Stop Time”**

Deceleration ramp time in case of emergency stop. The drive decelerates from maximum speed to zero speed if Quick stop mode (P2.3.13.1) = 1 (Ramp stop).

**P2.3.13.3 Quick stop Max brake power ID1293 “Quick Stop P Lim”**

Power limit value used when Quick stop function 3 Power/Torque Limit is used

**P2.3.13.4 Quick stop Max breaking torque ID1294 “Quick Stop T Lim”**

Torque limit value used when Quick stop function 3 Power/Torque Limit is used

**P2.3.13.5 Quick stop IO delay ID1254 “QuickStop IO Del”**

Delay time in seconds to activate the emergency stop function in the drive after the emergency stop has been activated through digital input.

**P2.3.13.6 Quick Stop Acknowledge Delay ID1263 “QuickStopAckDela”**

Delay after Master Drive or Single drive will change to speed control and will execute selected quick stop function if conditions defined by P2.3.13.7 Quick Stop Monitoring has not been met.

**P2.3.13.7 Quick Stop Monitoring ID1759 “QuickStopMonitor”**

Drive own quick stop function can be bypassed in case if e.g. upper control system is used to make Quick Stop functionality. This parameter defines what is monitored when quick stop command is received. If these monitoring function notices that upper control system has not taken control of quick stop functionality drive will active its own quick stop functions.

- 0** Acknowledgment and output frequency derivate.  
Drive checks that Aux Control Word B15 is high and output frequency has started to go towards zero speed.
- 1** Output frequency derivate  
Drive checks that output frequency has started to go towards zero speed
- 2** Acknowledgment.  
Drive checks that Aux Control Word B15 is high
- 3** None.  
Drive will start to make immediately quick stop functionality.

Output frequency derivate monitoring requires that output frequency decreased 0,50 Hz/s. If change in output frequency is less than 0,50 Hz/s for more than 100 ms drive will start its own quick stop function. Change is monitored at 5 ms time level.

### 7.3.3 Ramp Options

#### P2.3.14.1 Ramp: Skip S2/S4 ID1900

This function is used to bypass the second corner S ramp (i.e. to avoid the unnecessary speed increase, the blue line in Figure 7-4) when the reference is changed before the final speed is reached. Also S4 is bypassed when reference is increased while speed is ramping down.

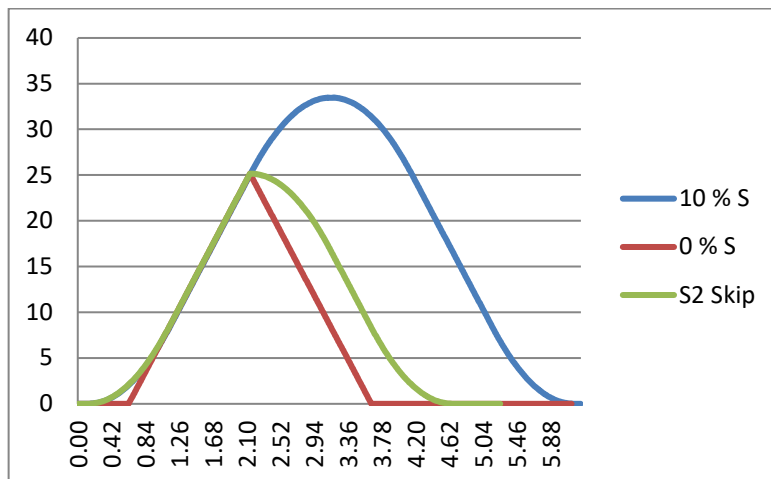


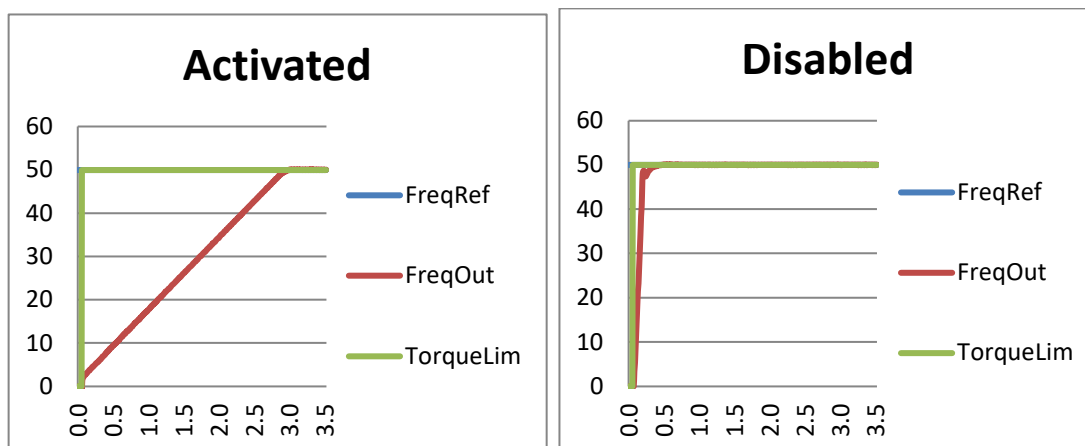
Figure 7-4. Second S curve is bypassed when reference changes at 25 Hz

#### P2.3.14.2 CL Ramp generator follows encoder ID1902 “CLRmpFollEncFreq”

In a normal situation, the ramp generator is not updated with the actual speed from the encoder (like in open loop control). So when the limiting situation has passed (with a step) speed is accelerated against the limit controller to the reference speed (if speed control is used). In case this parameter is active speed will increase with set ramp times.

This parameter also sets the Ramp Frequency to actual frequency when change from torque control to speed control is made.

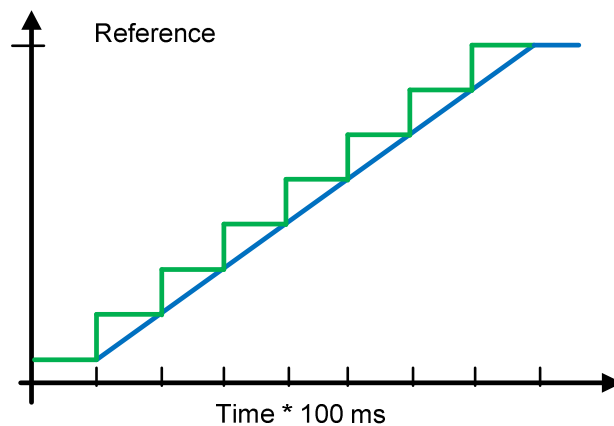
**Note:** When using undervoltage controller function 2 (Ramping to zero speed) this parameter needs to be activated to have similar operation than in open loop control.



**P2.3.14.3 Speed Reference Interpolator TC ID1184 “Ramp In Inter. TC”**

Set here time on what interval speed reference is updated. This function ramps the reference between updated values.

Function is used when PLC is updating reference e.g. 100 ms time level but drive own ramp is set much shorter to have fast response. When reference (Green) is used without interpolator also output frequency would behave same way causing torque and current spikes every time reference changes. When interpolator time is set to 100 ms output frequency behaves as blue line.



## 7.4 Input signals

### 7.4.1 Basic Settings

#### P2.4.1.1 Start/Stop logic selection ID300 “Start/Stop Logic”

This parameter defines start stop logic when using I/O control. Some of these selections do not include the 'Reverse' command. Reverse command can be activated by a separate digital input “Reverse”.

##### 0 “Forw – Rev” – Forward Start – Reverse Start

Start 1: closed contact = start forward DI “Start 1”

Start 2: closed contact = start reverse DI “Start 2”

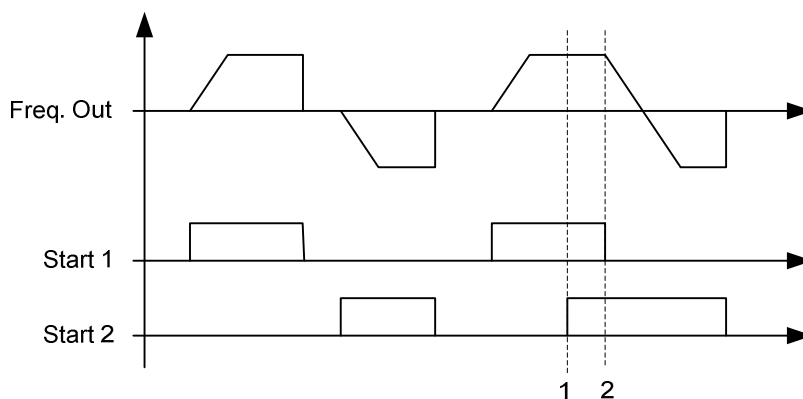


Figure 7-5. Start forward/Start reverse

- ① The first selected direction has the highest priority.
- ② When the DIN1 contact opens the direction of rotation starts the change.

##### 1 “Start – Rev” - Start command – Direction command

Start 1: closed contact = start

open contact = stop

Start 2: closed contact = reverse

open contact = forward

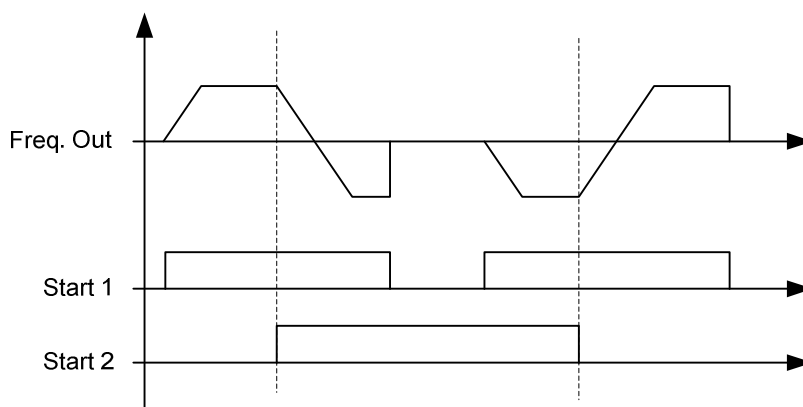


Figure 7-6. Start, Stop, Reverse

##### 2 “Start – Enable” – Start command – Run Enable

DIN1: closed contact = start

open contact = stop

DIN2: closed contact = start enabled

open contact = start disabled and drive stopped if running

### 3 “StartP-StopP” – Start Pulse – Stop Pulse

3-wire connection (pulse control):

DIN1: closed contact = start pulse

DIN2: open contact = stop pulse, falling edge.

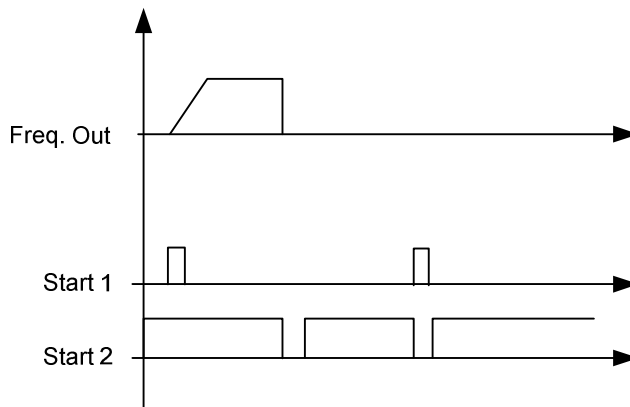


Figure 7-7. Start pulse/ Stop pulse.

The selections including the text '**Rising edge required to start**' shall be used to exclude the possibility of an unintentional start when, for example, power is connected, re-connected after a power failure, after a fault reset, after the drive is stopped by Run Enable (Run Enable = False) or when the control place is changed. The Start/Stop contact must be opened before the motor can be started.

### 4 “Strt-MotP UP” – Start – Motor potentiometer UP

DIN1: closed contact = start forward

DIN2: closed contact = Increases motor potentiometer reference, see Motor potentiometer function for more details.

### 5 “ForwR – RevR” – Forward start rising edge – Reverse start rising edge

DIN1: closed contact = start forward (**Rising edge required to start**)

DIN2: closed contact = start reverse (**Rising edge required to start**)

### 6 “StartR-Rev” - Start command rising edge – Direction command

DIN1: closed contact = start (**Rising edge required to start**)

open contact = stop

DIN2: closed contact = reverse

open contact = forward

### 7 “StrtR-Enable” – Start command rising edge – Run Enable

DIN1: closed contact = start (**Rising edge required to start**)

open contact = stop

DIN2: closed contact = start enabled

open contact = start disabled and drive stopped if running



### 7.4.2 Digital inputs

#### **P2.4.2.1 Start signal 1 ID403 "Start Signal 1"**

Signal selection 1 for the start/stop logic.  
Default programming A.1.Default Forward start.

#### **P2.4.2.2 Start signal 2 ID404 "Start Signal 2"**

Signal selection 2 for the start/stop logic.  
Default programming A.2. Default Reverse start.

#### **P2.4.2.3 Run enable ID407 "Run Enable"**

When run enable is removed from the drive coasting stop is made always.  
Drive will also show warning indication when run is disabled.

Contact open: Start of motor disabled  
Contact closed: Start of motor enabled

#### **P2.4.2.4 Reverse ID412 "Reverse"**

This reverse command is active when Start signal 2 is not used for reverse command because setting of "Start/Stop logic selection" parameter.

Contact open: Direction forward  
Contact closed: Direction reverse

#### **P2.4.2.5 Motor potentiometer DOWN ID417 "Mot Pot Ref Down"**

Contact closed: Motor potentiometer reference DECREASES until the contact is opened. See details in G2.2.11 Motor Pot.

#### **P2.4.2.6 Motor potentiometer UP ID418 "Mot Pot Ref Up"**

Contact closed: Motor potentiometer reference DECREASES until the contact is opened. See details in G2.2.11 Motor Pot.

#### **P2.4.2.7 Fault reset ID414 "Fault Reset"**

Rising edge required to reset fault.

#### **P2.4.2.8 External fault closing contactor ID405 "Ext Fault Close"**

External fault input closing contactor, response selected in protection parameter group G2.11.1 Protections / General. Gives fault "51 Ext Fault"

#### **P2.4.2.9 External fault opening contactor ID406 "Ext Fault Open"**

External fault input opening contactor, response selected in protection parameter group. Gives fault "51 Ext Fault"

#### **P2.4.2.10 Acceleration/Deceleration time selection ID408 "Acc/Dec Time Sel"**

Digital input to select between ramp time 1 and 2, times are set in "Ramp Control" parameter group.

Contact open: Acceleration/Deceleration time 1 selected  
Contact closed: Acceleration/Deceleration time 2 selected

**P2.4.2.11 Acceleration/Deceleration prohibited ID415 "Acc/Dec Prohibit"**

Contact closed: No acceleration or deceleration possible until the contact is opened.

With P2.9.3 Control Options B13 is possible to select that deceleration direction is allowed thus speed is reduced if reference is smaller than drive speed at the time.

**P2.4.2.12 DC-braking command ID416 "DC Brake Command"**

Contact closed: In STOP mode, the DC braking operates until the contact is opened.  
Current level is set with P2.7.1.16 DCBrakeCurlnStop parameter.

**P2.4.2.13 Inching Speed 1 ID413 "Inching Ref 1"**

Contact closed: Inching speed selected for speed reference  
Reference for Inching speed is set in G2.2.7 Constant Reference group.

**P2.4.2.14 I/O Reference 1/2 selection ID422 "I/O Ref. 1/2"**

With this parameter you can select either AI1 or AI2 signal for speed reference if I/O reference selection is "14 / AI1/AI2 Sel".

If selection for P2.2.4 I/O Reference is other than "14 / AI1/AI2 Sel" this digital input will change reference between P2.2.4 I/O Reference and P2.2.7 I/O Reference 2.

### 7.4.2.1 Forced control place

Digital inputs can be used to bypass parameter P3.1 Control Place, for example, in an emergency situation when PLC is not able to send command to the drive.

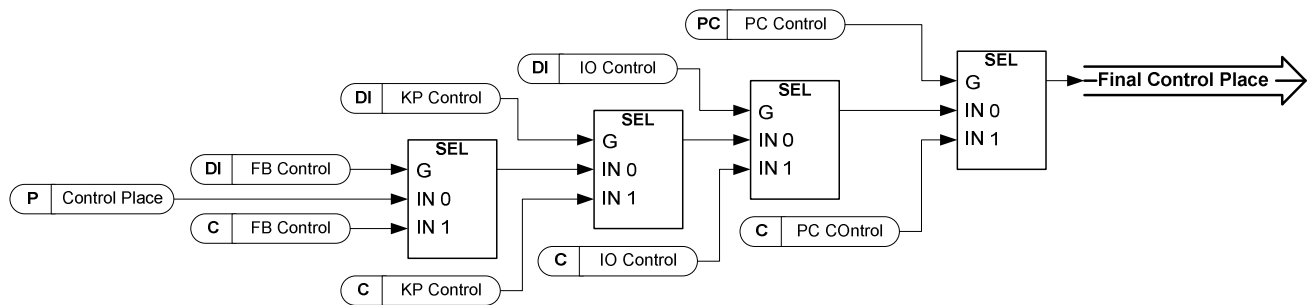


Figure 7-8. Control place selection priority order

#### P2.4.2.15 Control from I/O terminal ID409 "I/O Term Control"

Contact closed: Force control place to I/O terminal

#### P2.4.2.16 Control from keypad ID410 "Keypad Control"

Contact closed: Force control place to keypad

#### P2.4.2.17 Control from Fieldbus ID411 "Keypad Control"

Contact closed: Force control place to fieldbus

**NOTE:** When the control place is forced to change the values of Start/Stop, Direction and Reference valid in the respective control place are used. The value of parameter [ID125](#) (Keypad Control Place) does not change. When the input opens the control place is selected according to keypad control parameter [P3.1 Control Place](#)

#### P2.4.2.18 Parameter Set 1/Set 2 selection ID496 "Param Set1/Set2"

With this parameter you can select between Parameter Set 1 and Set 2.

Remember to put same input for both parameter set. Parameter sets cannot be changed while drive is in run state.

Digital input = FALSE:

- Set 1 is loaded as the active set

Digital input = TRUE:

- Set 2 is loaded as the active set
- 

When making two parameter sets from the keypad

1. Set all parameters as needed for SET1
2. In "P6.3.1 Parameter Set" select "Store Set1"
3. Set all parameters as needed for SET 1
4. In "P6.3.1 Parameter Set" select "Store Set2"

**Note:** The parameter values are stored only when selecting parameter P6.3.1 Parameter sets Store Set 1 or Store Set 2 or from NCDrive: Drive > Parameter Sets.

### P2.4.2.19 External brake acknowledgment. ID1210 “Ext. Brake ACK”

Connect this input signal to auxiliary contact of mechanical brake. If contact is not closed within given time when brake is controlled open the drive will generate a brake fault F58, response can be selected in G2.14 Brake Control parameter group.

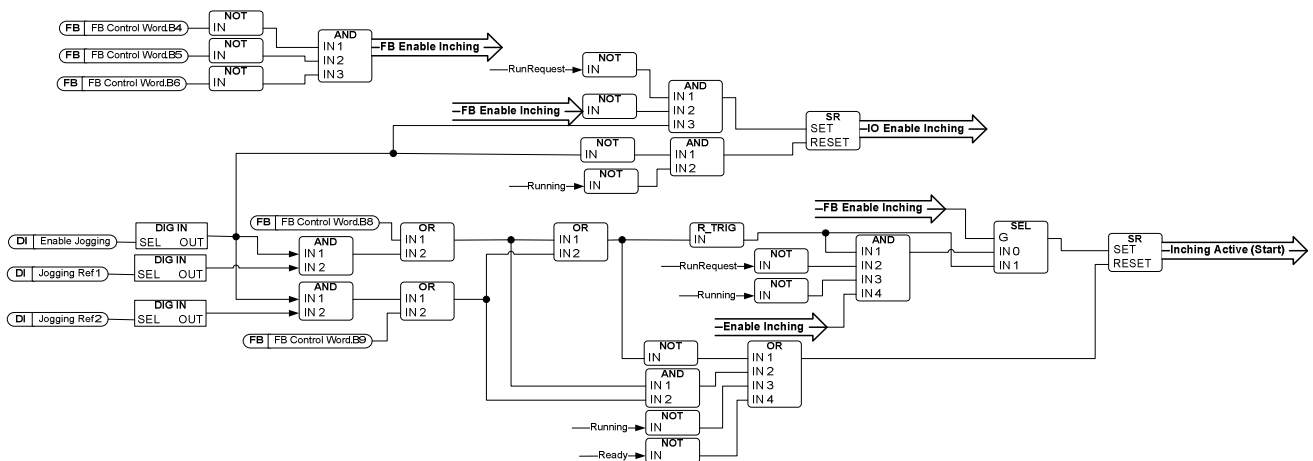
### P2.4.2.20 Cooling monitor ID750 “Cooling Monitor”

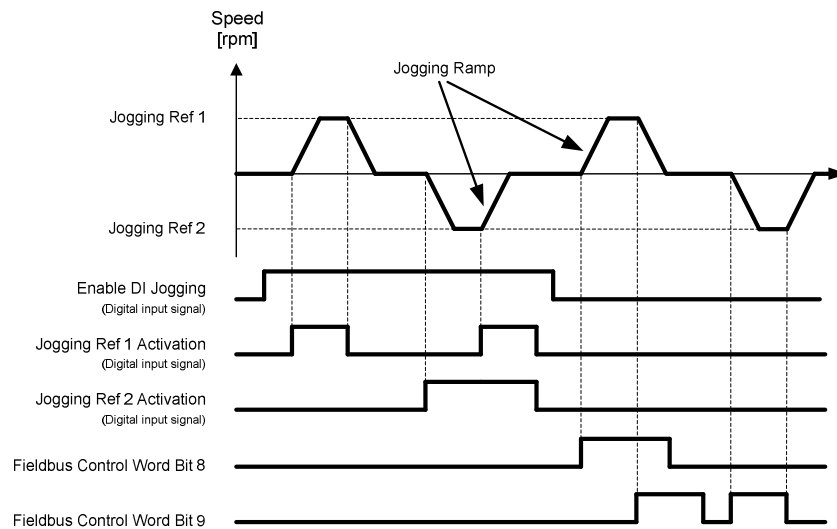
When using a liquid-cooled drive, connect this input to the *Cooling OK* signal from Vacon flow control application or any input that shows state of used cooling unit. Fault is generated if input is low when drive is in run state, while drive is in stop state only warning is generated. See product user manual of liquid-cooled drive. Delay and response can be selected in G2.11.9 Cooling parameters group.

### 7.4.2.2 Jogging function

**I/O Jogging Command:** Jogging function will start the drive to reference without additional start command regardless of control place when given from IO. Jogging function requires enabling from digital input before command is accepted. Inching is also disabled if there is start command active from active control place. If both inching references are active at the same time drive will stop.

**Fieldbus Jogging Command:** Jogging command is activated by B7 or B8 command but the ramp control bits CW.B4, B5 & B6 needs to be zero. Drive needs to be at zero speed before command is accepted and CW.B4, B5 & B6 are active after drive is at zero speed when jogging function is stopped.





#### **P2.4.2.21 Enable Jogging ID532 “Enable Jogging”**

If you are using jogging function the given input must be set TRUE by either digital signal or by setting the parameter value to 0.2.

#### **P2.4.2.22 Jogging reference 1 ID530 “Jogging Ref 1”**

#### **P2.4.2.23 Jogging reference 2 ID531 “Jogging Ref 2”**

These inputs activate jogging reference if jogging is enabled. These inputs also start the drive if activated and if there is no Run Request command from anywhere else.

Other parameter for jogging function

- P2.3.9 Jogging Ramp ID1257 “Jogging Ramp”
- P2.2.7.9 Jogging reference 1 ID1239 “Jogging Ref 1”
- P2.2.7.10 Jogging reference 2 ID1240 “Jogging Ref 2”
- 

#### **P2.4.2.24 Reset encoder counter ID1090 “Reset Position”**

When using encoder, the drive monitors the encoder rotations and angle (V: Shaft Rounds and V: Shaft Angle).

When this input has a rising edge monitoring values V: Shaft Angle (ID1169) and Shaft Rounds (ID1170) are set to zero. Reset command is also included in V: Aux Control Word.

#### **P2.4.2.25 Quick Stop Function ID1213 “Quick Stop Func.”**

Digital input for Quick Stop function.

#### **P2.4.2.26 Input switch acknowledgement**

Selects the digital input to acknowledge the status of input switch. The input switch is normally switch fuse unit or main contactor with which the power is fed to the drive. If the input switch acknowledgement is missing, the drive trips on “F64 Input Switch open” fault.

Other parameter for input switch function

- P2.5.1.29 MCC Close Cont.
- P2.5.1.30 MCC Close Pulse.

**P2.4.2.27 Digital input Max speed Limit 2 ID1511 “Max speed 2”**

With this parameter you can select the digital input that will limit the maximum speed to a lower value than what is defined by Positive and negative speed limits. This limit does not affect any constant references. The limit is set in G2.6.4 Speed. Limit Handling.

**P2.2.1.28 PI Controller activation ID1804 “PID Activation”**

Select the digital input that will activate PI controller. Set selection to 0.2 and PI-controller is activated without external wiring.

**P2.2.1.29 Motor Fan Acknowledge ID1211 “Motor Fan Ack.”**

Select the digital input that monitors motor fan status. If feedback is opposite to control signal more than six second, warning is generated.

**P2.4.2.30 Disable Positive Speed ID1813**

Digital input to disable running to positive directions.

**P2.4.2.31 Disable Negative Speed ID1814**

Digital input to disable running to negative directions.

**P2.4.2.32 Preset speed 1 ID419 “Preset Speed 1”****P2.4.2.33 Preset speed 2 ID420 “Preset Speed 2”****P2.4.2.34 Preset speed 3 ID421 “Preset Speed 3”**

Digital input selections for activating preset speeds.

References are set in the “Constant Reference” parameter group.

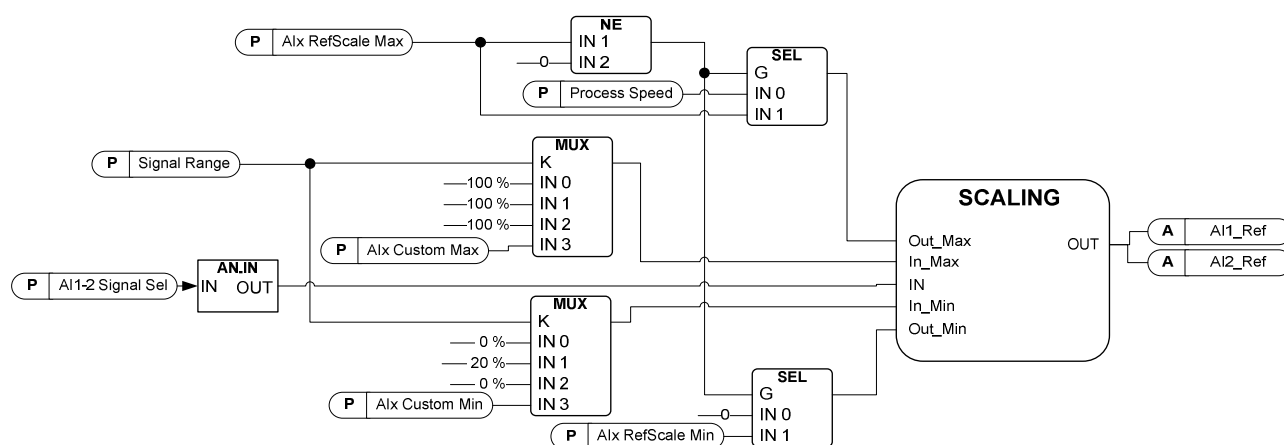
Speed	Digital Input Preset speed 1	Digital Input Preset speed 2	Digital Input Preset speed 3
Basic speed	0	0	0
Preset Speed 1	1	0	0
Preset Speed 2	0	1	0
Preset Speed 3	1	1	0
Preset Speed 4	0	0	1
Preset Speed 5	1	0	1
Preset Speed 6	0	1	1
Preset Speed 7	1	1	1

Related parameters

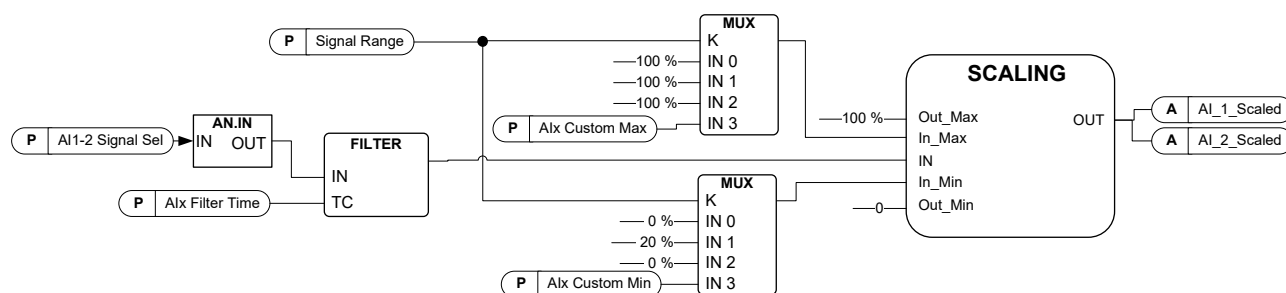
- G2.2.11 Constant Ref

**7.4.3 Analogue Input 1 & 2****7.4.3.1 Analogue input 1 & 2 for reference**

See details of reference chain on chapter 6.2 Reference Handling. Reference filtering is made after final reference selection.



#### 7.4.3.2 Analogue input 1 & 2 for scaling functions



**P2.4.3.1 AI1 signal selection**

**ID377 "AI1 Signal Sel"**

**P2.4.4.1 AI2 signal selection**

**ID388 "AI2 Signal Sel"**

Connect the AI1/AI2 signal to the analogue input of your choice with this parameter. For more information about the TTF programming method, see chapter 4.

**P2.4.3.2 Analogue input 1 signal filter time ID324 "AI1 Filter Time"**

**P2.4.4.2 Analogue input 2 signal filter time ID329 "AI2 Filter Time"**

First order filtering is used for analogue signals that are used to control e.g. the power limit. Second order filtering is used for speed reference filtering. Filtering affect is not visible in Analogue Input monitoring signals for AI1 or AI2.

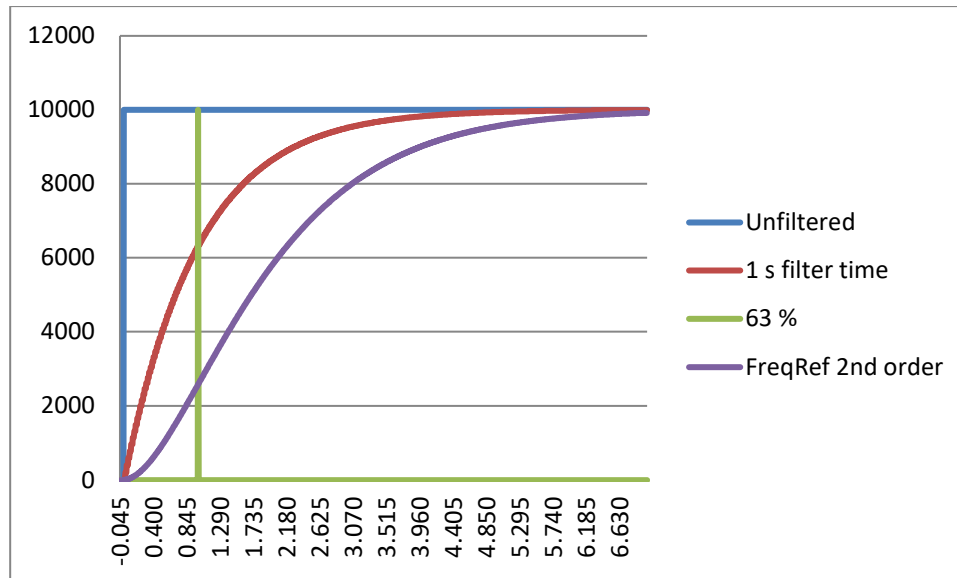
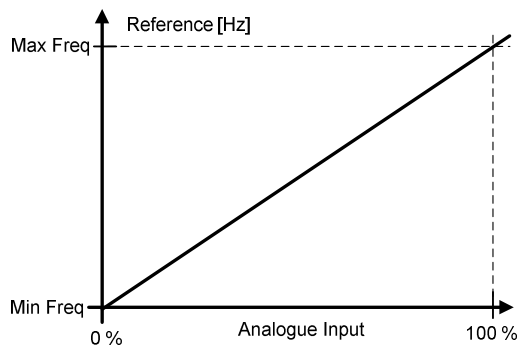


Figure 7-9. AI1 signal filtering

<b>P2.4.3.3</b>	<b>Analogue input signal 1 signal range</b>	<b>ID320</b>	<b>"AI1 Signal Range"</b>
<b>P2.4.4.3</b>	<b>Analogue input signal 2 signal range</b>	<b>ID325</b>	<b>"AI2 Signal Range"</b>

#### 0 "0-20mA/10V"

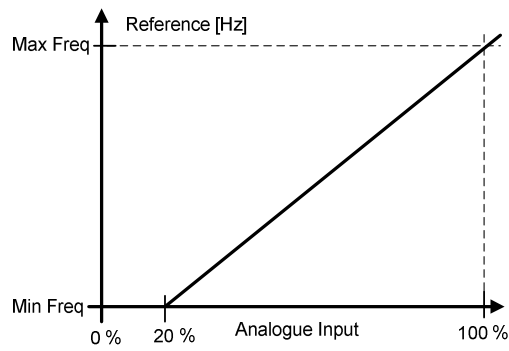
Signal input ranges: 0...10 V and 0...20 mA.  
Input signal is used from 0% to 100%.



#### 1 "4-20 mA"

Signal input ranges: 4 – 20 mA and 2 – 10 V  
Input signal is used from 20 % to 100 %

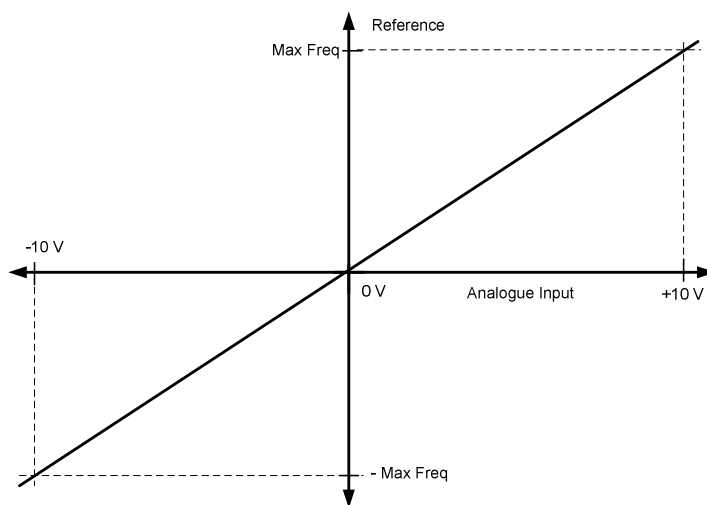




## 2 “-10 - +10 V”

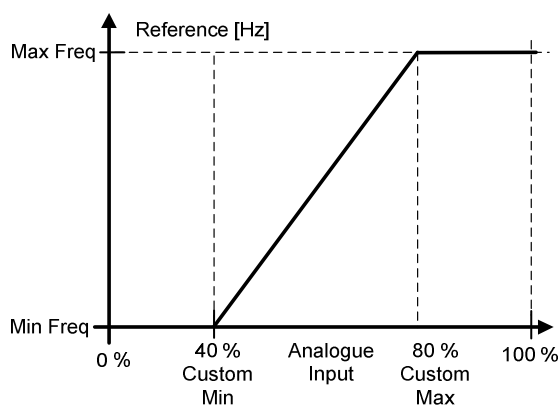
Signal input range: -10 V - +10 V.

Input signal is used from -100 % to +100 %.



## 3 “Custom Range”

With custom range it is possible to freely adjust what input level corresponds to the minimum and maximum speeds.

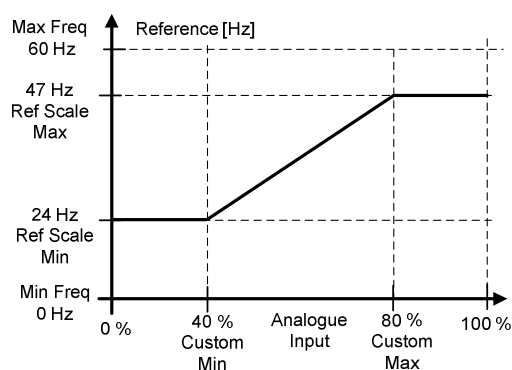
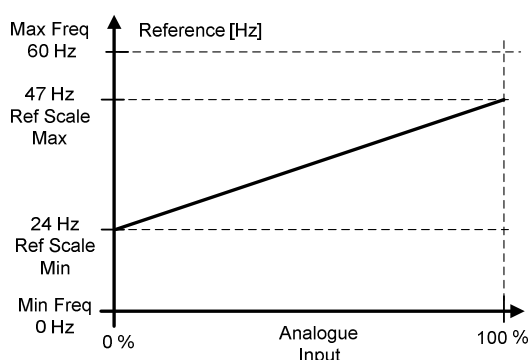


<b>P2.4.3.4</b>	<b>AI1 custom minimum setting</b>	<b>ID321</b>	<b>"AI1 Custom Min"</b>
<b>P2.4.3.5</b>	<b>AI1 custom maximum setting</b>	<b>ID322</b>	<b>"AI1 Custom Max"</b>
<b>P2.4.4.4</b>	<b>AI2 custom minimum setting</b>	<b>ID326</b>	<b>"AI2 Custom Min"</b>
<b>P2.4.4.5</b>	<b>AI2 custom maximum setting</b>	<b>ID327</b>	<b>"AI2 Custom Max"</b>

These parameters set the analogue input signal for any input signal span within -160...160%. E.g. if the signal input scaling is set to 40 %...80 % the reference can be changed from 8 mA (for Minimum Speed) to 16 mA (for Maximum Speed).

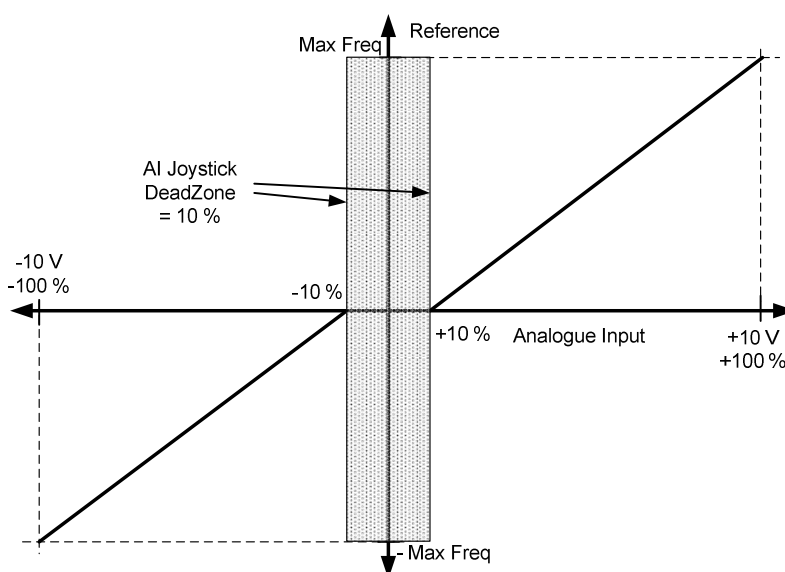
<b>P2.4.3.6</b>	<b>AI1 Reference scaling, minimum value</b>	<b>ID303</b>	<b>"AI2 RefScale Min"</b>
<b>P2.4.3.7</b>	<b>AI1 Reference scaling, maximum value</b>	<b>ID304</b>	<b>"AI2 RefScale Max"</b>
<b>P2.4.4.6</b>	<b>AI2 reference scaling, minimum value</b>	<b>ID393</b>	<b>"AI2 RefScale Min"</b>
<b>P2.4.4.7</b>	<b>AI2 reference scaling, maximum value</b>	<b>ID394</b>	<b>"AI2 RefScale Max"</b>

Additional reference scaling. Analogue input reference scaling can be set to a different value than the minimum and maximum speed.



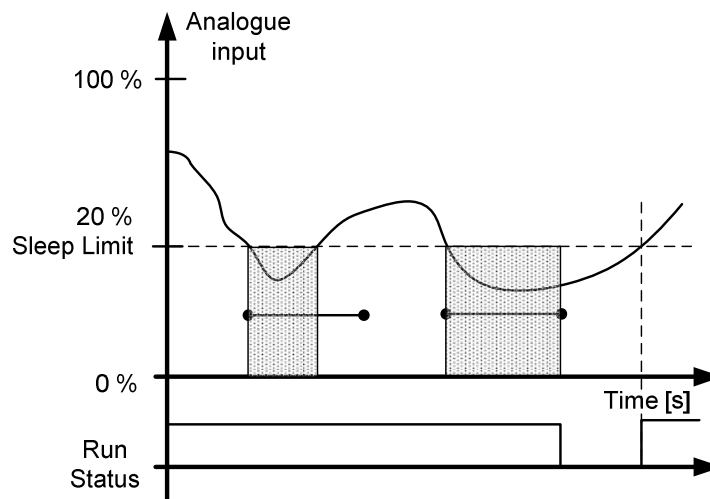
<b>P2.4.3.8</b>	<b>Analogue Input 1 joystick input dead zone</b>	<b>ID382</b>	<b>"AI1 JoysDeadZone"</b>
<b>P2.4.4.8</b>	<b>Analogue Input 2 joystick input dead zone</b>	<b>ID395</b>	<b>"AI2 JoysDeadZone"</b>

The small values of the reference around zero can be ignored by setting this value greater than zero. When the reference lies between zero and  $\pm$  this parameter, it is forced to zero.



#### 7.4.3.3 Sleep function

The drive can be stopped by sleep function when the analogue input falls below a certain value for a certain time and speed functions become active.



**P2.4.3.9 AI1 sleep limit ID385 "AI1 Sleep Limit"**

**P2.4.4.9 AI2 sleep limit ID396 "AI2 Sleep Limit"**

The drive is stopped automatically if the AI signal level falls below the Sleep limit defined with this parameter. In joystick function, when input is between zero and  $\pm$  this parameter the drive will go to sleep state.

**P2.4.3.10 AI1 sleep delay ID386 "AI1 Sleep Delay"**

**P2.4.4.10 AI2 sleep delay ID397 "AI2 Sleep Delay"**

This parameter defines the time the analogue input signal has to stay under the sleep limit in order to stop the drive.

**P2.4.3.11 AI1 joystick offset ID165 "AI1 Joyst.Offset"**

**P2.4.4.11 AI2 joystick offset ID166 "AI2 Joyst.Offset"**

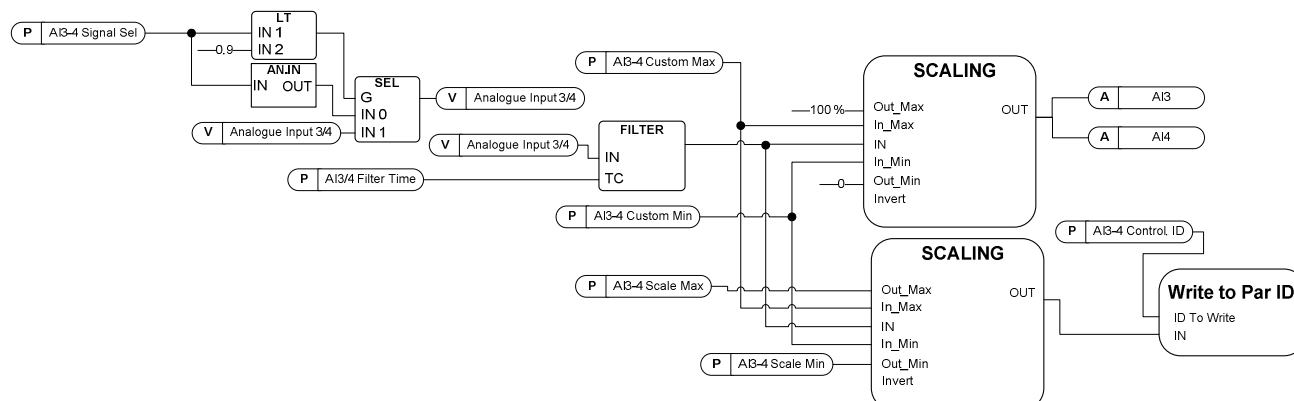
Defines the speed zero point as follows:

With this parameter on display, place the potentiometer in the assumed zero point and press *Enter* on keypad.

**Note:** This will not, however, change the reference scaling.  
Press *Reset* button to change the parameter value back to 0,00%.

### 7.4.4 Analogue input 3 & 4

Analogue Inputs 3 and 4 can be written from fieldbus. This allows signal scaling and inversion. useful e.g. in case when PLC is not operational (value zero received) signal will be automatically at maximum.



