

HDT brushless servodrives
DGM series

Profibus Manual



High Digital Technology

Version 1.0

Rev. date 14 October 2009

Main Index

1 Introduction to Profibus	7
1.1 Introduction.....	7
2 Profibus Control.....	8
1.2 DGM parameters for Profibus protocol setting.....	8
2.2 GSD file.....	9
2.3 Communication Parameter Codes.....	9
3 PPO2 Cyclic Data.....	10
3.1 PPO2 type data structure.....	10
3.2 PKW structure.....	10
3.3 PKW communication.....	11
3.4 PZD process data.....	13
3.4.1 PZD data in control of digital speed.....	14
3.4.2 PZD data in positioner control.....	15
3.4.3 PZD data in analogue speed control.....	16
3.4.4 PZD data in digital torque control.....	17
3.4.5 PZD data in analogue torque control.....	18
4 Drive control structure	19
4.1 State machine	19
4.2 Control variables.....	21
4.3 Control word – PNU 967.....	22
4.3.1 Control word bits 0..3	23
4.3.2 Control word bits 4,5,6,8,9,11,12,13,14,15.....	24
4.4 Status word – PNU 967.....	24
4.4.1 Status Word bits 8,10,11,12,13,14,15.....	26
4.5 Operation mode - PNU 830.....	27
4.6 Alarm datum – PNU 12.....	28
4.7 Communication error mode – PNU 15.....	29
4.8 Remote control OFF mode – PNU 16.....	29
4.9 Communication error deceleration – PNU 18.....	29
4.10 Deceleration remote control OFF – PNU 19.....	30
4.11 Deceleration OFF1 – PNU 20.....	30
4.12 Deceleration quick stop – PNU 21.....	30
4.13 Deceleration operational – PNU 22.....	30
4.14 Deceleration positioner – PNU 23.....	31
4.15 Current limit – PNU 30.....	31
4.16 Null speed window – PNU 31.....	31
4.17 Null speed time – PNU 32.....	31
4.18 Measured value averages – PNU 39.....	32
4.19 Kp speed regulator – PNU 40.....	32
4.20 Ki speed regulator – PNU 41.....	32
4.21 Kp position regulator – PNU 42.....	32
4.22 Speed reference window – PNU 64.....	33
4.23 Speed reference time – PNU 64.....	33
4.24 Node address – PNU 918.....	33
4.25 Telegram selection – PNU 922.....	33
4.26 Device Identification – PNU 964.....	34