**P2.4.5.1 AI3 signal selection ID141 “AI3 Signal Sel”**

**P2.4.6.1 AI4 signal selection ID152 “AI4 Signal Sel”**

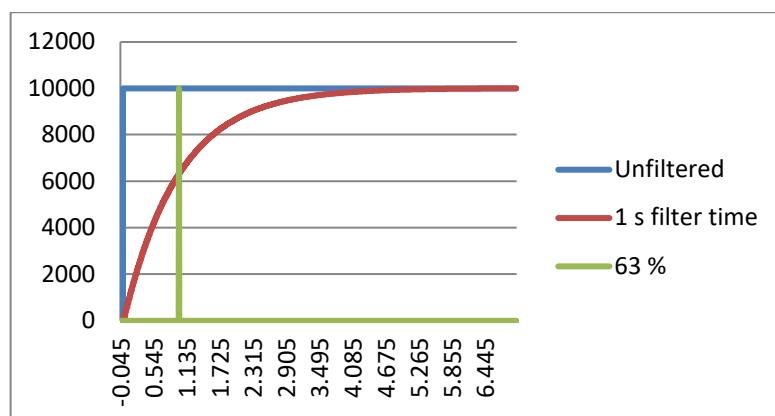
Connect the AI3/AI4 signal to the analogue input of your choice with this parameter. For more information, see Chapter 4 “Terminal To Function” (TTF) programming principle.

When the parameter for Analogue input signal selection is set to 0.1 you can control the analogue input monitoring variable from Fieldbus by assigning the Process Data Input ID number to the analogue input monitoring signal thus allowing the PLC input signals to be scaled with analogue input scaling functions.

**P2.4.5.2 Analogue input 3 signal filtering time ID142 “AI3 Filter Time”**

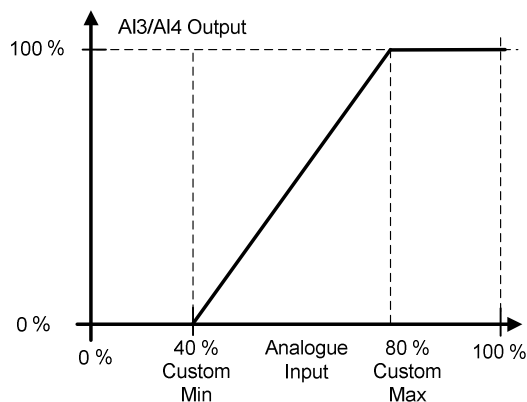
**P2.4.6.2 Analogue input 4 signal filtering time ID153 “AI3 Filter Time”**

First order filtering is used for analogue inputs signals 3 and 4.



<b>P2.4.5.3</b>	<b>AI3 custom setting minimum</b>	<b>ID144</b>	<b>"AI3 Custom Min"</b>
<b>P2.4.5.4</b>	<b>AI3 custom setting maximum</b>	<b>ID145</b>	<b>"AI3 Custom Max"</b>
<b>P2.4.6.3</b>	<b>AI4 custom setting minimum</b>	<b>ID155</b>	<b>"AI4 Custom Min"</b>
<b>P2.4.6.4</b>	<b>AI4 custom setting maximum</b>	<b>ID156</b>	<b>"AI4 Custom Max"</b>

Set the custom minimum and maximum input levels for the AI3 signal within -160...160%.

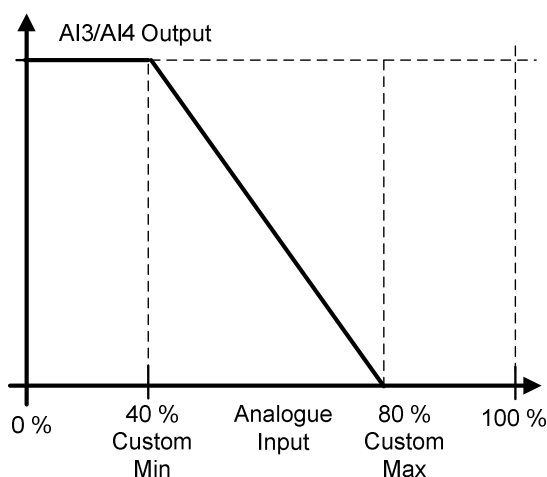


<b>P2.4.5.5.</b>	<b>AI3 signal inversion</b>	<b>ID151</b>	<b>"AI3 Signal Inv"</b>
<b>P2.4.6.5</b>	<b>AI4 signal inversion</b>	<b>ID162</b>	<b>"AI3 Signal Inv"</b>

The signal inversion function is useful in a situation when e.g. the PLC is sending power limit to the drive using fieldbus. If the PLC is unable to communicate with the drive the power limit from fieldbus to the drive would be zero. Using an inverted signal logic zero value from PLC would mean maximum power limit. When inversion is needed for the process data signal fieldbus values need to be written to Analogue input monitoring signals. See parameter P2.4.5.1 AI3 Signal selection for details.

**0** = No inversion

**1** = Signal inverted



#### 7.4.4.1 Analogue input to any parameter

This function allows control of any parameter by using an analogue input. The parameter selects what the range of control area and the ID number for the parameter that is controlled.

**P2.4.5.6** *Analogue input 3, minimum value ID1037 "AI3 Scale Min"*

**P2.4.5.7** *Analogue input 3, maximum value ID1038 "AI3 Scale Max"*

**P2.4.6.6** *Analogue input 4, minimum value ID1039 "AI4 Scale Min"*

**P2.4.6.7** *Analogue input 4, maximum value ID1040 "AI4 Scale Max"*

These parameters define the range for the controlled parameters. All the values are considered to be integers i.e. when controlling the Field Weakening Point (as in example) you also need to set numbers for decimals. e.g. FWP 100,00 needs to be set as 10000.

**P2.4.5.8** *AI3 Controlled ID ID1509 "AI3 Control. ID"*

**P2.4.6.8** *AI4 Controlled ID ID1510 "AI4 Control. ID"*

These parameters define the controlled parameter.

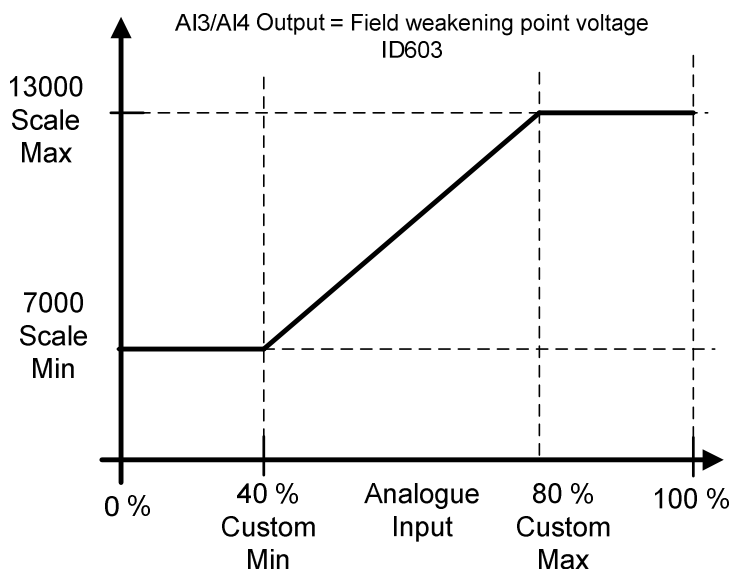
#### Example:

You want to control motor field weakening point voltage through an analogue input from 70,00 % to 130,00 %.

Set Scale min to 7000 = 70,00 %

Set Scale max to 13000 = 130,00 %

Set Controlled ID to 603 (Voltage at field weakening point)



Now analogue input 3 signal 0 V to 10 V (0 mA to 20 mA) will control the field weakening point voltage between 70,00 % - 130,00 %. When setting the value remember that decimals are handled as integers.

### 7.4.5 Inversion control

#### **P2.4.7.1 Inversion Control ID1091 “INV Control”**

Inversion control allows you to select which input signal operation will be inverted.

**B00** = +1 = Invert external fault 1

**B01** = +2 = Invert external fault 2

**B02** = +4 = Inverted Run Enable digital input

**B03** = +8 = Inverted Brake acknowledge digital input

## 7.5 Output signals

### 7.5.1 Digital output signals

In the System Interface application, all output signals are not used by default.

#### **P2.5.1.1 Ready ID432 "Ready"**

The frequency converter is ready to operate.

Missing ready signal can be traced by using monitoring values Non Ready Cause (ID1608) and Prevent MC Ready (ID1609).

#### **P2.5.1.2 Run ID433 "Run"**

The frequency converter is modulating.

#### **P2.5.1.3 Fault ID434 "Fault"**

A fault trip has occurred.

#### **P2.5.1.4 Inverted fault ID435 "Fault, Inverted"**

No active faults in the drive.

#### **P2.5.1.5 Warning ID436 "Warning"**

General warning signal.

#### **P2.5.1.6 External fault or warning ID437 "Ext. Fault/Warn."**

Fault or warning depending on parameter Response to external fault. P2.4.2.11 Ext Fault Close and P2.4.2.12 Ext Fault Open are used to trigger a fault. P2.12.1 External fault is used to select response.

#### **P2.5.1.7 Reference fault or warning (4mA) ID438 "AI Ref Faul/Warn"**

Fault or warning depending on parameter Response to the 4mA reference fault. Response is selected in G2.11.6.

#### **P2.5.1.8 Drive overtemperature warning ID439 "OverTemp Warn"**

Drive temperature has exceeded normal operation conditions. Temperature limit may vary depending on drive type on size.

#### **P2.5.1.9 Reverse ID440 "Reverse"**

Drive output speed is negative

#### **P2.5.1.10 Wrong direction ID441 "WrongDirection"**

Motor rotation direction is different from the requested one. This happens in situation when external force makes the motor rotate in different direction or when the direction change command has been given and the drive is still ramping down to change direction.

#### **P2.5.1.11 At reference speed ID442 "At Ref. Speed"**

**Induction motor:** Speed is within nominal slip of the reference.

**PMS motor:** Output frequency is within 1 Hz of the reference frequency.



**P2.5.1.12 Inching speed ID413 "Inching Speed"**

Inching speed command has been given.

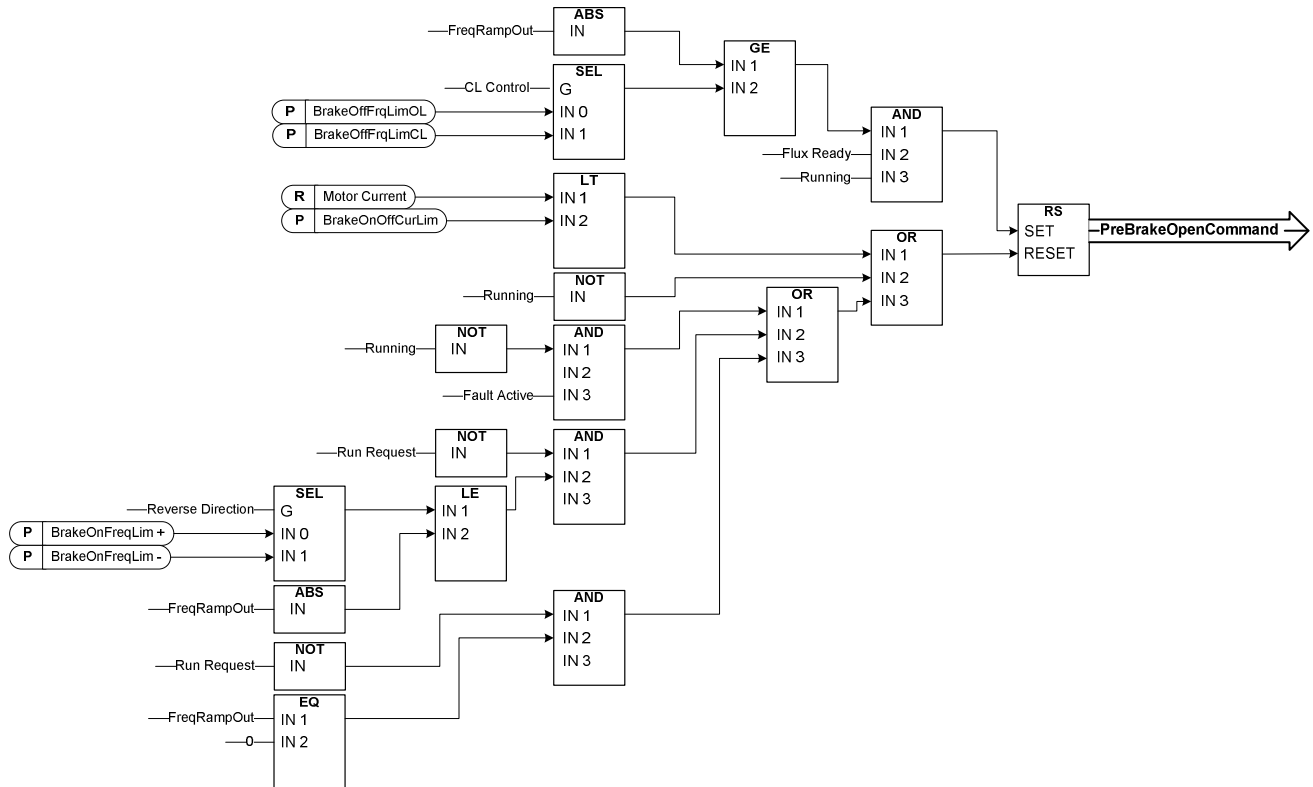
**P2.5.1.13 IO Control Place ID444 "IO Control Place"**

Active control place is I/O terminal defined by the parameter for Control place (P3.1) or forced with digital input function.

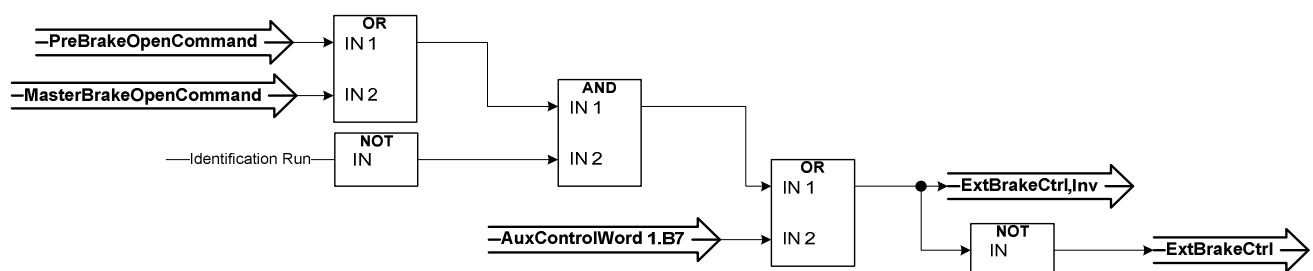
### 7.5.1.1 Brake Control

The mechanical brake control has two parts that need to be synchronically controlled. The first part is the *mechanical brake release* and the second is the *speed reference release*. Whole brake control logic is explained in chapter 6.15 Brake Control on page 207.

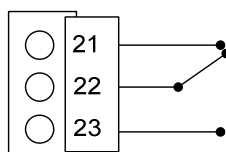
Conditions to open the brake:



**The final brake open command:** It is possible that in a Master/Follower system the master drive opens the brake. Also an overriding system may do this without any control from the drive using AucControlWord1.B7. During identification run the brake will not open.



Relay state when control unit is not powered



#### P2.5.1.14 External brake control

#### ID445 "Ext Brake Contrl"

See detailed description about brake operation in G2.15 Brake Control.

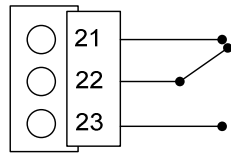
External brake ON/OFF control

Example: OPTA2 board RO1 :

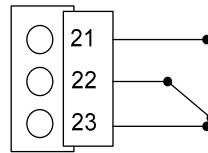
Brake function ON: Terminals 22-23 are connected (Relay is energized).

Brake function OFF: Terminals 22-23 are open (Relay not energized).

Brake Open Command  
Brake function OFF



Brake Close Command  
Brake function ON



**Note:** When power from control board is removed terminals 22-23 are open.

When using the Master Follower function, the follower drive will open the brake at the same time as the Master even if the Follower's conditions for brake opening have not been met.

#### **P2.5.1.15 External brake control, inverted ID446 “ExtBrakeCtrl,Inv”**

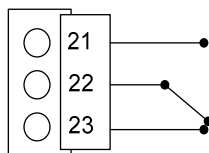
See detail description about brake operation in G2.15 Brake Control

Example: OPTA2 board RO1 :

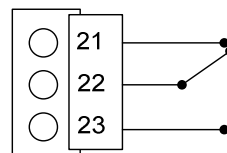
Brake function ON: Terminals 22-23 are open. (Relay not energized)

Brake function OFF: Terminals 22-23 are connected. (Relay is energized).

Brake Open Command  
Brake function OFF



Brake Close Command  
Brake function ON



When using the Master Follower function, the follower drive will open the brake at the same time as the Master does even if the Follower's conditions for brake opening have not been met.

#### **P2.5.1.16 Motor thermal protection ID452 “MotTherm Flt/Wrn”**

Motor thermistor initiates an overtemperature signal which can be led to a digital output. The response is selected with P2.12.5.6 ThermistorF.Resp.

#### **P2.5.1.17 Limit Control active ID454 “Limit Control ON”**

One or more of the drive limit controllers is active.

#### **7.5.1.2 Fieldbus digital inputs connection**

<b>P2.5.1.18</b>	<b>Fieldbus input data 1</b>	<b>ID455</b>	<b>"FB Dig Input 1"</b>
<b>P2.5.1.20</b>	<b>Fieldbus input data 2</b>	<b>ID456</b>	<b>"FB Dig Input 2"</b>
<b>P2.5.1.22</b>	<b>Fieldbus input data 3</b>	<b>ID457</b>	<b>"FB Dig Input 3"</b>
<b>P2.5.1.24</b>	<b>Fieldbus input data 4</b>	<b>ID169</b>	<b>"FB Dig Input 4"</b>
<b>P2.5.1.26</b>	<b>Fieldbus input data 5</b>	<b>ID170</b>	<b>"FB Dig Input 5"</b>

The data from the Fieldbus main control word can be led to the drive's digital outputs. See used fieldbus board manual for location of these bits. Note that FB Dig Input 1 is also used for fieldbus watch dog.

<b>P2.5.1.19</b>	<b>Fieldbus digital input 1 parameter</b>	<b>ID891</b>	<b>"FB Dig 1 Par ID"</b>
<b>P2.5.1.21</b>	<b>Fieldbus digital input 2 parameter</b>	<b>ID892</b>	<b>"FB Dig 2 Par ID"</b>
<b>P2.5.1.23</b>	<b>Fieldbus digital input 3 parameter</b>	<b>ID893</b>	<b>"FB Dig 3 Par ID"</b>
<b>P2.5.1.25</b>	<b>Fieldbus digital input 4 parameter</b>	<b>ID894</b>	<b>"FB Dig 4 Par ID"</b>
<b>P2.5.1.27</b>	<b>Fieldbus digital input 5 parameter</b>	<b>ID895</b>	<b>"FB Dig 5 Par ID"</b>

With these parameters you can define the parameter to be controlled by using FB Digital input.

#### **Example:**

All option board inputs are in use and you still want to give DI: DC Brake Command (ID416). You also have a fieldbus board in the drive.

Set parameter ID891 (Fieldbus digital input 1) to 416.

Now you are able to control DC Braking command from the fieldbus by Profibus control word (bit 11).

It is possible to control any parameter in the same way if values 0=FALSE and 1=TRUE are significant for that parameter. For example, P2.6.5.3 Brake Chopper (ID504) can be controlled on and off using this function (Brake Chopper; 0 = Not Used, 1 = On, Run).

#### **P2.5.1.28 Safe disable active ID756 "Safe Disable Act"**

Select the digital output to show the status of the Safe Disable.

#### **P2.5.1.29 MCC Close Continues ID1218 "MCC Close Cont."**

Signal to control input switch, this signal will go high when DC voltage is high enough to bypass charging resistor and allow drive to get direct power from the grid. This signal will stay continuously high when all the conditions for closing are valid.

#### **P2.5.1.30 MCC Close Pulse ID1219 "MCC Close Cont."**

Signal to control input switch, this signal will go high when DC voltage is high enough to bypass charging resistor and allow drive to get direct power from the grid. This signal will give pulse with 2 second intervals until feedback from the input switch is received.

#### **P2.5.1.31 Motor Fan Control ID1805 "Motor Fan Cont."**

Signal to control external fan of the motor. Delay to stop the fan is selectable in Motor Protection group. Warning is given if control and status are opposite.

### 7.5.2 Analogue outputs 1 & 2 & 3 & 4

<b>P2.5.2.1</b>	<b>Analogue output 1 signal selection ID464</b>	<b>"Iout 1 Signal"</b>
<b>P2.5.3.1</b>	<b>Analogue output 2 signal selection ID471</b>	<b>"Iout 2 Signal"</b>
<b>P2.5.4.1</b>	<b>Analogue output 3, signal selection</b>	<b>ID478 "Iout 3 Signal"</b>
<b>P2.5.5.1</b>	<b>Analogue output 4, signal selection</b>	<b>ID1527 "Iout 4 Signal"</b>

Connect the AO1 signal to the analogue output of your choice with this parameter.

<b>P2.5.2.2</b>	<b>Analogue output function ID307</b>	<b>"Iout Content"</b>
<b>P2.5.3.2</b>	<b>Analogue output 2 function</b>	<b>ID472 "Iout 2 Content"</b>
<b>P2.5.3.2</b>	<b>Analogue output 3, function</b>	<b>ID479 "Iout 3 Content"</b>
<b>P2.5.3.2</b>	<b>Analogue output 4, function</b>	<b>ID1520 "Iout 4 Content"</b>

This parameter selects the desired function for the analogue output signal.

- 0 "Not used"**  
Analogue output is forced to 20 % (= 2 V/4 mA)
- 1 "O/P Freq"**  
Output frequency from zero to maximum frequency.
- 2 "Freq Ref"**  
Freq. reference from zero to maximum frequency
- 3 "Motor speed "**  
Motor speed from zero speed to motor synchronous speed
- 4 "O/P Current"**  
Drive output current from zero to motor nominal current
- 5 "Motor Torque "**  
Motor torque from zero to motor nominal torque (100 %)
- 6 "Motor Power"**  
Motor power from zero to motor nominal power (100 %)
- 7 "Mot Voltage"**  
Drive output voltage from zero to motor nominal voltage
- 8 "DC-link volt"**  
500 V unit: DC voltage from zero to 1000 Vdc  
690 V unit: DC voltage from zero to 1317 Vdc
- 9 "AI1"**  
Unfiltered Analogue input 1 signal
- 10 "AI2"**  
Unfiltered Analogue input 2 signal
- 11 "Fout,min-max"**  
Output frequency from minimum frequency to maximum frequency
- 12 "(-2Tn)-(2Tn)"**  
Motor torque from negative two times motor nominal to positive two times motor nominal torque
- 13 "(-2Pn)-(2Pn)"**  
Motor power from negative two times motor nominal to positive two times motor nominal power
- 14 "PT100 Temp."**  
Maximum PT100 temperature value from used input scaling from -30 C to +200 C
- 15 "FB Data In4"**  
FB analogue output fieldbus process data value can be connected to analogue output by using monitoring signal ID48 .

**16 “(-2nN)-(2nN)”**

Motor speed from negative two times nominal to positive two times nominal speed

**17 “Enc 1 Speed”**

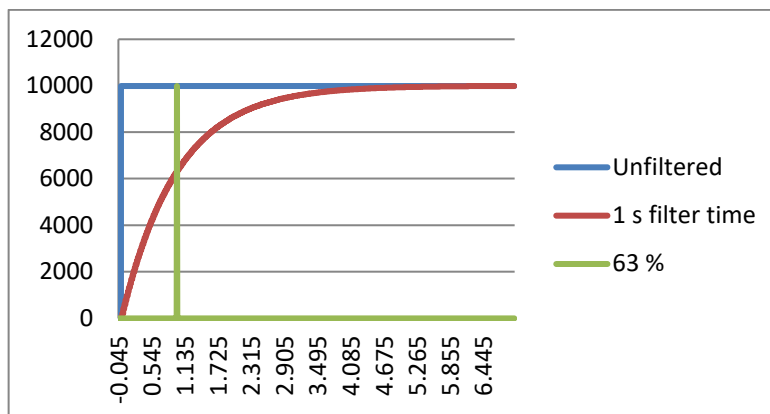
Encoder 1 speed from zero speed to motor synchronous speed.

**18 “Unit Temperature”**

Scaled between 0 – 100 C

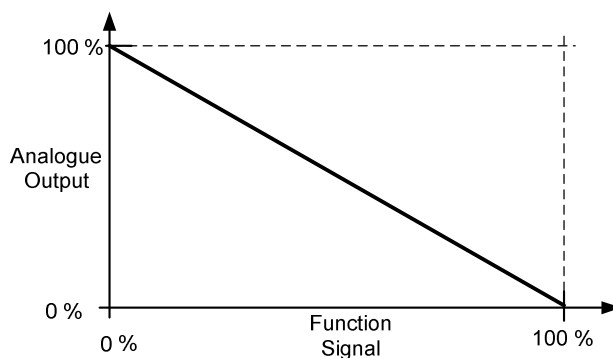
<b>P2.5.2.3</b>	<b>Analogue output filter time</b>	<b>ID308</b>	<b>“Iout Filter Time”</b>
<b>P2.5.3.3</b>	<b>Analogue output 2 filter time</b>	<b>ID473</b>	<b>“Iout 2 Filter T”</b>
<b>P2.5.4.3</b>	<b>Analogue output 3, filter time</b>	<b>ID480</b>	<b>“Iout 3 Filter T”</b>
<b>P2.5.5.3</b>	<b>Analogue output 4, filter time</b>	<b>ID1521</b>	<b>“Iout 4 Filter T”</b>

First order filtering is used for analogue output signals.



<b>P2.5.2.4</b>	<b>Analogue output inversion ID309</b>	<b>“Iout Invert”</b>
<b>P2.5.3.4</b>	<b>Analogue output 2 inversion ID474</b>	<b>“Iout 2 Invert”</b>
<b>P2.5.4.4</b>	<b>Analogue output 3 inversion ID481</b>	<b>“Iout 3 Invert”</b>
<b>P2.5.5.4</b>	<b>Analogue output 4 inversion ID1522</b>	<b>“Iout 4 Invert”</b>

Inverts the analogue output signal:

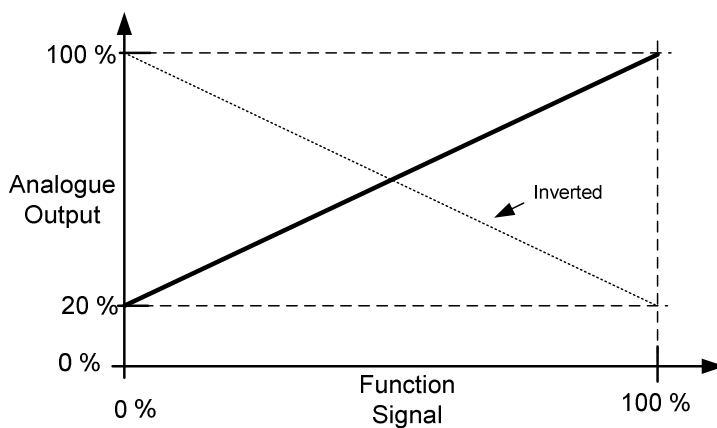


<b>P2.5.2.5</b>	<b>Analogue output minimum ID310</b>
<b>P2.5.3.5</b>	<b>Analogue output 2 minimum ID475</b>
<b>P2.5.4.5</b>	<b>Analogue output 3 minimum ID482</b>

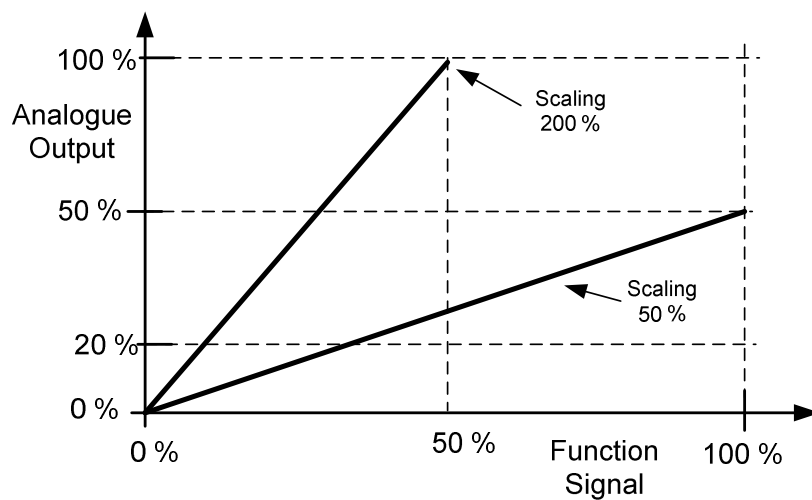
**P2.5.5.5    Analogue output 4 minimum    ID1523**

Defines the signal minimum to either 0 mA or 4 mA (living zero).

- 0** Set minimum value to 0 mA (0 %)
- 1** Set minimum value to 4 mA (20 %)



<b>P2.5.2.6</b>	<b>Analogue output scale</b>	<b>ID311</b>	<b>"Iout Scale"</b>
<b>P2.5.3.6</b>	<b>Analogue output 2 scaling</b>	<b>ID476</b>	<b>"Iout 2 Scale"</b>
<b>P2.5.4.6</b>	<b>Analogue output 3 scaling</b>	<b>ID483</b>	<b>"Iout 3 Scale"</b>
<b>P2.5.5.6</b>	<b>Analogue output 4 scaling</b>	<b>ID1525</b>	<b>"Iout 4 Scale"</b>

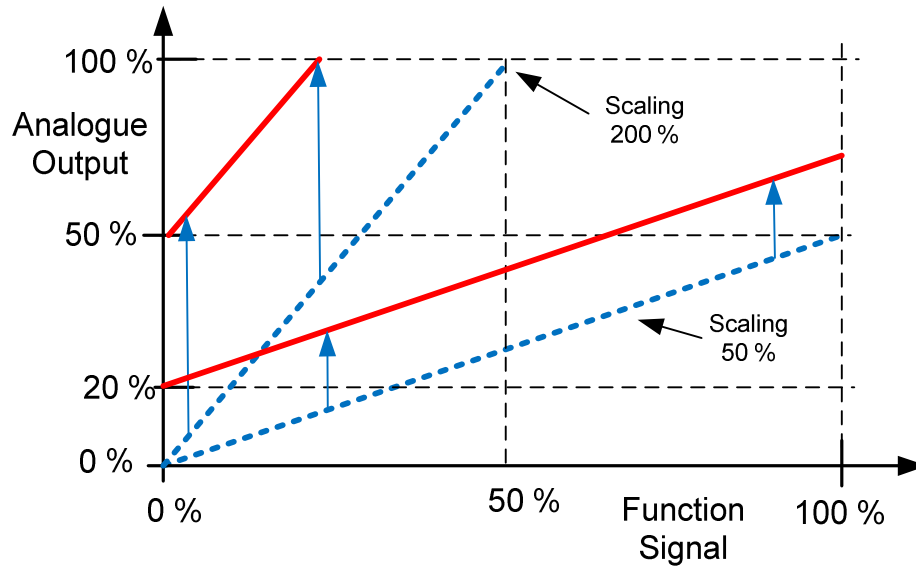


<b>P2.5.2.7</b>	<b>Analogue output offset</b>	<b>ID375</b>	<b>"Iout Offset"</b>
<b>P2.5.3.7</b>	<b>Analogue output 2 offset</b>	<b>ID477</b>	<b>"Iout 2 Offset"</b>
<b>P2.5.4.7</b>	<b>Analogue output 3 offset</b>	<b>ID484</b>	<b>"Iout 3 Offset"</b>
<b>P2.5.5.7</b>	<b>Analogue output 4 offset</b>	<b>ID1524</b>	<b>"Iout 4 Offset"</b>



Define the offset for the analogue output signal.

In picture below 50 % scaling signal has been given 20 % offset and for 200 % scaling 50 % offset.



### 7.5.3 Delayed Digital Output 1 & 2

**P2.5.6.1 Digital output 1 signal selection ID486 "Dig.Out 1 Signal"**

**P2.5.7.1 Digital output 2 signal selection ID489 "Dig.Out 2 Signal"**

Connect the delayed digital output signal to the digital output of your choice with this parameter. For more information about the TTF programming method, see chapter 4.

**P2.5.6.2 Digital output function ID312 "DO1 Content"**

**P2.5.7.2 Digital output 2 function ID490 "DO2 Content"**

**0 = "Not used"**

**1 = "Ready"**

The AC drive is ready to operate.

Missing ready signal can be traced by using monitoring values Non Ready Cause (ID1608) and Prevent MC Ready (ID1609).

**2 = "Run"**

The frequency converter is modulating.

**3 = "Fault"**

A fault trip has occurred

**4 = "FaultInvert"**

No active faults in the drive.

**5 = "OverheatWarn"**

Drive temperature has exceeded normal operation conditions. Temperature limit may vary depending on drive type and size.

**6 = "ExtFaul/Warm"**

External fault or warning depending on parameter response to external fault

**7 = "RefFaul/Warn"**

Fault or warning depending on parameter Response to the 4mA reference fault - occurs if analogue reference is 4—20 mA and signal is <4mA

**8 = "Warning"**

Always if a warning is on

**9 = "Reversed"**

Drive output speed is negative

**10 = "JogSpeedSel"**

The jogging, preset or inching speed has been activated with digital input.

**11 = "At speed"**

Induction motor: speed is within nominal slip of the reference.

PMS motor: output frequency is within 1 Hz of the reference.

**12 = "MotorRegAct"**

One of the limit regulators is active.

**13 = "Not Used"**

**14 = "Not Used"**

**15 = "Not Used"**

**16 = "Not Used"**

Reference limit supervision

Active reference goes beyond the set supervision low limit/high limit.

**17 = "ExtBrakeCont"**

External brake control

External brake ON/OFF control with programmable delay

**18 = "I/O ContAct"**

Control from I/O terminals

IO control place is active.

**19 = "Not Used"**

**20 = "WrongDirecti"**

Motor rotation direction is different from the requested one. This happens in situation when an external force makes the motor to rotate into different direction or when a command for direction change has been given and the drive is still ramping down to change direction.

**21 = "ExtBrakeInv"**

External brake control inverted

External brake ON/OFF control; Output active when brake control is OFF.

**22 = "ThermFlt/Wrn"**

Thermistor fault or warning

The thermistor input of option board indicates overtemperature. Fault or warning depending on the response parameter.

**23 = "Not Used"**

**24 = "FB DigInput1"**

Fieldbus digital input data 1

**25 = "FB DigInput2"**

Fieldbus digital input data 2

**26 = "FB DigInput3"**

Fieldbus digital input data 3

**27 = "Warning SR"**

Warning indication that requires pressing of Reset button. Normally the drive will remove warning indication when the fault situation has passed. This output requires that reset button is pressed before signal goes low after there has been a warning trigger.

**28 = "ID.Bit"**

Select the signal for controlling the DO. The parameter has to be set in format xxxx.yy where xxxx is the ID number of a signal and yy is the bit number. For example, the value for DO control is 1174.02. 1174 is the ID number of Warning Word 1. So the digital output is ON when bit number 02 of the warning word (ID no. 1174) i.e. Motor underload is high.

- P2.5.6.3**    **Digital output 1 on-delay**    **ID487**    **"DO1 ON Delay"**  
**P2.5.6.4**    **Digital output 1 off-delay**    **ID488**    **"DO1 OFF Delay"**  
**P2.5.7.3**    **Digital output 2 on-delay**    **ID491**    **"DO2 ON Delay"**  
**P2.5.7.4**    **Digital output 2 off-delay**    **ID492**    **"DO2 OFF Delay"**

With these parameters you can set on- and off-delays to digital outputs.

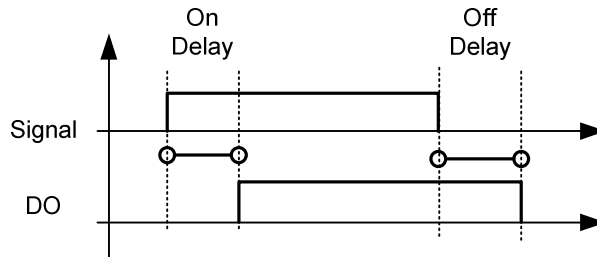
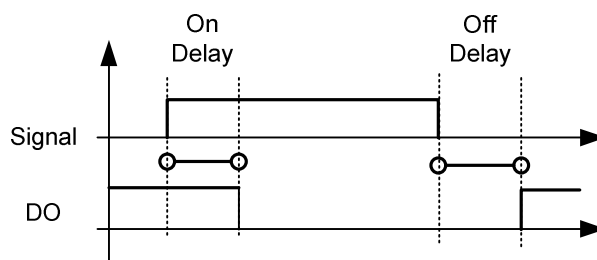


Figure 7-10. Digital outputs 1 and 2, on- and off-delays

- P2.5.6.5**    **Invert digital output 1**    **ID1587**    **"INV Delayed DO1"**  
**P2.5.7.5**    **Invert digital output 2**    **ID1588**    **"INV Delayed DO2"**



- P2.5.6.6**    **ID.Bit Free DO**    **ID1216**    **"ID.Bit Free DO"**  
**P2.5.7.6**    **ID.Bit Free DO**    **ID1385**    **"ID.Bit Free DO"**

Select the signal for controlling the DO. The parameter has to be set in format xxxx.yy where xxxx is the ID number of a signal and yy is the bit number. For example, the value for DO control is 1174.02. 1174 is the ID number of Warning Word 1. So the digital output is ON when bit number 02 of the warning word (ID no. 1174) i.e. *Motor underload* is high.

- 2.5.6.7**    **DDO1 Feed Back**    **ID1326**    **"DDO1 Feedback"**  
**2.5.7.7**    **DDO2 Feed Back**    **ID1277**    **"DDO1 Feedback"**

Select digital input that is used as a feedback for the output signal. If feedback signal do not get same status as the control within three second warning is generated.

- 2.5.6.8**    **DDO1 Feed Back Delay**    **ID1808**    **"Feedback Delay"**  
**2.5.7.8**    **DDO2 Feed Back Delay**    **ID1809**    **"Feedback Delay"**

Delay to warning if feedback is not received after the set delay.

## 7.6 Limit settings

### 7.6.1 Current limit handling

#### **P2.6.1.1 Current limit ID107 “Current Limit”**

This parameter determines the maximum motor current from the AC drive. The parameter's value range differs from size to size.

When the Current limit is changed the Stall current limit is internally calculated to 90% of the current limit (if the Stall current limit is greater than the Current limit). When the current limit is active the drive output frequency is reduced until current is below the set limit.

In closed loop control, the current limit affects the torque producing current limit, not total current. This can be changed in options group with the “LimitTotalCurrent” parameter.

In drive synch operation limiting is for average current of units.

#### **P2.6.1.2 Current Limit Kp ID1451**

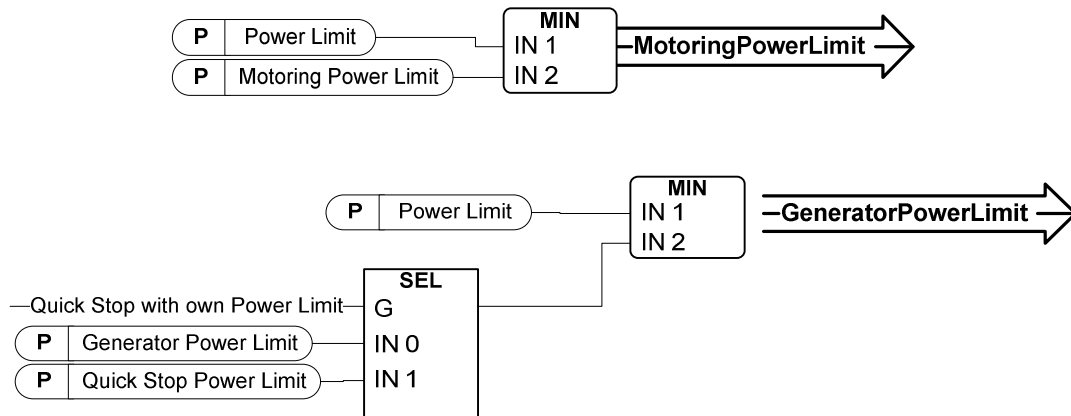
P-gain of motor side over current controller

#### **P2.6.1.3 Current Limit Ki ID1452**

I-gain of motor side over current controller

### 7.6.2 Power limit handling

Power limit function is meant to limit the drive output power to the motor. The general way to do this is to give a limiting signal from a primary system that gives information about how much power is available for drive operations.



#### P2.6.2.1 Power Limit ID1722 "Power Limit"

General power limit for both motoring and generator side. This value is the final limit for all scaling functions. This value should not be used for scaling but for the maximum safety limit because the ramp up rate function is ineffective when this parameter is changed.

#### P2.6.2.2 Generator power limit ID1290 "GenerPower Limit"

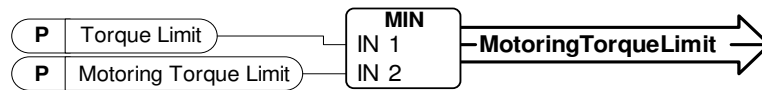
Generator side power limit. This limit value is used for all scaling functions and power limit ramp rate functions.

#### P2.6.2.3 Motoring power limit ID1289 "MotorPowerLimit"

Motoring side power limit. This limit value is used for all scaling functions and power limit ramp rate functions.

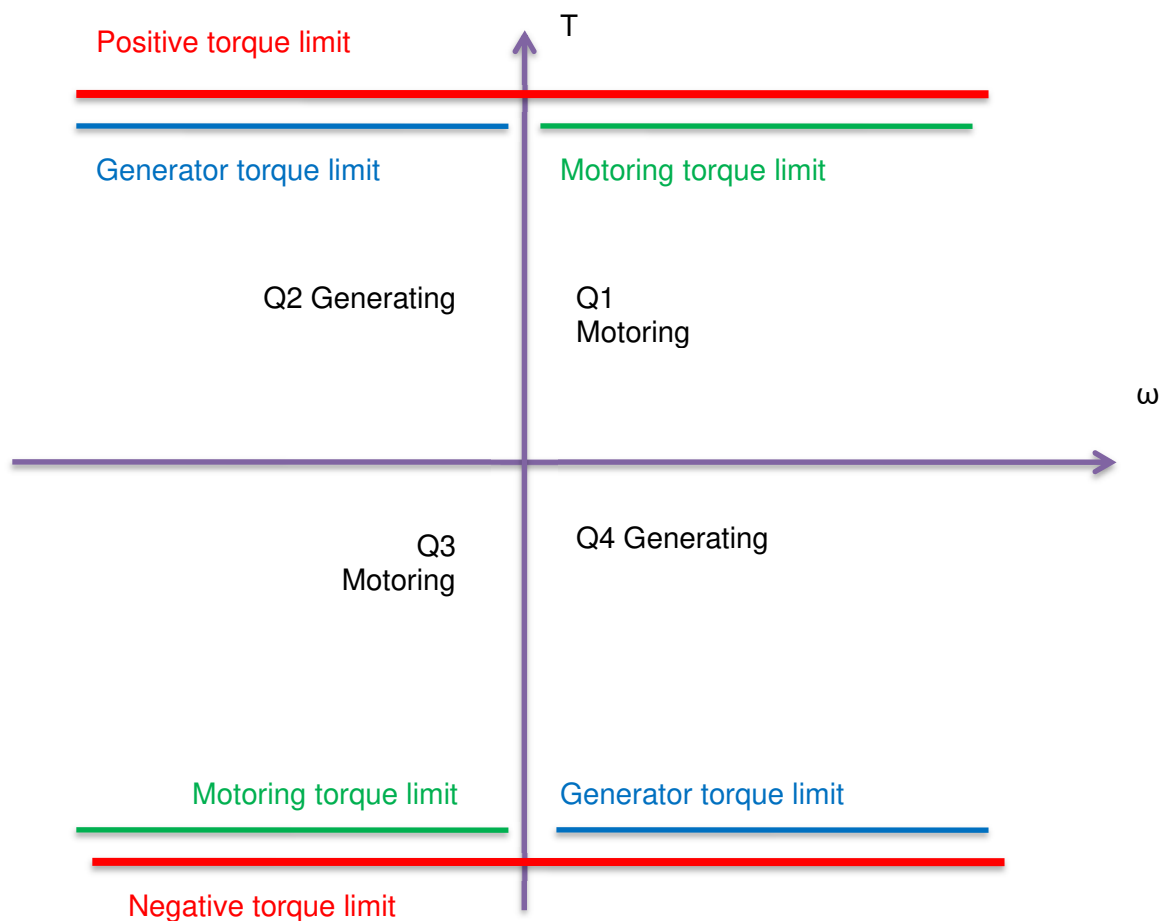
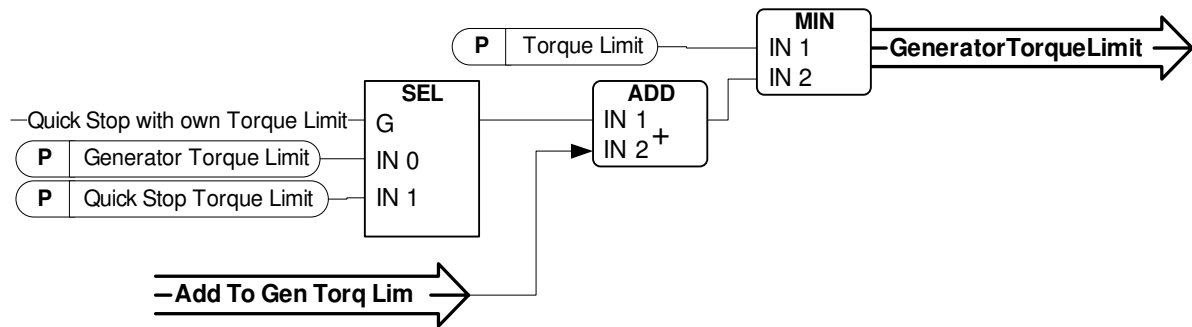
### 7.6.3 Torque limit handling

#### 7.6.3.1 Motoring Torque limit function



#### 7.6.3.2 Generator torque limit function

Details of “Add to Gen Torq Lim” can be found from Brake Control chapter.