4.27 Profile number – PNU 965.....	34
5 Inputs - Outputs.....	35
5.1 Digital inputs – PNU 200.....	36
5.2 Digital outputs - PNU 201.....	37
5.3 Input output settings – PNU 202.....	37
5.4 Digital outputs - PNU 210.....	38
6 Digital speed control.....	39
6.1.1 Setting the control word bit in digital speed.....	40
6.1.2 Setting the control word status bit in digital speed.....	41
6.2 Speed reference – PNU 60.....	42
6.3 Measured Speed – PNU 61.....	42
6.4 Digital speed acceleration – PNU 62.....	43
6.5 Digital speed deceleration – PNU 63.....	43
7 Positioner control.....	44
7.1 Setting the positioner control word bit.....	46
7.2 Setting the positioner status word bit.....	47
7.3 Positioner.....	49
7.3.1 Position reference – PNU 80.....	49
7.3.2 Position speed – PNU 81.....	49
7.3.3 Position acceleration – PNU 82.....	49
7.3.4 Position deceleration – PNU 83.....	49
7.3.5 Position Jerk – PNU 84.....	49
7.3.6 Position profile type – PNU 85	50
7.3.6.1 Start position management.....	50
7.3.7 Drive reference position – PNU 86.....	51
7.3.8 Position memory – PNU 87.....	51
7.3.9 Measured position – PNU 88.....	51
7.3.10 Position error – PNU 90.....	51
7.3.11 Position error time – PNU 91.....	52
7.4 Jog.....	53
7.4.1 Jog 1 speed – PNU 92.....	53
7.4.2 Jog 2 speed – PNU 93.....	53
7.4.3 Jog acceleration – PNU 94.....	53
7.4.4 Jog deceleration – PNU 95.....	53
7.5 Home Position.....	54
7.5.1 Home position method – PNU 120.....	54
7.5.1.1 Method 0 - No homing operation required.....	55
7.5.1.2 Method 1 - Homing on the negative limit switch and index pulse.....	55
7.5.1.3 Method 2 - Homing on the positive limit switch and index pulse.....	55
7.5.1.4 Method 3 - Homing on the positive home switch and index pulse.....	56
7.5.1.5 Method 4 - Homing on the positive home switch and index pulse.....	56
7.5.1.6 Method 5 - Homing on the negative home switch and index pulse.....	57
7.5.1.7 Method 6 - Homing on the negative home switch and index pulse.....	57
7.5.1.8 Method 7 - Homing on the home switch and index pulse.....	58
7.5.1.9 Method 8 - Homing on the home switch and index pulse.....	58
7.5.1.10 Method 9 - Homing on the home switch and index pulse.....	58
7.5.1.12 Method 11 - Homing on the home switch and index pulse.....	59
7.5.1.13 Method 12 - Homing on the home switch and index pulse.....	59
7.5.1.14 Method 13 - Homing on the home switch and index pulse.....	59
7.5.1.15 Method 14 - Homing on the home switch and index pulse.....	60

7.5.1.16 Methods from 17 to 30.....	60
7.5.1.17 Method 33 - Homing on index pulse (negative direction).....	61
7.5.1.18 Method 34 - Homing on index pulse (positive direction).....	61
7.5.1.19 Method 35 - Homing on the current position.....	62
7.5.2 Sensor search speed – PNU 121.....	62
7.5.3 Sensor output speed – PNU 122.....	62
7.5.4 Home position acceleration – PNU 123.....	62
7.6 Limit switch for home position procedure.....	62
8 Analogue speed control.....	64
8.2 Setting the control word in analogue speed bit.....	65
8.3 Setting the status word bit in analogue speed.....	66
8.4 Speed reference – PNU 140.....	67
8.5 Analogue speed acceleration – PNU 141.....	67
8.6 Analogue speed deceleration – PNU 142.....	68
9 Digital torque control.....	69
9.1 Setting the control word bit in digital torque.....	70
9.2 Digital torque status word bit setting.....	70
9.3 Digital torque reference – PNU 160.....	71
9.4 Measured torque percentage – PNU 162.....	71
10 Analogue torque control.....	72
10.1 Setting the control word bit in analogue torque.....	73
10.2 Setting the status word bit in analogue speed.....	73
10.3 Analogue torque bottom scale – PNU 161.....	74

Tables Index

Table 1: BaudRate.....	8
Table 2: Variable Type Abbreviations.....	9
Table 3: Variable attributes	9
Table 4: AK reading/writing code.....	11
Table 5: Error code with AK=7, 8.....	12
Table 6: Parameter values at address 930.....	13
Table 7: PZD digital speed control master.....	14
Table 8: PZD digital speed slave.....	14
Table 9: PZD Master (positioner).....	15
Table 10: PZD Slave (positioner).....	15
Table 11: PZD Master (analogue speed).....	16
Table 12: PZD Slave (Analogue speed).....	16
Table 13: PZD digital torque control master.....	17
Table 14: PZD digital torque control slave.....	17
Table 15: PZD Analogue torque control master.....	18
Table 16: PZD analogue torque control slave.....	18
Table 17: State description (State Machine).....	19
Table 18: Control parameters.....	21
Table 19: Control word bit description, common bits for all operation modes.....	23
Table 20: State machine transition.....	23
Table 21: Control word – operative mode bit.....	24
Table 22: Status word.....	26