**P2.6.3.1 Torque Limit ID609 "Torque Limit"**

The general torque limit for both motoring and generator sides.

**P2.6.3.2 Motoring Torque limit ID1287 "MotorTorqueLimit"**

Motoring side torque limit.

**P2.6.3.3 Generator Torque limit ID1288 "GenerTorqueLimit"**

Generator side torque limit.

**P2.6.3.4 Pull Out Slip Limit ID1291 "PullOutSlipLimit"**

This defined slip limit for pull out torque point. 100,0 % equals motor nominal slip.

**7.6.3.3 Open Loop settings only****P2.6.3.9.1 Torque limit control P-gain ID610 "TorqLimCtrl P"**

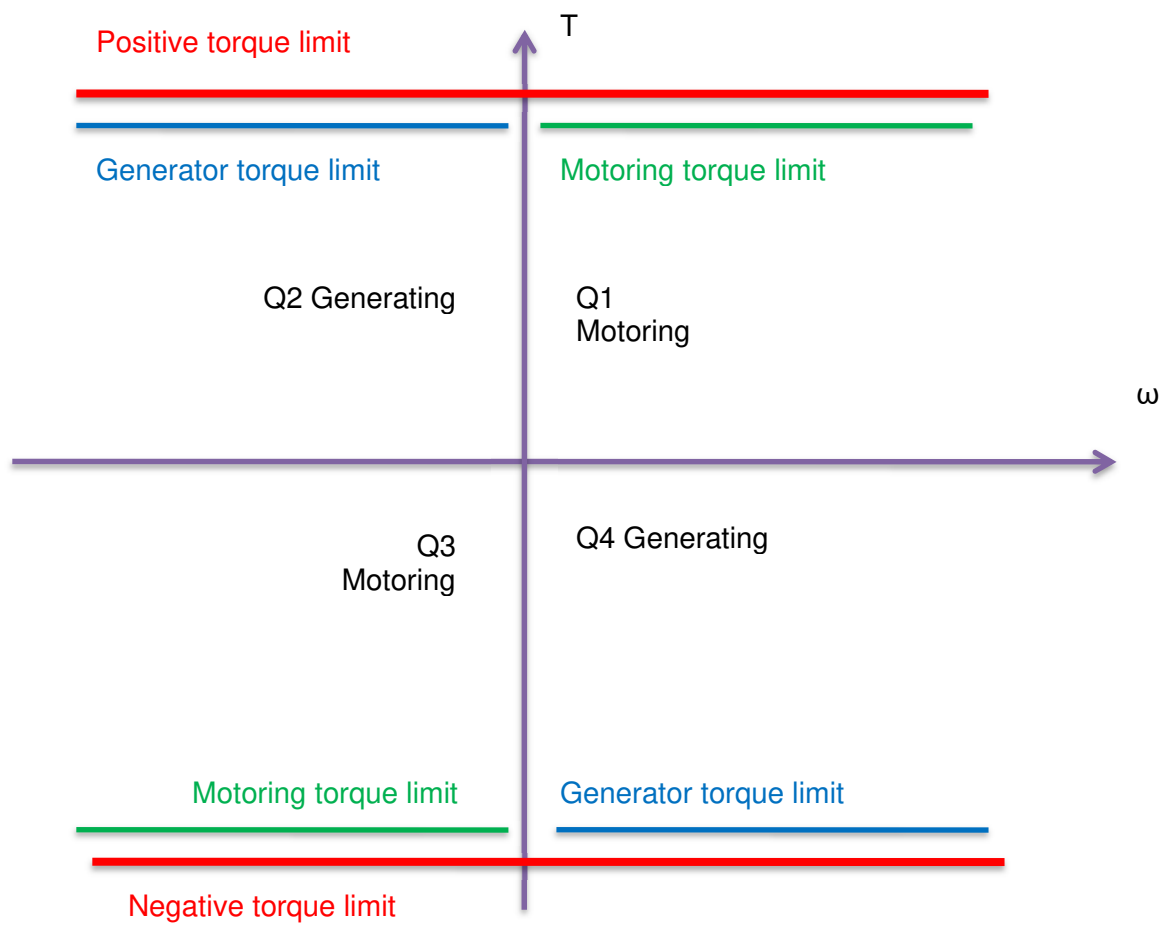
This parameter defines the gain of the torque limit controller. It is used in Open Loop control mode only.

**P2.6.3.9.2 Torque limit control I-gain ID611 "TorqLimCtrl I"**

This parameter determines the I-gain of the torque limit controller. It is used in Open Loop control mode only.



## 7.6.3.4 Closed Loop settings only

**P2.6.3.10.1 Speed Control output limit ID1382 "SPC Out Limit"**

Torque limit for the speed controller. It affects both the positive and negative direction torques.

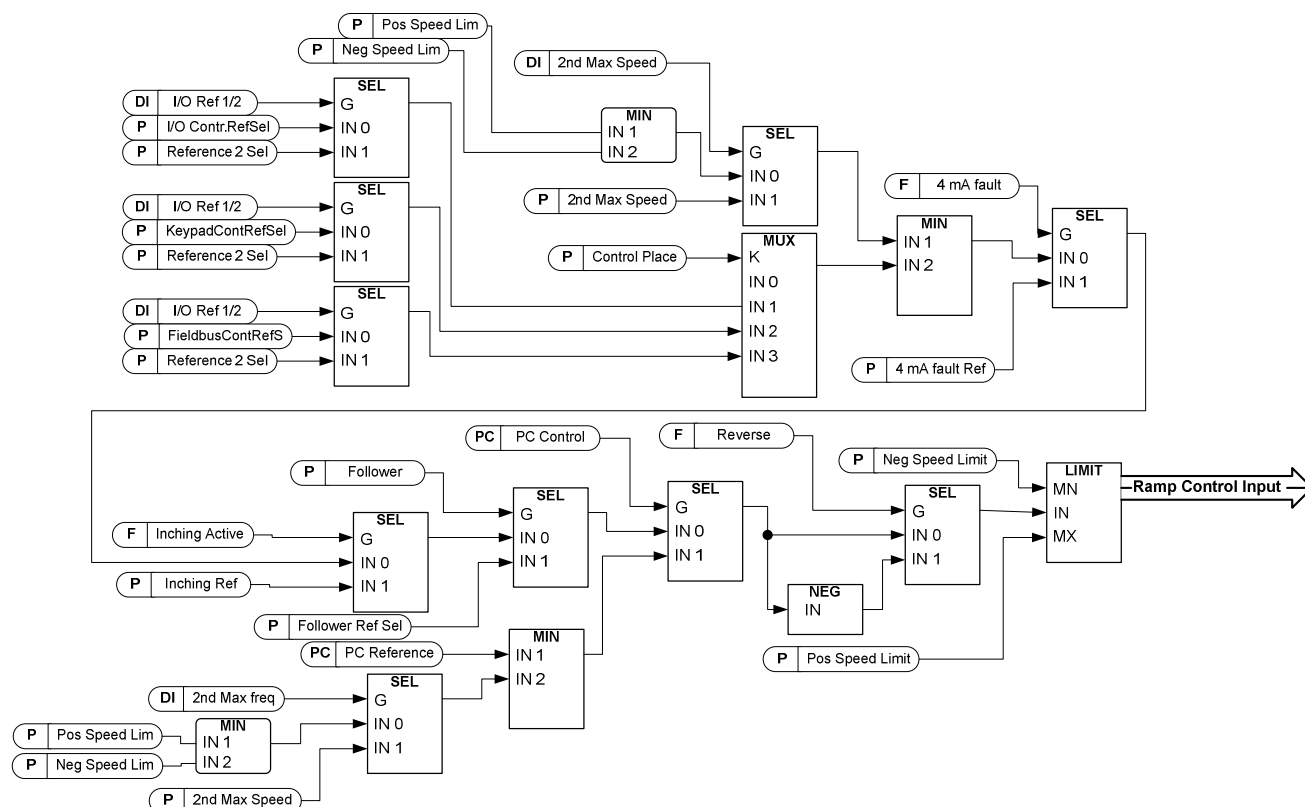
**P2.6.3.10.2 Speed Control positive limit ID646 "SPC Pos Limit"**

Positive torque limit for speed controller output.

**P2.6.3.10.3 Speed Control negative limit ID645 "SPC Neg Limit"**

Negative torque limit for speed controller output.

### 7.6.4 Speed limit handling



#### P2.6.4.1 Negative Speed Limit ID1286 "Neg Speed Limit"

Negative direction speed limit.

By default drive will coast stop if this limit is exceeded by 120 rpm.

**NOTE:** When changed in closed loop control mode change is made without ramp.

##### DriveSynch operation

The maximum recommended corresponding frequency is 100 Hz.

#### P2.6.4.2 Positive Speed Limit ID1285 "Pos Speed Limit"

Positive direction Speed limit.

By default drive will coast stop if this limit is exceeded by 120 rpm.

**NOTE:** When changed in closed loop control mode change is made without ramp.

##### DriveSynch operation

The maximum recommended corresponding frequency is 100 Hz.

#### P2.6.4.3 Zero Speed limit ID1283 "Zero speed Limit"

Defines the zero Speed limit.

Used to determine when load drooping is set to zero if load drooping removal function 1 is selected

#### P2.6.4.4 Maximum Speed Limit 2 ID1512 "Max Speed 2"

This parameter defines the maximum speed when the digital input “Max Speed 2” is activated. This limit does not affect the reference values that are of constant type, e.g. preset speed references.

**P2.6.4.5    *Above speed limit***

When motor speed is above this limit, MainStatusWord Bit10 is set.

### 7.6.5 DC Link handling

#### P2.6.5.1 Overvoltage controller ID607 "Overvolt Contr"

The parameter selects the behaviour of the overvoltage controller in open loop control. It also activates the closed loop overvoltage controller but the operation is always of type 'PI' in closed loop control modes.

##### 0 "Off" - Controller switched off

Both open and closed loop overvoltage controllers are off.

##### 1 "On:NoRamping" – Activated P-Controller type operation

Both open and closed loop controllers are activated.

Open loop controller is a P-type controller.

Closed loop controller is a PI-type controller.

##### 2 "On: Ramping" – Activated PI-Type controller

Both open and closed loop controllers are activated.

Open loop controller is a PI-type controller.

Closed loop controller is PI-type controller (as in selection 1).

#### P2.6.5.2 Overvoltage Reference Select ID1262 "OverVolt.Ref.Sel"

Overvoltage reference level depending on the status of the brake chopper.

In closed loop control, the overvoltage controller level is adjusted by "OverVoltageRef." The parameter can be found in the CL setting parameter group.

ID1262	Brake chopper in use	Brake chopper not in use
0 / High Voltage	500 V Unit: 844 V 690 V Unit: 1164 V	500 V Unit: 797 V 690 V Unit: 1099 V
1 / Norm.Voltage	1.25*Estimated DC nominal voltage	1.18*Estimated DC nominal voltage
2 / BrakeChLevel	1.07*brake chopper level	Brake chopper level

#### P2.6.5.3 Over Voltage Kp ID1468 "Over Voltage Kp"

Gain of the P-term of the PI type overvoltage controller. The range is 0...32767.

#### P2.6.5.4 Over Voltage Ki ID1409 "Over Voltage Ki"

Gain of the P-term of the PI type overvoltage controller. The range is 0...32767.

#### P2.6.5.5 Over Voltage Ki Add ID1425 "OverVoltageKpAdd"

Additional gain of the P-term of the PI type overvoltage controller at field weakening point.

#### P2.6.5.6 Brake chopper ID504 "Brake Chopper"

When the AC drive is decelerating the motor, the inertia of the motor and the load are fed into an external brake resistor. This enables the drive to decelerate the load with a torque equal to

that of acceleration (provided that the correct brake resistor has been selected). See separate Brake resistor installation manual. Brake chopper test mode generates pulse to resistor every second. If the pulse feedback is wrong (resistor or chopper is missing) fault F12 is generated.

Over Voltage Reference Select	Brake chopper level
0 / High voltage	500 V Unit: 797 V 690 V Unit: 1099 V
1 / Norm.Voltage	1.18* Estimated DC nominal voltage
2 / BrakeChLevel	Brake chopper level

**0 = “Not Used” - No brake chopper used**

Brake chopper not active or present in the DC link. **NOTE:** The overvoltage controller level is set to a little lower, see parameter P2.6.5.2.

**1 = “On, Run” - Brake chopper in use and tested when running.**

The drive's own brake chopper is activated and operational when the drive is in Run state. The drive also sends test pulses for feedback from the brake resistor.

**2 = “External” - External brake chopper (no testing)**

The system has an item that handles the DC link voltage. This could be a system with AFE or there is an external BCU unit. When this option is selected the drive overvoltage level is set a little higher so that its operation does not conflict with AFE or BCU units.

**3 = “On, Run+Stop” - Used and tested in READY state and when running**

Brake chopper is also active when the drive is not in Run state. This option can be use e.g. when other drives are generating but energy levels are low enough to be handled with only one drive.

**4 = “On, No test” - Used when running (no testing)**

Brake chopper is active in Run state but no test pulse to resistor is generated.

**Note:** In the system menu there is a parameter “InternBrakeRes”. This parameter is used for brake resistor overheating calculations. If an external brake resistor is connected to the drive the parameter should be set to ‘Not connected’ to disable temperature calculation for the brake resistor.

**P2.6.5.7 Brake Chopper Level ID1267 “BrakeChopperLeve”**

Brake chopper control activation level in volt. This parameter is active when “OverVolt.Ref.Sel” is 2 / “BrakeChLevel”

**For 400V Supply:**  $400 * 1.35 * 1.18 = 638 \text{ Vdc}$

**For 500V Supply:**  $500 * 1.35 * 1.18 = 797 \text{ Vdc}$

**For 690V Supply:**  $690 * 1.35 * 1.18 = 1100 \text{ Vdc}$

**P2.6.5.8 Brake Resistor Torque Limit ID12678 “BrakeResTorqLim”**

This parameter value is set as a generator side torque limit to avoid the overheating of brake resistor during continuous braking. This is active only when Brake chopper (P2.6.2) is selected, emergency stop is not active and drive is not decelerating.

**P2.6.5.9 Undervoltage controller ID608 “Undervolt Contr”**

Undervoltage controller will decrease the output frequency in order to get energy from the motor when the DC voltage has dropped to a limit where the undervoltage controller activates trying to keep DC voltage at the minimum level.

**0 “Off” - Controller switched off**

Both open and closed loop overvoltage controllers are off.

**1 “On:NoRamping” – Activated PI-Controller type operation**

Both open and closed loop controllers are activated.

If power comes back while drive is at undervoltage the controller output frequency will regain the reference value.

**2 “On: Ramping” – PI controller type and ramping down.**

Both open and closed loop controllers are activated.

If power comes back after under voltage controller has been active, drive will ramp to zero speed using ramp time 2 and generate an under voltage fault (F9) with sub code S3.

**Note:** In closed loop control, also parameter “CLrmpFollEncFreq” needs to be activated to achieve identical operation.

**P2.6.5.10 Under Voltage Kp ID1415 “Under Voltage Kp”**

Gain for the P-term of the PI type under voltage controller.

**P2.6.5.11 Under Voltage Ki ID1416 “Under Voltage Ki”**

Gain for the I-term of the PI type under voltage controller.

**7.6.5.1 CL Settings****P2.6.5.12.1 Overvoltage reference ID1528 “OverVoltageRef.”**

Defines the overvoltage reference level in Closed Loop control mode.

$690 \text{ Vac} * 1,35 * 118 \% = 1099 \text{ Vdc}$

$500 \text{ Vac} * 1,35 * 118 \% = 796 \text{ Vdc}$

**P2.6.5.12.2 Overvoltage controller motoring torque limit ID1623 “CL OV ConMotTLim”**

Defines motoring torque limit, when drive is operating under over voltage controller.

**P2.6.5.12.3 Under voltage reference ID15367 “CL UnderVolt.Ref”**

Defines the under voltage reference level in Closed Loop control mode.

$690 \text{ Vac} * 1,35 * 65 \% = 605 \text{ Vdc}$

$500 \text{ Vac} * 1,35 * 65 \% = 438 \text{ Vdc}$

**7.6.6 Limit options****P2.6.6.1 Limit total current ID1901 “LimitTotalCurren”**

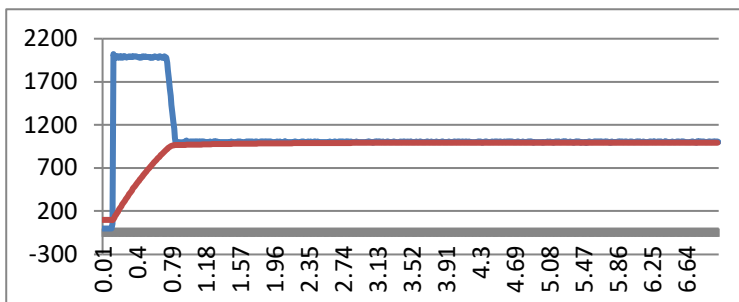
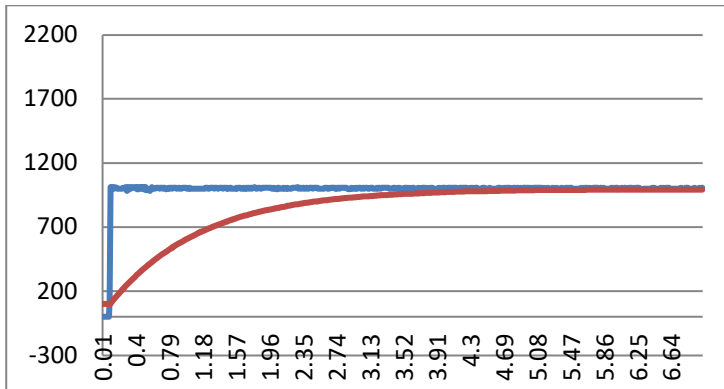
This function activates the total current limit function in close loop control. Normally in closed loop the current limit only affects the torque producing current.

## 7.7 DC current and magnetization handling

The DC brake can be used to hold the motor in place (nominal torque at nominal slip). It can be also used to keep the motor warm in places with high humidity and to speed up the generation of rotor flux. Rotor flux is needed in the induction motor to generate torque. The current that is needed to make the nominal flux is defined by the magnetization current parameter but, depending on motor size, nominal flux takes a different time to produce after start command.

Giving a higher current on start to the motor will decrease the time when the motor is able to generate nominal torque.

Blue: Motor Current. Red: Rotor Flux.



### 7.7.1 Open loop settings

#### P2.7.1.1 DC-braking current ID627 "DC-Brake Current"

Defines the current injected into the motor during DC-braking. On start this parameter is used together with DC Brake time to decrease the time when motor is able to produce nominal torque. When DC brake current is applied to the motor the output frequency is zero.

#### P2.7.1.2 DC-braking time at start ID507 "Start DC-BrakeTm"

DC-brake is activated when the start command is given. This parameter defines for how long DC current is given to the motor before acceleration starts. DC brake current at start is used in order to magnetize the motor before running which will improve torque performance at start. Needed time depends on motor size, value varying between 100 ms to 3 second. The bigger the motor the more time is needed.

The default setting 0,00 s means that 200 ms is spent to magnetize motor. This 200 ms can be set to zero with parameter "MakeFluxTime".

Activating flying start will disable the DC brake functions at start.

#### P2.7.1.3 DC-braking time at stop ID508 "Stop D-BrakeTm"

Defines the time to use DC brake at stop. The operation is different depending on the selected stop mode (coasting or ramping).

#### **Stop function = 0 / Coasting:**

After the stop command, the motor coasts to a stop without control of the drive.

With DC injection, the motor can be electrically stopped in the shortest possible time, without using an optional external braking resistor.

The braking time is scaled according to the speed at the moment of stop command. If the speed is the nominal speed of the motor or higher, the set value of DC braking time at stop is used as the braking time. When the speed is below the nominal speed, the relation between the nominal speed and the actual speed at the time of stop command will determine the DC braking time. For example, 1500 rpm motor is running at 750 rpm when the stop command is given. The DC brake time will be 50 % of the DC braking time at stop. If the speed is below 150 rpm the minimum DC braking time is 10 % of the DC braking time at stop.

DC braking is started after a short restart delay following the stop command if stop function is coasting.

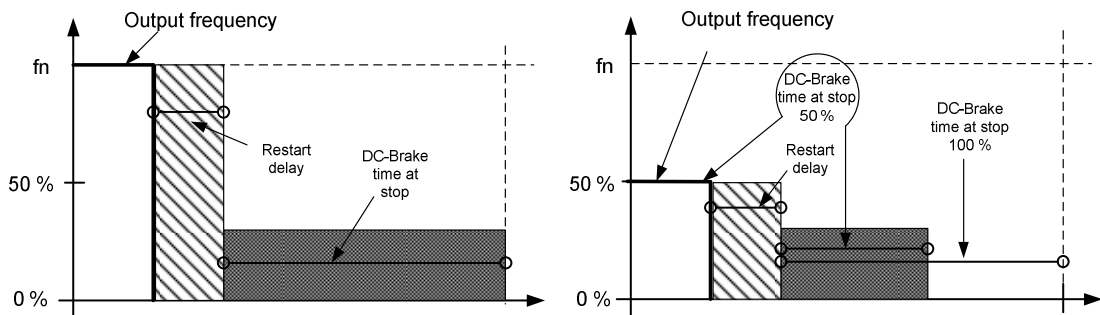


Figure 7-11. DC-braking time when Stop mode = Coasting, from nominal speed and 50 % of nominal speed.

#### **Stop function = Ramp:**

After the Stop command, the speed of the motor is reduced according to the set deceleration parameters, to the speed defined with parameter DC braking speed at stop, where the DC braking starts.

The braking time is defined with parameter *DC braking time at stop*. If high inertia exists, it is recommended to use an external braking resistor for faster deceleration. See Figure 7-12.

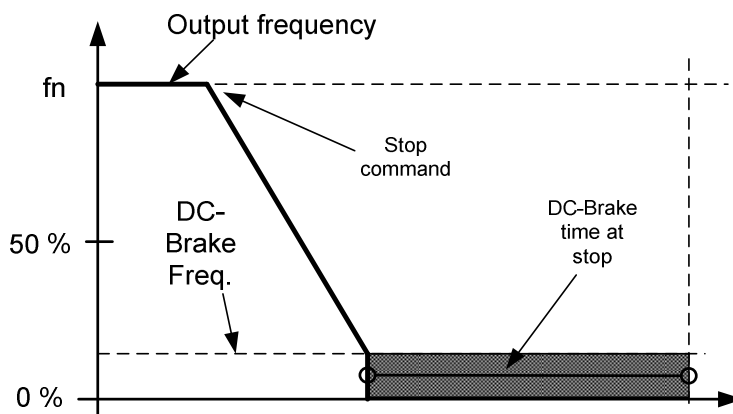




Figure 7-12. DC-braking time when Stop mode = Ramp

**P2.7.1.4 DC braking speed at stop ID515 “DC Brake Speed”**

The motor speed at which the DC braking is applied when making ramping stop.

**P2.7.1.5 Scaling of DC-braking current ID400 “DC-currnt Sclng”**

The DC braking current can be reduced with the free analogue input signal between zero current and the current set with parameter *DC Braking Current*.

**0** = Not used

**1** = AI1

**2** = AI2

**3** = AI3

**4** = AI4

**5** = FB Limit Scaling ID46 Monitoring value

**P2.7.1.6 DC brake current in stop ID1080 “DCBrakeCurlnStop”**

Defines the current injected to the motor in stop state when the digital input signal “DC Brake Command” is used to activate the DC brake when no run request is active. When the DC brake is activated the drive will indicate being in Run state.

**7.7.1.1 Flux braking**

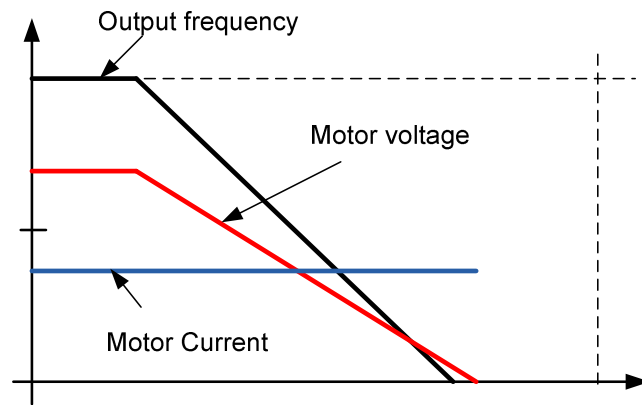
**P2.7.1.7 Flux brake ID520 “Flux Brake”**

Instead of DC braking, flux braking is a useful way to raise the braking capacity in cases where additional brake resistors are not needed.

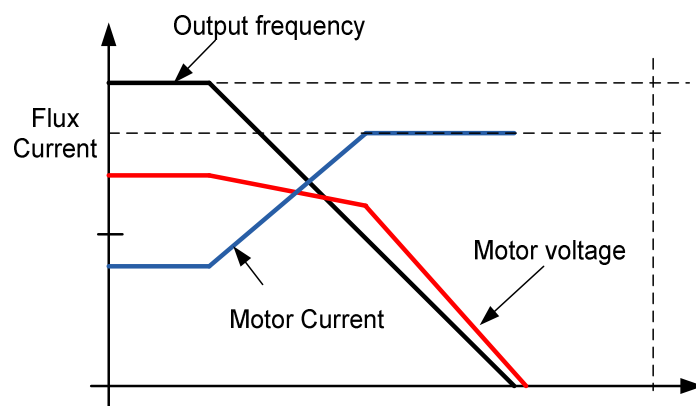
When braking is needed, the speed is reduced and the flux in the motor is increased. This increases losses on motor, which in turn increases the motor's capability to brake. Unlike in DC braking, the motor speed remains controlled during braking.

The flux braking can be set ON or OFF.

**0** = Flux braking OFF



**1** = Flux braking ON



**P2.7.1.8 Flux braking current ID519 "FluxBrakeCurrent"**

Defines the flux braking current value. The value setting range depends on the used unit size.

### 7.7.2 Closed loop settings

#### P2.7.2.1 Magnetizing current at start ID627 "Start Magn Curr"

Defines the current that is applied to the motor when the start command is given in closed loop control. At start this parameter is used together with *Magnetizing time at start* to decrease the time when the motor is able to produce nominal torque. In closed loop control actual speed is not forced to zero while magnetization current is applied to motor.

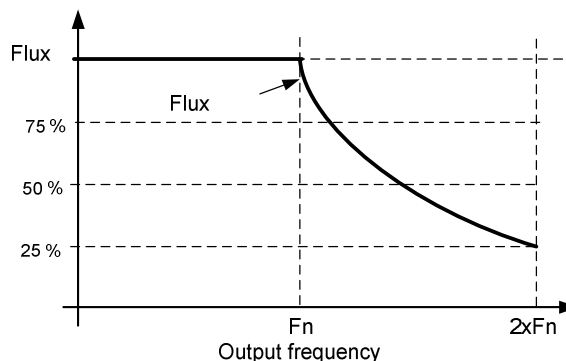
#### P2.7.2.2 Magnetizing time at start ID628 "Start Magn Time"

Defines the time for how long magnetization current is applied to motor at start. *Magnetizing current at start* is used to shorten the time when flux is at nominal level. This will improve the torque performance at start. The time needed depends on the motor size, value varying between 100 ms to 3 second. The bigger the motor the more time it needs. Set this time so that the rotor flux is more than 90 % before speed is released (Start Zero Speed Time ID615) or mechanical brake is released.

#### P2.7.2.3 Flux reference ID1250 "FluxReference"

Reference value for rotor flux. Rotor flux can be reduced by changing the magnetization current. This, however, also affects the motor model making the torque calculations a little less accurate. When using this parameter the motor model can compensate the effect of the different magnetization current in torque calculations.

$$[FW]RotorFlux = \left( \frac{f(MotorNomFreq)}{f(Out)} \right)^2 \quad \text{when } f(Out) > f(MotorNomFreq)$$



#### P2.7.2.4 Flux Off Delay ID1402 "Flux Off Delay"

The Flux off delay function will keep the motor magnetized after a stop command thus making the next start faster because flux is already available in the motor. The function is used e.g. in a system where several repeated starts are made in short cycles. The flux level can be adjusted by parameter *Stop State Flux*.

- 0 = Flux is not maintained in the motor
- >0 = Flux off delay in seconds.
- 1 = Flux is maintained indefinitely in the motor

#### P2.7.2.5 Stop State Flux ID1401 "Stop State Flux"

The amount of flux in percentage of the motor nominal flux maintained in the motor after the drive is stopped. The flux is maintained for the time set by parameter ID1402 *Flux Off Delay*. This parameter can only be used in closed loop motor control.

## 7.8 Motor Control

### Open Loop control

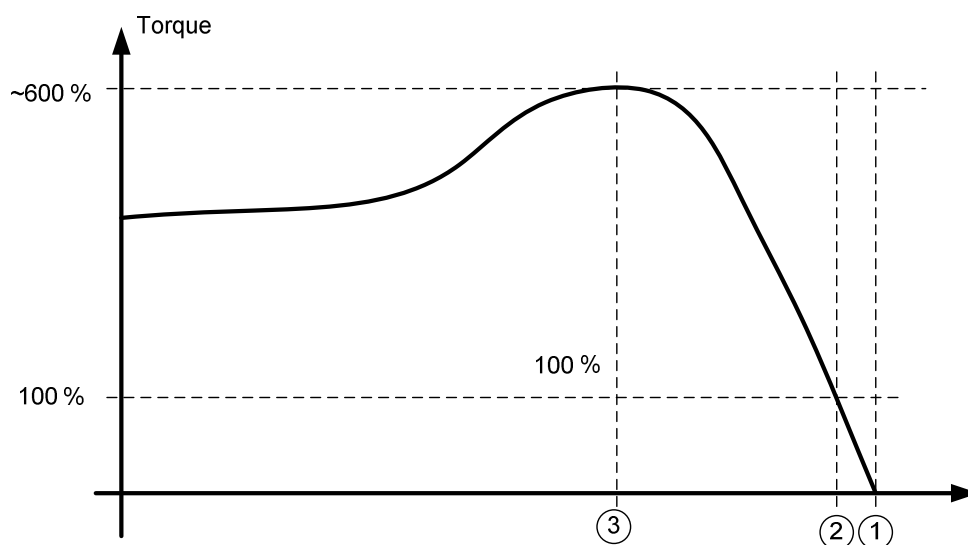
Open loop control controls the motor without encoder feedback from the motor shaft. Control mode selections 0, 1 and 2 are open loop control modes.

### Slip

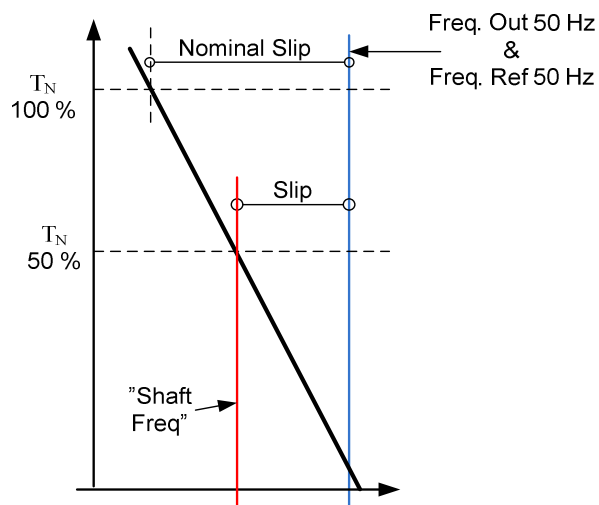
Induction motor torque is based on slip. When load increases also slip will increase. Slip is the speed that rotor is behind of stator electrical frequency.

Below picture presents torque that is produced by induction motor when connected directly on line.

1. Motor Synchronous speed. Motor is taking only magnetization current.
2. Motor nominal operation point. Motor is producing 100 % of rated torque and power. Actual shaft speed is motor nominal speed and motor takes nominal current.
3. Pullout torque. This is point where motor produced torque start to decrease when slip increases. After this point motor will stop if load is not reduced.

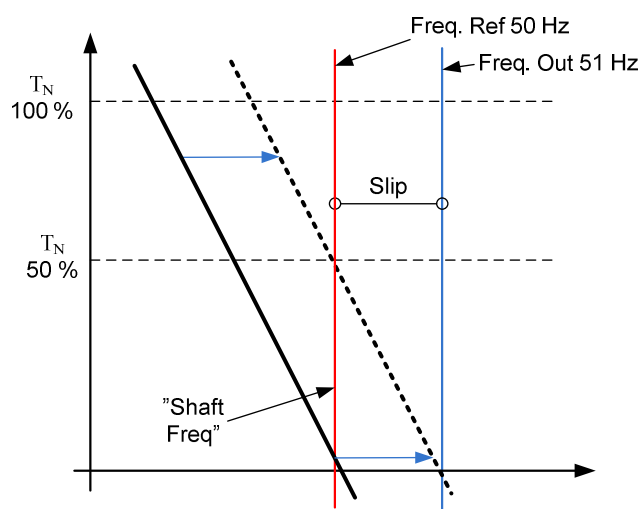


In frequency control, the load will determine the actual shaft speed



### ***Slip compensation in open loop control***

The drive uses motor torque and motor nominal rpm to compensate slip. If the motor nominal rpm is 1440 -> the nominal slip is 60 rpm. And when the motor torque is 50 % the slip is 30 rpm. To keep the reference speed the drive must increase the output frequency by 1 Hz.



### **Closed Loop control**

Closed loop control controls the motor using the exact information of the motor speed from the encoder. Control mode selections 3 and 4 are closed loop control modes. Using these modes without encoder board (and encoder) will result in encoder fault.

**P2.8.1 Motor control mode ID600 “Motor Ctrl Mode”**

When the drive is follower and drive synch is enabled the motor control mode is internally set to Frequency control.

**0 “Freq Control”**

Open loop frequency control:

Drive frequency reference is set to output frequency without slip compensation. Motor speed is defined by motor load.

**1 “OL SpeedCont”**

Open loop speed control:

Drive frequency reference is set to motor speed reference. Motor speed stays the same regardless of motor load.

**2 “Open Loop”**

Open loop Speed or Torque control

In this control mode the drive can be selected to run in torque control mode. The operation is selected by parameter *Torque Select* P2.8.2. The default selection is Speed Control.

**3 “Close Loop”**

Closed loop speed or torque control

In this control mode the drive can be selected to run in torque control mode. The operation is selected by parameter *Torque Select* P2.8.2. The default selection is Speed Control.

**4 “Sensorless”**

Sensorless speed or torque control

To use this control mode DTC Identification or Ident All is needed to perform.

### P2.8.2 Torque Select ID1278 "Torque Select"

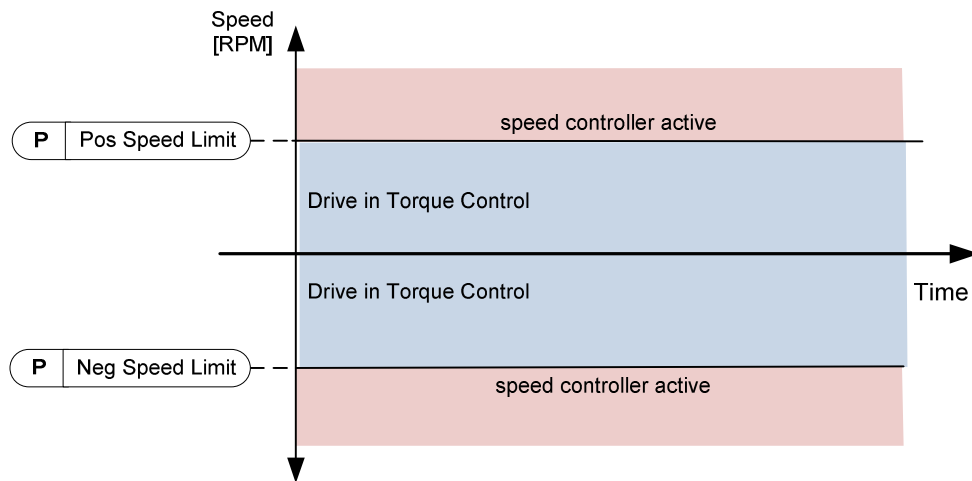
This parameter defines the speed limiting mode in torque control mode. This parameter can be used as single motor control mode selection when no change is made between open loop and closed loop controls.

#### 0 and 1 = "SpeedControl" - Speed control mode

The drive is forced to operate in speed control mode while the motor control mode parameter is set to torque control mode thus allowing selection of speed control and torque control mode with single parameter e.g. from Fieldbus.

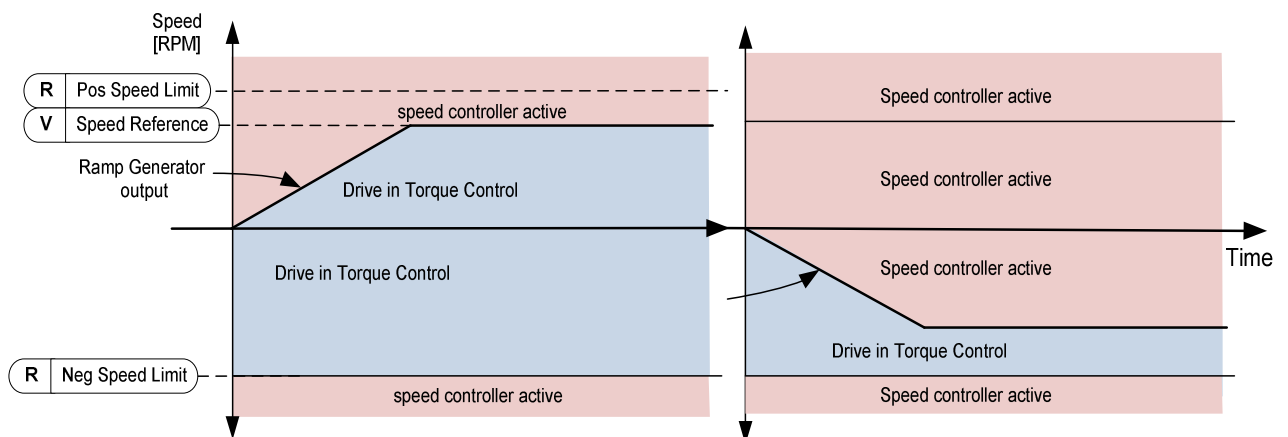
#### 2="Torque" - Positive and negative speed limits

Speed is not limited by speed reference, only Positive and Negative speed limits will limit the speed if load torque is smaller than reference.



#### 3="Min" – Minimum from speed reference and torque reference.

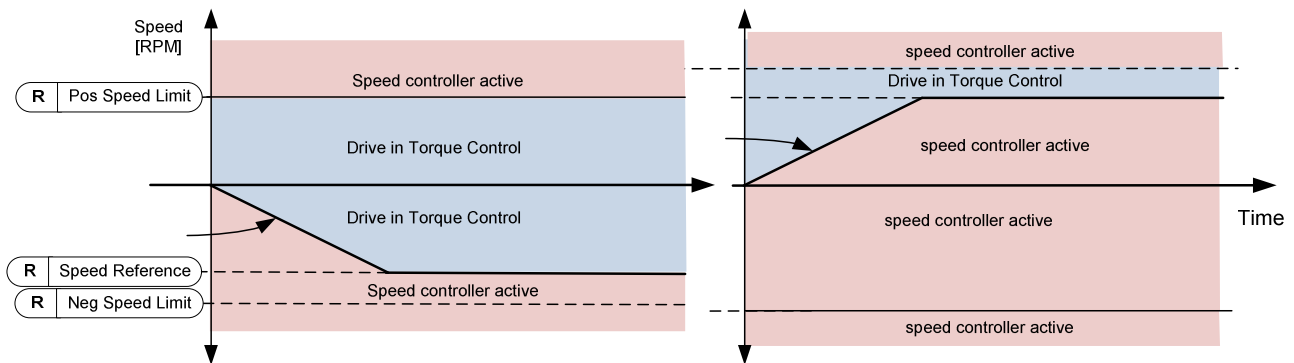
The minimum of the speed controller output and the torque reference is selected as final torque reference.





#### 4="Max" – Maximum from speed reference and torque reference

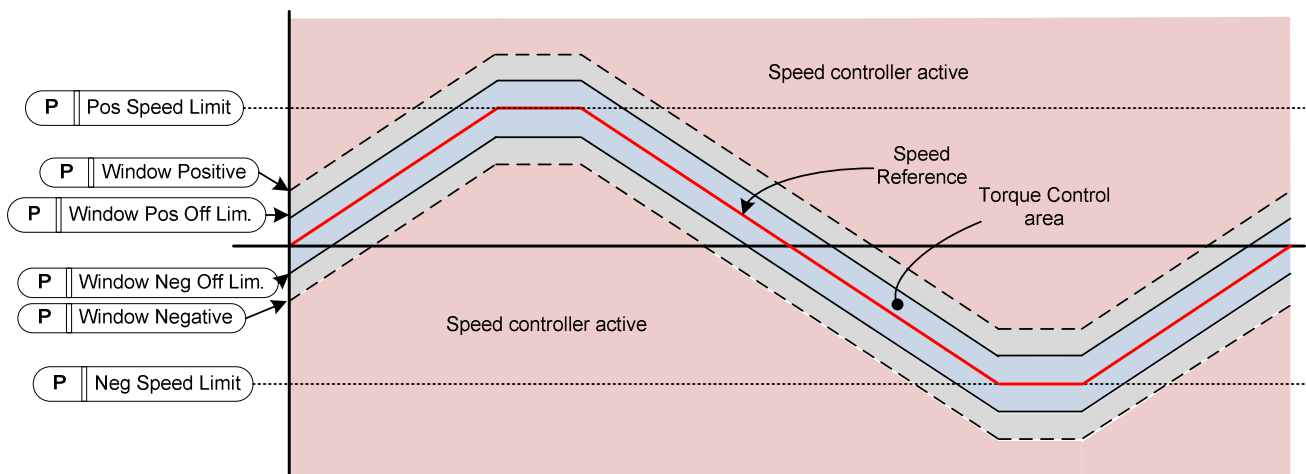
The maximum of the speed controller output and the torque reference is selected as final torque reference.



#### 5="Window" – Window control

Speed is limited within window from speed reference.

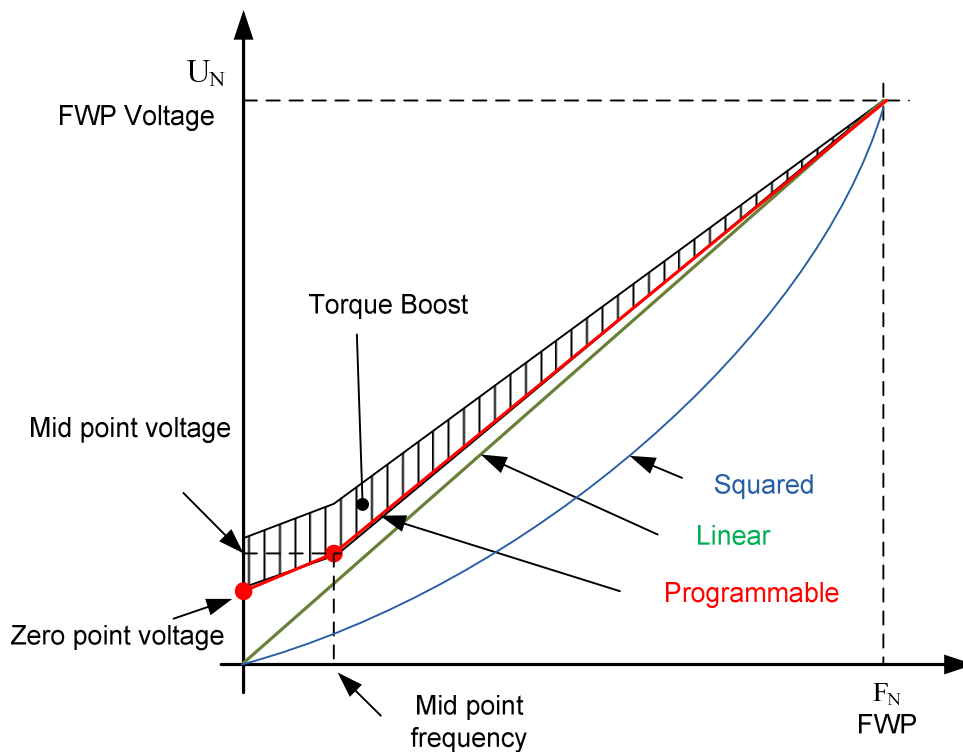
Speed control activation limit is different from the speed limit. Speed needs, therefore, to go first to "Window Pos" or "Window Neg" limit before the speed controller activates, when speed controller is active speed will be restricted to limit defined by "Window Pos Off" and "Windows Neg Off" from the "FinalFreqRef"





### 7.8.1 Open Loop

U/f settings are mainly used in open loop control modes with the exception of the *Field weakening point voltage* that is also used in closed loop control mode as a limit for voltage. U/f settings are used to control the voltage level that are applied to the motor at different frequencies and different load situations.



What changes are required to start with load from 0 Hz?

- ◆ First set the motor nominal values (Parameter group 2.1).

#### Option 1: Automatic functions

Step 1: Make identification with rotating motor

Step 2 (If needed): Activate speed control or U/f optimization (Torque boost).

Step 3 (If needed): Activate both speed control and U/f optimization.

#### Option 2: Manual tuning

##### Step 1:

Run the motor using 2/3 of motor nominal frequency as the frequency reference. Read the motor current in the monitoring menu or use NCDrive for monitoring. This current shall be set as the motor magnetizing current.

Change the U/f curve ratio selection to programmable (= 2).

Run the motor with zero frequency reference and increase the motor zero point voltage until the motor current is approximately same as the motor magnetising current. (If the motor is in a low frequency area for only short periods, it is possible to use up to 65 % of the motor nominal current).

Set then the midpoint voltage to  $\sqrt{2} \cdot \text{Zero Point Voltage}$   
and  
the midpoint frequency to  $(\text{Zero Point Voltage}/100\%) \cdot \text{Nominal frequency of motor}$

Step 2 (If needed): Activate speed control or U/f optimization (Torque boost).

Step 3 (If needed): Activate both speed control and U/f optimization.

**NOTE!** *In high torque – low speed applications – it is likely that the motor will overheat. If the motor has to run long times under these conditions, special attention must be paid to cooling of the motor. Use external cooling for the motor if the temperature tends to rise too high.*

### **P2.8.3.1 U/f optimisation ID109 “U/f Optimization”**

**Automatic torque boost** The voltage to the motor changes proportionally to required torque which makes the motor produce more torque at start and when running at low frequencies. Automatic torque boost can be used in applications where starting torque due to starting friction is high, e.g. in conveyors. Even with linear U/f curve, the torque boost has an affect but the best result will be achieved after the identification run when programmable U/f curve is activated.

### **P2.8.3.2 U/f ration selection ID108 “U/f Ratio Select”**

**Linear:**

**0** The voltage of the motor changes linearly from zero point voltage to the field weakening point where the voltage at FWP is supplied to the motor.

**Squared:**

**1** The voltage of the motor changes from zero point voltage following the squared curve form zero frequency to the field weakening point. The motor runs undermagnetised below the field weakening point and produces less torque. Squared U/f ratio can be used in applications where torque demand is proportional to the square of the speed, e.g. in centrifugal fans and pumps.

**Programmable U/f curve:**

**2** The U/f curve can be programmed with three different points.

1. Zero point voltage
2. Midpoint frequency and Midpoint voltage.
3. Field weakening point and field weakening point voltage.

Programmable U/f curve can be used if more torque is needed at low frequencies. Make the Identification run for optimal setting (ID631).

**Linear with flux optimisation:**

**3** The frequency converter starts to search for the minimum motor current in order to save energy. This function can be used in applications with constant motor load, such as fans, pumps etc.

### **P2.8.3.3 Field weakening point ID602 “Field WeakngPnt”**

The field weakening point is the output frequency at which the output voltage reaches the field weakening point voltage.

**P2.8.3.4 Voltage at field weakening point ID603 “Voltage at FWP”**

Above the frequency at the field weakening point, the output voltage remains at the set maximum value. Below the frequency at the field weakening point, the output voltage depends on the setting of the U/f curve parameters.

When the parameter *Motor nominal frequency* is set, the parameter *Field weakening point* is automatically given the corresponding value. If you need different values for the field weakening point and the maximum output voltage, change these parameters **after** setting the *Nominal frequency*.

In closed loop control this defines maximum voltage to the motor, can be increases if sufficient DC voltage is available.

**P2.8.3.5 U/f curve, middle point frequency ID604 “U/f Mid Freq”**

If the programmable U/f curve has been selected with parameter U/f ratio this parameter defines the middle point frequency of the curve. See also parameter *Middle point voltage*. When the programmable U/f curve is selected this value is set to 10 % of motor nominal frequency.

**P2.8.3.6 U/f curve, middle point voltage ID605 “U/f mid Voltg”**

If the programmable U/f curve has been selected with the parameter U/f ratio this parameter defines the middle point voltage of the curve. See also parameter *Middle point frequency*. When the programmable U/f curve is selected this value is set to 10 % (of motor nominal voltage).

**P2.8.3.7 Output voltage at zero frequency ID606 “Zero Freq Voltg”**

This parameter defines the zero frequency voltage of the U/f curve. The default value is unit size dependent.

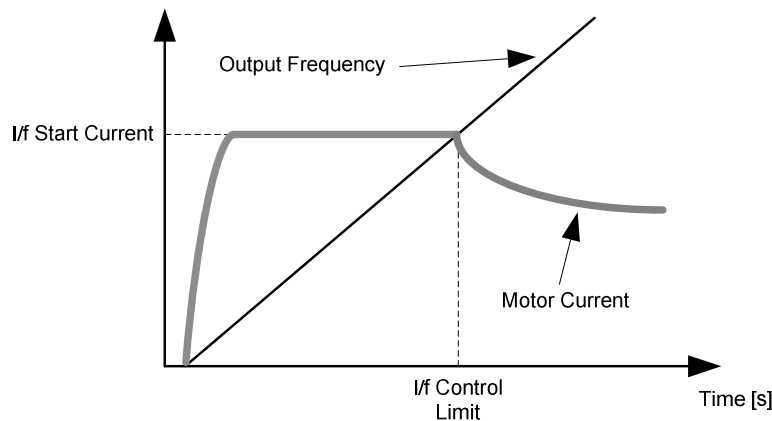
**NOTE:** If the value of parameter *U/f Ratio Select* is changed this parameter is set to zero.

### 7.8.1.1 I/f Control

I/f-control can be used to start the motor using a constant current control. This is useful especially, if the motor stator resistance is low, which makes the motor current sensitive for u/f-curve tuning at low speed area.

#### **P2.8.3.8 I/f Start ID534**

Activates I/f control



#### **P2.8.3.9 I/f Current ID1693 "I/f Current"**

**NOTE:** I/f Current parameter is used for several different purposes.

##### I/f Control

This parameter defines the current level during I/f control, in percent of the motor nominal current

##### Zero position with incremental encoder and Z-Pulse

In closed loop control utilizing the encoder z-pulse, defines also the current level used in starting before the z-pulse is received to synchronize with.

##### DC Start Angle identification

This parameter defined DC Current level when Start Angle Identification Time is set greater than zero. See P2.8.5.5 Start Angle Identification Time.

#### **P2.8.3.10 I/f Control Limit ID1790 "I/f Control Lim"**

This parameter sets the frequency limit for I/f-control in per cent of the motor nominal frequency. I/f-control is used if the frequency is below this limit. The operation changes back to normal when the frequency is above this limit with 1 Hz hysteresis.

#### **P2.8.3.11 MakeFluxTime ID660**

Time for magnetize the motor in ms. In Open Loop control drive will remain in zero speed during this time. Using DC Brake in start will bypass Make Flux Time. During the Make Flux Time voltage reference can be set separately, in Marine application Make Flux Voltage is same as Zero Freq Voltage.

## 7.8.2 Close Loop Settings

### P2.8.4.1 Current control P gain ID617 "CurrentControlKp"

Sets the gain for the current controller. The controller generates the voltage vector reference to the modulator. The gain is also used in open loop flying start. When the Sine filter parameter (parameter P6.7.5 in the System menu) has been set to *Connected* the value of this parameter is changed to 20.00 %.

The value is also identified when using a PMS motor and making identification run with rotating motor. At low speed the motor values may increase up to 300 %. At high speed motor gain and motor with sine filter may have gain values of 10...40 %.

### P2.8.4.2 Current control Ti ID657 "CurrentControlTi"

Current controller integrator time constant.

### P2.8.4.3 Encoder Selection ID1595 "Encoder Selector"

With this parameter it is possible to select which encoder input is used for closed loop control. Encoder board OPT-A7 is needed because of the possibility to connect two encoders.

### P2.8.4.4 Motor Temperature Compensation ID1426 "MotorTempComMode"

This parameter is used to select how motor temperature compensation is made.

#### 0 / Not Used

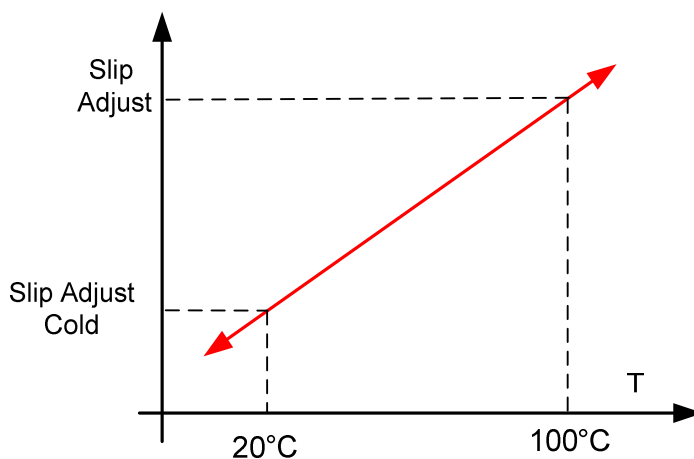
Slip adjust value is a constant value set by parameter P2.8.4.5 Slip Adjust.

#### 1 / Internal

When the motor cools down or warms up the slip of the motor will change. When this function is activated in closed loop control mode the drive will estimate changes in motor resistance and correct the changes of motor slip automatically to achieve the best torque estimation. This function is automatically activated when identification run with rotating motor is successfully finished. This option is available in closed loop control mode only.

#### 2 / MeasTemp1

Slip is adjusted based on Measured Temperature 1. Temperature points are fixed 20°C and 100°C. Slip of the 20°C point is adjusted by P2.8.4.6 Slip Adjust Cold and 100°C point is adjusted P2.8.4.5 Slip Adjust.



**P2.8.4.5 Slip adjust ID619 “Slip Adjust”**

The motor name plate speed is used to calculate the nominal slip. This value is used to adjust the voltage of motor when loaded. The name plate speed is sometimes inaccurate and this parameter can therefore be used to trim the slip. Reducing the slip adjust value increases the motor voltage when the motor is loaded.

**P2.8.4.6 Slip adjust Cold ID1183 “SlipAdjustCold”**

Slip adjusts tuning point for 20°C.

**P2.8.4.7 Speed Control Torque Chain Select ID1557 “SCTorqueChainSel”**

Values are bit coded. For example, after identification run with rotating motor the value will be 98. External acceleration compensation is active by default.

**B0 +1 = Additional torque limit**

The torque reference chain can be used as an additional torque limit. This option is available in closed loop control mode only.

**B1 +2 = External acceleration compensation**

The torque reference is added to the speed control output, allowing the external controller to give inertia compensation for the drive in speed control mode. This option is available in closed loop control mode only.

Note: This needs to be active that Torque Step Can be used.

**B4, +16 = Disable closed loop speed control I-factor**

This bit will disable speed controller I part operation and forces I part to zero.

**B5&B6, +96 = Internal motor temperature compensation**

When the motor cools down or warms up the slip of the motor will change. When this function is activated in closed loop control mode the drive will estimate changes in motor resistance and correct the changes of motor slip automatically to achieve the best torque estimation. This function is automatically activated when identification run with rotating motor is successfully finished. This option is available in closed loop control mode only.

**B12 +4096 = Enable Voltage Flux Model**

**False:** Current Flux Model, robust when flux curve and slip adjust are correct.

**True:** Voltage flux model. Robust in higher frequencies, requires that DTC identification run has been made successfully with correct motor name plate data.

**P2.8.4.8 Torque Control Speed Limit Select ID1568 “TCSpeedLimitSel”**

Options for torque control mode. These words are changed by application depending on other parameter setting.

**B0 +1** = Update Ramp generator when changed from torque control to speed control.



**P2.8.4.9    TCDunDampGain            ID1576**

Dynamic damping gain in closed loop torque control mode.

**P2.8.4.10    TCDynDampTC                            ID1577**

Bandpass time constant in ms for dynamic damping

**P2.8.4.11    Closed Loop MC Mode**

Select Flux model.

**0** = Flux Mode 1

Current Flux Model, robust when flux curve and slip adjust are correct.

**1** = Flux Mode 2

Voltage flux model. Robust in higher frequencies, requires that DTC identification run has been made successfully with correct motor name plate data.

### 7.8.3 Permanent magnet synchronous motor settings

There are three ways to know the magnet positions when using the closed loop control. The first one will identify the motor magnet position during every start when using incremental encoder without Z-pulse. Second one uses incremental encoder Z-pulse and the third one uses absolute encoder information. See details of selecting correct mode from chapter "Identification function for permanent magnet synchronous motor".

#### **P2.8.5.1 PMSM Shaft Position ID649 "PMSMShaftPositio"**

Absolute encoder position value corresponding to the shaft position where rotor magnet axis is aligned with the stator U-phase magnet axis will be stored here as a result of the encoder identification run. If incremental encoder with a z-pulse is used, z-pulse position will be stored instead. Depending on the motor shaft mechanical position, this parameter can have different values, as there is one right value for each pole-pair of the motor. If incremental encoder and the z-pulse is utilized, the first start after power up is less optimal and i/f-control (see 6.8.3.2) will be used until the drive finds the z-pulse and is able to synchronize in that.

#### **P2.8.5.2 Start Angle Identification Mode ID1691 "StartAngleIdMode"**

Start angle, i.e. rotor magnet axis position in respect to the stator U-phase magnet axis, identification is needed if there are no absolute encoder or incremental encoder with z-pulse used. This function defines how the start angle identification is made in those cases. Identification time depends on the motor electrical characteristics but takes typically 50ms...200ms.

In case of absolute encoders, start angle will read directly from the encoder absolute angle value. On the other hand, incremental encoder z-pulse will be used automatically for synchronization if it's position is defined different from zero in P2.8.5.1. Also for absolute encoders, P2.8.5.1 must be different from zero, otherwise it is interpreted that the encoder identification run has not been done and the running will be prohibited except if the absolute channel is bypassed by the start angle identification.

#### **NOTE!**

ModulatorType (P2.10.2) need to be > 0 to be able to use this function.

#### **0 = Automatic**

Decision to use start angle identification is made automatically based on the encoder type connected to the drive. This will serve common cases.

#### **1 = Forced**

Bypasses the drive automatic logic and forces the start angle identification to be active. Can be used, for example, with absolute encoders to bypass absolute channel information and to use start angle identification instead.

#### **2 = On Power UP**

As a default, start angle identification will be repeated in every start if the identification is active. This setting will enable identification only in a first start after drive is powered up. In consecutive starts, angle will be updated based on the encoder pulse count.

#### **10 = Disabled**

Used when Z- pulse from encoder is used for start angle identification.

#### **P2.8.5.3 Start Angle Identification Current ID1759 "StartAngleIdCurr"**

This parameter defines the current level that is used in start angle identification. The correct level depends of the motor type used. In general, 50% of motor nominal current seems to sufficient, but depending for example on the motor saturation level, higher current might be needed.

**P2.8.5.4    Polarity Pulse Current                      ID1566                      “PolarityPulseCur”**

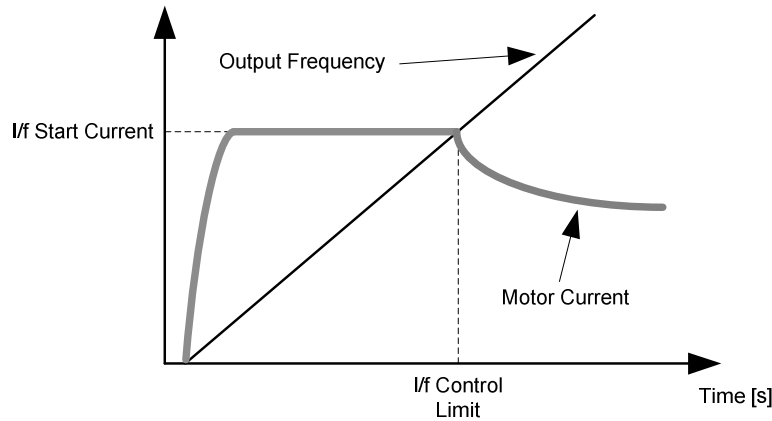
This parameters defines the current level for the magnet axis polarity direction check during the start angle identification (P2.8.5.2). Value 0 means that the internal current level is used, which is typically slightly higher than the normal identification current defined by P2.8.5.3. Polarity direction check is seldom needed because the identification itself gives already the right direction. Hence in most cases, this function can disabled by setting any negative parameter value, which is recommended especially if there occurs F1 faults during the identification.

**P2.8.5.5    Start Angle Identification Time                      ID1755                      “StartAngleIdTime”**

Start angle can be determined also by feeding dc-current into the motor. Then dc-current will align the rotor magnet axis with the stator magnet axis. This function is activated by determining the time duration dc-current is injected to the motor. Motor must be free to move during the alignment and the time need to be long enough for shaft oscillations to damp out. Hence, this method is not so practical and is intended to be used mainly for testing purposes or to improve starting in together with i/f-control. Dc-current level is determined by P2.8.5.6. Also P2.8.5.2 need to disabled otherwise overriding this function.

### 7.8.3.1 I/f Control

I/f-control can be used to start the motor using a constant current control. This is useful especially, if the motor stator resistance is low, which makes the motor current sensitive for u/f-curve tuning at low speed area. I/f-control is activated by setting AdvancedOptions2.B9 = 1 (P2.10.6) for PM-motors.



#### P2.8.5.6 I/f Current ID1693 "I/f Current"

**NOTE:** I/f Current parameter is used for several different purposes.

##### I/f Control

This parameter defines the current level during I/f control, in percent of the motor nominal current

##### Zero position with incremental encoder and Z-Pulse

In closed loop control utilizing the encoder z-pulse, defines also the current level used in starting before the z-pulse is received to synchronize with.

##### DC Start Angle identification

This parameter defined DC Current level when Start Angle Identification Time is set greater than zero. See P2.8.5.5 Start Angle Identification Time.

#### P2.8.5.7 I/f Control Limit ID1790 "I/f Control Lim"

This parameter sets the speed limit for I/f-control in percent of the motor nominal speed (1000 = 100.0%). I/f-control is used if the speed is below this limit. The operation changes back to normal when the speed is above this limit with 60 rpm hysteresis.

### 7.8.3.2 Flux current controller

The flux current controller is used with a PMS motor when running in closed loop control in the field weakening area. This function controls negative Id current to PM motor in the field weakening area that motor terminal voltage do not increase above maximum level (set by field weakening point voltage, maximum drive output voltage) . Field weakening area operation depends on motor construction and motor construction may prohibit operation above field weakening area.

If there is instability in the field weakening area, gain can be decreased and/or time constant increased.

#### **P2.8.5.8    Flux Current Kp    ID551    "FluxCurrent Kp"**

Defines gain for the flux current controller when using a PMS motor. Depending on motor construction and the ramp rate that is used to go to field weakening area high may be needed that output voltage do not reach maximum limit and prevent proper motor control. Too high gain may also lead to unstable control. Integration time is more significant in this case for control.

#### **P2.8.5.9    Flux Current Ti    ID652    "FluxCurrent Ti"**

Defines the integration time for the flux current controller when using a PMS motor. Depending on motor construction and the ramp rate that is used to go to field weakening area, short integration times may be needed that output voltage do not reach maximum limit and prevent proper motor control. Too fast integration time may also lead to unstable control.

#### **P2.8.5.10    ExtIdRef    ID1730    "ExtIdRef"**

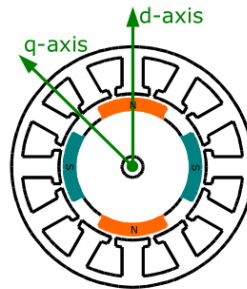
This reference value can be used for the external control of the motor id-current i.e. reactive current. Normally there is no need for that as the control uses already the optimal value. This reference value is additive to drive internal values but, for example, field-weakening controller can override the given reference in field-weakening operation.

#### **P2.8.5.11    EnableRsIdentifi    ID654    "EnableRsIdentifi"**

This parameter enables the Rs identification during DC brake current operations and in closed loop control for every start. If the identification run was made successfully it is recommended to keep this parameter disabled.

### 7.8.3.3 D and Q axis voltage drops

If d-axis and q-axis reactances (voltage drops) are defined, drive calculates the optimal d-axis current reference based on the reactance values and the motor torque in order to account motor reluctance torque part. In this way, motor Torque/Current ratio can be increased.



#### P2.8.5.12 Lsd Voltage Drop ID1757 “Lsd Voltage Drop”

D-axis reactance voltage drop 2560 = 100%.

Gives the % voltage drop across the stator inductance at nominal current and frequency.

$$X_d[\text{Drive scale}] = \frac{X_d[\Omega] * I_n[A] * \sqrt{3} * 2560}{U_n[V]}$$

#### P2.8.5.13 Lsq Voltage Drop ID1758 “Lsq Voltage Drop”

Q-axis reactance voltage drop 2560 = 100%.

Gives the % voltage drop across the stator inductance at nominal current and frequency.

$$X_q[\text{Drive scale}] = \frac{X_q[\Omega] * I_n[A] * \sqrt{3} * 2560}{U_n[V]}$$

#### P2.8.6.14 Encoder ID Current % ID1734

Current reference for encoder identification run

#### P2.8.6.15 Polarity ID Mode ID1737

0 = Current Pulse

1 = Torque Pulse

#### P2.8.6.16 Polarity Pulse Length ms ID1742

Pulse length for Polarity ID Run.

#### P2.8.6.17 Polarity Detection Angle Deg ID1748

Detection angle for Polarity ID Run.

**P2.8.6.18 Angle Identification Mode ID1749**

0 = Current Pulse  
 1 = High Frequency Sine  
 2 = Low Frequency Sine

**P2.8.6.19 Current Control Kp d % ID1761**

Current controller gain for d-axis

**P2.8.6.20 Voltage Margin % ID1759**

Voltage margin to prevent current controller from saturating.

**P2.8.6.21 Encoder ID Run Mode "EncIdRunMode" ID680**

This parameter defines how the start angle identification is made for absolute encoder with the identification mode selections 3 / "Enc. ID Run" or 4 / "Ident All".

**0** = Default

This mode feeds the DC current to the motor and aligns the rotor to find the zero position. The rotor needs to be able to rotate freely to align correctly.

**1** = Current Pulses

This mode sends current pulses to the motor, and the rotor can be locked to a position, for example with a mechanical brake. This mode should be tested to the motor in use, since all PMSM are not suitable for this identification mode.

**2** = ID with Run

This method is the most reliable to find the zero position but requires that the motor can be accelerated to 2/3 of motor nominal speed to find the absolute encoder zero position. After 2/3 of nominal speed is reached, the motor is coasted to determine the encoder zero position after the DC brake is applied to make the rotor to stop to stand still. This method can be used also when step-up transforms are used.

**P2.8.6.22 Start Angle Offset Dec ID696**

Offset angle added to identified start angle.

**P 2.8.6.23 VoltageCorr. Kp ID1783**

Flux integrator drift compensator proportional par

**P 2.8.6.23 VoltageCorr. Ki ID1784**

Flux integrator drift compensator integral part

### 7.8.4 Stabilization settings

#### 7.8.4.1 Torque stabiliser

The torque stabiliser is basically a first order high-pass filter for the estimated torque  $[T]$ . The output of the filter is a frequency correction term  $df$  added to the output frequency reference. The purpose of the torque stabiliser is to stabilise the possible oscillations in the estimated torque. The controller gain is changing linearly between the zero and field weakening point frequencies. The zero and field weakening point gains can be controlled independently with gains. The stabiliser operates at frequencies above 3 Hz.

The discrete implementation of the filter is:

$$\frac{1000}{TorqStabDamp} df_k = \frac{1000}{TorqStabDamp} G(T_k - T_{k-1}) + df_{k-1} = G_f(T_k - T_{k-1}) + df_{k-1}$$

Where  $G_f$  is the total gain of the filter. The gain and the corner frequency of the filter is controlled by the following parameters

#### **P2.8.6.1 Torque stabiliser damping ID1413 “TorqStabDamp”**

If a PMS motor is used in open loop control mode it is recommended to use value 980 instead of 800. The value ‘980’ is set automatically when PMS motor is selected.

This parameter defines the corner frequency of the high-pass filter. The time constant of the filter is calculated as

$$T_c = T_s \frac{TorqStabDamp}{1000 - TorqStabDamp} = 1ms \frac{TorqStabDamp}{1000 - TorqStabDamp}$$

It follows that the corner frequency of the filter is obtained from

$$\omega_c = \frac{1}{T_c} rad/s$$

For example, if Torque stabilizer damping = 600, it follows that  $T_c = 1.5$  ms and  $\omega_c = 667$  rad/s.

#### **P2.8.6.2 Torque stabiliser Gain ID1412 “TorqStabGain”**

These parameters define together with the Torque Stabiliser Damping the actual gain of the filter. Torque Stabiliser Gain is the gain at the zero frequency. Torque stabiliser Gain in FWP is



the gain at the field-weakening frequency. The gain changes linearly with the frequency between these two points so that the gain is

$$G = \text{TorqStabGainFWP} + \text{TorqStabGain} - \frac{f}{f_{\text{FWP}}} \text{TorqStabGain}, \quad \text{if } f < f_{\text{FWP}}$$

$$G = \text{TorqStabGainFWP}, \quad \text{if } f \geq f_{\text{FWP}}$$

The final gain is obtained by considering the value of Torque Stabiliser Damping and the scaling in which 256 means the gain 1. So, the final and the actual gain of the filter is obtained from

$$G_f = \frac{1000 * G}{256 * \text{TorqStabDamp}}$$

**P2.8.6.3 Torque stabiliser Gain in FWP area ID1414 “TorqStabGainFWP”**

Gain of the torque stabiliser at field weakening point in open loop motor control operation. See details from Torque Stabiliser Gain.

**P2.8.6.4 Torque stabiliser Limit ID1720 “TorqStabLimit”**

This defines how much torque stabiliser can affect output frequency.

#### 7.8.4.2 Flux Circle stabiliser

##### P2.8.6.5 Flux Circle stabiliser Gain ID1550 "FluxCircleStabG"

Gain for flux circle stabiliser. This will control the flux to origin when error is detected. Controller output is added to output frequency. Affect decreases at low frequencies where flux stabiliser has more affect. used at frequencies where output voltage is at maximum limit (set by field weakening point voltage or maximum drive output voltage).

#### 7.8.4.3 Flux stabiliser

Flux stabilizer is a first order high-pass filter for the estimated flux producing current  $I_d$ . The output of the filter is correcting term  $dU$  added to the output voltage reference. The gain and the corner frequency of the filter is controlled by the following parameters.

##### P2.8.6.6 Flux Stabiliser Gain ID1797 "Flux Stab Gain"

Flux stabilizer gain is 0 at the zero speed and is increased linearly with the frequency to value defined by the Flux Stab Gain which is reached at the 1 Hz. So, the gain is obtained from

$$G = \text{Flux Stab Gain} * f, \quad \text{if } f < 1 \text{ Hz}$$

$$G = \text{Flux Stab Gain}, \quad \text{if } f \geq 1 \text{ Hz}$$

The gain is scaled by 1000 and the actual gain of the filter is obtained from

$$G_f = \frac{G}{1000} = \frac{\text{Flux Stab Gain}}{1000}$$

##### P2.8.6.7 Flux stabiliser TC ID1551 "FluxStab TC"

Flux Stabiliser TC defines the corner frequency of the high-pass filter. The time constant of the filter is calculated from:

$$T_c = T_s \frac{65536 - 2 * \text{FluxStab TC}}{2 * \text{FluxStab TC}} = 1\text{ms} \left( \frac{65536}{2 * \text{FluxStab TC}} - 1 \right)$$

For example, if Flux Stabiliser TC = 64, it follows that  $T_c = 511 \text{ ms}$  and  $\omega_c = 1.96 \text{ rad/s}$ .

#### 7.8.4.4 Voltage stabiliser

The voltage stabilizer is similar to the torque stabilizer controlling the change in DC-link voltage at frequencies above 3 Hz. It is a first order high-pass filter for the measured DC-link voltage  $U_{dc}$ . The output of the filter is a frequency correction term  $df$  added to the output frequency reference. Gain is adjusted relative to the estimated torque. As the torque increases from 10% to 50 % of the motor nominal torque, the controller gain decreases from the voltage stabiliser Gain down to zero. The gain and the corner frequency of the filter are controlled by the following parameters:

##### **P2.8.6.9 Voltage stabiliser TC ID1552 "VoltageStab TC"**

This parameter defines the corner frequency of the high-pass filter. The time constant of the filter is calculated as

$$T_c = T_s \frac{\text{VoltageStab TC}}{1000 - \text{VoltageStab TC}} = 1ms \frac{\text{VoltageStab TC}}{1000 - \text{VoltageStab TC}} ms$$

##### **P2.8.6.8 Voltage stabiliser Gain ID1738 "VoltStabGain"**

Voltage Stabilizer Gain is a function of a torque. If the torque is below 15%, the gain is the value defined by the Voltage Stabilizer Gain. If the torque is above 50% the gain is 0. Between 15-50% the gain decreases linearly with the torque from Voltage Stabilizer Gain to 0. In other words,

$$G = \text{VoltStabGain}, \quad \text{if } T < 15 \%$$

$$G = \frac{\text{VoltStabGain}}{35\%} (50\% - T(\%)), \quad \text{if } 15\% \leq T < 50 \%$$

$$G = 0, \quad \text{if } T > 50 \%$$

The final gain is obtained by considering the value of Voltage stabiliser TC and the scaling in which 256 means the gain 1. So, the final and the actual gain of the filter is obtained from

$$G_f = \frac{1000 * G}{256 * \text{VoltStab TC}}$$

##### **P2.8.6.10 Voltage stabiliser Limit ID1553 "VoltStabLimit"**

This parameter sets the limits for the voltage stabilizer output.

The maximum and the minimum value for the correction term  $df$  in FreqScale.

### 7.8.5 Tuning settings

#### **P2.8.7.1 Flying Start Options ID1610**

- b0** = +1= Disable movement to reverse direction
- b1** = +2=Disable AC Scanning
- b2** = +4=Disable Fly Brake phase
- b3** = +8=Use encoder information for speed estimate
- b4** = +16=Use speed reference for initial guess
- b5** = +32=Disable DC scanning for step-up application

#### **P2.8.7.2 Motor Control Options ID1740**

Reserved for future use.

#### **P2.8.7.3 Resonance Damping Select ID1760**

This feature can be used to dampen the constant frequency torque oscillations in the drive system.

- 0** Not in use  
Only monitoring if Resonance damping frequency > 0,0 Hz.  
See FW: ResonanceFrequency and FW: ResonanceAmplitude.
- 1** Band pass, Speed Error  
Oscillation damping with band pass filter from speed error.
- 2** Band Stop + Band Pass, Speed Error  
Oscillation damping with band stop and band pass filter from speed error.
- 3** Band Pass. Iq Current.  
Oscillation damping with band pass filter from Iq Actual.

#### **P2.8.7.4 Resonance Damping Frequency ID1763**

Frequency of torque oscillations to be damped in Hz.

#### **P2.8.7.5 Resonance Damping Gain ID1764**

The gain for the oscillation damping. This changes amplitude of the compensating signal used for oscillation damping.

#### **P2.8.7.6 Resonance Damping Phase ID1765**

The compensating signal used for oscillation damping can be phase shifted 0 to 360 degrees using this parameter.

#### **P2.8.7.7 Resonance Damping Activation frequency ID1770**

Defines the frequency limit when resonance damping is started.

#### **P2.8.7.8 Resonance Damping Filtering TC ID1771**

Filter TC for external feedback (Iq) signal .

#### **P2.8.7.9 Over modulation limit ID1515**

Output Voltage Limit for partial modulation in 1%. 100% means maximum sinusoidal modulation. 113% is full six step.  
Use P6.7.5 if sine filter is used.

**P2.8.7.10 Modulation Index Limit ID655**

Modulation index in % for closed loop operation. Higher value of motor terminal voltage can be achieved by increasing this value.

**P2.8.7.11 DC Voltage Filtering Time ID1591**

Cut off frequency in 0.1Hz for 2nd order butterworth filter used in DCV-compensation.

**P2.8.7.12 Process Frequency ID1811**

In cases where higher process speed is needed than 6500,0 rpm. Set here needed process frequency and process speed parameter will be bypassed. Keep zero if Process Speed is used.

Maximum is 320 Hz for SIA-II application.  
Use APFIF08 advanced application to reach frequencies up to 599 Hz.

**P 2.8.7.13 GearRatioMultipl ID1558**

Gear ratio multiplier when resolver encoder is after the gearbox.

**P 2.8.7.14 GearRatioDivider ID1559**

Gear ratio divider when resolver encoder is after the gearbox.

### 7.8.6 Identification settings

#### P2.8.8.1 to

#### P2.8.8.15 Flux 10...150% ID1355 – ID1369

Motor voltage corresponding to 10%...150% of flux as a percentage of Nominal Flux voltage. Measured during identification.

#### P2.8.8.16 Measured Rs voltage drop ID662 “RsVoltageDrop”

The measured voltage drop at stator resistance between two phases with the nominal current of the motor. This parameter is identified during identification run.

This parameter defines the motor stator resistance as a voltage drop at nominal current. The parameter value is defined according to motor nominal voltage and the current and the actual stator resistance as

$$R_s[\text{Drive scale}] = \frac{R_s[\Omega] * I_n[A] * \sqrt{3} * 2560}{U_n[V]}$$

#### P2.8.8.17 Ir: Add zero point voltage ID664 “IrAddZeroPVoltag”

Defines how much voltage is applied to motor in zero speed when torque boost is used.

#### P2.8.8.18 Ir: Add generator scale ID665 “IrAddGeneScale”

Defines the scaling factor for generator side IR-compensation when torque boost is used.

#### P2.8.8.19 Ir: Add motoring scale ID667 “IrAddMotorScale”

Defines the scaling factor for motoring side IR-compensation when torque boost is used.

#### P2.8.8.20 Measured Ls voltage drop ID673 “LsVoltageDrop”

Leakage inductance voltage drop with nominal current and frequency of the motor. This parameter defines the Ls voltage drop between two phases. Use identification run to determine the optimum setting.

#### P2.8.8.21 Motor BEM Voltage ID674 “Motor BEM Voltage”

Motor-induced back voltage.

#### P2.8.8.22 IU Offset ID668 “IU Offset”

#### P2.8.8.23 IV Offset ID669 “IV Offset”

#### P2.8.9.24 IW Offset ID670 “IW Offset”

Offsets the value for phase current measurement. Identified during identification run.

#### P2.8.8.25 Estimator Kp ID1782 “Estimator Kp”

Estimator gain for PMS motor. Identified during identification run.

#### P2.8.9.26 Estimator Ki ID1782 “Estimator Ki”

Estimator gain and Ti for PMS motor. Identified during identification run.

#### P2.8.9.27 Voltage Drop ID671 “Voltage Drop”

Measured residual voltage error.

**P2.8.8.28 ID Run Current Kp ID695 "ID Run Curr.Kp**

Current controller gain during identification fun.

**P2.8.8.29 DeadTimeComp. ID1751**

Dead Time Compensation in ns. Identified during 7 / DTC Identification run.

**P2.8.8.30 DeadTieContCurl ID1752**

Continuous/discontinuous current limit for Dead Time Compensation. Identified during 7 / DTC Identification run.

**7.8.7 Fine tuning parameters**

These parameters are for special cases.

**P 2.8.9.1 DeadTHWCompDisab ID1750**

Hardware dead time compensation 0 = enabled, 1 = disabled

**P 2.8.9.2 CurrMeasFCompTC ID1554**

**P 2.8.9.3 CurrLimOptions ID1702**

**P 2.8.9.4 AdConvStartShift ID1701**

**P 2.8.9.5 DCVoltageBalGain ID1519**

CL DcVoltage balancing gain for master follower application.

### 7.8.8 Synchronous machine control

#### **P2.8.10.1 No Load Magnetization Current ID1966**

Set here synchronous machine no load magnetization current.

#### **P2.8.10.2 Magnetization Current Limit ID1973**

Set here maximum magnetization current that overall system can provide. E.g. current limit can be because analogue signal scaling.

### 7.8.8.1 SM Tuning

#### **P2.8.10.3.1 Magnetization Offset ID1872**

Use this parameter to make step response test.

#### **P2.8.10.3.2 CosPhii Kp ID1975**

Power factor controller gain.

#### **P2.8.10.3.3 CosPhii Ti ID1976**

Power factor controller Ti.

#### **P2.8.10.3.4 Flux Control Kp ID1772**

### 7.8.8.2 SM Reference AO

#### **P2.8.10.4.1 Magnetization Reference AO ID1963**

Select what analogue output is used for magnetization reference.

**Note:** See that normal analogue outputs do not use same terminal.

#### **P2.8.10.4.2 20 mA Reference ID1971**

Magnetization reference that corresponds to 20 mA (100 %) analogue output signal.  
Per cent value of no load magnetization current.



#### 7.8.8.3 SM Actual AI

**P2.8.10.5.1 Magnetization Actual AI** **ID1964**

Select analogue input that is used to monitor actual magnetization current.

**P2.8.10.5.2**      *Magn Al Nom Level*      **ID1974**

Analogue signal level that corresponds to no load magnetization current.

#### 7.8.8.4 SM Magn DO / DI

**P2.8.10.6.1    StartMgnSystem                  [DigOUT:]                  ID1958**

Command to start magnetization system, magnetization system will not give magnetization current but will be ready to give excitation current immediately when Start Magnetization command is received.

This output Follows Fieldbus Control Word B00 when drive is in fieldbus control. In PC Control this could be PC Control request in NCDrive operation window.

**P2.8.10.6.2**     **Start Magnetizatr**     **[DigOUT:]**     **ID1959**

Command to feed magnetization current to motor. When field is ready magnetization system will give magnetization ready for load.

Follows Fieldbus Control Word B03 in fieldbus control.

In PC Control this will be the NCDrive run request command.

**P2.8.10.6.3**    **MgnReadyToStart**    **[DigIN:]**    **ID1956**

Input from magnetization unit. Unit is ready for system start command, no active fault or warning in a system.

**P2.8.10.6.4** *MgnReadyForLoad* [DigIN:] ID1957

Input from magnetization unit. Unit has magnetized motor correctly, ready for load. Drive can release speed reference.

## 7.9 Speed Control settings

### 7.9.1 Closed Loop Speed Control Settings

Speed control formula:

$$y = Kp \left[ 1 + \frac{1}{Ti s} \right] e$$

$$u(k) = y(k-1) + Kp[e(k) - e(k-1) + \frac{Ts}{Ti} e(k)]$$

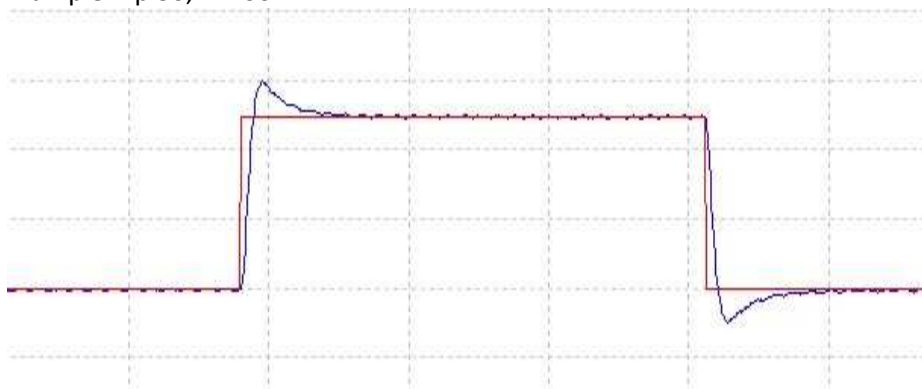
#### P2.9.1.1 Speed control P gain ID613 "Speed Control Kp"

Gain for the speed controller in closed loop motor control operation. Gain value 100 means that the nominal torque reference is produced at the speed controller output for the frequency error of 1Hz.

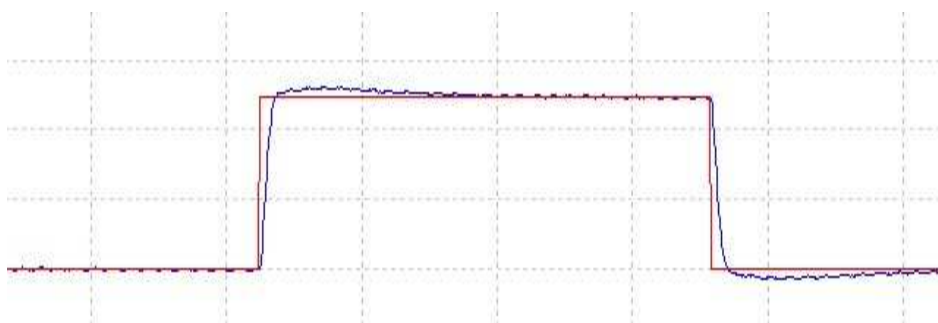
#### P2.9.1.2 Speed control I time ID614 "Speed Control Ti"

Sets the integral time constant for the speed controller. Increasing the I-time increases stability but lengthens the speed response time.

Example: Kp 30, Ti 100



Example: Kp 30, Ti 300

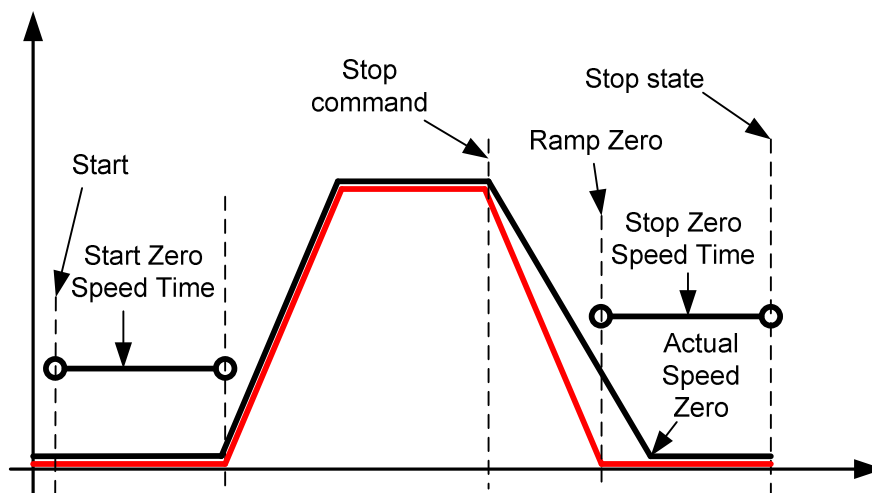


### P2.9.1.3 Zero speed time at start ID615 "Start 0SpeedTime"

After giving the start command the drive will remain at zero speed for the time defined by this parameter. The ramp will be released to follow the set frequency/speed reference after this time has elapsed counted from the instant when the command was given.

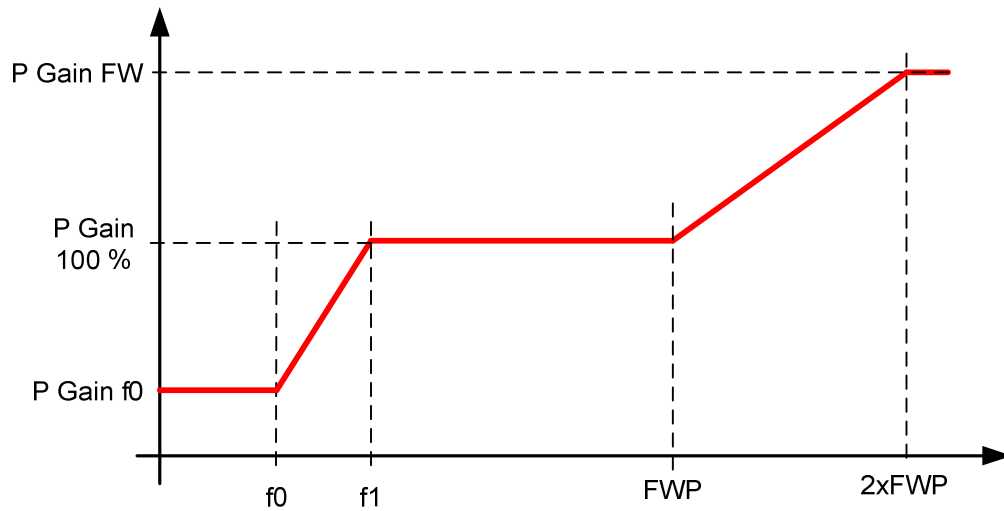
### P2.9.1.4 Zero speed time at stop ID616 "Stop 0 SpeedTime"

The drive will remain at zero speed with controllers active for the time defined by this parameter after reaching the zero speed when a stop command is given. This parameter has no effect if the selected stop function is *Coasting*. Note that the zero speed time starts when the ramp time is expected to reach the zero speed, not when the actual speed reaches zero. Such situation can happen when the generator power limit is small or the overvoltage controller is active while decelerating.