Table 23: controlword – operation mode bit.....	26
Table 24: Operation mode.....	27
Table 25: DGM alarm bit	28
Table 26: Communication error mode.....	29
Table 27: Emergency mode.....	29
Table 28: Measured value averages.....	32
Table 29: Measured value averages.....	35
Table 30: DGM Drive inputs.....	36
Table 31: DGM Drive outputs.....	37
Table 32: Input output setting.....	38
Table 33: Digital speed control parameters.....	39
Table 34: Digital speed control word bit	40
Table 35: status word digital speed.....	42
Table 36: Positioner control parameters.....	44
Table 37: Jog parameters.....	45
Table 38: Home position parameters.....	45
Table 39: Control word bit in positioner	47
Table 40: Status word positioner.....	48
Table 41: Position profile type setting.....	50
Table 42: Home position methods.....	54
Table 43: Inputs set for limit switch.....	62
Table 44: Limit switch voltage setting.....	63
Table 45: Analogue speed control parameters.....	64
Table 46: Analogue speed control word bit	65
Table 47: status word in digital speed.....	67
Table 48: Digital torque control parameters.....	69
Table 49: control word bit digital torque.....	70
Table 50: status word in digital torque.....	71
Table 51: Analogue torque control parameters.....	72
Table 52: control word bit in analogue torque.....	73
Table 53: Status word in analogue torque.....	74

Diagrams Index

Diagram 1: PPO2 structure.....	10
Diagram 2: PKW structure.....	11
Diagram 3: PPO2 Communication (Master/Slave).....	12
Diagram 4: PZD, control word - status word.....	13
Diagram 5: State Machine	20
Diagram 6: Bit 4,5,6 control word digital speed.....	41
Diagram 7: Method 1 – Homing on CCW limit switch and zero resolver impulse.....	55
Diagram 8: Method 2 – Homing on CW limit switch and zero resolver impulse.....	55
Diagram 9: Method 3 – Homing with home sensor.....	56
Diagram 10: Method 4 – Homing with home sensor.....	56
Diagram 11: Method 5 – Homing with home sensor.....	57
Diagram 12: Method 6 – Homing with home sensor.....	58
Diagram 13: Methods 7,8,9,10 – Homing with the home sensor.....	59
Diagram 14: Methods 11,12, 13, 14 – Homing with the home sensor.....	60

Diagram 15: Method 17 – Homing with the CCW limit switch.....61

Diagram 16: Method 18 – Homing with the CW limit switch.....61

Diagram 17: Methods 3,4 – Homing on resolver zero impulse.....61

Diagram 18: control word bits 4, 5 and 6 in analogue speed66

1 Introduction to Profibus

1.1 Introduction

This document gives a description of the data regarding the communication and parameters used to control the DGM drive using the Profibus field bus. Drive management was structured using a set of parameters that can be accessed from a specific address and a state machine that has been implemented for controlling the main states of the DGM drive.

2 Profibus Control

1.2 DGM parameters for Profibus protocol setting

The Profibus DP (**D**ecentralized **P**eripheral) protocol, a master/slave system, was implemented in the DGM drive. In this system the DGM drive acts as the slave, and the master is usually represented by a PLC that communicates cyclically over a 485 serial line with packages made up of 11 bit characters (1 start bit, 8 data bit, 1 parity bit and 1 stop bit). A unique address is assigned to each Profibus network device, and the DGM drive has a parameter for activating Profibus type communication and another for setting the node address:

- The **S.7000** parameter: enables communication on the Profibus bus by setting the “**3-PrF**” option.
- The **S.7300** parameter: makes it possible to set the drive address in a range from 1 to 125.

The baudrate is set in the master on the basis of the cable length, that can even reach 1200 m, and it is possible to set up to a maximum of 127 nodes using repeaters (31 without repeaters). The baudrate does not need to be set on the DGM drive because it is automatically found and hooked to the specific interface present on the drive control card which, as well as managing the network packages, also provides optical isolation compared to 485 bus cables .

BaudRate
12 Mbit/s
6 Mbit/s
3 Mbit/s
1.5 Mbit/s
500 Kbit/s
187.5 Kbit/s
93.75 Kbit/s
19.2 Kbit/s
9.6 Kbit/s

Table 1: BaudRate

2.2 GSD file

The GSD file combined with the DGM drive contains all the information for device insertion and loading in a Profibus network.

2.3 Communication Parameter Codes

The address interval of the parameters used for Profibus communication in the DGM drive goes from 1 to 2047, and the variable dimensions and signs can vary. The following tables give the code that is used later on to set the applied parameters.

Code	Variable type
UINT8	8 bit unsigned parameter
INT8	8 bit signed parameter
UINT16	16 bit unsigned parameter
INT16	16 bit signed parameter
UINT32	32 bit unsigned parameter
INT32	32 bit signed parameter

Table 2: Variable Type Abbreviations

Attributes	Description
r	Read only parameter
w	Write only parameter
rw	Write and read parameter

Table 3: Variable attributes

3 PPO2 Cyclic Data

After having correctly parameterised and configured a slave, the master moves to the data cyclic exchange phase. The cyclic package is structured in PPO mode, and PPO2 is used in the DGM drive. This mode contains an area for parameter reading and writing management on the basis of the parameter address, and another for direct data access according to the type of control being used.

3.1 PPO2 type data structure

The PPO2 type data package is made up of two data structures:

- **PKW structure:** package made up of 8 bytes (4 words of 16 bits), used for reading or writing a datum in a specific parameter on the basis of a preset address for each parameter.
- **PZD structure:** packet made up of 12 bytes (6 words) that is used to directly set the process parameters, in other words it supplies the control references or the measured data...to verify the application state according to the type of control that is set.

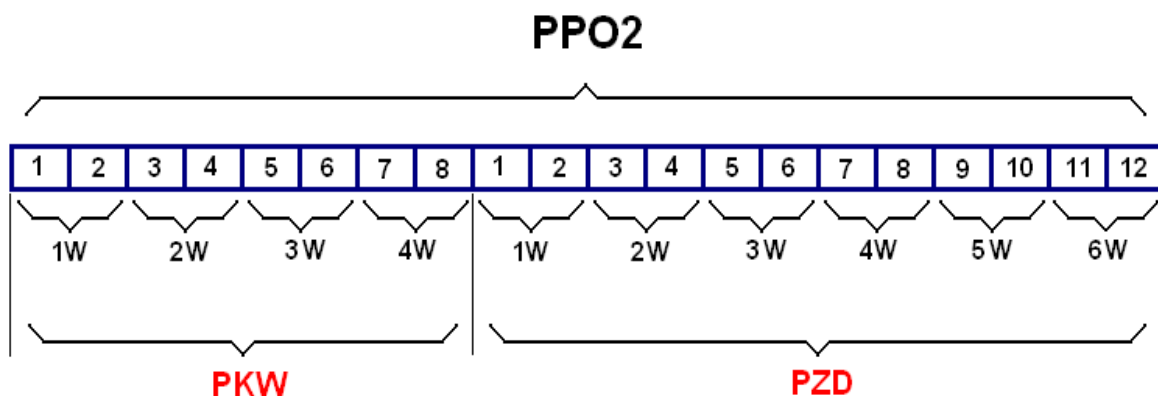


Diagram 1: PPO2 structure

3.2 PKW structure:

The PKW structure is used to read and write all the drive parameters that are set for communication via Profibus. Access is made with the parameter address and the setting of special bits to indicate writing or reading.

The PKW structure is made up of 3 fields:

- **PKE structure:** this structure is made up of two bytes, which in turn include the following components:
 - **AK:** datum made up of 4 bits between bits 12 and 15, it specifies reading or writing.
 - **Bit 11:** not used
 - **PNU:** datum made up of 11 bits between bits 0 and 10, used to indicate the drive parameter address.