### 7.9.2 Speed controller tuning for different speed areas

The speed controller can be tuned for different gains in different speed areas, for slow speed and above the parameter *Field weakening point*. Gains for different speed areas are percentages of the original Speed Controller Gain value.



#### P2.9.1.5 Speed Controller $f_0$ point ID1300 “SPC $f_0$ Point”

The speed level in Hz below which the speed controller gain is *Speed Controller gain  $f_0$* .

#### P2.9.1.6 Speed Controller $f_1$ point ID1301 “SPC $f_1$ Point”

The speed level in Hz above which the speed controller gain is *Speed Controller P gain*. Gain changes linearly between  $f_0$  and  $f_1$  points.

#### P2.9.1.7 Speed Controller gain $f_0$ ID1299 “SPC $K_p f_0$ ”

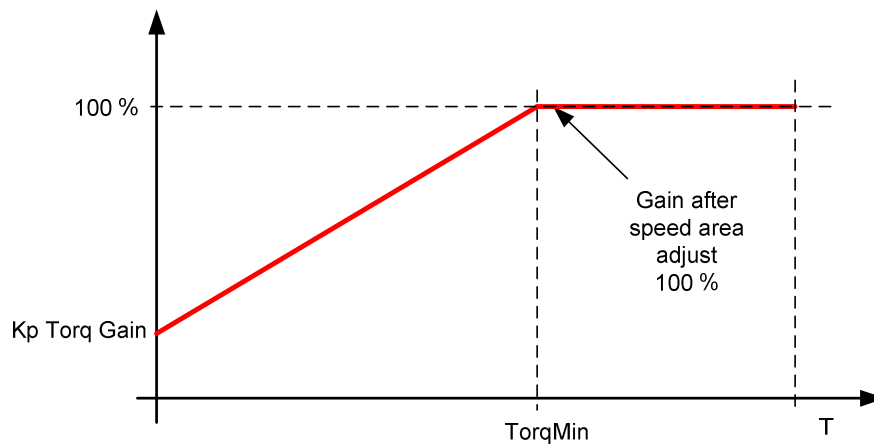
The relative gain of the speed controller as a percentage of the *Speed Controller P Gain* when the speed is below the level defined by *Speed Controller  $f_0$  point*.

#### P2.9.1.8 Speed controller gain in field weakening area ID1298 “SPC $K_p \text{FWP}$ ”

Relative gain of the speed controller in field weakening area as a percentage of *Speed Controller P Gain* values. The set value is reached at two times the *Field weakening point*.

### 7.9.3 Speed controller gain with different loads

The speed controller can also be tuned for different loads. Speed controller gain is first manipulated by the speed area gain function and this result is then further adjusted by torque related relative gain.



#### **P2.9.1.9**    **Speed Controller torque minimum ID1296**    **“SPC Torq Min”**

The level of speed controller output which the speed controller gain is changed to with parameter P2.9.1.11 “Speed Controller torque minimum gain” using a filter set by parameter P2.9.1.12 “Speed Controller torque minimum filtering time”. This is in percent of the motor nominal torque.

#### **P2.9.1.10**    **Speed Controller torque minimum gain ID1295**    **“SPC Kp Torq Min”**

Relative gain as a percentage of the speed controller gain after speed area adjustment when the speed control output is less than the “Speed Controller torque minimum”. This parameter is normally used to stabilise the speed controller for a drive system with gear backlash.

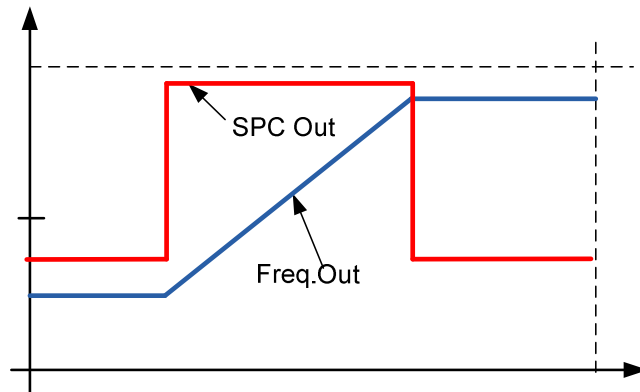
#### **P2.9.1.11**    **Speed Controller torque minimum filtering time ID1297**    **“SPC Kp TC Torq”**

Filtering time for torque. When the speed controller gain is changed below the Speed Controller torque minimum.

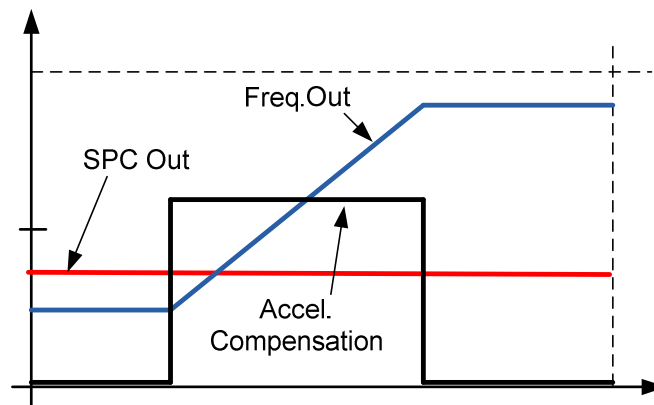
### P2.9.1.12 Acceleration compensation ID626 "Accel.Compens."

Sets the inertia compensation to improve the speed response during acceleration and deceleration. The time is defined as acceleration time to nominal speed with nominal torque. This function is used when the inertia of the system is known to achieve the best speed accuracy when reference is changed.

Acceleration compensation is added to *TorqueReferenceActual* i.e. torque is added after speed controller. The speed controller can, therefore, be tuned only for speed error and the acceleration compensation makes sure that the system inertia does not affect the speed controller.



Acceleration compensation not in use



Acceleration compensation in use

$$AccelCompensationTC = J \cdot \frac{2\pi \cdot f_{nom}}{T_{nom}} = J \cdot \frac{(2\pi \cdot f_{nom})^2}{P_{nom}},$$

J = System inertia (kg\*m<sup>2</sup>)

f<sub>nom</sub> = Motor nominal frequency (Hz)

T<sub>nom</sub> = Motor nominal torque

P<sub>nom</sub> = Motor nominal power (kW).

**P2.9.1.13 Speed Error filtering time constant ID1311 "SpeedErrorFiltTC"**

Filter time constant for speed reference and actual speed error. May be used to remove small disturbances from encoder signal.

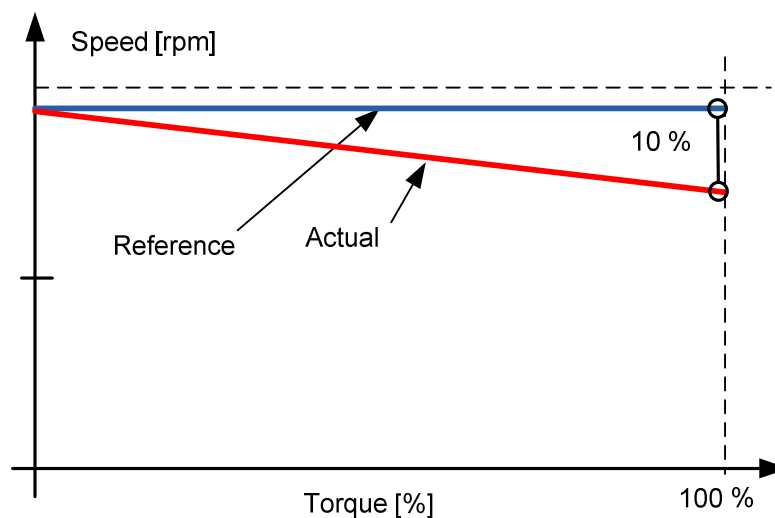
**P2.9.1.14 Encoder filter time ID618 "Encoder1FiltTime"**

Sets the filter time constant for speed measurement.

The parameter can be used to eliminate encoder signal noise. Too high a filter time reduces speed control stability. Values over 10 ms are not recommended in normal cases.

**P2.9.2 Load drooping ID620 "LoadDrooping"**

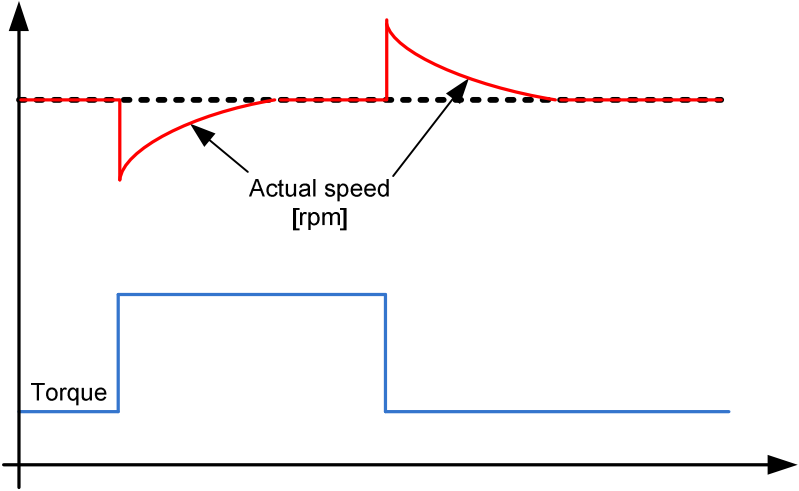
The drooping function enables speed drop as a function of load. This parameter sets the value corresponding to the nominal torque of the motor.



**Example:** If load drooping is set to 10 % for a motor that has a nominal frequency of 50 Hz and is nominally loaded (100 % of torque) the output frequency is allowed to decrease 5 Hz from the frequency reference. The function is used for e.g. when balanced load is needed for mechanically connected motors.

**P2.9.2 Load Drooping Time ID656 "LoadDroopingTime"**

This function is used in order to achieve a dynamic speed drooping because of changing load. The parameter defines the time during which the speed is restored to the level it was before the load increase.





### P2.9.3 Load Drooping Removal ID1534 "LoadDroopRemoval"

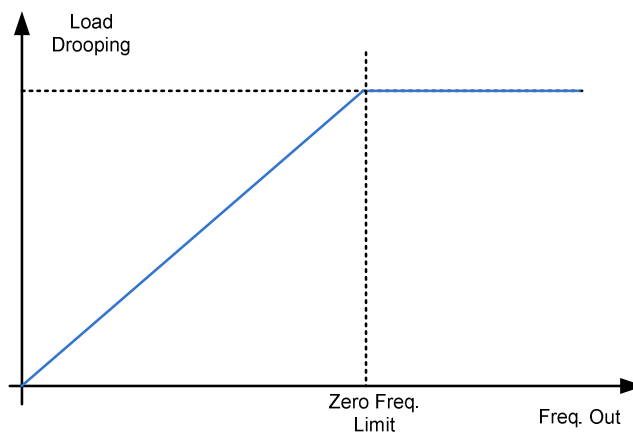
This function defines how load drooping is removed with reference to speed. It is used in lifting situations when it is necessary to keep to load at the same position without closing the brake. When using option 'Normal' the load will slowly come down depending on load and the drooping factor.

#### Normal

**0** Load Drooping factor is constant through the whole speed range.

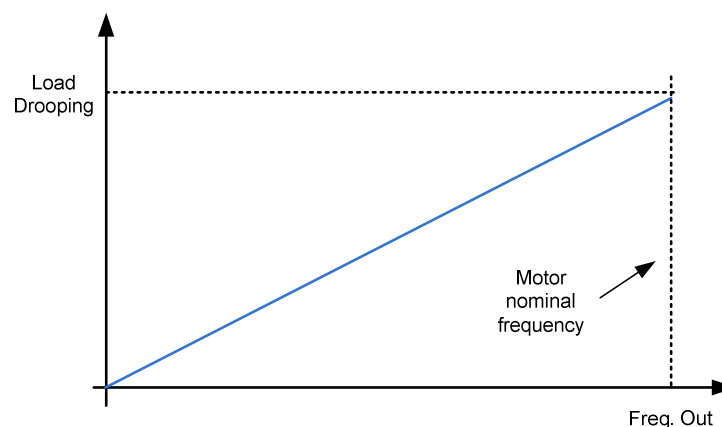
#### Removed below zero frequency limit

**1** Load drooping is removed linearly below the zero frequency limit (defined in G2.6.4 Freq. Handling).



#### Linearly increased to nominal frequency (Default)

**2** Load drooping is removed linearly from nominal frequency to zero frequency.



### 7.9.4 Open Loop Settings

#### **P2.9.5.1    Speed controller P gain, Open Loop    ID637    “OL Speed Reg P”**

Defines the P gain for the speed controlled in Open Loop control mode.

#### **P2.9.5.2    Speed controller I gain, Open Loop ID638    “OL Speed Reg I”**

Defines the I gain for the speed controlled in Open Loop control mode.

### 7.10 Drive Control

#### **P2.10.1    Switching frequency    ID601    “Switching Freq”**

Motor noise can be minimised using a high switching frequency. Note, however, that increasing the switching frequency increases losses of the frequency converter. Lower frequencies are used when the motor cable is long and the motor is small.

The range of this parameter depends on the size of the frequency converter:

Type	Min. [kHz]	Max. [kHz]	Default [kHz]
0003—0061 NX_5 0003—0061 NX_2	1.0	16,0	10.0
0072—0520 NX_5	1.0	10.0	3.6
0041—0062 NX_6 0144—0208 NX_6	1.0	6.0	1.5

Table 7-2. Size-dependent switching frequencies

#### **Note!**

The actual switching frequency might be reduced down to 1,5kHz by thermal management functions. This has to be considered when using sine wave filters or other output filters with a low resonance frequency.

#### **Note!**

If the switching frequency is changed it is necessary to redo the identification run.

#### **DriveSynch operation**

When using DriveSynch the maximum switching frequency is limited to 3,6 kHz.

Minimum recommended switching frequency in Open Loop control is 1,7 kHz.

Minimum recommended switching frequency in Closed Loop control is 2,5 kHz.

#### **P2.10.2    Modulator Type    ID1516    “Modulator type”**

Select modulator type. Some operations require use of a software modulator.

**0 = ASIC modulator**

A classical third harmonic injection. The spectrum is slightly better compared to the Software 1 modulator.

**NOTE:** An ASIC modulator cannot be used when using DriveSynch or PMS motor with an incremental type encoder.

**1 = Software Modulator 1**

Symmetric vector modulator with symmetrical zero vectors.

**NOTE:** Recommended for DriveSynch (Set by default when DS activated) and needed when using PMS motor with an incremental encoder.

**2 = Software modulator 2**

One phase at a time in IGBT switches is not modulated during a 60-degree period of the frequency cycle. The unmodulated phase is connected to either positive or negative DC-bus. This modulator type reduces switching losses up to two-thirds and all switches become evenly loaded.

BusClamp modulation is useful if the voltage is >80% of the maximum voltage, in other words, when the drive is operating near full speed. Then again, the motor ripple at low speeds is the double compared to selection 1.

**3 = Software modulator 3**

Unsymmetrical BusClamp in which one switch always conducts 120 degrees to negative DC-rail to reduce switching losses. However, upper and lower switches are unevenly loaded and the spectrum is wide.

**P2.10.3    Control Options    ID1084    “Control Options”**

These parameter functions are dependent of Vacon System Interface application version.

**B06 =**    Activate Closed Loop type speed limit function in Open Loop. This function is active by default.

- B07** = Disables switching frequency decrease due to drive temperature rise.
- B08** = Disable Encoder fault when brake is closed. Some cases 100 % torque is needed against brake before brake is opened. When torque is above 100 % and there is no pulses from encoder this situation is determined as a encoder fault. With this function encoder fault can be disable while drive own brake control has not opened the brake.
- B12** = Disable Process Data locking function when Profibus communication fails. When using Profibus, an occurring communication fault will lock the process data to previous values. This bit will disable the locking of process data forcing the values to zero. NOTE: This bit can only be used with Profibus.

**P2.10.4      *Control Options 2*    ID1798      “ControlOptions2”**

Reserved for future use

**P2.10.5      *Advanced Options 1*      ID1560      “AdvancedOptions1”**

- B00** = Disable Synchronous modulation
- B01** = Use encoder information to slip compensation in Open Loop Speed control
- B03** = Disable slip compensation for reverse direction
- B06** = Enable synchronous symmetrical modulation
- B15** = Cosphi = 1 control. This controls the motor reactive power to zero. Possible to use only with PMS motors in closed loop control.

**P2.10.6      *Advanced Options 2*      ID1561      “AdvancedOptions1”**

- B00** = Sensorless control for PMS motors. This is an open loop control but uses the same control system than the normal closed loop control. Calculations try to estimate the encoder speed instead of using the encoder signal. This mode has speed and torque range limitations and therefore application limitations. A lower speed controller gain may be required to gain stability. Useful for generator applications.
- B04** = Enable Start Positioning damping for PMSM
- B08** = Current optimization for PMS motor. This function activates the current optimization for PMSM motor based on torque calculation and motor parameters. When activated, the optimization starts after 13 % of the motor nominal speed and below this a normal U/f curve is used. The activation of this selection requires a performed identification with run.
- B09** = I/f control for PMS motors. PMS motor can be started with I/f control. Used with high power motor when there is low resistance in motor and U/f is difficult to tune to be stable.

**P2.10.7      *Advanced Options 4*      ID1563      “AdvancedOptions4”**

**P2.10.8      *Advanced Options 5*      ID1564      “AdvancedOptions5”**

- B11** = Current measurement anti-aliasing for low switching frequencies, prevents torque calculation distortions. Requires Software Modulator 1.

**P2.10.9    Advanced Options 6    ID1565    “AdvancedOptions6”**

**B05 =** To reduce aliasing effects in current measurement, it is possible to take an average from all internal samples taken at fast time level. It must be noted, that this mode does not affect the motor control, only monitoring.

**P2.10.10    Advanced Options 7    ID1589    “AdvancedOptions7”**

**B05 =** Invert output phase order without changing frequency or torque signs. (NXP00002V202 and newer). Will also change modulator to software if ASIC is selected.

**P2.10.11    Restart Delay    ID1424    “Restart Delay”**

The time delay within which the drive cannot be restarted.

**P2.10.12    Reverse VW Phases ID1062    “ReverseVWPhases”**

This parameter can change phase order between V and W phases without changing the sign of frequency/torque reference.

## 7.11 Master Follower

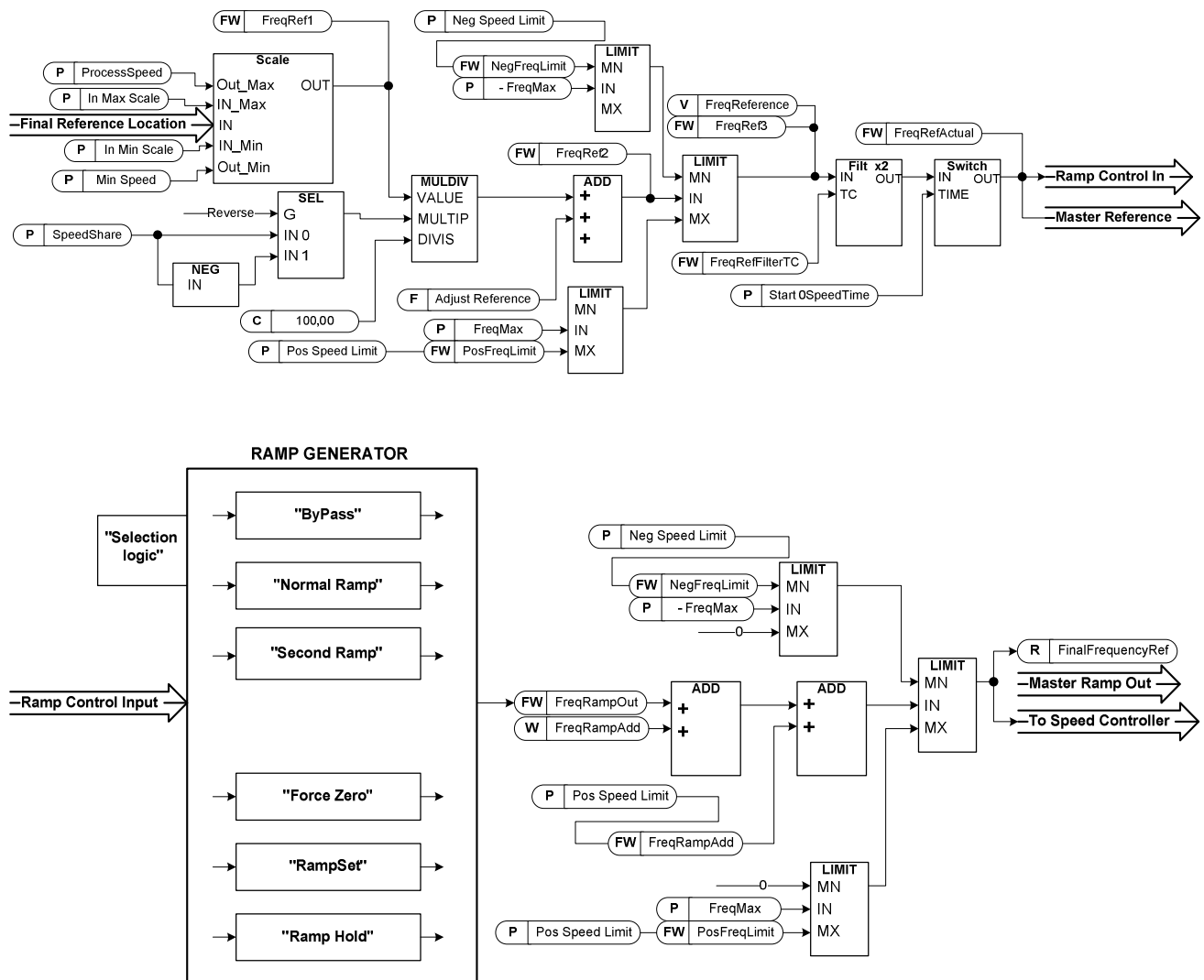
### 7.11.1 Master Follower: Standard system

The Master/Follower function is designed for applications in which the system is run by several NXP drives and the motor shafts are coupled to each other via gearing, chain, belt etc. The NXP drives are in closed loop control mode.

The external control signals are connected to the Master NXP only. The Master controls the Follower(s) via a System bus. The Master station is typically speed-controlled and the other drives follow its torque or speed reference.

Torque control of the Follower should be used when the motor shafts of the Master and Follower drives are coupled solidly to each other by gearing, a chain etc., so that no speed difference between the drives is possible.

Speed control of the Follower should be used when the motor shafts of the Master and the Follower drives are coupled flexibly to each other so that a slight speed difference between the drives is possible. When both the Master and Followers are speed-controlled, drooping is typically also used.



### 7.11.2 Master Follower: DriveSynch system

DriveSynch is used to control parallel drives. Up to four drives can be connected parallel. The motor can be a single winding motor or there can be several winding motors.

Vacon DriveSynch works in open loop and closed loop motor control modes. With closed loop motor control, the encoder feedback needs to be wired only to the master drive. If case redundancy is required, it may be necessary to wire the encoder feedback also to follower drives using the double encoder option board OPTA7.

#### Note!

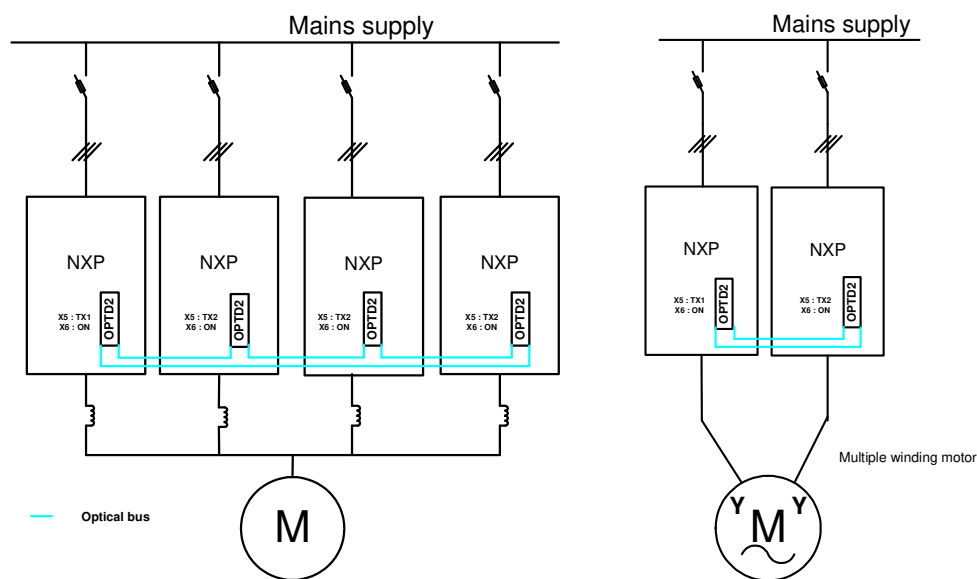
The maximum switching frequency for the drives using Vacon DriveSynch is 3.6 kHz.

Minimum recommended switching frequency in Open Loop control is 1.7 kHz.

Minimum recommended switching frequency in Closed Loop control is 2.5 kHz.

#### Note!

The NXP control board must be VB00661 or later.



#### 7.11.2.1 Redundancy

The units working in parallel with Vacon DriveSynch have a high level of redundancy. The system keeps running without interruption even if any of the follower units is non-functional. In case of a hardware failure, the failed unit need be isolated before the system can be restarted.

The actual level of redundancy, however, needs to be carefully defined considering the motor, load and the requirements of the process.

The master drive unit and the fast drive to drive optical communication has to be functional for the Vacon DriveSynch functionality. The auxiliary power (+24V) must be continuously provided for all the control units including the non-functional drive units in Vacon drive synch system.

It is also a common practice to use (n+1) units, where n is the number of required units for full functionality of the system. In this case, the system is fully operational even if any follower is non-functional.

	<b>Master (D1)</b>	<b>Follower (D2)</b>	<b>Follower (D3)</b>	<b>Follower (D4)</b>
<b>Parameter settings</b>				
Motor Nominal Voltage	Motor Nominal voltage from the motor name plate	Motor Nominal voltage from the motor name plate	Motor Nominal voltage from the motor name plate	Motor Nominal voltage from the motor name plate
Motor nominal Frequency	Motor Nominal frequency from the motor name plate	Motor Nominal frequency from the motor name plate	Motor Nominal frequency from the motor name plate	Motor Nominal frequency from the motor name plate
Motor Nominal Current	Motor Nominal current from the motor name plate / Number of drives in parallel using Vacon Drive Synch	Motor Nominal current from the motor name plate / Number of drives in parallel using Vacon Drive Synch	Motor Nominal current from the motor name plate / Number of drives in parallel using Vacon Drive Synch	Motor Nominal current from the motor name plate / Number of drives in parallel using Vacon Drive Synch
Motor COS PHI (Motor nominal power factor)	Motor COS PHI from the motor name plate	Motor COS PHI from the motor name plate	Motor COS PHI from the motor name plate	Motor COS PHI from the motor name plate
Motor Nominal Power	Motor Nominal power from the motor name plate / Number of drives in parallel using Vacon Drive Synch	Motor Nominal power from the motor name plate / Number of drives in parallel using Vacon Drive Synch	Motor Nominal power from the motor name plate / Number of drives in parallel using Vacon Drive Synch	Motor Nominal power from the motor name plate / Number of drives in parallel using Vacon Drive Synch
Master Follower Mode	Master, DriveSynch	Follower, DriveSynch	Follower, DriveSynch	Follower, DriveSynch
Motor Control Mode (Open Loop)	Open Loop Frequency	If used as Secondary Master: Open Loop Frequency. When used as Follower: no meaning.	No meaning, internally handled. Recommended to have same setting as in master.	No meaning, internally handled. Recommended to have same setting as in master.
Motor Control Mode (Closed Loop)	Closed Loop Speed /Torque	If used as Secondary Master: Closed Loop Speed/Torque. When used as Follower: no meaning.	No meaning, internally handled Recommended to have same setting as in master.	No meaning, internally handled Recommended to have same setting as in master.
Magnetizing current (needed only for closed loop motor control)	Motor nominal magnetizing current / Number of drives in parallel using Vacon Drive Synch	Motor nominal magnetizing current / Number of drives in parallel using Vacon Drive Synch	Motor nominal magnetizing current / Number of drives in parallel using Vacon Drive Synch	Motor nominal magnetizing current / Number of drives in parallel using Vacon Drive Synch
Switching Frequency	Max 3.6 KHz	Same as in Master	Same as in Master	Same as in Master
Modulator Type	1, Software	Same as in Master	Same as in Master	Same as in Master
Follower Phase shift (single winding motor)	0 degrees	0	0	0
Follower Phase shift (multiple winding motor)	0 degrees	As per motor name plate	As per motor name plate	As per motor name plate

### 7.11.3 Master follower configuration

The OPTD2 board in the Master has default jumper selection, X5:1-2. For the followers, the jumper positions have to be changed: **X5:2-3**. This board also has a CAN communication option that is useful for multiple drive monitoring with NCDrive PC software when commissioning Master Follower functions or line systems. Older boards has X6, leave this to ON (X6:1-2).



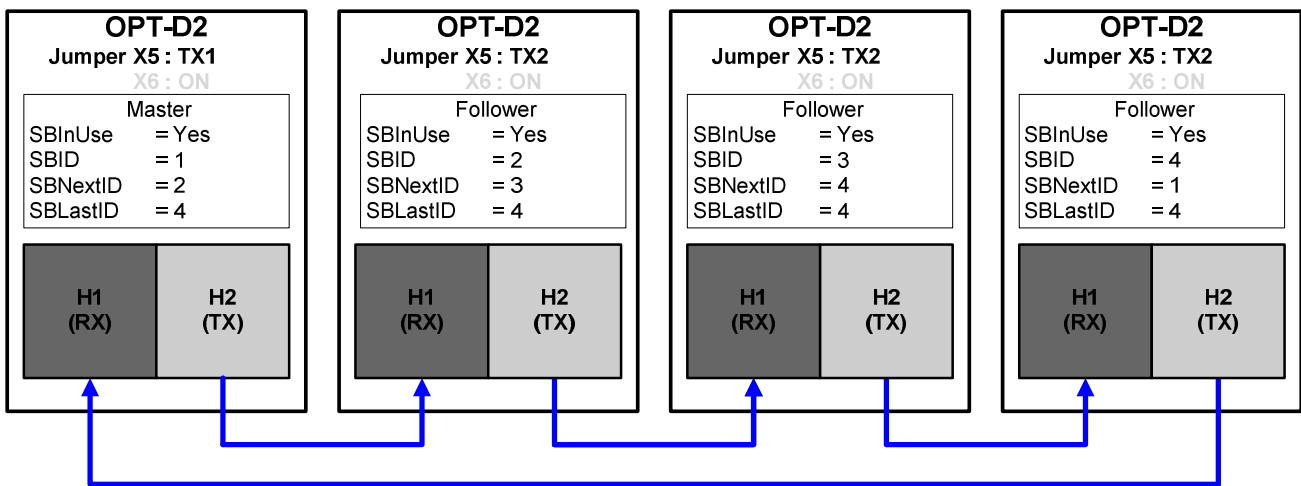


Figure 7-13. System bus physical connections with the OPT-D2 board

### P2.11.1 Master/Follower selection ID1324 “MF Mode”

Select the Master Follower mode. Even if master follower mode is selected drive needs to be parameterized to take start command from System Bus Master Drive by parameter P3.1 Control Place.

0 = Single drive

System bus is deactivated

1 = Master

Drive sends control word to follower drive.

2 = Follower

Drive receives control word from Master and sends some diagnostic information to the Master drive.

3 = “DSynchMaster” - Drive Synch Master

Drive number 1 must be selected as the parallel drive configuration master (in redundancy mode drive number 2 can be selected as master but certain diagnostic functions are no longer available).

4 = “DSynchFlwr” - Drive Synch Follower

Selection for parallel drive configuration follower drive

### P2.11.2 Follower stop function ID1089 “FollowerStopFunction”

When the follower drive does not use the Master Drive Ramp Output as reference this parameter defines how the follower drive will stop as Run request is removed from the Master drive.

0=Coasting; the follower remains in control even if master has stopped to fault.

1=Ramping; the follower remains in control even if master has stopped to fault.

**2**=As master; the follower behaves as master.

**P2.11.3      *Follower drive winding phase shift ID1518*      “FollPhaseShift”**

Windings phase shift between master and follower drive. Used with drive synch operation when the motor has multiple windings.

## 7.12 Protections

### 7.12.1 General settings

#### **P2.12.1.1 Input phase supervision ID730 "Input Ph. Superv"**

Defines the response when the drive notices that one of the input phases is missing.

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop Function

**3** = Fault, stop mode after fault always by coasting

#### **P2.12.1.2 Response to undervoltage fault ID727 "UVolt Fault Resp"**

In some applications it is normal that the drive will be powered down when in run state. With this parameter it is possible to choose whether undervoltage faults are stored to the fault history of the drive.

**0** = Fault stored in fault history

**1** = Fault not stored in fault history

Undervoltage fault limits:

**500 V units:** 333 Vdc

**690 V units:** 460 Vdc

#### **P2.12.1.3 Output phase supervision ID702 "OutputPh. Superv"**

Output phase supervision of the motor ensures that the motor phases have an approximately equal current.

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop Function

**3** = Fault, stop mode after fault always by coasting

#### **P2.12.1.4 Response to slot fault ID734 "SlotComFaultResp"**

Set here the response mode for a board slot fault due to a missing or broken board.

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop Function

**3** = Fault, stop mode after fault always by coasting

#### **P2.12.1.5 Safe Torque Off (STO) mode ID755 "SafeDisableResp."**

With this parameter it is possible to choose whether the STO signal is handled as fault or warning. The STO input will stop the drive from modulating regardless of this parameter value.

**0** = Warning, No history

**1** = Warning

**2** = Fault

**P2.12.1.6 Keypad and PC Com. Responce ID1329 “KP PC Fault Mode”**

With this parameter it's possible to select what responce is taken fault or warning. However drive will be always stopped in case of keypad or PC communication fault.

### 7.12.2PT-100

The PT100 protection function is used to measure temperatures and issue warnings and/or faults when the set limits are exceeded. The System Interface application supports two PT100 boards. One can be used for the motor winding and one for the motor bearings.

#### **P2.12.2.1    Number of PT100 inputs in use                      ID739    “PT100 Numbers”**

If you have a PT100 input board installed in your AC drive you can choose here the number of PT100 inputs in use. See also the Vacon I/O boards manual.

**0** = Not used (ID Write, value of maximum temperature can be written from fieldbus)

**1** = PT100 input 1

**2** = PT100 input 1 & 2

**3** = PT100 input 1 & 2 & 3

**4** = PT100 input 2 & 3

**5** = PT100 input 3

**Note:** If the selected value is greater than the actual number of used PT100 inputs, the display will read 200°C. If the input is short-circuited the displayed value is –30°C.

#### **P2.12.2.3    Response to PT100 fault    ID740    “PT100 FaultRespo”**

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop Function

**3** = Fault, stop mode after fault always by coasting

#### **P2.12.2.4    PT100 warning limit                      ID741    “PT100 Warn.Limit”**

Set here the limit at which the PT100 warning will be activated.

#### **P2.12.2.5    PT100 fault limit                      ID742    “PT100 Fault Lim.”**

Set here the limit at which the PT100 fault (F56) will be activated.

#### **P2.12.2.5    Number of PT100 2 inputs in use    ID743    “PT100 2 Numbers”**

If you have two PT100 input boards installed in your frequency converter you can choose here the number of PT100 inputs in use in the second board. See also the Vacon I/O boards manual.

**0** = Not used (ID Write, value of maximum temperature can be written from fieldbus)

**1** = PT100 input 1

**2** = PT100 input 1 & 2

**3** = PT100 input 1 & 2 & 3

**4** = PT100 input 2 & 3

**5** = PT100 input 3

#### **P2.12.2.6    PT100 2 warning limit                      ID745    “PT100 2 Warn. Lim”**

Set here the limit at which the second PT100 warning will be activated.

#### **P2.12.2.7    PT100 2 fault limit ID746    “PT100 2 FaultLim”**

Set here the limit at which the second PT100 fault (F61) will be activated.

**P2.12.2.8 PT100 Analogue Input ID1222 "PT100 AI In"**

Select analogue input and how many sensors in series. This function needs that 10 mA is send to PT100 sensor. This can be achieved by selection correct analogue output with content of "Not Used" this will set analogue output to 4 mA and missing 6 mA can be programed with Offset parameter of 30 %.

**P2.12.2.9 KTY Analogue Input ID1224 "KTY AI In"**

Select analogue input and how many sensors in series. This function needs that 2 mA is send to PT100 sensor. This can be achieved by selection correct analogue output with content of "Not Used" this will set analogue output to 4 mA and extra 2 mA can be removed by Offset parameter -10 %.

**7.12.2.1 Individual channel monitoring**

Individual channel monitoring is activated by setting one of the warning limits (per board) different than zero. Common limits in above parameters will be channel A warning and fault limits. Channel B and C limits are set with below parameters.

**P2.12.2.10.1 Channel 1B Warn ID764****P2.12.2.10.2 Channel 1B Fault ID765**

First board second (1B) channel warning and fault limits.

**P2.12.2.10.3 Channel 1C Warn ID768****P2.12.2.10.4 Channel 1C Fault ID769**

First board third (1C) channel warning and fault limits.

**P2.12.2.10.5 Channel 2B Warn ID770****P2.12.2.10.6 Channel 2B Fault ID771**

Second board second (2B) channel warning and fault limits.

**P2.12.2.10.7 Channel 2C Warn ID772****P2.12.2.10.8 Channel 2C Fault ID773**

Second board third (2C) channel warning and fault limits.

### 7.12.3 Stall protection

The motor stall protection protects the motor from short time overload situations such as one caused by a stalled shaft. The reaction time of the stall protection can be set shorter than that of the motor thermal protection. The stall state is defined with two parameters, Stall current and Stall frequency limit. If the current is higher than the set limit and the output frequency is lower than the set limit, the stall state is true. There is actually no real indication of the shaft rotation. Stall protection is a kind of overcurrent protection.

#### P2.12.3.1 Stall protection ID709 "Stall Protection"

- 0 = No response
- 1 = Warning
- 2 = Fault, stop mode after fault according to Stop Function
- 3 = Fault, stop mode after fault always by coasting

#### P2.12.3.2 Stall current limit ID710 "Stall Current"

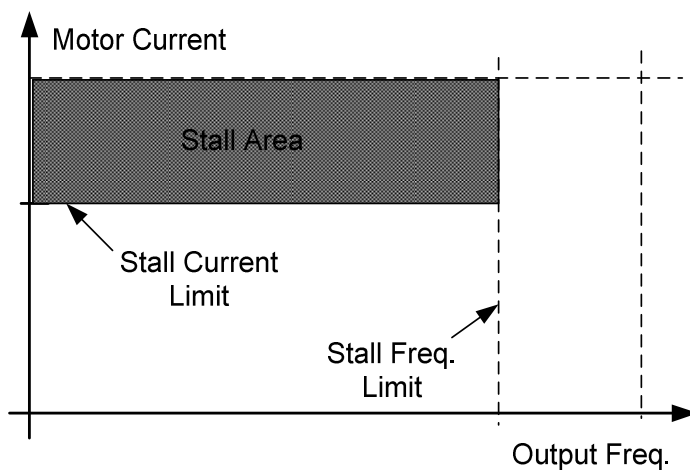
The current can be set to  $0 \dots 2 \cdot I_H$ . For a stall stage to occur, the current must have exceeded this limit. The software does not allow entering a greater value than  $2 \cdot I_H$ . If the motor current limit is changed this parameter is automatically recalculated to the value 90 % of motor current limit.

**Note:** This limit must be set below the current limit in order for this function to operate.

#### P2.12.3.3 Stall frequency limit ID712 "Stall Freq Lim"

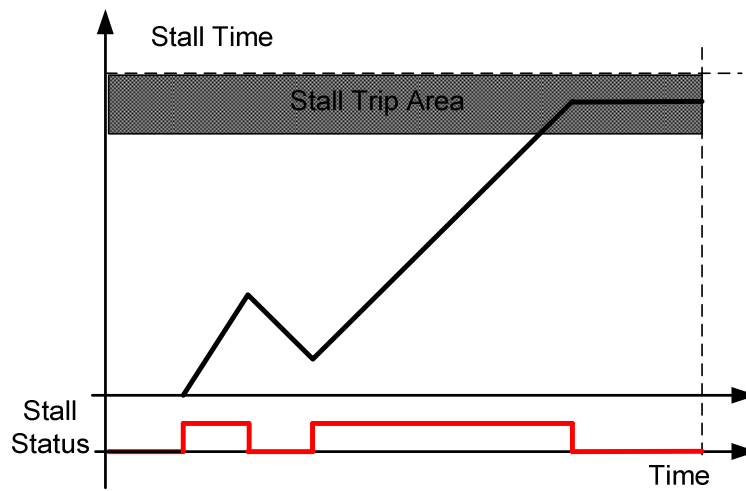
The frequency can be set between  $1 \dots f_{\max}$  (Max Frequency).

For a stall state to occur, the output frequency must have remained below this limit for a certain time. This function requires that the output frequency is 1 Hz below the frequency reference before the stall time count is started.



**P2.12.3.4 Stall time ID711 “Stall Time Lim”**

This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/down counter. If the stall time counter value goes above this limit the protection will cause a trip.





### 7.12.4 Speed Error

The Speed error monitoring function compares the encoder frequency and the ramp generator output. The function is used with a PMS motor to detect if the motor is off synchronization or to disable the open loop function using the encoder speed for slip compensation. The slip compensation is disabled regardless of the response and needs to be re-activated once a speed error is detected (set parameter again or power down the drive).

#### P2.12.4.1 Speed error fault function ID752 "Speed Error Mode"

Defines the fault function when the speed reference and the encoder speed are above the set limits.

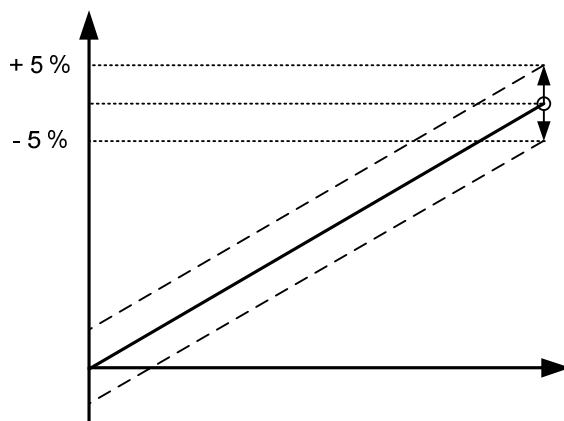
0 = No response

1 = Warning

2 = Fault, stop mode after fault always by coasting

#### P2.12.4.2 Speed error maximum difference ID753 "SpeedErrorLimit"

Defines the limit when fault situation is noted. The difference between the speed reference and the encoder speed. Percentage value is in relation to motor nominal frequency.



#### P2.12.4.3 Speed error fault delay ID754 "Speed Fault Delay"

Defines the delay after which a speed error is considered as a fault.

When used to disable open loop slip compensation based on encoder frequency it is recommended to set this time to zero to avoid a speed jump at the time of encoder malfunction.

#### P2.12.4.4 Over Speed Protection ID1812 "OverSpeed F Resp"

Response when motor speed minimum or maximum speed is exceeded by 120 rpm.

### 7.12.5 Motor Protection



**CAUTION!** *The calculated model does not protect the motor if the airflow to the motor is reduced by blocked air intake grill.*

The motor thermal protection is to protect the motor from overheating. The drive is capable of supplying higher than nominal current to the motor. If the load requires this high current there is a risk that the motor will be thermally overloaded. This is the case especially at low frequencies. At low frequencies the cooling effect of the motor is reduced as well as its capacity. If the motor is equipped with an external fan the load reduction at low speeds is small.

The motor thermal protection is based on a calculated model and it uses the output current of the drive to determine the load on the motor.