- **IND**: third byte of the PKW structure, represents a possible index if the parameter being accessed is made up of a vector
- **Byte 4**: not used.
- **PWE**: contains the datum to be read or written, or indicates the error code if errors are found in data writing or reading. The least important byte of the datum is positioned at byte 8, while the most important ones are positioned in the previous bytes, as shown in the figure.

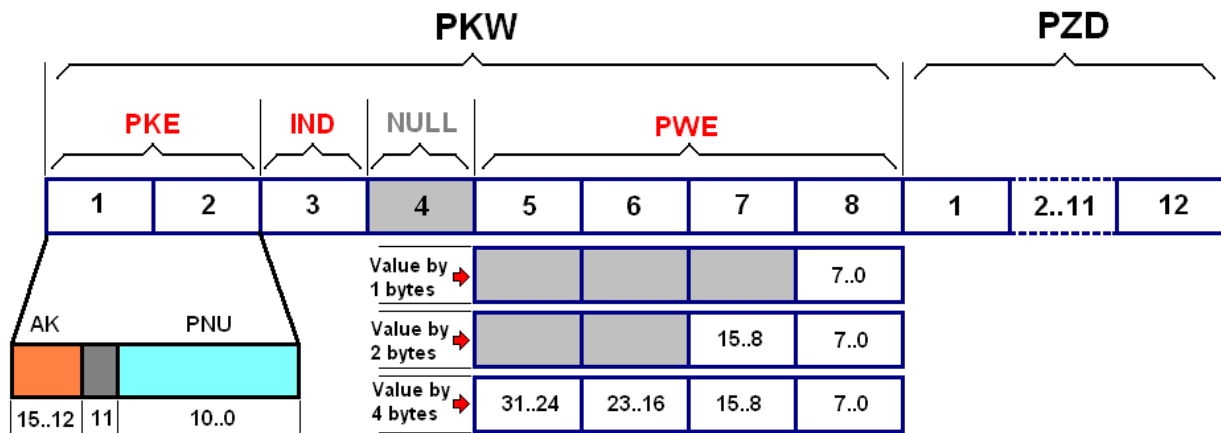


Diagram 2: PKW structure

3.3 PKW communication

Data transmission using the PKW structure is managed by setting AK to 1 to read and to 3 to write a parameter. The DGM drive responds by preparing the PKW structure with the data requested by the master and setting AK at 2 if transmission is correct or AK at 7 if errors are found in transmission data setting. If the master sends a request with an AK value that is neither 1 nor 3, the DGM replies with AK equal to 8 to indicate an error in the transmission service.

Master (PLC)		Slave (DGM)		
AK (request)	Description	AK(reply)		Description
		OK	Error	
0	No request	0	-	No request
1	Read parameter request	2	7	Read parameter reply
3	Write parameter request	2	7	Write parameter reply
other	Request unknown	-	8	AK error reply

Table 4: AK reading/writing code

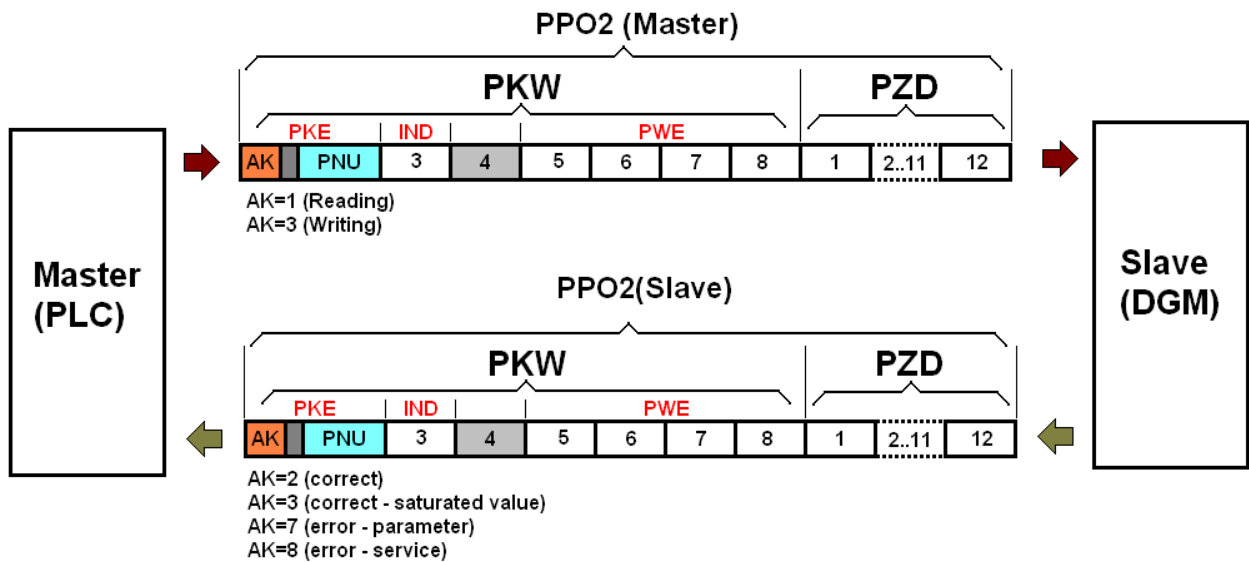


Diagram 3: PPO2 Communication (Master/Slave)

For writing, the master copies the datum to be written (where AK=3) in the PWE field. If there are no problems the DGM replies AK=2 and recopies the reply package in the PNU and PWE fields. If errors are found, AK is set equal to 7 or 8 and the PWE field contains a numeric value that indicates the type of anomaly.

If the master requests that a parameter be read (where AK=1), the DGM replies by copying the value of PNU with AK=2 and the parameter value in the PWE field. If errors are found AK is set as equal to 7 or 8 and the PWE field contains a numeric value that indicates the type of anomaly found.

AK	PWE	Error code description where AK=7, 8
7	1	PNU wrong, parameter address does not exist
	2	IND wrong, vector index does not exist
	3	Attempt made to write in a read-only parameter
	4	Parameter cannot be written because of the current drive state
	5	Parameter limits exceeded during writing phase
8	6	Service error, AK different from 1 and from 3

Table 5: Error code with AK=7, 8

Note: If the master sends a request to write a parameter with a value that exceeds the permitted limits, the DGM firmware automatically brings the variable within the maximum or minimum values permitted for that specific parameter. To signal the saturation operation of the written datum, the AK field is placed as equal to 3 while the PWE field contains the value of the written variable.

3.4 PZD process data

The section called PZD is made up of 12 bytes and in this part of the PPO2 structure it is usually the master that sends the control reference data while the slave replies with the measured data inherent to the master references.

The data set in the PZD section depend on the parameter at address 930, which defines the set operation mode. The possible values are:

PNU = 930	Description
1	Digital Speed
2	Positioner
-1	Analogue speed
-2	Digital torque
-3	Analogue torque

Table 6: Parameter values at address 930

Regardless of the type of control set, the first word (16 bits) of the PZD data is for the **control word**, while for the slave the first word is the **status word**.