The motor thermal protection can be adjusted with parameters. The thermal current  $I_T$  specifies the load current above which the motor is overloaded. This current limit is a function of the output frequency.

#### **P2.12.5.1 Motor thermal protection response ID704 “Motor Therm Prot”**

Defines the response when the calculated temperature of the motor has reached 105 % (monitoring signal).

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop Function

**3** = Fault, stop mode after fault always by coasting

#### **P2.12.5.2 Motor ambient temp. factor ID705 “MotAmbTempFactor”**

Defines the temperature factor for conditions where the motor is located. The factor can be set between -100.0%—100.0%.

-100.0 % = 0°C,

0.0 % = 40°C,

100.0 % = 80°C

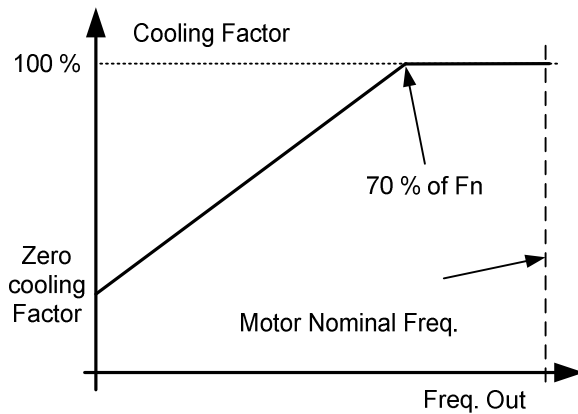
#### **P2.12.5.3 Motor cooling factor at zero speed ID706 “MTP f0 Current”**

Defines the cooling factor at zero speed in relation to the point where the motor is running at nominal speed without external cooling.

The default value is set assuming that there is no external fan cooling the motor. If an external fan is used this parameter can be set to 90% (or even higher).

**Note:** The value is set as a percentage of the motor name plate data, (Nominal current of motor), not the drive's nominal output current. The motor's nominal current is the current that the motor can withstand in direct on-line use without being overheated.

Setting this parameter does not affect the maximum output current of the drive which is determined by parameter Motor Current Limit alone.



#### P2.12.5.5 Motor thermal protection: Time constant ID707 "MTP Motor T"

This time can be set between 1 and 200 minutes.

This is the thermal time constant of the motor. The bigger the motor, the bigger the time constant. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.

The motor thermal time is specific to motor design and it varies between different motor manufacturers. The default value changes between unit sizes.

If the motor's  $t_6$ -time ( $t_6$  is the time in seconds the motor can safely operate at six times the rated current) is known (given by the motor manufacturer) the time constant parameter can be set basing on it. As a rule of thumb, the motor thermal time constant in minutes equals to  $2 \times t_6$ . If the drive is in stop stage the time constant is internally increased to three times the set parameter value. The cooling in the stop stage is based on convection and the time constant is increased.

#### P2.12.5.5 Motor thermal protection: Motor duty cycle ID708 "Motor Duty Cycle"

The value can be set to 0%...150%.

Setting value to 130 % motor calculated temperature will reach nominal temperature with 130 % of motor nominal current.

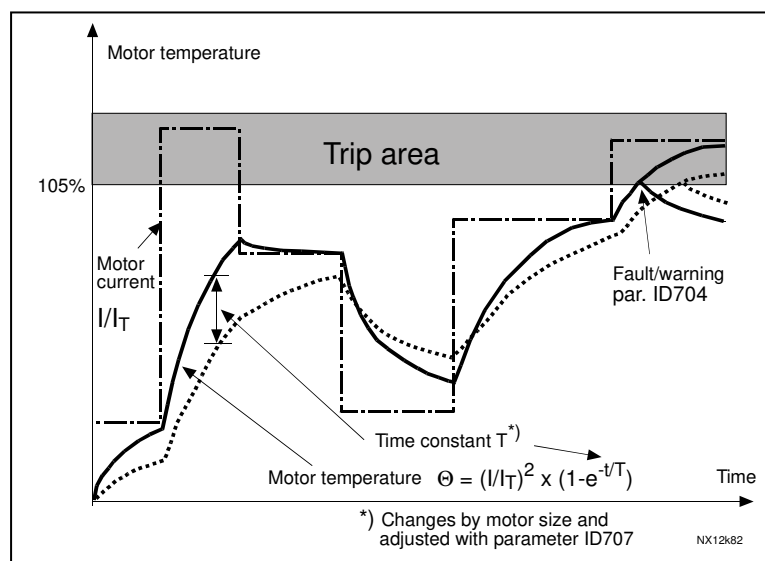


Figure 7-14. Motor temperature calculation

**P2.12.5.6 Response to thermistor fault ID732 "ThermistF.Resp"**

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to [ID506](#)

**3** = Fault, stop mode after fault always by coasting

Setting the parameter to **0** will deactivate the protection.

**P2.12.5.7 Motor Fan Off Delay ID1320 "MotorFanOffDelay"**

Delay how long motor fan is kept on after drive has been stopped

**P2.12.5.8 Motor Nominal Temperature Rise ID1922 "MotorNomTempRise"**

The difference between the ambient temperature and that of a motor operating under load is the temperature rise (temperature rise = hot temperature – ambient temperature)

Motor temperature (ID 9) is calculated in Celsius when this parameter is not zero value.

### 7.12.64mA Protection

The 4 mA protection monitors the analogue input signal level from Analogue input 1 and Analogue input 2. The monitoring function is active when signal range 4 mA – 20 mA is selected. A fault or warning is generated when the signal falls below 3.5 mA for 5 seconds or below 0.5 mA for 0.5 seconds.

#### **P2.12.6.1    Response to the 4mA reference fault            ID700    “4mA Input Fault”**

**0** = No response

**1** = Warning

**2** = Warning, the frequency from 10 seconds back is set as reference

**3** = Warning, the Preset Frequency is set as reference

**4** = Fault, stop mode after fault according to Stop Function

**5** = Fault, stop mode after fault always by coasting

#### **P2.12.6.2    4mA reference fault: preset speed reference            ID728    “4mA Fault Speed”**

If value 3 in parameter P2.12.6.1 is selected and a fault occurs the speed reference to the motor is the value of this parameter.

### 7.12.7 Underload protection

The purpose of the motor underload protection is to ensure that there is load on the motor when the drive is running. If the motor loses its load there might be a problem in the process, e.g. a broken belt or a dry pump.

The underload curve is a squared curve set between the zero frequency and the field weakening point. The protection is not active below 5 Hz (the underload time counter is stopped).

The torque values for setting the underload curve are set in percent which refers to the nominal torque of the motor. The motor's name plate data, parameter motor nominal current and the drive's nominal current  $I_H$  are used to find the scaling ratio for the internal torque value.

#### P2.12.7.1 Underload protection ID713 "Underload Protec"

- 0 = No response
- 1 = Warning
- 2 = Fault, stop mode after fault according to Stop Function
- 3 = Fault, stop mode after fault always by coasting

If tripping is set active the drive will stop and activate the fault stage.

Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero.

#### P2.12.7.2 Underload protection, zero frequency load ID715 "UP F0 Torque"

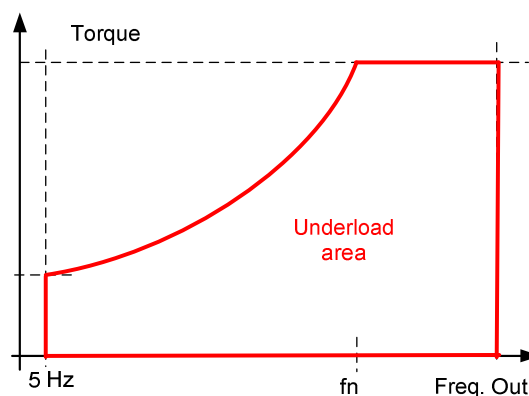
The torque limit can be set between 5.0—150.0 % x  $T_{nMotor}$ .

This parameter gives the value for the minimum torque allowed with zero frequency.

#### P2.12.7.3 Underload protection, field weakening area load ID714 "UP fnom Torque"

The torque limit can be set between 10.0—150.0 % x  $T_{nMotor}$ .

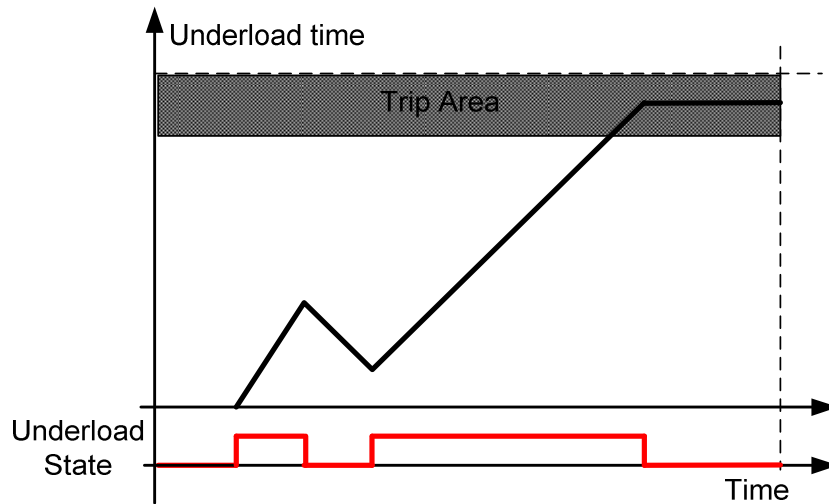
This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point.



**P2.12.7.4 Underload time ID716 "UP Time Limit"**

This time can be set between 2.0 and 600.0 s.

This is the maximum time allowed for an underload state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit the protection will cause a trip according to parameter Underload Protection.



### 7.12.8 Earth Fault

The earth fault protection ensures that the sum of the motor phase currents is zero. The overcurrent protection is always working and protects the frequency converter from earth faults with high currents.

#### **P2.12.8.1 Earth fault protection ID703 "Earth fault"**

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop Function

**3** = Fault, stop mode after fault always by coasting

#### **P2.12.8.2 Eart fault current limit ID1333 "EartFaultCurLim"**

Maximum level for Earth current in % of the unit nominal current.



### 7.12.9 Cooling protection

Protection for liquid cooled units. An external sensor is connected to the drive (DI: Cooling Monitor) to indicate if cooling liquid is circulating. If the drive is in Stop state this is only a warning. In Run state, the drive will issue a fault with a coast stop.

#### **P2.12.9.1 Cooling fault delay ID751 “Cooling F Delay”**

This parameter defines the delay after which the drive goes to fault state when ‘Cooling OK’ signal is missing.

#### **P2.12.9.2 Cooling fault response ID762 “CoolingFaultResp”**

In some cases it is more important to allow the drive to run even if the cooling liquid is not circulating. Then it is possible to select warning as the response. The drive will then continue running until its internal protection will stop it.

**1** = Warning

**2** = Fault, stop mode after fault always by coasting

### 7.12.10 *Fieldbus communication*

#### **P2.12.10.1 Response to fieldbus fault ID733 “FBComm.FaultResp”**

Set here the response for a fieldbus fault if the active control place is fieldbus. For more information, see the respective Fieldbus Board Manual.

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop Function

**3** = Fault, stop mode after fault always by coasting

**4** = Warning, Previous frequency. Forced fault after delay. Only for profibus communication

**5** = Quick Stop, Drive will stop by defined quick stop function.

#### **P2.12.10.2 Fieldbus fault delay ID1850 “FB Fault Delay”**

This how long drive will stay in run state after the communication has been lost if fault response is set to 4 / Warning, previous frequency. If time is set to zero drive will remain running until communication is established and stop command is given.

#### **P2.12.10.3 Fieldbus Watch Dog delay ID1354 “FB WD Delay”**

Defines delay when fault is generated when watch dog pulse is missing from fieldbus. Set the time to zero to disable watchdog monitoring. 2 Hz pulse is optimal for this function.

### 7.12.11 Master Follower communication

#### **P2.12.11.1 SystemBus communication fault response ID1082 “SB Comm Fault”**

Defines the action when the System Bus heartbeat is missing.

The master drive sends a heartbeat signal to all follower drives and this heartbeat is sent back to the master drive.

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop function

**3** = Fault, stop mode after fault always by coasting

#### **P2.12.11.2 Systembus fault delay ID1352 “SB fault Delay”**

Defines the delay before fault generation when heartbeat is missing.

#### **P2.12.11.3 Follower Fault ID1536 “Follower Fault”**

Defines the response in the Master drive when a fault occurs in any of the follower drives. When one of the drives trips to fault the master drive will send a command to trigger the Data Logger in all the drives for diagnostic purposes.

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop function

#### **P2.12.11.4 DriveSynch Follower Fault ID1531 “DS Follower Fault”**

Defines the response in the Master drive when a fault occurs in any of the follower drives. When one of the drives trips to fault the master drive will send a command to trigger the Data Logger in all the drives for diagnostic purposes.

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop function

### 7.12.12 Brake monitoring function

The brake monitoring function is activated when the function Brake acknowledge is used. The brake monitoring function compares the brake feedback to the control signal. In other words, a fault will be issued if the feedback is missing when drive is in Run state and the output frequency is above the opening limit and the fault delay has expired. A fault is also triggered if the brake feedback indicates that the brake is open while the drive is in stop state.

In some cases it is possible that an encoder fault appears when the drive is run against closed brake. The encoder fault can be disabled with Control Options B8 when the drive is controlling the brake to be closed.

#### **P2.12.12.1 Brake fault response ID1316 "Brake Fault"**

Defines the action after detection of a brake fault.

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop Function

**3** = Fault, stop mode after fault always by coasting

#### **P2.12.12.2 Brake fault delay ID1317 "BrakeFaultDelay"**

The delay before the brake fault (F58) is activated. Used when there is a mechanical delay in the brake. See digital input signal *External brake acknowledge*.

### 7.12.13 External Fault function

#### **P2.12.13.1 Response to external fault ID701 “External Fault 1”**

#### **P2.12.13.2 Response to external fault ID747 “External Fault 2”**

Defines the response to a digital input signal informing about an external condition where the drive needs to react to. The external warning/fault indication can be connected to a digital output.

**0** = No response

**1** = Warning

**2** = Fault, stop mode after fault according to Stop Function

**3** = Fault, stop mode after fault always by coasting

### 7.12.14 Encoder fault

Encoder supervision gives fault in case there are no pulses from encoder. Requirement is that reference is above 1 Hz and torque can reach normal torque limit. Detection Iq (torque) limit can be adjusted by Iq Fault limit parameter. This limit may need adjustment when torque limit is below Iq Fault limit, default 100 %. Alternative method to detect encoder fault is Speed Error detection.

#### **P2.12.14.1 Encoder supervision ID1353 "Encoder Superv."**

Select response to encoder supervision fault.

Do not select 3 while drive is in run state.

**1** = Warning

**2** = Fault

**3** = Warning; Change to Open Loop

This selection changes operation mode to Open Loop Sensorless when encoder fault is detected.

Note: It's recommended to activate I/f start when this is selection is used and speed remains long period of times in zero speed area.

#### **P2.12.14.2 Iq Fault Limit ID1800 "Iq Fault Limit"**

This defined Iq current limit what must be exceeded before situation is determine to be encoder fault is pulses are missing from encoder at the same time.

#### **P2.12.14.3 Fast Hz Limit ID1801 "Fast Hz Limit"**

Frequency limit where detection is made differently.

### 7.12.15 Signal Monitoring Function

With this function it's possible to select any signal with ID number and select if low or high limit is monitored. Warning level and fault level can be given separately.

#### **P2.12.15.1 Monitored ID1431**

Select ID of the signal that is monitored

#### **P2.12.15.2 Monitored Level ID1432**

Select if signal is monitored for going above level or going below the set level

**0**=High Level

**1**=Low Level

#### **P2.12.15.3 Warning Level ID1433**

Set here the level when warning signal is given.

#### **P2.12.15.4 Fault Level ID1437**

Set here the level when fault signal is given.

**P2.12.16    Disable Stop Lock            ID1086**

Some parameters are locked during the Run state, with this parameter it's possible to bypass this Run State parameter lock. Be careful what you change and how big change you make to those parameters.

**P2.12.17    Reset Datalogger            ID1857****0 = Auto**

Datalogger signals will changed based on motor control mode automatically. Setting datalogger from NCDriver will disable signal change automatically, to reactivate automatic change set this parameter to 1.

**1 = Reset to Auto**

When datalogger signals has been changed in NCDriver use this to set datalogger back to Auto mode.

**2 = SW Default**

System software default are activated and mode changes automatically to 4.

**3 = Auto Fast**

Same as selection 0 but signals are recorded at fast time level. This selection will increase system load.

**4 = No Change**

Application will not make changes to signal.

### 7.13 Fieldbus settings

#### 7.13.1 General settings

##### P2.13.1 to

##### P2.13.8 **Fieldbus data out selections 1 to 8 ID852-ID859 “FB Data OutX Sel”**

Using these parameters, you can monitor any monitoring or parameter value from the fieldbus. Enter the ID number of the item you wish to monitor for the value of these parameters. See monitoring signals for full details of ID numbers.

Default settings:

Data	Value	Unit	Scale	ID
Status Word	Main Status Word			
FB General Status Word	MCStatus			64
FB Actual Speed	Actual Speed	%	0,01 %	
Process data OUT 1	Output Frequency	Hz	0,01 Hz	1
Process data OUT 2	Motor Speed	rpm	1 rpm	2
Process data OUT 3	Motor Current	A	0,1 A	45
Process data OUT 4	Motor Torque	%	0,1 %	4
Process data OUT 5	Motor Power	%	0,1 %	5
Process data OUT 6	Motor Voltage	V	0,1 V	6
Process data OUT 7	DC link voltage	V	1 V	7
Process data OUT 8	Active Fault Code	-	-	37

##### P2.13.9 to

##### P2.13.16 **Fieldbus data out selections 9 to 16 ID558-ID565 “FB Data OutX Sel”**

Using these parameters, you can monitor any monitoring or parameter value from the fieldbus. Enter the ID number of the item you wish to monitor for the value of these parameters. See monitoring signals for full details of ID numbers.

##### P2.13.17 to

##### P2.13.24 **Fieldbus data IN selections 1 to 8 ID876-833 “FB Data In X Sel”**

Using these parameters, you can control any monitoring or parameter value from the fieldbus. Enter the ID number of the item you wish to control for the value of these parameters. Monitoring signals that can be controlled from fieldbus are shadowed.

Default settings:

Data	Value	Unit	Scale	ID
Reference	Speed Reference	%	0.01%	-
Control Word	Main Control Word	-	-	-
Control Word 2	General Control Word			
Process Data IN1	Torque Reference	%	0.1%	1140
Process Data IN2	Free Analogue INPUT	%	0.01%	46
Process Data IN3	Adjust Input	%	0.01%	47
Process Data IN4	FB Analogue Output	%	0.01%	48
PD5 – PD8	Not Used	-	-	-

##### P2.13.25 to

##### P2.13.32 **Fieldbus data IN selections 9 to 16 ID550-557 “FB Data In X Sel”**



Using these parameters, you can control any monitoring or parameter value from the fieldbus. Enter the ID number of the item you wish to control for the value of these parameters

**P2.13.33    *Fieldbus General Status Word ID    ID897    “GSW ID”***

With this parameter it is possible to select which data are sent in FBGeneralStatusWord (see for details and availability in used fieldbus manual).

**P2.13.34    *Control Slot selector            ID1440            “ControlSlotSel.”***

This parameter defines which slot is used as the main control place when two fieldbus boards have been installed in the drive. When values 6 or 7 are selected, the drive uses the Fast fieldbus profile. Fast fieldbus profile also enables full accuracy if FB Reference Scale. If FB Reference Scale is 20000, internal calculation accuracy is 0,0025 Hz when FB Process Speed is 1500 rpm. When the Fast fieldbus profile is used, type ‘B’ boards or other C type boards cannot be used. Since NXP3 V188 this limitation has been removed.

- 0** = All slots
- 4** = Slot D
- 5** = Slot E
- 6** = Slot D, Fast fieldbus support
- 7** = Slot E, Fast fieldbus support
- 8** = Slot D, 16 process data support
- 9** = Slot F, 16 process data support

Restrictions when activated:

1. Set first the Slave Address, PPO type (PPO 5) and Operate Mode (ByPass) before selecting the Fast fieldbus mode.
2. Fast fieldbus profile is not available for all fieldbus board, contact factory for more detail.
3. Service data of profibus board cannot be used.
4. Fieldbus board parameters cannot be accessed.
5. Profibus option board will operate only in ByPass mode.
6. Standard F53 fault detection is not available. WD Pulse monitoring needs to be used to monitor communication faults.
7. P2.12.10.1 selection 4 / Warning previous frequency function is not available.

Restrictions for speed reference:

1. Although using fast fieldbus function, fieldbus speed reference remains in 5 ms cycle time if control place is not fieldbus. When control place is fieldbus reference cycle time is 1 ms.
2. Max Speed 2 limitation function is not available. This function is bypassed.
3. Speed limitation for brake control is not available. This function is bypassed.
4. Prohibited speeds are not available. This function is bypassed.

Restrictions for torque reference:

1. Torque reference can be only given from Process Data 1.
2. Although using fast fieldbus function, fieldbus torque reference remains in 5 ms cycle time if control place is not fieldbus or drive is not follower drive. When control place is fieldbus or drive is a follower drive reference cycle time is 1 ms.
3. Torque reference maximum and minimum do not limit torque reference from fieldbus.
4. If torque reference dead zone is used this value is subtracted from given reference.

**P2.13.35    *State Machine***

Application has possibility to select what kind of state machine is used.

#### **0: Echo**

Process data In 1-16 are send back to Process data Out 1-16

#### **1: Standard**

This mode makes fieldbus control behave as in explained in used fieldbus board manual.

#### **2: ProfiDrive**

This mode uses ProfiDrive type state machine in application level. This mode is possible to use on fieldbus boards that does not have state machine itself or has possibility to bypass state machine functionality in option board.

See Chapter 7: Status and Control Word In Detail

#### **P2.13.36    *Fieldbus reference filtering time*    ID863    “FB Ref Filter TC”**

Filtering time for fieldbus reference.

#### **P2.13.37    *Enable FB Monitoring*    ID1629    “FB Monitoring”**

Enable Fieldbus communication monitoring while active control place is not fieldbus.

Can be used in cases where drive is in system bus control but follower drive torque reference is written from upper system.

#### **P2.13.38    *SW ID.Bit selection B11*    ID1625**

#### **P2.13.39    *SW ID.Bit selection B12*    ID1626**

#### **P2.13.40    *SW ID.Bit selection B13*    ID1627**

#### **P2.13.41    *SW ID.Bit selection B14*    ID1628**

Select the bit that used in FB Status Word Bit 11, 12, 13 and 14.

## 7.14 ID Functions

Listed here are the functions that use the parameter ID number to control and monitor the signal.

### 7.14.1 Value Control

The value control parameters are used to control an input signal parameter.

#### **P2.14.1.1 Control Input Signal ID ID1580 “ContrInSignal ID”**

With this parameter you can select what signal is used to control selected parameter.

#### **P2.14.1.2 Control Off Limit ID1581 “Contrl Off Limit”**

This parameter defines the limit when the selected parameter value is forced to Off value.

#### **P2.14.1.3 Control On Limit ID1582 “Contrl On Limit”**

This parameter defines the limit when the selected parameter value is forced to On value.

#### **P2.14.1.4 Control Off Value ID1583 “Contrl Off Value”**

This parameter defines the value that is used when the used input signal is below Off limit.

#### **P2.14.1.5 Control On Value ID1584 “Contrl On Value”**

This parameter defines the value that is used when the used input signal is above On limit.

#### **P2.14.1.6 Control Output Signal ID ID1585 “ContrlOutSignID”**

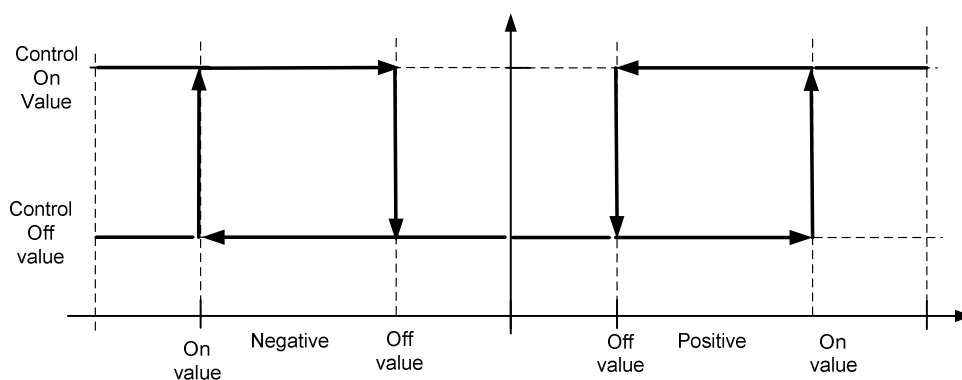
This parameter defines which parameter is forced to On and Off values when selected input signal exceeds the set limits.

#### **P2.14.1.7 Control Mode ID1586 “Control Mode”**

This parameter defines how the value control output behaves.

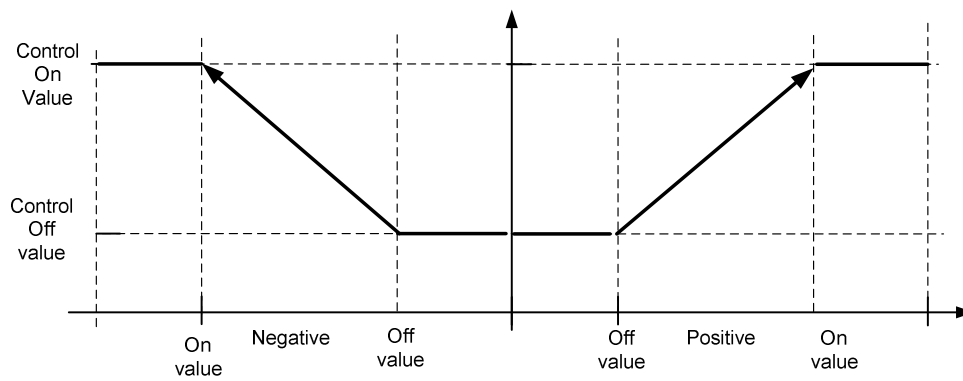
**0 = SR ABS**

Absolute input value is used to make a step change in the output between On and Off values.



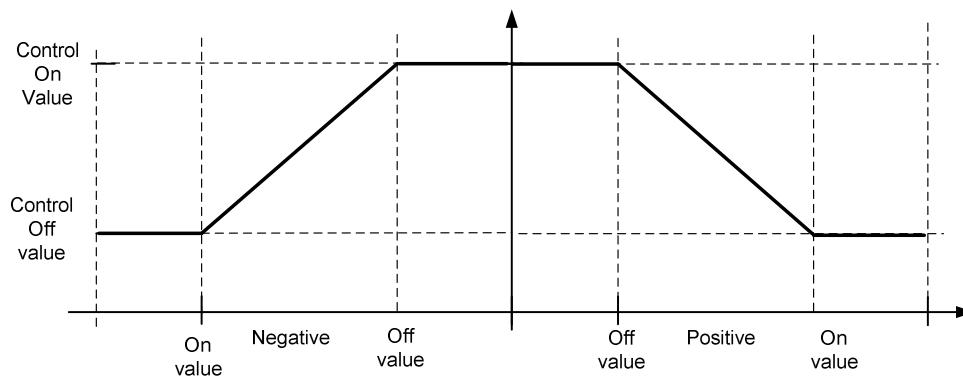
**1 = Scale ABS**

Absolute input value is scaled linearly between On and Off values.



### 2 = Scale ABS Inverted

Inverted absolute value is scaled linearly between On and Off values.



### 3 = SR

Input value is used to make a step change in the output between On and Off values.

### 4 = Scale ABS

Input values is scaled linearly between On and Off values.

### 5 = Scale Inverted

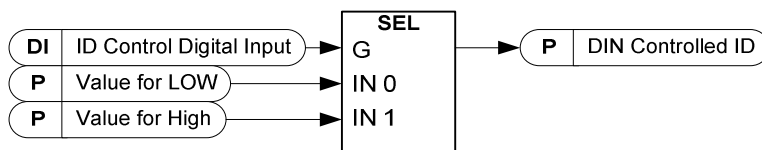
Inverted value is scaled linearly between On and Off values

#### P2.14.1.8 Control Signal Filtering TC ID1586 "Control Filt TC"

This parameter is used to filter the scaling function output. Used e.g. when unfiltered torque is used to control a parameter that needs stabilization.

### 7.14.2 DIN ID Control

This function is used to control any parameter between two different values with a digital input. Different values are given for DI 'low' and DI 'high'.



**P2.14.2.1 ID Control Digital Input ID1570 "ID Control DIN"**

**P2.14.3.1 ID Control Digital Input ID1590 "ID Control DIN"**

**P2.14.4.1 ID Control Digital Input ID1578 "ID Control DIN"**

Select digital input to be used for controlling the parameter selected by ID1571.

**P2.14.2.2 DIN Controlled ID ID1571 "Controlled ID"**

**P2.14.3.2 DIN Controlled ID ID1575 "Controlled ID"**

**P2.14.4.2 DIN Controlled ID ID1579 "Controlled ID"**

Select parameter ID controlled by ID1570.

**P2.14.2.3 Value for Low digital input (FALSE) ID1572 "FALSE Value"**

**P2.14.3.3 Value for Low digital input (FALSE) ID1592 "FALSE Value"**

**P2.14.4.3 Value for Low digital input (FALSE) ID1594 "FALSE Value"**

Set here the controlled parameter value when the digital input (ID1570) is LOW for the parameter selected by ID1571. The function does not recognize decimals. Give, therefore, e.g. 10.00 Hz as '1000'.

**P2.14.2.4 Value for High digital input (TRUE) ID1573 "TRUE Value"**

**P2.14.3.4 Value for High digital input (TRUE) ID1593 "TRUE Value"**

**P2.14.4.4 Value for High digital input (TRUE) ID1596 "TRUE Value"**

Set here the controlled parameter value when the digital input (ID1570) is HIGH for the parameter selected by ID1571. The function does not recognize decimals. Give, therefore, e.g. 10.00 Hz as '1000'.

### 7.14.3 ID-controlled DO

This function is used to control any Digital output by any status that can be presented as bit. The input signal is selected with the ID number and bit number.

**Example:** Most of the faults and warnings are normally presented in the common digital output. With the ID-controlled DO function, it is possible to select a specific fault to be connected to the digital output.

Warning Word 1 ID1174		
	Fault	Comment
b0	Motor stalled	W15
b1	Motor over temperature	W16
b2	Motor under load	W17
b3	Input phase loss	W10
b4	Output phase loss	W11
b5	Safe disable	W30 (Not implemented)
b6	FieldBus communication fault in slot D	W53 (Not implemented)
b7	FieldBus communication fault in slot E	W67 (Not implemented)
b8	Drive over temperature	W14
b9	Analogue input < 4mA	W50
b10	Not used	
b11	Emergency stop	W63
b12	Run disabled	W62
b13	Not used	
b14	Mechanical Brake	W58
b15	Not used	

#### P2.14.5.1 ID.Bit Free Digital output control ID1217 “ID.Bit Free DO1”

Select the signal for controlling the DO. The parameter has to be set in format xxxx.yy where xxxx is the ID number of a signal and yy is the bit number. For example, the value for DO control is 1174.02. 1174 is the ID number of Warning Word 1. So the digital output is ON when bit number 02 of the warning word (ID no. 1174) i.e. *Motor underload* is high.

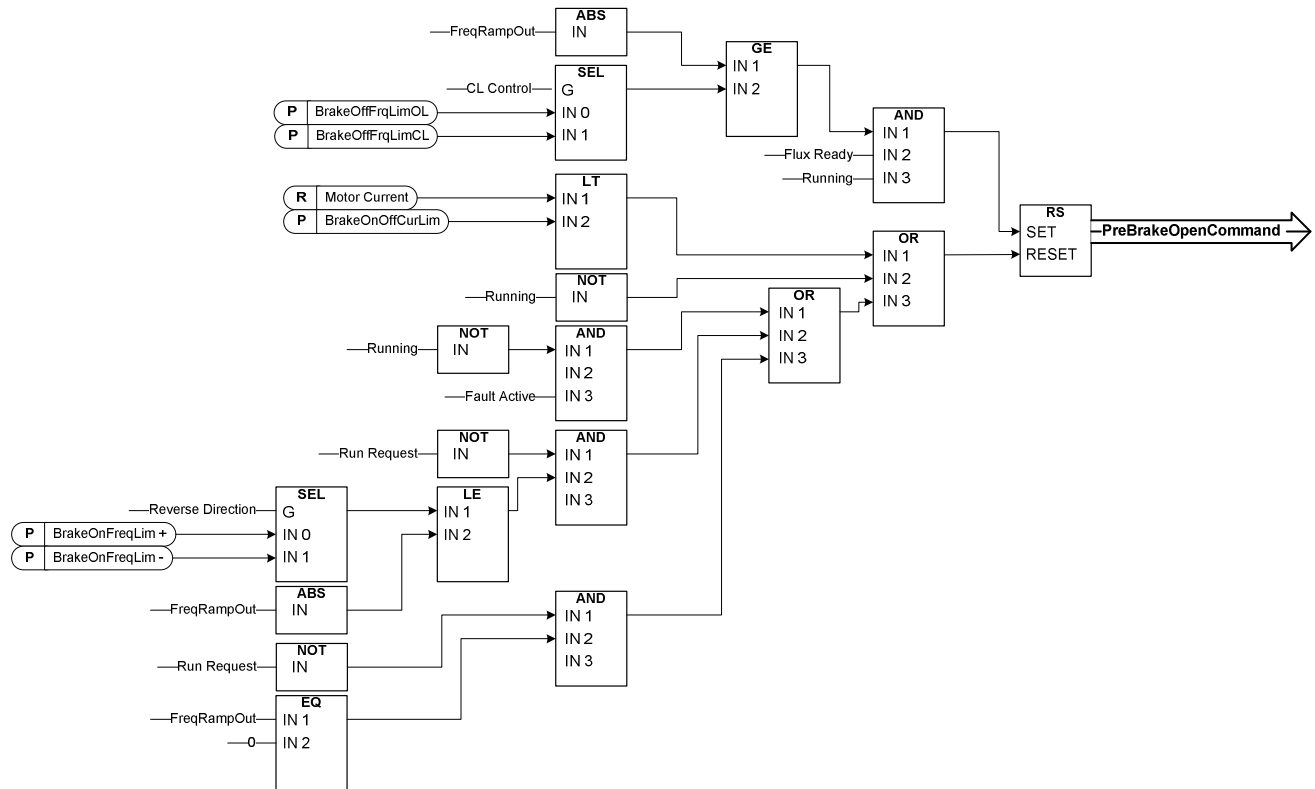
#### P2.14.5.2 Free Digital Output selector ID1574 “Free DO1 Sel.”

Select the output terminal to be controlled with the parameter ID.bit Free Digital output control.

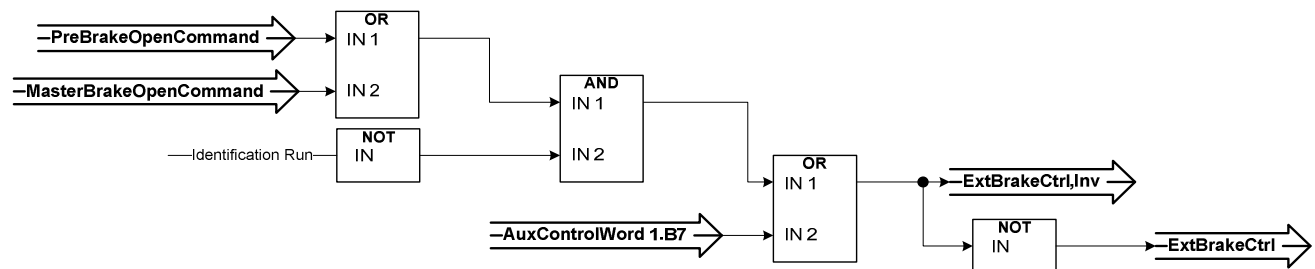
### 7.15 Brake Control

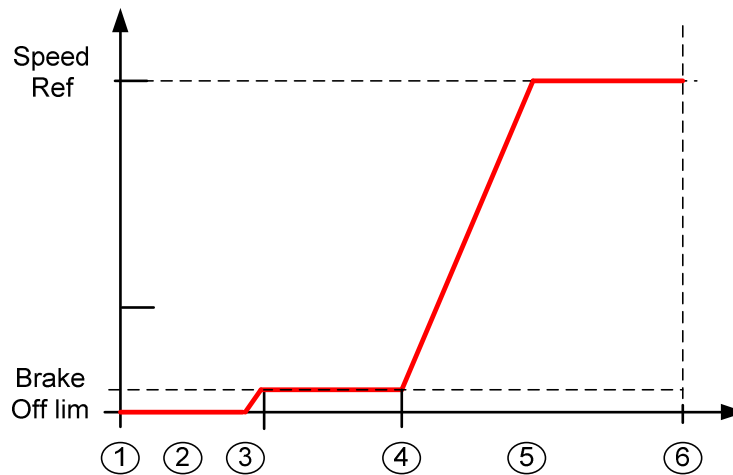
The mechanical brake control has two parts that need to be synchronically controlled. The first part is the *mechanical brake release* and the second is the *speed reference release*.

Conditions to open the brake:



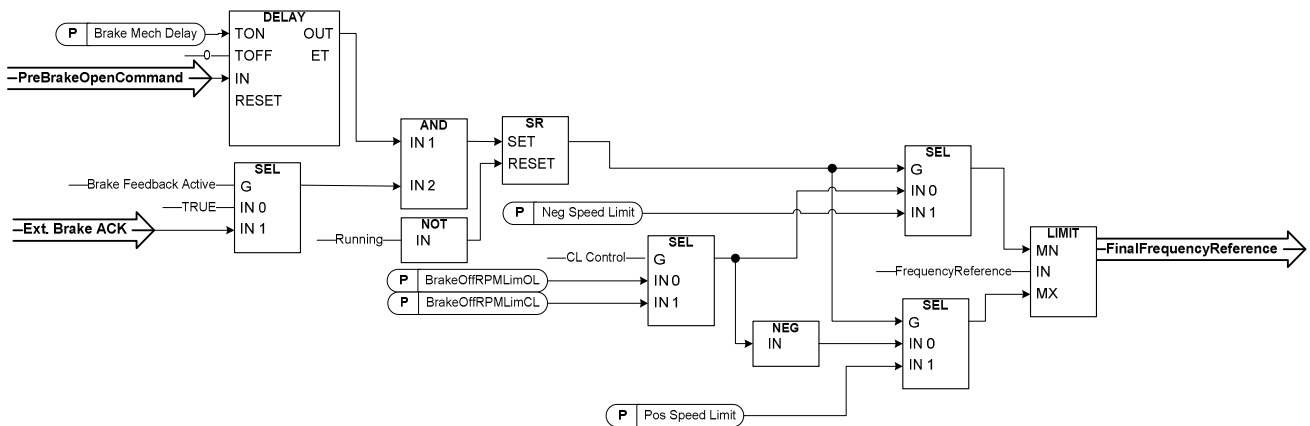
**The final brake open command:** It is possible that in a Master/Follower system the master drive opens the brake. Also an overriding system may do this without any control from the drive using AucControlWord1.B7. During identification run the brake will not open.





1. Start command
2. Start magnetization is used to build rotor flux fast. The drive *Zero speed time* is used during this.
3. When the rotor flux is > 90 % and the start zero time has expired the speed reference is released to BrakeOpenRPM limit.
4. Speed is kept at this speed until feedback is received from the brake acknowledge or when brake mechanical delay time has passed.
5. Speed follows normal reference signal.

Speed reference release function:



### P2.15.1 Mechanical brake reaction time ID1544 “Brake Mech Delay”

After the brake open command has been given, speed is kept at the Brake Open limit until the reaction time has passed. This hold time should be set corresponding to the mechanical brake reaction time. This function is used to avoid current and/or torque spikes eliminating a situation where the motor is run at full speed against the brake. If this parameter is used when simultaneously with the brake acknowledge input both time and brake acknowledgements are needed before the speed reference is released.



**P2.15.2    Brake Speed limit Open Loop    ID1535    “BrakeOFFRPMLimOL”**

This parameter defines the frequency limit to release the brake.

This value also applies as the maximum frequency reference limit while the brake is closed. In open loop control it is recommended to use a value that is equal to the motor's nominal slip.

**P2.15.3    Brake speed limit Closed Loop    ID1555    “BrakeOFFRPMLimCL”**

This parameter defines the frequency limit to release the brake.

This value also applies as the maximum frequency reference limit while the brake is closed. In closed loop control it is recommended to use zero value so that the brake is released while the drive has zero speed at start. If torque is needed to avoid position change at the moment the brake mechanically opens use the start-up torque function.

**P2.15.4    Closing speed from forward direction    ID1539    “BrakeOnRPMLim +”**

Output frequency limit to close the brake when the speed approaches zero speed from positive direction. Lifting direction must be given as positive frequency.

**P2.15.5    Closing speed from reverse direction    ID1540    “BrakeInRPMLim –”**

Output frequency limit to close the brake when the speed approaches zero speed from positive direction. Lowering direction must be given as negative frequency.

**P2.15.6    Brake On/Off Current limit ID1085    “BrakeOnOffCurLim”**

If motor current is below this value the brake is closed immediately.

It is recommended to set this value to approximately 25 % of the magnetization current from the maximum used frequency.

### 7.15.1 Run away load protection

Run away load protection is used to increase the generator torque limit in case when the speed of the load is increasing above the defined frequency limit. Used in cases when upper system is controlling generator torque limit and its needed to drive itself control situation when speed increases too high.

**Note!** The maximum generator side torque limit is still limited by the General torque limit parameter.

#### P2.15.7 Generator Torque limit increase speed level ID1547 “TorqLimInc Hz”

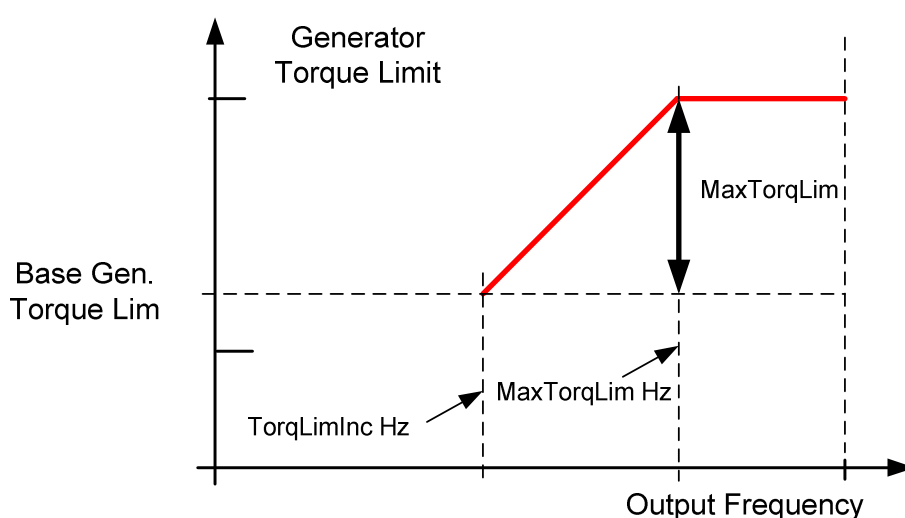
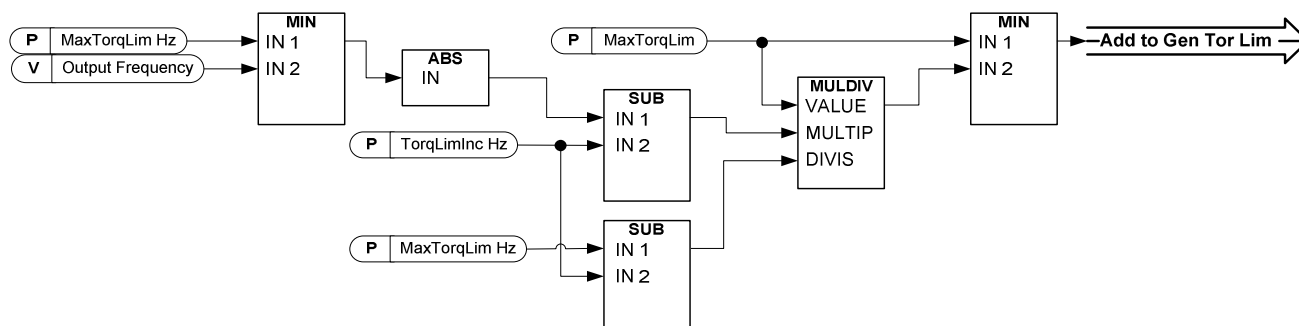
The frequency limit at which the generator side torque limit is started to increased when speed of the motor increases (over speed).

#### P2.15.8 Generator Torque limit increase high speed limit ID1548 “MaxTorqLim Hz”

The frequency level at which point the torque defined by the “Generator Torque Limit increase maximum addition” is added entirely to the final torque limit.