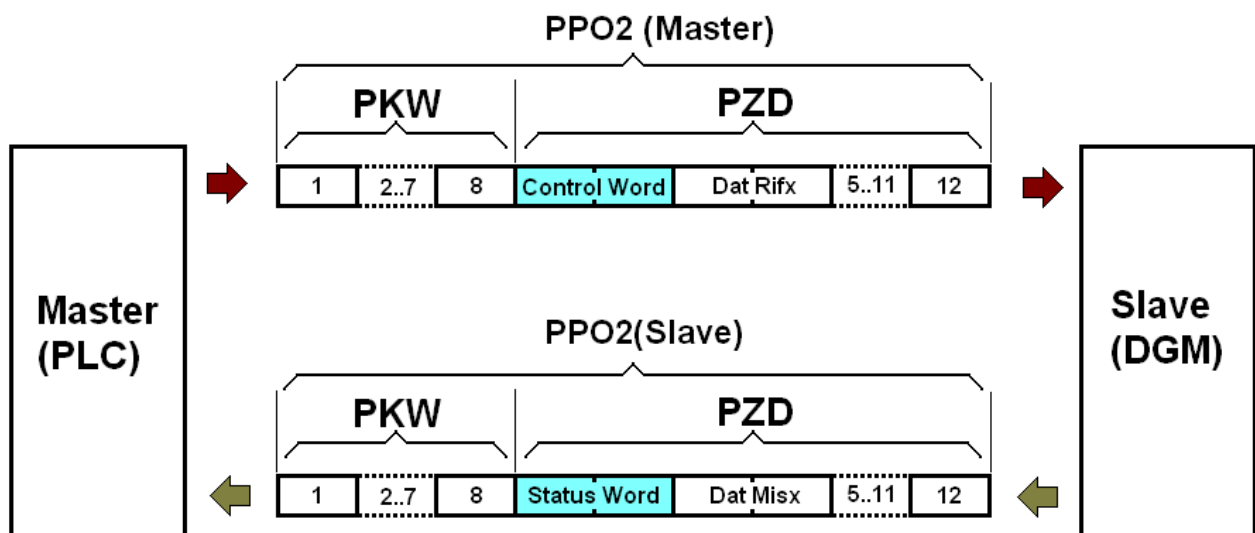


Diagram 4: PZD, *control word - status word*

3.4.1 PZD data in control of digital speed

Parameter at address 930 set at 1:

- PZD data sent to the Master:

PZD Master (digital speed)		
Position	Bytes	Description
1,2	2	Control word
3,4	2	Speed reference
5,6	2	Null
7,8	2	Null
9,10	2	Null
11,12	2	DGM outputs

Table 7: PZD digital speed control master

1	2	3	4	5	6	7	8	9	10	11	12
Control word		Speed ref.		Null		Null		Null		DGM outputs	

- PZD data sent by the Slave:

PZD Slave (digital speed)		
Position	Bytes	Description
1,2	2	Status word
3,4,5,6	4	Measured position
7,8	2	Measured speed
9,10	2	DGM analogue input
11,12	2	DGM inputs

Table 8: PZD digital speed slave

1	2	3	4	5	6	7	8	9	10	11	12
Status word		Measured position				Measured speed		Analogue input		DGM inputs	

3.4.2 PZD data in positioner control

Parameter at address 930 set at 2:

- PZD data sent by the Master:

PZD Master (positioner)		
Position	Bytes	Description
1,2	2	Control word
3,4,5,6	4	Position reference
7,8	2	Position speed
9,10	2	Null
11,12	2	DGM outputs

Table 9: PZD Master (positioner)

1	2	3	4	5	6	7	8	9	10	11	12
Control word		Position reference				Position speed		Null		DGM outputs	

- PZD data sent by the Slave:

PZD Slave (positioner)		
Position	Bytes	Description
1,2	2	Status word
3,4,5,6	4	Measured position
7,8	2	Measured speed
9,10	2	DGM analogue input
11,12	2	DGM inputs

Table 10: PZD Slave (positioner)

1	2	3	4	5	6	7	8	9	10	11	12
Status word		Measured position				Measured speed		Analogue input		DGM inputs	

3.4.3 PZD data in analogue speed control

Parameter at address 930 set at -1:

- PZD data sent by the Master:

PZD Master (analogue speed)		
Position	Bytes	Description
1,2	2	Control word
3,4	2	Null
5,6	2	Null
7,8	2	Null
9,10	2	Null
11,12	2	DGM outputs

Table 11: PZD Master (analogue speed)