#### P2.15.9 Generator Torque limit increase added torque ID1549 “MaxTorqLim”

When this parameter is set greater than zero the generator torque limit increases at high speed is activated. This parameter defines the torque that is added to generator torque limit, linearly starting from ID1547 to ID1548.



### 7.15.2 Closed Loop settings

#### 7.15.2.1 Start Up torque

The start-up torque is used to generate torque against the brake so that when the brake is mechanically opened there will be no position change because the drive is already generating the torque needed to keep the load in place.

Settings the start-up torque time is set to -1 means that the start-up torque is removed when the drive notices encoder movement. Setting the time greater than 0 will define the actual time for how long the start-up torque is applied to the motor even if the motor shaft is already rotating thus making the motor accelerate without control until time has expired.

#### **P2.15.10.1 CL: Startup torque ID621 "StartUp Torque!"**

**0** = Not Used

**1** = Torque Memory

Torque memory uses the torque that was used by the speed controller last time the drive was in running state. Normally, this is the torque generated when the zero speed time at stop has expired and the drive has stopped modulation or started the flux off delay function.

**2** = Torque Reference

The normal torque reference chain is used (expect TorqueStep) for the start-up torque level. This can be used when the external system knows the load on the shaft when brake is released.

**3** = Torque Forward/Reverse

Drive uses torque values defined by the start-up torque forward and reverse.

**4** = StartUpTorque Reference

Start Up torque reference is given to P2.15.10.5 StartupTorq Ref

#### **P2.15.10.2 Start-up torque, forward ID633 "StartupTorq FWD"**

Sets the start-up torque for forward direction if selected with parameter Startup Torque.

#### **P2.15.10.3 Start-up torque, reverse ID634 "StartupTorq REV"**

Sets the start-up torque for reverse direction if selected with parameter Startup Torque.

#### **P2.15.10.4 Start-Up Torque Time ID1371 "StartupTorq Time"**

This parameter defines for how long the start-up torque will be used instead of the speed controller output. If the time is set to -1 the drive will automatically start to use the speed controller when speed change is read from encoder. When the setting is >0 the drive will use this defined torque even if speed changes are read from encoder.

#### **P2.15.10.5 Start-Up Torque Reference ID1375 "StartupTorq Ref"**

PLC system can write here the torque needed against the brake. This can be used when the external system knows the load on the shaft when brake is released.

### 7.15.3 Functions

#### **P2.15.11.1 Stop Torque Release Time ID1858**

This parameter defines how fast torque is released against closed brake when drive is stopped.

### 7.16 Auto Fault Reset

The Auto reset function tries to reset the fault automatically during the trial time. An individual fault can be defined to be reset certain number of times before the actual fault indication is given. The function will operate as Automatic Restart function if the start command is received as a static signal. In I/O control of the System Interface application, the default start function requires a rising edge command after fault trigger.

#### P2.16.1 Automatic reset: Wait time ID717 "Wait Time"

Defines the time for the attempted fault reset after the fault trigger has passed.

Note: In case of external fault, remove the cause of fault on the external device. The wait time count starts only when the cause of fault has been removed.

#### P2.16.2 Automatic reset: Trial time ID718 "Trial Time"

The Automatic reset function keeps trying to reset the faults appearing during the time set with this parameter. If the number of faults during the trial time exceed the value of the respective parameter set with ID720 to ID725 a permanent fault is generated.

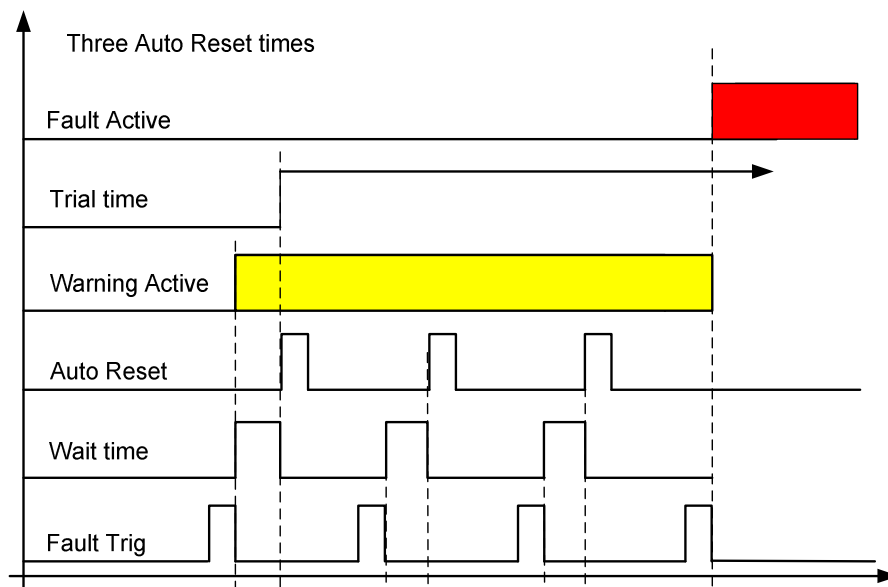


Figure 7-15. Example of Automatic restarts with three restarts

#### P2.16.3 Automatic restart: Start function ID719 "Start Function"

The Start function for restart is selected with this parameter; restart will take place if there is a static Start command active when an automatic fault reset is made.

0 = Start with ramp

1 = Flying start

2 = Start according to Start Function parameter (Default)

The following 'Number of tries' parameters determine the maximum number of automatic restarts during the trial time. The time count starts from the first autoreset. If the number of faults occurring during the trial time exceeds the values set by number of tries the fault state becomes active.

#### P2.16.4 Number of tries after undervoltage fault trip

#### ID720 "Undervolt. Tries"

This parameter determines how many automatic fault resets can be made during the trial time after undervoltage trip.

- 0** = No automatic reset
- >0** = Number of automatic fault resets after undervoltage fault.

**P2.16.5**      **Number of tries after overvoltage trip**      **ID721 "Overvolt. Tries"**

This parameter determines how many automatic fault resets can be made during the trial time after overvoltage trip.

- 0** = No automatic fault reset after overvoltage fault trip
- >0** = Number of automatic fault resets after overvoltage fault trip.

**P2.16.6**      **Number of tries after overcurrent trip**      **ID722 "Overcurr. Tries"**

(NOTE! IGBT temp faults also included)

This parameter determines how many automatic fault resets can be made during the trial time after overcurrent trip.

- 0** = No automatic fault reset after overcurrent fault trip
- >0** = Number of automatic fault resets after overcurrent trip, saturation trip and IGBT temperature faults.

**P2.16.7**      **Number of tries after reference trip**      **ID723 "4mA Fault Tries"**

This parameter determines how many automatic fault resets can be made during the trial time after 4 mA reference fault.

- 0** = No automatic fault reset after reference fault trip
- >0** = Number of automatic fault resets after the analogue current signal (4...20mA) has returned to the normal level ( $\geq 4\text{mA}$ )

**P2.16.8**      **Number of tries after motor temperature fault trip**      **ID726 "MotTempF Tries"**

This parameter determines how many automatic fault resets can be made during the trial time after calculated motor temperature fault trip.

- 0** = No automatic fault reset after Motor temperature fault trip
- >0** = Number of automatic fault resets after the motor temperature has returned to its normal level

**P2.16.9**      **Number of tries after external fault trip**      **ID725 "Ext.Fault Tries"**

This parameter determines how many automatic fault resets can be made during the trial time after external fault trip.

- 0** = No automatic fault reset after External fault trip
- >0** = Number of automatic fault resets after External fault trip

**P2.16.10**      **Number of tries after underload fault trip**      **ID738 "Underload tries"**

This parameter determines how many automatic fault resets can be made during the trial time after underload trip.

- 0** = No automatic fault reset after Underload fault trip  
**>0** = Number of automatic fault resets after Underload fault trip

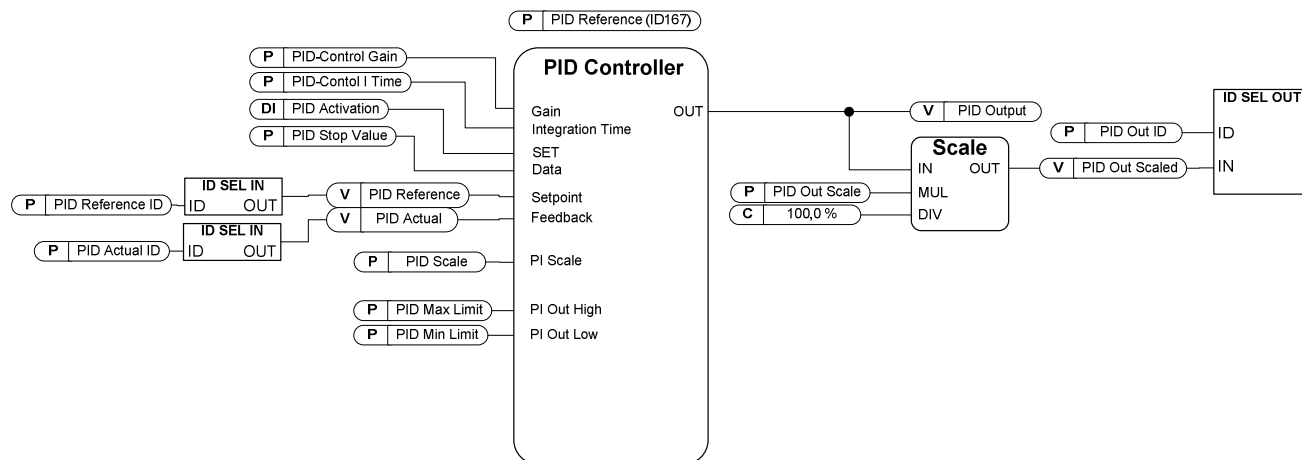
**P2.16.11**    **Fault Simulation**                      **ID1569**                      **“Fault Simulation”**

With this parameter it's possible to simulate different faults without actually causing e.g. over current situation.

- B00** = +1 = Simulates over current fault (F1)  
**B01** = +2 = Simulates over voltage fault (F2)  
**B02** = +4 = Simulates under voltage fault (F9)  
**B03** = +8 = Simulates output phase supervision fault (F11)  
**B04** = +16 = Simulates earth fault (F3)  
**B05** = +32 = Not used  
**B06** = +64 = Simulates encoder fault (F43)

## 7.17 PI Control

PI Control in system interface application uses ID number to make connection between reference, actual value and output.



### P2.17.1 PI Controller Gain

This parameter defines the gain of the PID controller. If the value of the parameter is set to 100% a change of 10% in the error value causes the controller output to change by 10%. If the parameter value is set to 0 the PID controller operates as ID-controller.

### P2.17.2 PI Controller I time

The parameter ID119 defines the integration time of the PID controller. If this parameter is set to 1,00 second a change of 10% in the error value causes the controller output to change by 10.00%/s. If the parameter value is set to 0.00 s the PID controller will operate as PD controller.

### P2.17.3 PI Controller reference

PI controller reference from keypad, used also when reference is controlled from Fieldbus.

### P2.17.4 PI Controller reference value ID number

Select ID number of the signal that is used as reference valued for PI controller.

### P2.17.5 PI Controller actual value ID number

Select ID number of the signal that is used as actual value for PI controller.

PI Actual value can be written from Fieldbus directly to monitoring variable ID21 when this parameter is set to zero.

### P2.17.6 PI Controller output ID

Select ID number of parameter of signal that is controlled by PI controller.

### P2.17.7 PI Controller Scale

This parameter allows you to invert the error value of the PID controller (and thus the operation of the PID controller).

**1** No inversion

**-1** Inverted

This value is a multiplier for P and I part of the control thus working as additional gain.

NOTE! Zero is illegal value for PI controller

**P2.17.8**     ***PI Controller minimum output***

**P2.17.9**     ***PI Controller maximum output***

With these parameters you can set the minimum and maximum limits for the PID controller output.

These limits are of importance for example when you define the gain and I-time for the PID controller.

**P2.17.10**    ***PI Controller output scale***

This parameter is used to scale PI output to have more controlling are for the PI controller. e.g. PI controller maximum limit can be set to 10000 and by setting scaling to 10% PI output can be used directly to e.g. motoring torque limit.

PI Output \* Scaling [%] = P2.18.5 -> 10000 \* 10 % = 1000, (1000 = 100,0 % of T<sub>n</sub>).

**P2.17.11**    ***PI Stop state value***

This value is forced to PI controller out when controller is not activated by digital input P2.2.1.15.



## 7.18 Functional Safety

**P2.18.1 SQS Reaction ID545****0=No Action****1=Quick Stop**

Activates same function as Digital Input Quick Stop P2.4.2.25.

**P2.18.2 SS1 Reaction ID542****0=No Action****1=Stop****2=Quick Stop**

Makes a normal stop command. Uses currently active ramp times

**P2.18.3 SS2 Reaction ID546****0=No Action****1=Zero Speed****2=Quick Stop**

Reference is forced to zero. Uses currently active ramp times.

**P2.18.4 SLS Reaction ID543****0=No Action****1=Limit Reference**

Speed Reference is limited to Safe Board limit – Motor Nominal Slip. Used currently active ramp times.

**P2.18.5 SSR Reaction ID547****0=No Action****1=Limit Reference**

Speed Reference is limited to Safe Board limit – Motor Nominal Slip. Used currently active ramp times.

**P2.18.6 Safety Options ID548 "SafetyOptions"****B01 =** Ignore speed deviation warning from the safety system

## 7.19 Condition Based Monitoring

### 7.19.1 Baseline Settings

#### P2.19.1.1 Baseline Type ID3501

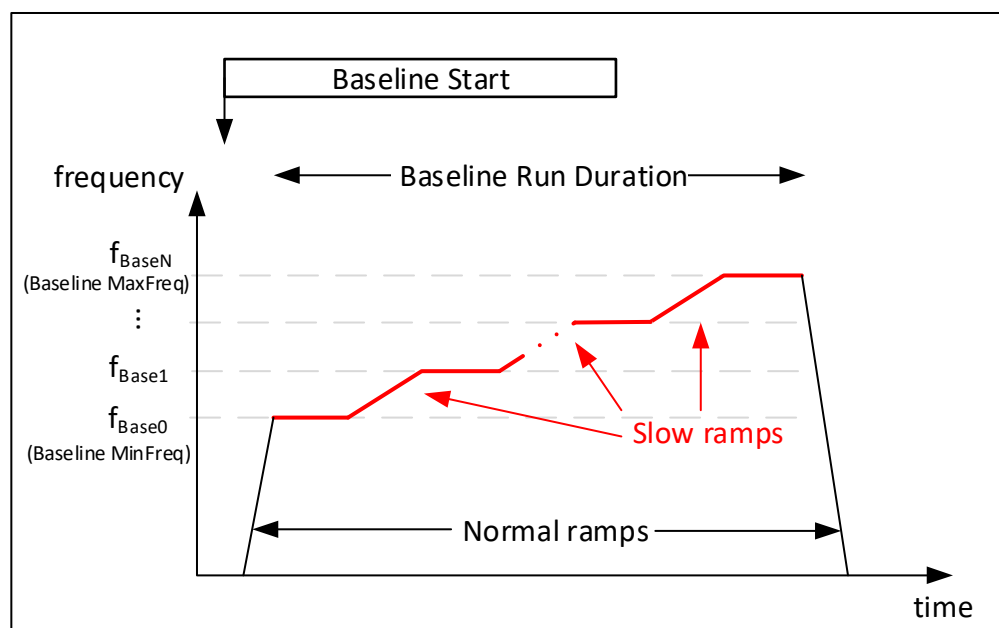
Use this parameter to select baseline type.

##### 1. Baseline Run

Baseline run is made before normal operation. Idea is to compare actual measurements with measurements taken when the system was in healthy/normal condition. The measurements from healthy condition is called “baseline”.

In this application measurements of the motor current and voltage unbalances for stator winding is collected. The current unbalance is used in open loop and voltage unbalance is used in closed loop and sensorless control. Other measurements are load and vibration if vibration input is set.

The principle is to run the application through 10 frequency points including 10 steady and 9 ramp states, collect the min, max, mean and standard deviation values and store the statistical baseline data in arrays.



##### 2. Online Baseline

Online baseline can be done during normal operation when process is running. For the user-specified period of time, the relevant signals are gathered by the drive. Signals are only gathered between baseline min and max freqs when signal is inside speed band. This method provides a better representation of normal variation in the application.

##### 3. Baseline Finished

This option is automatic chosen after successful baseline operation. This option needs to also chose after manual baseline is finished. Condition based monitoring can start when baseline is finished.

**P2.19.1.2 Baseline MinFreq ID3502**

Use this parameter to set frequency point where baseline run is started.

**P2.19.1.3 Baseline MaxFreq ID3503**

Use this parameter to set frequency point where baseline run is ended.

**P2.19.1.4 Baseline Duration ID3504**

Use this parameter to set the duration of the baseline run.

**P2.19.1.5 Modified Array ID3506**

One array includes 10 points in steady state and 9 points in ramp state. Before or after the baseline run, each measurement point can be modified using parameters ID 3505, ID 3507, and ID 3508. Use this parameter to select a modified array.

- 0 = Freq Points
- 1 = Current Max Steady
- 2 = Current Min Steady
- 3 = Current Mean Steady
- 4 = Current Std Steady
- 5 = Voltage Max Steady
- 6 = Voltage Min Steady
- 7 = Voltage Mean Steady
- 8 = Voltage Std Steady
- 9 = Vibration Max Ramp
- 10 = Vibration Min Ramp
- 11 = Vibration Mean Ramp
- 12 = Vibration Std Ramp
- 13 = Load Max Steady
- 14 = Load Min Steady
- 15 = Load Mean Steady
- 16 = Load Std Steady

**P2.19.1.6 Modified Point ID3507**

Use this parameter to select which measurement point to modify in the array. Steady array includes 10 points and ramp array includes 9 points. First point has value 0.

**P2.19.1.7 Modified Value ID3508**

Use this parameter to give new value to the point selected with ID 3507.

**P2.19.1.8 Modified Activation ID3505**

Before or after the baseline, each measurement point can be modified. Use this parameter to activate Modified value (ID 3508) of the Modified point (ID 3507).

**P2.19.2.9 Baseline Data Selector ID3509**

This parameter can be chosen which array points can be monitored in the monitor group G1.32.1 Baseline data.

- 0 = Freq Points

- 1 = Current Max Steady
- 2 = Current Min Steady
- 3 = Current Mean Steady
- 4 = Current Std Steady
- 5 = Voltage Max Steady
- 6 = Voltage Min Steady
- 7 = Voltage Mean Steady
- 8 = Voltage Std Steady
- 9 = Vibration Max Ramp
- 10 = Vibration Min Ramp
- 11 = Vibration Mean Ramp
- 12 = Vibration Std Ramp
- 13 = Load Max Steady
- 14 = Load Min Steady
- 15 = Load Mean Steady
- 16 = Load Std Steady
- 17 = Current Counter
- 18 = Voltage Counter
- 19 = Vibration Counter
- 20 = Load Counter

Counter shows the stored two minutes to capture monitoring values for speed points in online baseline.

#### **P2.19.2.10 Speed Band ID3510**

Use this parameter to define a window to capture the baseline data for different speed points when the speed of drive is within the specified band percentage. Setting the parameter increases a chance to capture all speed points in online baseline mode.

### 7.19.2 Stator Winding

For stator winding monitoring motor currents and voltages are being evaluated for evolving unbalances. For this purpose, current and voltage unbalances are computed and monitored. In case of unbalanced grid voltage a resonance-like oscillation may occur if the motor frequency matches the grid frequency.

#### **P2.19.2.1 Stator Winding Fault Mode ID3540**

This parameter can be set which of stages to be activated.

**0** = No response

**1** = Warning, warning levels S1 and S2 are used

**2** = Fault + Warnings, warning S1, warning S2 and alarm/fault levels are used

#### **P2.19.2.2 Line Frequency ID1913**

This parameter sets the incoming line voltage for the drive.

#### **P2.19.2.3 Line Frequency Hysteresis ID1914**

This parameter can be set the hysteresis of the line frequency. Stator winding monitoring is not used in the hysteresis area.

### 7.19.3 Vibration

#### **P2.19.3.1 Stator Winding Fault Mode ID3588**

This parameter can be set which of stages to be activated.

**0** = No response

**1** = Warning, warning levels S1 and S2 are used

**2** = Fault + Warnings, warning S1, warning S2 and alarm/fault levels are used

#### **P2.19.3.2 Vibration Input ID3587**

Use this parameter to select the analogue input to vibration

**0** = Not Used

**1** = AI1

**2** = AI2

**3** = AI3

**4** = AI4

### 7.19.4 Load

#### **P2.19.4.1 Load Fault Mode ID3589**

This parameter can be set which of stages to be activated.

**0** = No response

**1** = Warning, warning levels S1 and S2 are used

**2** = Fault + Warnings, warning S1, warning S2 and alarm/fault levels are used

### 7.19.5 Threshold Value

The several statistical data points (mean, min, max and std) from the baseline data can be combined one threshold value.

Threshold value = MeanFactor\*mean + MinFactor\*min + MaxFactor\*max ± StdFactor\*stddev.

**P2.19.2.4.1      Current Unbalance Mean Factor      ID3511**

**P2.19.2.6.1      Voltage Unbalance Mean Factor      ID3526**

**P2.19.3.3.1      Vibration Mean Factor      ID3550**

**P2.19.4.2.1      Load Mean Factor      ID3567**

This parameter can be set mean factor in the threshold value. If the threshold value is zero, the mean factor is not used.

**P2.19.2.4.2      Current Unbalance Min Factor      ID3512**

**P2.19.2.6.2      Voltage Unbalance Min Factor      ID3527**

**P2.19.3.3.2      Vibration Min Factor      ID3551**

**P2.19.4.2.2      Load Min Factor      ID3568**

This parameter can be set min factor in the threshold value. If the threshold value is zero, the min factor is not used.

**P2.19.2.4.3      Current Unbalance Max Factor      ID3513**

**P2.19.2.6.3      Voltage Unbalance Max Factor      ID3528**

**P2.19.3.3.3      Vibration Mean Factor      ID3552**

**P2.19.4.2.3      Load Mean Factor      ID3569**

This parameter can be set max factor in the threshold value. If the threshold value is zero, the max factor is not used.

**P2.19.2.4.4      Current Unbalance Std Factor      ID3514**

**P2.19.2.6.4      Voltage Unbalance Std Factor      ID3529**

**P2.19.3.3.4      Vibration Std Factor      ID3553**

**P2.19.4.2.4      Load Std Factor      ID3570**

This parameter can be set std factor in the threshold value. If the threshold value is zero, the std factor is not used.

**P2.19.2.4.5      Current Unbalance Interpolation Type      ID3515**

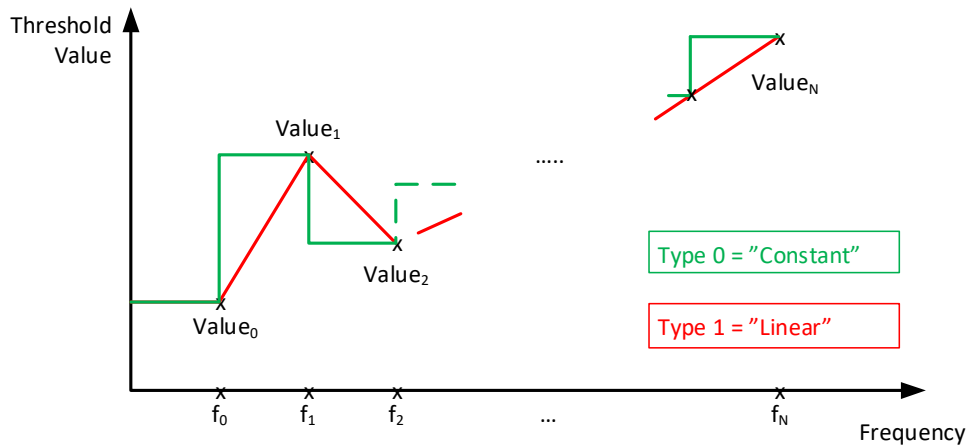
**P2.19.2.6.5      Voltage Unbalance Interpolation Type      ID3530**

**P2.19.3.3.5      Vibration Interpolation Type      ID3554**

**P2.19.4.2.5      Load Interpolation Type      ID3571**

The threshold value contains values for specific frequency points.

This parameter can be select interpolation type for the threshold values across frequency points.



#### 7.19.6 Limits

Each of the three detection levels (Warning S1, Warning S2, Alarm/Fault) have a configurable timer associated that delays the response. The timing principle is like an electrical fuse where the response time is long for low levels and it is short for high levels.

<b>P2.19.2.5.1</b>	<b>Current Unbalance Warning S1 Mode</b>	<b>ID3516</b>
<b>P2.19.2.7.1</b>	<b>Voltage Unbalance Warning S1 Mode</b>	<b>ID3531</b>
<b>P2.19.3.4.1</b>	<b>Vibration Warning S1 Mode</b>	<b>ID3555</b>
<b>P2.19.4.3.1</b>	<b>Load Warning S1 Mode</b>	<b>ID3572</b>
<b>P2.19.2.5.4</b>	<b>Current Unbalance Warning S2 Mode</b>	<b>ID3519</b>
<b>P2.19.2.7.4</b>	<b>Voltage Unbalance Warning S2 Mode</b>	<b>ID3534</b>
<b>P2.19.3.4.4</b>	<b>Vibration Warning S2 Mode</b>	<b>ID3558</b>
<b>P2.19.4.3.4</b>	<b>Load Warning S2 Mode</b>	<b>ID3575</b>
<b>P2.19.2.5.7</b>	<b>Current Unbalance Alarm/fault Mode</b>	<b>ID3522</b>
<b>P2.19.2.7.7</b>	<b>Voltage Unbalance Alarm/fault Mode</b>	<b>ID3537</b>
<b>P2.19.3.4.7</b>	<b>Vibration Alarm/fault Mode</b>	<b>ID3561</b>
<b>P2.19.4.3.7</b>	<b>Load Alarm/fault Mode</b>	<b>ID3578</b>

Use this parameter to select the detection level mode which is used for calculating detection level notification threshold

0 = Absolute: Absolute value is considered as threshold

1 = Offset: Calculates threshold as sum of the computed baseline data and the offset values

2 = Factor: Calculates threshold as baseline data factor

<b>P2.19.2.5.2</b>	<b>Current Unbalance Warning S1 High Limit</b>	<b>ID3517</b>
<b>P2.19.2.7.2</b>	<b>Voltage Unbalance Warning S1 High Limit</b>	<b>ID3532</b>
<b>P2.19.3.4.2</b>	<b>Vibration Warning S1 High Limit</b>	<b>ID3556</b>
<b>P2.19.4.3.3</b>	<b>Load Warning S1 High Limit</b>	<b>ID3573</b>

<b>P2.19.2.5.5</b>	<b>Current Unbalance Warning S2 High Limit</b>	<b>ID3720</b>
<b>P2.19.2.7.5</b>	<b>Voltage Unbalance Warning S2 High Limit</b>	<b>ID3535</b>
<b>P2.19.3.4.5</b>	<b>Vibration Warning S2 High Limit</b>	<b>ID3559</b>
<b>P2.19.4.3.7</b>	<b>Load Warning S2 High Limit</b>	<b>ID3576</b>
<b>P2.19.2.5.8</b>	<b>Current Unbalance Alarm/fault High Limit</b>	<b>ID3523</b>
<b>P2.19.2.7.8</b>	<b>Voltage Unbalance Alarm/fault High Limit</b>	<b>ID3538</b>
<b>P2.19.3.4.8</b>	<b>Vibration Alarm/fault High Limit</b>	<b>ID3562</b>
<b>P2.19.4.3.11</b>	<b>Load Alarm/fault High Limit</b>	<b>ID3579</b>
<b>P2.19.4.3.2</b>	<b>Load Warning S1 Low Limit</b>	<b>ID3584</b>
<b>P2.19.4.3.6</b>	<b>Load Warning S2 Low Limit</b>	<b>ID3585</b>
<b>P2.19.4.3.10</b>	<b>Load Alarm/fault Low Limit</b>	<b>ID3586</b>

Enter the threshold value for computing the detection level low (load only) and high notification thresholds. Threshold value range varies based on detection level mode selection. This limit is not used when value is zero.

<b>P2.19.2.5.3</b>	<b>Current Unbalance Warning S1 Delay</b>	<b>ID3518</b>
<b>P2.19.2.7.3</b>	<b>Voltage Unbalance Warning S1 Delay</b>	<b>ID3533</b>
<b>P2.19.3.4.3</b>	<b>Vibration Warning S1 Delay</b>	<b>ID3557</b>
<b>P2.19.4.3.4</b>	<b>Load Warning S1 Delay</b>	<b>ID3574</b>
<b>P2.19.2.5.6</b>	<b>Current Unbalance Warning S2 Delay</b>	<b>ID3721</b>
<b>P2.19.2.7.6</b>	<b>Voltage Unbalance Warning S2 Delay</b>	<b>ID3536</b>
<b>P2.19.3.4.6</b>	<b>Vibration Warning S2 Delay</b>	<b>ID3560</b>
<b>P2.19.4.3.8</b>	<b>Load Warning S2 Delay</b>	<b>ID3577</b>
<b>P2.19.2.5.9</b>	<b>Current Unbalance Alarm/fault Delay</b>	<b>ID3521</b>
<b>P2.19.2.7.9</b>	<b>Voltage Unbalance Alarm/fault Delay</b>	<b>ID3536</b>
<b>P2.19.3.4.9</b>	<b>Vibration Alarm/fault Delay</b>	<b>ID3563</b>
<b>P2.19.4.3.12</b>	<b>Load Alarm/fault Delay</b>	<b>ID3580</b>

This parameter can be define how long time the actual value must be above the detection level notification level to trigger the warning or fault. This level is not used when delay is zero.



## 7.20 Keypad control parameters

Unlike the parameters listed above, these parameters are located in the **M3** menu of the control keypad. The reference parameters do not have an ID number.

### **P3.1      Control Place      ID125      “Control Place”**

The active control place can be changed with this parameter.

Pushing the Start button for 3 seconds selects the control keypad as the active control place and copies the Run status information (Run/Stop, direction and reference).

**0** = PC Control, Activated by NCDrive.

**1** = I/O terminal

**2** = Keypad

**3** = Fieldbus

**4** = MF Master

Note that activating PC Control from NCDrive is possible only when drive is in keypad control. Safety feature that process is not stopped accidentally.

### **R3.2      Keypad Reference      No ID      “Keypad Reference”**

The frequency reference can be adjusted from the keypad with this parameter.

### **P3.3      Keypad Direction      ID123      “Keypad Direction”**

**0**      Forward: The rotation of the motor is forward, when the keypad is the active control place.

**1**      Reverse: The rotation of the motor is reversed, when the keypad is the active control place.

### **P3.4      Stop button activated      ID114      “StopButtonActive”**

If you wish to make the Stop button a "hotspot" which always stops the drive regardless of the selected control place, give this parameter the value **1**.

### **R3.5      Torque reference      No ID      “Torque Reference”**

Define here the torque reference within 0.0...100.0%.

### **P3.6      License Key      ID1995      “License Key”**

Enter here the license key for Condition Based Monitoring.

## 8. STATUS AND CONTROL WORD IN DETAIL

Combination	P7.x.1.4 Operate Mode	P2.13.19 State machine	
1	1 / ProfiDrive	1 / Standard	Control and Status Word are explained in fieldbus option board manual
2 Recommended	2 / ByPass Some fieldbus board operate by default in "ByPass" mode	2 / ProfiDrive	<u>Control word</u> is ProfiDrive type and explained in this manual. <u>Status Word</u> is can be selected by ID number, default is ProfiDrive type ID65 V1.25.3 FB Status Word
3	2 / ByPass	1 / Standard	<u>Control word</u> is "Three Bit" control. Status Word. <u>Status Word</u> is can be selected by ID number, default is ProfiDrive type ID65 V1.25.3 FB Status Word
4	1 / ProfiDrive	2 / ProfiDrive	Drive cannot be operated in this combination from fieldbus.

## 8.1 Combination 1, ProfiDrive – Standard with Profibus option board

### 8.1.1 Control Word Combination 1, ProfiDrive – Standard with profibus option board

Main Control Word for Profibus in Combination 1			
	FALSE	TRUE	Comment
b0	STOP 1 (by ramp)	ON 1	Keep this TRUE
b1	STOP 2 (by cost)	ON 2	Keep this TRUE
b2	STOP 3 (by ramp)	ON 3	Keep this TRUE
b3	RUN DISABLE	ENABLE	Use this for start and stop command
b4	No Action	START	Keep this TRUE
b5	No Action	START	Keep this TRUE
b6	No Action	START	Keep this TRUE
b7	No Action	Fault Reset 0 > 1	Use this for fault reset
b8	No Action	No Action	Not used
b9	No Action	No Action	Not used
b10	Disable Profibus control	Enable fieldbus control	See profibus manual
b11	Fieldbus DIN1=OFF	Fieldbus DIN1=ON	See P2.5.1.17 -18
b12	Fieldbus DIN2=OFF	Fieldbus DIN2=ON	See P2.5.1.19 -20
b13	Fieldbus DIN3=OFF	Fieldbus DIN3=ON	See P2.5.1.21 -22
b14	Fieldbus DIN4=OFF	Fieldbus DIN4=ON	See P2.5.1.23 -24
b15	Fieldbus DIN5=OFF	Fieldbus DIN5=ON	Not used

### 8.1.2 Status Word Combination 1, ProfiDrive – Standard with profibus option board

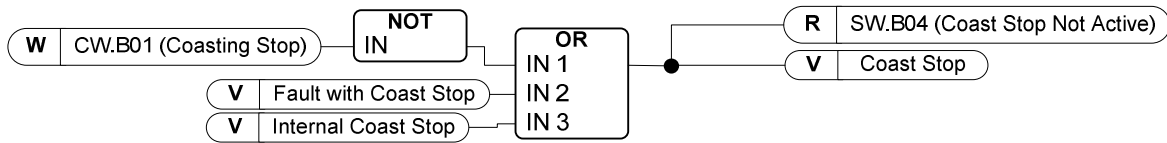
Main Status Word for Profibus in Combination 1			
	FALSE	TRUE	Comment
b0	Not Ready (initial)	READY 1 (SM)	See profibus manual
b1	Not Ready	READY 2 (SM)	See profibus manual
b2	DISABLE	ENABLE (SM)	See profibus manual
b3	NO FAULT	FAULT ACTIVE	Directly from the drive
b4	STOP 2	NO STOP 2 (SM)	See profibus manual
b5	STOP 3	NO STOP 3 (SM)	See profibus manual
b6	START ENABLE	START DISABLE (SM)	See profibus manual
b7	No Warning	Warning	Directly from the drive
b8	Reference ≠ Actual value	Reference = Actual value	
b9	Fielbus control OFF	Fielbus control ON	See profibus manual
b10	Not used	Not used	
b11	Not used	Not used	
b12	FC Stopped	Running	Directly from the drive
b13	FC not ready	Ready	Directly from the drive
b14	Not used	Not used	
b15	Not used	Not used	

SM = Profibus board State Machine

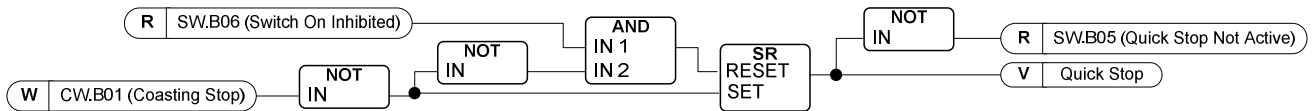


## 8.2.2 State Machine

### 8.2.2.1 Coasting Stop

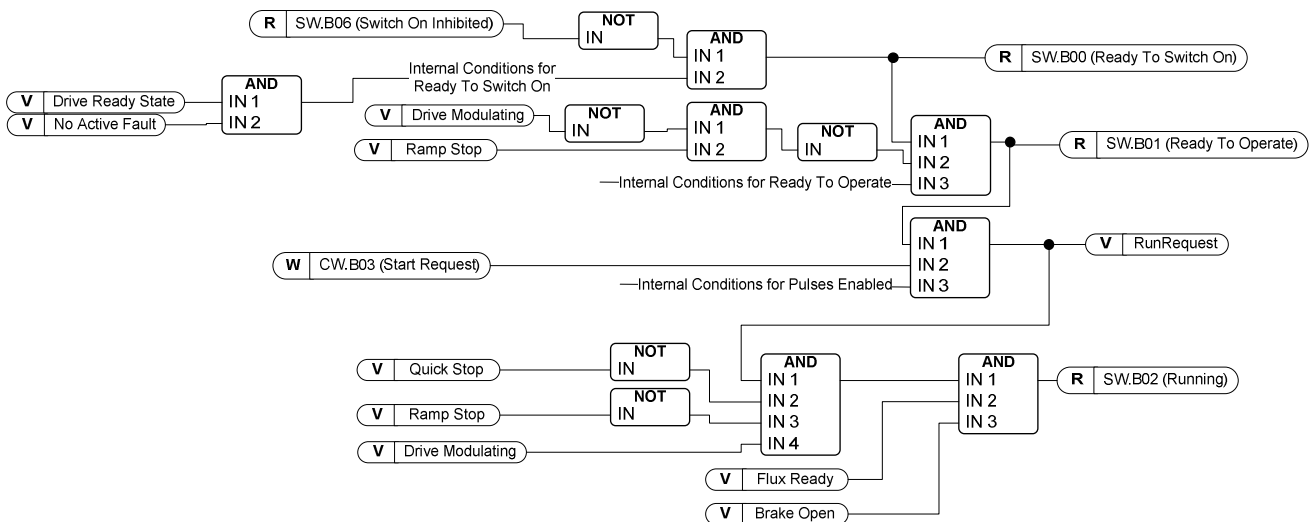


### 8.2.2.2 Quick stop



### 8.2.2.3 Switch On Inhibit

### 8.2.2.4 Ready to Switch-On, Operate and Running



### 8.2.3 FB Control Word

FB Control Word ID1160		
	Signal	Comment
b0	ON	0>1 will reset the Switch On Inhibit state and bring the drive to Ready Run. Should be reset after fault, Coast Stop (b1) and Emergency Stop (b2) .
b1	Coasting Stop	0=Coast stop Active 1=Coast stop NOT active
b2	Quick Stop	0=Quick stop Active 1=Quick stop NOT active
b3	Start	Normal start command 0=Stop the drive 1=Start the drive
b4	Ramp Output to Zero	0=Force speed ramp output to zero 1=Release speed ramp output
b5	Ramp Hold	0=Hold speed ramp output 1=Release speed ramp
b6	Ramp Input to Zero	0=Force speed ramp input to zero 1=Release speed ramp input
b7	Fault Reset	0=No Action 1=Reset active faults
b8	Jogging 1	Run the drive with defined constant speed 0=No Action 1=Run with constant speed
b9	Jogging 2	Run the drive with defined constant speed 0=No Action 1=Run with constant speed
b10	Fieldbus Control Enable	Activate Fieldbus control when P3.1 =3/Fieldbus 0=Fieldbus Control NOT active 1=Activate Fieldbus Control
b11	Watch Dog (FB DIN1)	0>1>0>1...1 sec square wave clock. This is used to check data communication between Profibus master and the drive. Used to generate FB Communication -Fault.
b12	FB DIN 2	
b13	FB DIN 3	
b14	FB DIN 4	
b15	Internal Use	FB Communication fault. Always zero with fast profibus mode.

**B00:** FALSE = OFF 1, TRUE = ON 1

**OFF 1:** Drive will make ramping stop and goes to “Ready to switch-on”. If drive is in “Switch on Inhibit” state this bit is used to reset this status.

**ON:** Voltage connected to drive and/or DC link charged if drive has the control.

**B01:** FALSE = Coast stop (OFF 2), TRUE = ON 2

**Coast Stop:** Drive will make coasting stop and goes to “Switch-on Inhibit” state

**ON 2:** No Coast Stop command

**B02:** FALSE = Quick Stop (OFF 3), TRUE = ON 3

**Quick Stop:** Drive will make stop function defined by Quick Stop function parameter.

**ON 3:** No Quick stop command.

**B03:** FALSE = Stop Request, TRUE = Start Request

**Stop Request:** Drive will make stop defined by stop function.

**Start Request:** Start Command to the drive.

**B04: FALSE = Reset Ramp Generator, TRUE = Enable Ramp Generator**

This bit has priority over B05 and B06 in Control Word.

**Reset Ramp Generator:** Closed Loop: Ramp generator is forced to zero, drive will make stop as fast as possible running against set torque limits or e.g. over voltage controller.

**Enable Ramp Generator:** Ramp Generator function is enabled.

To activate Jogging function from fieldbus B04, B05 and B06 needs to be zero.

**B05: FALSE = Freeze Ramp Generator, TRUE = Unfreeze Ramp Generator**

This bit has priority over B06 but not over B05.

**Freeze Ramp Generator:** Drive will not accept new reference from Fieldbus, drive remain in same speed.

**Unfreeze Ramp Generator:** Drive will follow reference from Fieldbus.

To activate Jogging function from fieldbus B04, B05 and B06 needs to be zero.

**B06: FALSE = Disable Set point, TRUE = Enable Set point**

This bit has lower priority compared to B04 and B05.

**Disable Set point:** Reference (FW:FreqRef1) is forced to zero, drive will ramp to zero speed

**Enable Set point:** Drive will follow reference.

To activate Jogging function from fieldbus B04, B05 and B06 needs to be zero.

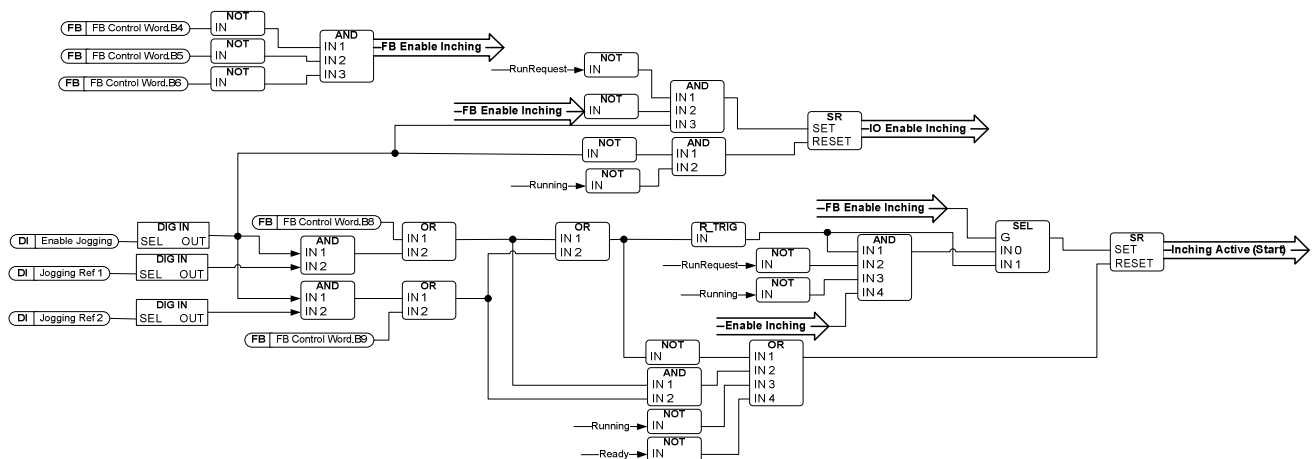
**B07: FALSE = No significance, TRUE = Fault Acknowledge**

**Fault Acknowledge:** The group signal is acknowledged with a positive edge; the drive reaction to a fault depends on the type of fault (refer to "alarm handling in Appendix A.8). If the fault reaction has isolated the voltage, the drive then goes into the "Switching On Inhibited" condition.

#### 8.2.3.1 Jogging function

**I/O Jogging Command:** Jogging function will start the drive to reference without additional start command regardless of control place when given from IO. Jogging function requires enabling from digital input before command is accepted. Inching is also disabled if there is start command active from active control place. If both inching references are active at the same time drive will stop.

**Fieldbus Jogging Command:** Jogging command is activated by CW.B7 or CW.B8 command but the ramp control bits CW.B4, B5 & B6 needs to be zero. Drive needs to be at zero speed before command is accepted and CW.B4, B5 & B6 are active after drive is at zero speed when jogging function is stopped.



B08: FALSE = No Function, TRUE = Jogging 1

**Jogging 1:** Drive follows reference set by Jogging Ref 1. Function needs to separately activated by Aux Control Word or by digital input Enable Jogging when IO control used for Jogging.

B09: FALSE = No Function, TRUE = Jogging 2

**Jogging 2:** Drive follows reference set by Jogging Ref 2. Function needs to separately activated by Aux Control Word or by digital input Enable Jogging when IO control used for Jogging.

B10: FALSE = FB Control disabled TRUE = FB Control Enabled

**FB Control Disabled:** Drive will not follow main control word from Fieldbus. If removed while running drive will make coasting stop.

**FB Control Enabled:** Drive follows control word from fieldbus

B11: FALSE = FB WD Pulse Low, TRUE = FB WD Pulse High

**Watch dog pulse:** This pulse is used to monitor that PLC is alive. If pulse is missing drive will go to fault state. Use 2 Hz signal. This function is activated by P2.12.10.3 FB WD Delay, when parameter is zero pulse is not monitored.



## 8.2.4 FB Status Word

FB Status Word ID65		
	Signal	Comment
b0	Ready to switch On	0=The drive NOT ready to switch ON 1=The drive is ready to switch ON
b1	Ready to Operate	0=The drive is NOT ready to run 1=The drive is ready to run
b2	Running	0=The drive is NOT running 1=The drive is running and ready to release the reference
b3	Fault Active	0=No fault active 1=Fault IS active
b4	Coast Stop NOT active	0=Coast stop active 1=Coast stop NOT active
b5	EM Stop not Active	0=Emergency stop active 1=Emergency stop NOT active
b6	Switch On Inhibit	0=No Inhibit 1=The drive is out of fault and coast / emergency stop state.
b7	Warning	0=NO alarm 1=Alarm IS active
b8	Speed At Ref	0=Speed actual is NOT equal to speed reference 1=Speed actual is equal to speed reference
b9	FB Control Active	0=Fieldbus Control NOT active 1=Fieldbus Control active
b10	Above Limit	Indicate if speed actual is below the limit P2.4.16 0=Speed actual is below the speed limit 1=Speed actual is above the speed limit
b11	SW ID.Bit selection B11	P2.13.22 SW B11 ID.Bit
b12	SW ID.Bit selection B11	P2.13.23 SW B12 ID.Bit
b13	SW ID.Bit selection B11	P2.13.24 SW B13 ID.Bit
b14	SW ID.Bit selection B11	P2.13.25 SW B14 ID.Bit
b15	Watch Dog Feedback	

B00: FALSE = Not Ready to Switch On, TRUE = Ready to Switch On

**Not Ready to Switch On:** Fault Active, Switch On Inhibited.

**Ready to Switch On:** Power supply is switched on, electronics initialized, main contactor, if available, has dropped out, pulses are inhibited.

B01: FALSE = Not Ready To Operate, TRUE = Ready To Operate

**Not Ready To Operate:** Not Ready to Switch On & NOT(CW.B00).

**Ready To Operate:** Ready to Switch On & CW.B00

B02: FALSE = Drive is not operating, TRUE = Drive is operational

**Drive is not operating:** Drive is not run state (not modulating)

**Drive is operational:** Drive is in run state and modulating. Also rotor flux is ready and brake is opened if feedback signal is sued.

B03: FALSE = No Fault, TRUE = Fault Present

**No Fault:** Drive is not on fault state.

**Fault Present:** Drive is in fault state.

B04: FALSE = Coast Stop Activated, TRUE = Coast Stop Not Activated

**Coast Stop Activated:** "Coast Stop (OFF 2)" command is present.

**Coast Stop Not Activated:** Coast stop command is not active.

B05: FALSE = Quick Stop Activated, TRUE = Quick Stop Not Activated

**Quick Stop Activated:** " Quick Stop (OFF 3)" command is present.

**Quick Stop Not Activated:** Quick stop command is not active.

B06: FALSE = Switching On Not Inhibit, TRUE = Switching On Inhibited

**Switching On Not Inhibit:**

**Switching On Inhibited:** The drive goes only again in the "Switched On" condition with "No Coast Stop AND No Quick Stop" followed by "ON". This means that the "Switching On Inhibited" bit is only set back to zero if the OFF command is set after "No Coast Stop AND No Quick Stop".

B07: FALSE = No Warning, TRUE = Warning Present

**No Warning:** There is no warning or the warning has disappeared again.

**Warning Present:** Drive still works; warning in the service/maintenance parameter; no acknowledgement.

B08: FALSE = Speed Error Out Of Tolerance Range, TRUE = Speed Error Within Tolerance Range

**Speed Error Out Of Tolerance Range:**

**Speed Error Within Tolerance Range:**

B09: FALSE = No Control Requested, TRUE = Control Requested

**No Control Requested:** Control by the automation system is not possible, only possible at the device or by another interface.

**Control Requested:** The automation system is requested to assume control.

B10: FALSE = f Or n Not Reached, TRUE = f Or n Reached Or Exceeded

**f Or n Not Reached:** Speed is below P2.6.4.5 Above Speed Limit.

**f Or n Reached Or Exceeded:** Speed is above P2.6.4.5 Above Speed Limit.

B11: FALSE = SW ID.Bit selection B11, TRUE = SW ID.Bit selection B11

**SW ID.Bit selection B11 Low:** Selected bit is low.

**SW ID.Bit selection B11 High:** Selected bit is high.

B12: FALSE = SW ID.Bit selection B12, TRUE = SW ID.Bit selection B12

**SW ID.Bit selection B12 Low:** Selected bit is low.

**SW ID.Bit selection B12 High:** Selected bit is high.

B13: FALSE = SW ID.Bit selection B13, TRUE = SW ID.Bit selection B13

**SW ID.Bit selection B13 Low:** Selected bit is low.

**SW ID.Bit selection B13 High:** Selected bit is high.

B14: FALSE = SW ID.Bit selection B14, TRUE = SW ID.Bit selection B14

**SW ID.Bit selection B14 Low:** Selected bit is low.

**SW ID.Bit selection B14 High:** Selected bit is high.

B15: FALSE = FB DW Feedback Low, TRUE = FB DW Feedback High

**FB DW Feedback:** FB Control Word B11 is echoed back to the Fieldbus. Can be use to monitor communication status from the drive.

### 8.3 Combination 3, ByPass – Standard

#### 8.3.1 FB Control Word Combination 3, ByPass – Standard

FB Control Word for Profibus in Combination 3			
	FALSE	TRUE	Comment
b0	STOP	START	
b1	Clockwise	Counter clockwise	
b2	No action	FAULT RESET (0 -> 1)	
b3	FB DIN 1 = FALSE	FB DIN 1 = TRUE	
b4	FB DIN 2 = FALSE	FB DIN 2 = TRUE	
b5	FB DIN 3 = FALSE	FB DIN 3 = TRUE	
b6	FB DIN 4 = FALSE	FB DIN 4 = TRUE	
b7	FB DIN 5 = FALSE	FB DIN 5 = TRUE	
b8	Not used	Not used	
b9	Not used	Not used	
b10	Not used	Not used	
b11	Not used	Not used	
b12	Not used	Not used	
b13	Not used	Not used	
b14	Not used	Not used	
b15	Not used	Not used	

#### 8.3.2 FB Status Word Combination 3, ByPass – Standard

Most of the field busses use “MCStatus” as Status word that is shown below. For profibus it can be selected what is the status word, default is Combination 2 Status Word, ProfiDrive type ID68 V1.3.2 MainStatusWord. Below Status Word can be selected with P2.10.17 GSW Data by setting it to ID64

FB Status Word for Profibus in Combination 3			
	FALSE	TRUE	Comment
b0	Not Ready	READY	
b1	STOP	RUN	
b2	Clockwise	Counter clockwise	
b3	NO FAULT	FAULT ACTIVE	
b4	No Warning	Warning	
b5	Reference ≠ Actual value	Reference = Actual value	
b6	Speed > Zero	At Zero Speed	
b7	Flux Not Ready	Flux Ready	
b8	TC Speed Limit Active	TC Speed Limit Not Active	
b9	Detected Encoder Direction Clockwise	Encoder Direction Counter clockwise	
b10	UV Fast Stop Active	UV Fast Stop Not Active	
b11	Not used	Not used	
b12	Not used	Not used	
b13	Not used	Not used	
b14	Not used	Not used	
b15	Not used	Not used	

SM = Profibus board State Machine

## 8.4 Aux Control Word

Aux Control Word ID1161		
	Function	Comment
b0	Data logger restart	Reserved
b1	Data logger force trigger	Reserved
b2	Bypass ramp	Reserved
b3	Force reference from I/O Ref 2	Reference is taken from I/O Reference 2
b4	DC Brake In Stop State	
b5	Reserved	Reserved
b6	Reserved	Reserved
b7	Ext brake is forced open	Command to open external brake unconditionally
b8	Force Ramp Out to zero	Reserved
b9	Reset encoder position	
b10	Reserved	Reserved
b11	Reserved	Reserved
b12	Reserved	Reserved
b13	Reserved	Reserved
b14	Reserved	Reserved
b15	Reserved	Reserved

B02: FALSE = Ramp generator used, TRUE = By pass ramp generator

**Ramp Generator Used:** Drive uses its own ramp function. e.g. ramp follower function will bypass ramp function without external control from PLC.

**ByPass Ramp Generator:** Drive's own ramp function are bypassed, this function is available only in closed loop control. For open loop control ramp time can be adjusted short enough.

B03: FALSE = Normal Reference operation, TRUE = Reference forced to I/O Reference 2

**Normal Reference operation:** Normal reference selection parameters are operational.

**Reference forced to I/O Reference 2:** Reference is forced to I/O Reference 2, function is same as P2.4.2.14 I/O Ref 1/2.

B04: FALSE = No Function, TRUE = DC Brake in Stop

**DC Brake in Stop:** Activates DC Brake in Stop state. Same function as P2.4.2.12 DC Brake Command.

B07: FALSE = Drive own brake control, TRUE = Brake is forced open

**Drive own brake control:** Drive's own brake control is active.

**Brake is forced open:** Brake is forced open. This will bypass drive's own brake control and force

B09: FALSE = No Action, TRUE = Reset encoder incremental position

**Reset encoder incremental position:** Monitoring values V1.26.21 Shaft Rounds and V1.26.22 Shaft Angle values are set to zero.

## 8.5 Aux Status Word

Aux Status Word ID1163		
	Function	Comment

b0	Data Logger triggered	
b1	Speed limiter active in torque control	Window control active and speed outside of widow
b2	Motoring or Generator side limits active	
b3	Under or over voltage regulator	
b4	Reversing	
b5	IO Control active	
b6	Reserved	
b7	Brake Open Command	
b8	DC Ready, Pulse	Pulse
b9	Charge SW State	
b10	Drive in torque control mode	
b11	Speed zero	
b12	Reserved	Reserved
b13	Reserved	Reserved
b14	Reserved	Reserved
b15	Reserved	Reserved

B00: FALSE = Data Logger not triggered, TRUE = Data Logger triggered

**Data Logger not triggered:** No new information stored to data logger.

**Data Logger triggered:** Data logger triggered, new data stored to data logger buffer. If single mode trigger has been used this bit is high until data logger is set again. If continues mode bit is high until active fault has been reset.

B01: FALSE = No Function, TRUE = Speed limiter active in torque control

**Speed limiter active in torque control:** Speed limit is reached in torque control. Drive has switched from torque control mode to speed control mode internally because speed is in Speed Control Active area defined in P2.2.9.6 Torque Select.

B02: FALSE = No Function, TRUE = Current Or Torque Limiter

**Current Or Torque Limiter:** Current or torque limiter is active, both motoring side and generator side status are shown.

B03: FALSE = No Function, TRUE = Under or Over voltage regulator

**Under or Over voltage regulator:** Drive over voltage or under voltage regulator is active.

B04: FALSE = Positive direction, TRUE = Negative direction

**Positive direction:** Drive output frequency is positive.

**Negative direction:** Drive output frequency is negative.

B07: FALSE = Drive own brake control, TRUE = Brake is forced open

**Drive own brake control:** Drive own brake control is active.

**Brake is forced open:** Brake is forced open. This will bypass drive own brake control and force

B08: FALSE = DC Not Ready, TRUE = DC Ready Pulse

**DC Ready:** This output will give 2 s pulse when DC is Ready and there is not feedback from main breaker.

B09: FALSE = DC Not Ready, TRUE = DC Ready

**DC Not Ready:** Drive is not ready to be connected to directly to grid.

**DC Ready:** Drive DC link is charged high enough to be connected directly to the grid.

B10: FALSE = Speed Control, TRUE = Torque Control

**Speed Control:** Drive is in speed controlled mode, Drive operation mode may be torque control but speed limits have been reached.

**Torque Control:** Drive is in Torque Controlled mode.

B11: FALSE = Speed Not Zero, TRUE = Speed Zero

**Speed Not Zero:** Speed is above Zero Speed Level

**Speed Zero:** Speed is below Zero Speed Level

## 8.6 Status Word (Application)

Application Status Word combines different drive statuses to one data word.  
Recommended signal for NCDrive monitoring.

	<b>Application Status Word ID43</b>	
	FALSE	TRUE
b0	Flux not ready	Flux ready (>90 %)
b1	Not in Ready state	Ready
b2	Not Running	Running
b3	No Fault	Fault
b4	Direction Forward	Direction Reverse
b5	Emergency Stop Active	Emergency Stop NOT Active
b6	Run Disabled	Run Enable
b7	No Warning	Warning
b8		
b9		
b10		
b11	No DC Brake	DC Brake is active
b12	No Run Request	Run Request
b13	No Limit Controls Active	Limit control Active
b14	External Brake Control OFF	External Brake Control ON
b15		

B00: FALSE = Flux not ready, TRUE = Flux ready

**FALSE:** Rotor flux is below 90 %

**TRUE:** Rotor flux is above 90%.

B01: FALSE = Not in ready state, TRUE = Drive in Ready state

**FALSE:** -Run Enable signal is low

- Drive in fault state

- DC too low

- DC too high

**TRUE:** Drive is in Ready state.

B00: FALSE = , TRUE =

**FALSE:** A

**TRUE:** B.



## 9. IDENTIFICATION FUNCTION FOR PERMANENT MAGNET SYNCHRONOUS MOTOR

PM Motor has several zero positioning identification modes. This chapter explains what kind of identification mode is needed to select when using different kind of hardware configuration.

This chapter is addition to P2.1.9 Identification parameter description and P2.8.5.2 Start Angle Identification mode description.

### 9.1 Zero position identification with absolute encoder.

When using absolute encoder identification is made only once. Remade is needed if encoder and rotor position changes related to each other.

Motor needs to be able to rotate freely that magnet positions can be identified.

Identification mode in this case is selected by "P2.1.9 Identification" selection "3 / Enc.ID Run".

During identification drive feeds DC current to motor (~90 % of motor nominal), this causes motor to move zero position, there may be oscillatory movement on the shaft. When identification is successful "P2.8.5.1 PMSM Shaft Position" is updated, if not successful value is set to zero and identification warning is displayed for 10 seconds (W57). If identification is made several times, result may be different; there are as many positions as there are pole pairs in the motor.

Benefit to use absolute encoder is that magnet position is always known thus motor can be fully loaded from the start.

Related parameters:

P2.1.9	Identification	ID631
P2.8.5.1	PMSM Shaft Position	ID649

### 9.2 Start position with incremental encoder without Z-pulse input.

When using incremental encoder without Z-pulse, no actual identification is made. But start angle is find in every start. Identification mode can be selected by "P2.8.5.2 Start Angle Identification Mode" In this case encoder identification cannot be done because zero position cannot be identified without Z-pulse. But identification P2.1.9 Identification selection "2 / ID With Run" is needed to make. Identification at every start will be automatically active if "P2.8.5.1 PMSM Shaft Position" parameter value is zero.

Best result is get when motor has a mechanical brake that prevents shaft movements. Acceptable result can be achieved also when motor has high load and/or inertia that prevent shaft movements during identification.

Angle identification is done in every start by feeding motor with a DC pulses that identifies magnet position. DC pulses are in two different groups. First one identifies zero position and second one makes polarity check. These DC current levels are adjusted by "P2.8.5.3 Start Angle Identification Current" and "P2.8.5.4 Polarity Pulse current", respectively.

**NOTE:** Not all motors are suitable for this identification mode.

Benefit of this mode is that motor can be fully loaded from the start.

Related parameters:

P2.8.5.2	Start Angle Identification Mode	ID1691
P2.8.5.1	PMSM Shaft Position	ID649
P2.8.5.3	Start Angle Identification Current	ID1759
P2.8.5.4	Polarity Pulse current	ID1566

### 9.3 Identification with incremental encoder with Z-pulse input.

When using incremental encoder with Z-pulse, identification is made only once. Remade is needed if encoder and rotor position changes related to each other.

Motor needs to be able to rotate freely that magnet positions can be identified. Identification mode in this case is selected by "P2.1.9 Identification" selection "3 / Enc.ID Run".

During identification drive feeds DC current to motor (~90 % of motor nominal), this causes motor to move to zero position, there may be oscillatory movement on the shaft. When motor oscillatory movement has stopped motor is rotated until Z-pulse is received from the encoder. When identification is successful "P2.8.5.1 PMSM Shaft Position" is updated, if not successful value is set to zero and identification warning is displayed for 10 seconds (W57). If identification is made several times result may be different, there are as many positions as there are pole pairs in the motor.

When motor is started and zero position is not "remembered": Drive will start to feed DC current to motor (Defined by "P2.8.5.6 I/f Current") till Z-pulse is received from the encoder. During this DC injection motor may not be able to produce 100 % torque. When running without load Z-pulse position can be seen in the motor current when current goes nearly to zero.

Related parameters:

P2.1.9 Identification

P2.8.5.1 PMSM Shaft Position

P2.8.5.6 I/f Current

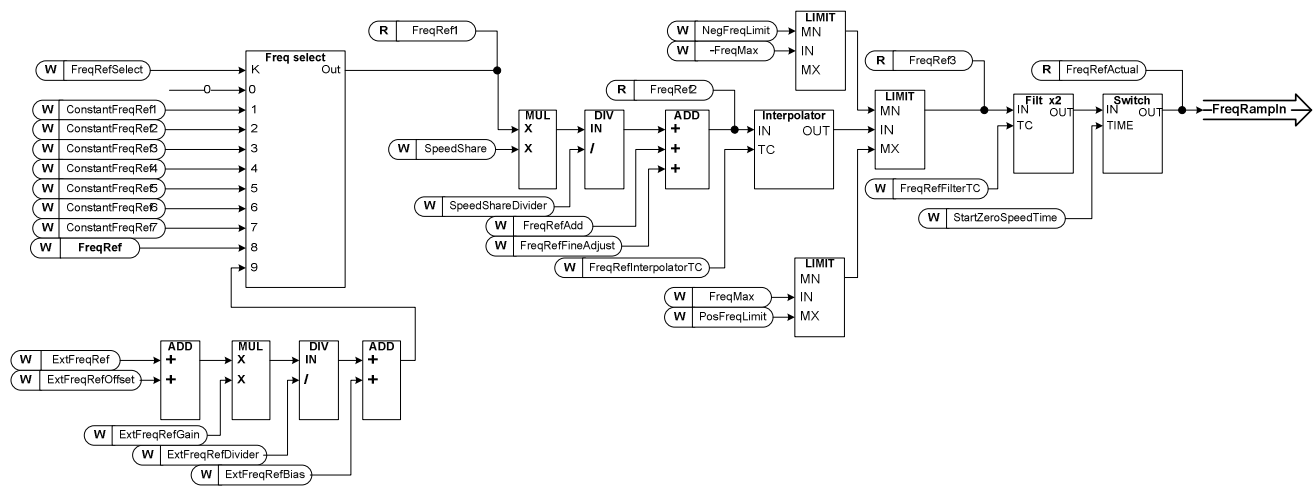
## 10. MONITORING SIGNAL FOR DIFFERENT PURPOSES

### 10.1 Signals for basic monitoring

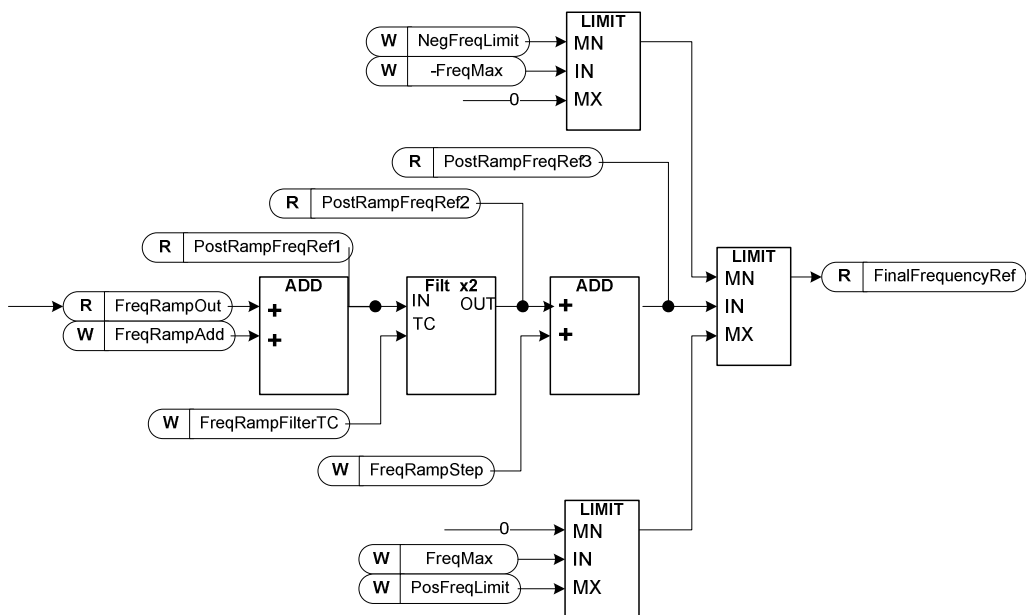
Type	Signal Name	Actual	Unit	Min	
Value	Status Word	20583			65E
Value	Torque	17,6			00
Value	Current	900			12
Value	FreqReference	12,3			5,1
Value	DC Voltage	562	V	0,0	100
Value	Output Frequency	12,3	Hz	-55,00	55,1
Value	Encoder 1 freq	12,1	Hz	-55,00	55,1
Value	Motor Voltage	57,1	V	0,0	100

## 10.2 Firmware Reference Chain

### 10.2.1 Reference chain before ramp generator.



### 10.2.2 Reference chain after ramp generator.



The block diagram illustrates a speed control system. It starts with inputs  $W$  LoadDrooping,  $R$  FinalFrequencyRef,  $R$  DroopFrequency,  $W$  EncoderFrequency, and  $W$  EncoderInitTime. These inputs feed into a series of processing blocks:  $MUL$ ,  $SUB$ ,  $Filter$  (with  $TC$ ),  $BAND STOP$  (with  $IN$  and  $OUT$  for StopFreq), and a  $Speed\ controller$  block containing "Normal gain", "Gain selection", and "Initialization". The output of the speed controller goes to a  $LIMIT$  block (with  $MN$  and  $IN$  for  $MX$ ). This is followed by an  $ADD$  block and another  $LIMIT$  block (with  $MN$  and  $IN$  for  $MX$ ). The final output is  $IqReferenceActual$ . Feedback paths include  $R$  NegTorqueLim,  $W$  RotorFlux,  $W$  PosTorqueLim,  $W$  RotorFlux,  $R$  NegCurrentLimitActual,  $R$  PosCurrentLimitActual, and  $R$  RotorFlux, which feed into various blocks like  $ADD$ ,  $LIMIT$ , and  $MN$  IN  $MX$ . The system also includes a  $Filter$  block for  $EncoderFrequency$  and  $EncoderInitTime$ , and a  $BAND STOP$  block for  $StopFreq$ .

```

graph LR
    FreqRampOut["R FreqRampOut"] --> ddt["d/dt"]
    FrequencyDelta["R FrequencyDelta"] --> ddt
    ddt --> MUL["MUL"]
    AccelCompensationTC["W AccelCompensationTC"] --> MUL
    MUL --> Filter["Filter"]
    AccelCompensationTC --> Filter
    Filter --> AccelCompensation["R AccelCompensation"]
  
```

## 11. DATA LOGGER TRIGGER WORD

There is a special trigger word in application level that can be used to trigger data logger. This word can be used for triggering when source is selected from Application and original Vacon SIA application vcn is used. Variable is called "DataLoggerTrigWord"

	<b>DataLoggerTrigWord</b>	
	Function	Comment
b0	Fault Status	Logger is triggered when there is a fault
b1	Warning Status	Logger is triggered when there is a warning
b2	Auto Reset Warning	Logger is triggered when there is a fault that has been defined to be automatically reset. This bit can be used to get the first fault situation.
b3	Fault Status OR Warning Status	B0 OR B1 triggering situation has happened
b4	Fault Status OR Auto Reset Warning	B0 OR B2 triggering situation has happened
b5		
b6		
b7		
b8		
b9		
b10		
b11		
b12		
b13		
b14		
b15		

## 12. PROBLEM SOLVING

While proper information is needed from the problem, it's also recommended to try with latest application- and system software versions available. Software is continuously developed and default settings are improved.

Type	Signal Name	Actual	Unit	Min	Max
Value	Status Word	20583			65535
Value	Torque	17,6			100
Value	Current	900			1200
Value	FreqReference	12,3			50
Value	DC Voltage	562	V	0	1000
Value	Output Frequency	12,3	Hz	-55,00	55,00
Value	Encoder 1 freq	12,1	Hz	-55,00	55,00
Value	Motor Voltage	57,1	V	0,0	1000

Figure 1. The recommended signals for NCDriver

Use the fastest communication speed (Baudrate: 57 600) and a 50 ms update interval for signals for the RS232 communication.

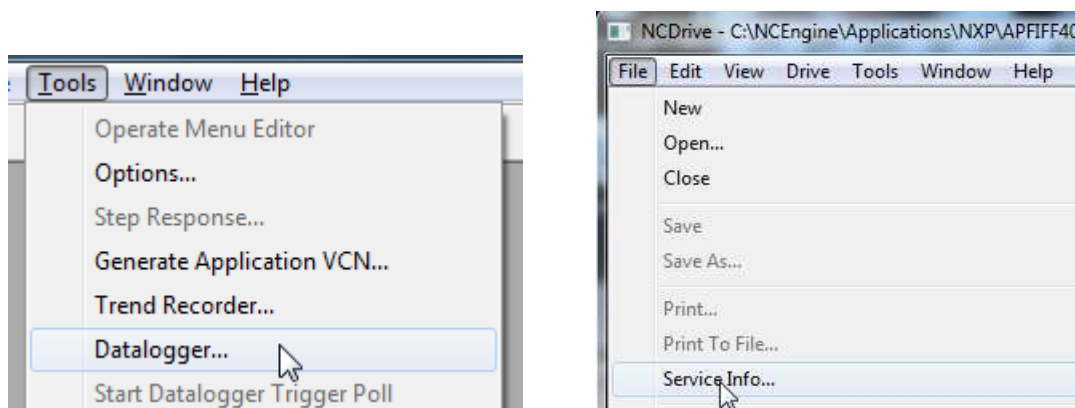
For the CAN communication, use a 1 Mbit communication speed and 7 ms update interval for signals.

When you contact the support, send the \*.trn, \*.par and Service info (\*.txt) files with a description of the situation. If the situation is caused by a fault, take also the Datalogger data from the drive.

Note that Datalogger settings can be changed to catch correct situation and it's also possible to make manual force trig for Datalogger.

Before storing the parameter file, upload the parameters from the drive and save when NCDriver is in the ON-LINE state. If it is possible, do this while the problem is active.

It's also helpful to have single line diagram from the system where problem is faced.



## 13. FAULT CODES

### **F1      *Overcurrent fault***

Drive has detected a high current in the output phase.

**S1 = Hardware trip:** Current above 4\*I<sub>h</sub>

**S2 = Only in NXS unit**

**S3 = Current controller supervision.** Current limit too low or current peak value too high.

#### **Possible cause and solutions**

1. Sudden increase in load
  - Check motor load.
2. Short circuit in motor cables
  - Check motor and cables.
3. Motor is under magnetized at start.
  - Make identification run
4. Unsuitable motor
5. Sine filter is used but drive settings are not correct
  - Activate Sine filter parameter (P6.7.5) in system menu

### **F2      *Overvoltage fault***

DC-link voltage has exceeded the drive protection limits.

**S1 = Hardware trip.**

500 Vac unit DC voltage above 911 Vdc

690 Vac unit DC voltage above 1200 Vdc

**S2 = Overvoltage control supervision (only 690 Vac unit).**

DC voltage has been above 1100 Vdc for too long.

#### **Possible cause and solutions**

1. Too short a deceleration time
  - Increase deceleration time.
  - Use brake chopper and brake resistor.
  - Use Brake chopper unit.
  - Use active front end unit (AFE ARFIF02).
  - Activate overvoltage controller.
2. High overvoltage spikes in supply
  - Activate overvoltage controller.
3. 690 V unit operating too long above 1100 Vdc
  - Check input voltage.

### **F3      *Earth fault***



Earth fault protection ensures that the sum of the motor phase currents is zero. The overcurrent protection is always working and protects the frequency converter from earth faults with high currents.

**S1 = Sum of motor current is not zero**

**Possible cause and solutions**

1. Insulation failure in cables or motor
  - Check motor cables and motor.

**F5      *Charge switch***

Charge switch status is not correct when start command is given.

**S1 = Charge switch was open when START command was given.**

**Possible cause and solutions**

1. Charge switch was open when the START command was given.
  - Check connection of the feedback from charging relay
  - Reset the fault and restart.

Should the fault re-occur, contact your local distributor.

**F6      *Emergency stop***

Emergency stop command has been given by using a special option board.

**F7      *Saturation fault***

**S1 = Hardware failure**

**Possible cause and solutions**

1. If there is a brake chopper in use
  - Check the isolation resistance and the resistance on the brake resistor.
2. FR4-FR8: Power module
  - Measure the power module directly from its terminals.
3. Hardware
  - Check the capacitors.

**F8 System Fault**

A system fault indicates several different fault situations in drive operation.

**S1 = Feedback fault**

- Disturbance. Reset the unit and try again.
- If there is star coupler in the unit, check the fibre connections and phase order.
- Driver board or IGBT broken.
- FR9 and the bigger size drives, which includes not star coupler, ASIC board (VB00451) is broken.
- FR8 and smaller size drives: control board broken.
- FR8 and smaller size drives: if there is boards VB00449 / VB00450 in use, failure might be in there.

**S7 = Charge switch****S8 = No power to driver card****S9 = Power unit communication (TX)****S10 = Power unit communication (Trip)****S11 = Power unit comm. (Measurement)****S12 = SystemBus synchronization has failed in DriveSynch operation****S30 = Safe disable inputs are in different state (OPT-AF)****S31 = Thermistor short circuit detected (OPT-AF)****S32 = OPT-AF board has been removed****S33 = OPT-AF board EEPROM error****S34-36 = OPT-AF supply voltage hardware problem detected.****S37-40 = Single hardware problem detected in STO inputs.****S41-43 = Single hardware problem detected in the thermistor input.****S44-46 = Single hardware problem detected in STO inputs or in the thermistor input.****S47 = OPT-AF board mounted in old NXP control board.****S48 = Parameter Expander boards/SlotB/Therm Trip(HW) is set to OFF even if the jumper wire X12 is not cut.****S49 = OPT-AF board mounted in NXS control board.****F9 Undervoltage fault**

DC-link voltage is below the fault voltage limit of the drive.

**S1 = DC-link too low during run****S2 = No data from power unit****S3 = Under voltage controller has been active and speed is ramped to zero with ramp time 2.**

Possible cause

1. Too low a supply voltage
2. Frequency converter internal fault
3. One of the input fuses is broken.
4. External charge switch has not been closed.

Correcting measures

- In case of temporary supply voltage break, reset the fault and restart the frequency converter.
- Check supply voltage.
- Check function of DC charge.
- Contact your local distributor.

**F10 Input line supervision****S1 = Phase supervision diode supply**

**S2 = Phase supervision active front end**

Possible cause:

1. Input line phase is missing.

Correcting measures

- Check supply voltage, fuses and cable.

**F11 Output phase supervision**

Current measurement has detected that there is no current in one phase or one phase current is considerably different from other phases.

Correcting measures

- Check motor cable and motor.

**F12 Brake chopper supervision**

Brake chopper supervision generates pulses to the brake resistor for response. If no response is received within set limits a fault is generated.

Possible cause:

1. No brake resistor installed.
2. Brake resistor is broken.
3. Brake chopper failure.

Correcting measures:

- Check brake resistor and cabling.
- If these are ok the chopper is faulty. Contact your local distributor.

**F13 Drive undertemperature fault**

Possible cause:

1. Heatsink temperature is under  $-10^{\circ}\text{C}$

**F14 Drive overtemperature fault**

Possible cause:

1. Heatsink temperature is over acceptable limits. See user's manual for the temperature limit. Overtemperature warning is issued before actual trip limit is reached.

Correcting measures

- Check correct amount and flow of cooling air.
- Check the heatsink for dust.
- Check ambient temperature.
- Make sure that switching frequency is not too high in relation to ambient temperature and motor load.

**F15 Motor Stalled**

The motor stall protection protects the motor from short time overload situations such as one caused by a stalled shaft. The reaction time of the stall protection can be set shorter than that of motor thermal protection. The stall state is defined with two parameters, Stall current and Stall frequency limit. If the

current is higher than the set limit and output frequency is lower than the set limit the stall state is true. There is actually no real indication of the shaft rotation. Stall protection is a type of over current protection.

- Check motor and load.

### **F16 Motor over temperature**

Motor overheating has been detected by frequency converter motor temperature model. Motor is overloaded.

Possible cause:

1. Motor load is too high.
2. Motor values are set incorrectly.

Correcting measures:

- Decrease motor load.
- If no motor overload exists, check the temperature model parameters.

### **F17 Motor underload fault**

The purpose of the motor underload protection is to ensure that there is load on the motor when the drive is running. If the motor loses its load there might be a problem in the process, e.g. a broken belt or a dry pump.

The underload curve is a squared curve set between the zero frequency and the field weakening point. The protection is not active below 5Hz (the underload time counter is stopped).

The torque values for setting the underload curve are set in percentage which refers to the nominal torque of the motor. The motor's name plate data, parameter motor nominal current and the drive's nominal current  $I_H$  are used to find the scaling ratio for the internal torque value..

Correcting measures:

- Check load.

**F22    *EEPROM checksum fault***

Possible cause:

1. Parameter save fault
2. Faulty operation
3. Component failure

Correcting measures:

- Should the fault re-occur, contact your local distributor.

**F24    *Counter fault***

Possible cause:

1. Values displayed on counters are incorrect

Correcting measures:

- Have a critical attitude towards values shown on counters.

**F25    *Microprocessor watchdog fault***

Possible cause:

1. Start-up of the drive has been prevented.
2. Run request is ON when a new application is loaded to the drive.

Correcting measures:

- Reset the fault and restart.
- Should the fault re-occur, contact your local distributor.

**F26    *Start-Up prevention***

Possible cause:

1. Start-up of the drive has been prevented.
2. Run request is ON when a new application is loaded to drive

Correcting measures:

- Cancel prevention of start-up if this can be done safely.
- Remove Run Request.

**F29    *Thermistor fault***

The thermistor input of the option board has detected too high a motor temperature.

Possible cause:

1. Motor is overheated.
2. Thermistor cable is broken.

Correcting measures:

- Check motor cooling and load
- Check thermistor connection (If thermistor input of the option board is not in use it has to be short circuited).

**F31 IGBT temperature Hardware**

IGBT Inverter Bridge over temperature protection has detected too high a short term overload current.

Possible cause:

1. Too high load
2. Identification run has not been made which causes the motor to start undermagnetized.

Correcting measures:

- Check load.
- Check motor size.
- Make identification Run.

**F32 Fan cooling**

Possible cause:

1. Cooling fan of the frequency converter does not start when ON command is given.

Correcting measures:

- Contact your local distributor.

**F37 Device change**

Option board or power unit changed.

Possible cause:

1. New device of same type and rating.

Correcting measures:

- Reset. Device is ready for use.

**F38 Device added**

Option board added.

Correcting measures:

- Reset. Device is ready for use. Old board settings will be used.

**F39 Device removed**

Option board removed.

Correcting measures:

- Reset. Device no longer available.

**F40 Device unknown**

Unknown option board or drive.

**S1 = Unknown device**

**S2 = Power1 not same type as Power2**

Correcting measures:

- Contact the distributor near to you.

**F41 IGBT temperature Software**

IGBT inverter bridge overtemperature protection has detected too high a short term overload current.

- Check load.
- Check motor size.
- Make Identification run.

**F42 Brake resistor overtemperature**

**S1: Brake resistor high temperature**

Calculation for internal brake resistor has exceeded the tripping limit. If the internal brake resistor is not in use set the brake chopper parameter in System menu to 'Not connected'.

**S2: Brake resistor resistance is too high**

**S3: Brake resistor resistance is too low**

**S4: No brake resistor detected**

**F43 Encoder fault**

Encoder fault is issued when the drive is not able to operate in closed loop control mode (encoder is used). See subcodes for details for the reason of the fault:

**S1** = Encoder 1 channel A is missing

**S2** = Encoder 1 channel B is missing

**S3** = Both encoder 1 channels are missing

**S4** = Encoder reversed

**S5** = Encoder board missing

**S6** = Serial communication fault

**S7** = Ch A / Ch B Mismatch

**S8** = Resolver/Motor pole pair mismatch

**S9** = Missed Start Angle

**S10** = Sin/Cos encoder feedback is missing.

**S11** = Encoder angle is drifting fault.

**S12** = Dual speed supervision fault

**S13** = Encoder angle supervision fault

**S14** = Encoder estimated missing pulse fault, switch from the CL ctrl to the OL sensorless ctrl.

1. Modulation type is ASIC while incremental encoder is used.
  - Change modulator type to Software 1
2. Start identification do not work due low identification current
  - Increase identification current
3. Start angle identification is not working at all because there is no saturation based saliency in the motor
  - Use absolute encoder

4. There are too much noise pick-ups in encoder cable
  - check encoder cable shield and grounding in drive

**F44    *Device changed (Default param.)***

Possible cause:

1. Option board or power unit changed.
2. New device of different type or different rating from the previous one.

Correcting measures:

- Reset
- Set the option board parameters again if option board was changed. Set converter parameters again if power unit was changed.

**F45    *Device added (default param.)***

Possible cause:

1. Option board of different type added.

Correcting measures:

- Reset
- Set the option board parameters again.

**F50    *4mA supervision***

Possible cause:

1. Current at the analogue input is below 4mA.
2. Signal source has failed
3. Control cable is broken or loose

Correcting measures:

- Check the current loop circuitry.

**F51    *External fault 1***

Possible cause:

1. Digital input fault.

Correcting measures:

- Remove fault situation from external device.

**F52    *Keypad communication***

Possible cause:

1. The connection between the control keypad or NCDrive and the AC drive is broken.

Correcting measures:

- Check keypad connection and possible keypad cable.

**F53    *Fieldbus communication***

Possible cause:

1. The data connection between the fieldbus Master and the fieldbus board is broken.

Correcting measures:



- Check installation.
- If installation is correct contact the nearest Vacon distributor.

**F54 Slot fault**

Possible cause:

1. Defective option board or slot
2. High system load

Correcting measures:

- Check board and slot.
- Contact the nearest Vacon distributor.

**F55 SystemBus communication**

The master drive sends pulses to all follower drives. If the pulses are missing a system bus communication fault is generated. The master drive also receives pulses back from the follower drives (max. four drives) and generates warnings if pulses are missing.

SystemBus communication is broken between master and follower.

Correcting measures:

- Check expander board parameters.
- Check optical fibre.
- Check option board jumpers.

**F56 PT100 temperature fault**

PT100 protection function is used to measure temperature and give warning and/or fault when set limits are exceeded. System Interface application supports two PT100 boards. One can be used for the motor winding and the other for the motor bearings.

Possible cause:

1. Temperature limit values set for the PT100 board parameters have been exceeded

Correcting measures:

- Find the cause of temperature rise

**F57 Identification**

Identification run has failed.

- A1 = Current measurement offset**
- A2 = Identification current level**
- A3 = Acceleration time too long**
- A4 = Identification frequency reference not reached**
- A5 = Too low or high magnetization current**
- A6 = Flux curve outside expected levels**
- A7 = PMSM, Encoder zero position**
- A8 = Too low maximum frequency limit**
- A9 = PMSM, encoder zero pulse not found.**
- A10 = Ls Identification timeout**
- A11 = Ls Identification current**

Possible cause:

1. There was load on the motor shaft when making the identification run with rotating motor.
2. Motoring or generator side torque/power limits are too low to achieve a stable run.
3. Too low torque, current or power limit
4. Too long acceleration time.

Correcting measures:

- Run command was removed before identification was ready
- Motor is not connected to the AC drive.
- There is load on the motor shaft.
- Set limiting parameters 100 % or above
- Set acceleration time smaller than 20 s.
- In some cases, leveraging the DC-Link voltage may help, for example, by stopping AFE boosting.

**F58 Mechanical brake**

This fault is generated when the acknowledge signal from the brake is used. If the status of the signal is opposite from the control signal for a longer period of time than the delay defined with P2.15.11 *Brake Fault Delay* a fault is generated.

Correcting measures:

- Check the condition and connections of mechanical brake.

**F59 Fan Cooling**

This fault is generated when FAN feedback signal is used. If feedback is opposite more than a six second warning is generated

**F60 Cooling**

Protection for the liquid-cooled units. An external sensor is connected to the drive (DI: Cooling Monitor) to indicate if cooling liquid is circulating. If the drive is in Stop state only a warning is issued. In Run state a fault is issued and the drive makes a coast stop.

Possible cause:

1. Liquid cooled drive cooling circulation have been failed

Correcting measures:

- Check reason for cooling failure from external system.

**F61 Speed Error**

Speed error monitoring function compares the encoder frequency and the ramp generator output. This function is used with PMS motors to detect if the motor is out of synchronization or to disable open loop function that uses encoder speed for slip compensation. The slip compensation is disabled regardless of the response and needs to be re-activated once speed error is detected (set parameter again or power down the drive).

Possible cause:

1. Motor speed is not the same as the reference. For example, motor speed is limited by torque limit.
2. PMS motor has gone off synchronization.
3. Encoder cable is broken.

**F62 Run Disabled**

Run Disable warning signal is issued when Run Enable signal has been removed from the IO.

**F63 Quick stop**

Quick stop command has been given to the drive.

Possible cause:

1. A command has been given from a digital input or the fieldbus to make an emergency stop.

Correcting measures:

- New run command is accepted after the emergency stop is reset.

**F64 Input switch open**

This fault is given when input switch feedback signal is used. Default in DIN5.

Possible cause:

1. The drive main power is switched off and DIN5 is inactive/low.

Correcting measures:

- Check the main power switch of the drive.

**F65 PT100 board 2**

PT100 protection function is used to measure temperature and give a warning and/or a fault when the set limits are exceeded. System Interface application supports two PT100 boards. One can be used for the motor winding and the other for the motor bearings.

Possible cause:

1. Temperature limit values set for the PT100 board parameters have been exceeded.
2. The number of inputs selected is higher than what is actually connected.
3. PT100 cable is broken

**F72 License**

Licence has not been given or licence key is wrong

**F74 Follower fault**

When using the normal master follower function this fault code is given if one or more follower drives trip to fault. When this fault occurs, master drive sends a command to all drives to trig the data logger.

Correcting measures:

- See what fault is active in the follower drives.

- Check also master drive fault history.

### **F75    *Drive Synch follower***

In DriveSynch mode the Master drive has detected a fault in one or more follower drives. When this fault occurs, master drive sends a command to all drives to trig the data logger.

Correcting measures:

- See what fault is active in the follower drives.
- Check also master drive fault history.

### **F81    *External Fault 2***

Signal from external source has indicated fault situation. Indication to drive is given by digital input.

Correcting measures:

- Remove fault situation from external device.

### **F82    *DDO Feed Back***

Feedback function of delayed digital output has detected that feedback has not been received within 3 seconds. This is always a warning.

Possible cause:

1. Controlled system do not send feedback signal

Correcting measures:

- Check reason for missing feedback signal.

### **F83    *Signal Monitoring Fault***

Signal monitoring is used to monitor any signal selectable by ID number for low and high situation

Possible cause:

1. Signal has exceeded set limits

Correcting measures:

- See reason of monitored signal behaviour.

### **F84    *Speed Protection***

Motor speed has exceeded min or max speed limit by 120 rpm.

Possible cause:

1. Torque Step is too high for the current load.
2. Acceleration compensation has wrong settings.

### **F85    *Baseline Run***

Baseline run has failed.

**A1:**

Possible cause: There was a failure during the baseline run.

**A2:**

Online run interrupted before completion.

Correcting measures:

- Restart baseline run

**F86 Condition Based Monitoring**

Current or voltage unbalance has exceeded the detection high limit.

Vibration has exceeded the detection high limit.

Load outside of the window limits

**A1 = Motor Stator Winding Current Fault**

**A2 = Motor Stator Winding Voltage Fault**

**A3 = Motor Stator Winding Current Warning S2**

**A4 = Motor Stator Winding Voltage Warning S2**

**A5 = Motor Stator Winding Current Warning S1**

**A6 = Motor Stator Winding Voltage Warning S1**

**A7 = Vibration Fault**

**A8 = Vibration Warning S2**

**A9 = Vibration Warning S1**

**A10 = Load Fault**

**A11 = Load Warning S2**

**A12 = Load Warning S1**

**F87 Zeros in baseline**

Zeros in baseline measurement data detected after baseline run completed.

Correcting measures:

- Check baseline data arrays and use modified point activation to correct data arrays or run new baseline.

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