1	2	3	4	5	6	7	8	9	10	11	12
Control word	Null		Null		Null		Null		Null		DGM outputs

- PZD data sent by the Slave:

PZD Slave (Analogue speed)		
Position	Bytes	Description
1,2	2	Status word
3,4,5,6	4	Measured position
7,8	2	Measured speed
9,10	2	DGM analogue input
11,12	2	DGM inputs

Table 12: PZD Slave (Analogue speed)

1	2	3	4	5	6	7	8	9	10	11	12
Status word	Measured position				Measured speed		Analogue input		DGM inputs		

3.4.4 PZD data in digital torque control

Parameter at address 930 set at -2:

- PZD data sent by the Master:

PZD Master (digital torque)		
Position	Bytes	Description
1,2	2	Control word
3,4	2	Torque reference
5,6	2	Null
7,8	2	Null
9,10	2	Null
11,12	2	DGM outputs

Table 13: PZD digital torque control master

1	2	3	4	5	6	7	8	9	10	11	12
Control word		Ref. Torque		Null		Null		Null		DGM outputs	

- PZD data sent by the Slave:

PZD Slave (digital torque)		
Position	Bytes	Description
1,2	2	Status word
3,4	2	Measured torque
5,6	2	Measured speed
7,8	2	Null
9,10	2	DGM analogue input
11,12	2	DGM inputs

Table 14: PZD digital torque control slave

1	2	3	4	5	6	7	8	9	10	11	12
Status word		Measured torque		Measured speed		Null		Analogue input		DGM inputs	

3.4.5 PZD data in analogue torque control

Parameter at address 930 set at -3:

- PZD data sent by the Master:

PZD Master (analogue torque)		
Position	Bytes	Description
1,2	2	Control word
3,4	2	Null
5,6	2	Null
7,8	2	Null
9,10	2	Null
11,12	2	DGM outputs

Table 15: PZD Analogue torque control master

1	2	3	4	5	6	7	8	9	10	11	12
Control word		Null		Null		Null		Null		DGM outputs	

- PZD data sent by the Slave:

PZD Slave (analogue torque)		
Position	Bytes	Description
1,2	2	Status word
3,4	2	Measured torque
5,6	2	Measured speed
7,8	2	Null
9,10	2	DGM analogue input
11,12	2	DGM inputs

Table 16: PZD analogue torque control slave

1	2	3	4	5	6	7	8	9	10	11	12
Status word		Measured torque		Measured speed		Null		Analogue input		DGM inputs	

4 Drive control structure

4.1 State machine

The drive state is managed by a state machine that controls the enabling and disabling phases of the drive and the *fault* caused by any drive alarm.

State	Description
Start	The drive is not ready because it is in the loading and parameter initialisation phases.
Switch On Inhibited	<ul style="list-style-type: none">• Parameter initialisation has terminated.• The drive is ready• The power is disabled
Ready for Switch On	<ul style="list-style-type: none">• The drive is ready• The power is disabled
Switch On	<ul style="list-style-type: none">• The power is enabled, the drive is stopped in torque.• The operative mode can be modified in parameter 930.• In this state the reference values present in the PZD section are ignored.
Operation	<ul style="list-style-type: none">• The power is enabled• The control type cannot be modified using parameter 930.• The reference values present in the PZD section are being elaborated.
Switching Off	<ul style="list-style-type: none">• Transitory state not reported by the word status, indicates the switching off phase following a stop in ramp command.• At ramp termination the power is disabled.
Fault	<ul style="list-style-type: none">• There is a drive alarm: bit 3 of the status word is placed at 1.• The power is disabled, subsequently the drive moves to the Switch On Inhibited state.

Table 17: State description (State Machine)

All the various phases that cause a drive state variation are given in the **status word**, a 16 bit read only variable, that is sent to the Master in the first word of the PZD data.

The commands that allow communication between one state and another are instead managed by the master and are set using the **control word**. This 16 bit variable is sent to the master in the first word of the PZD data.

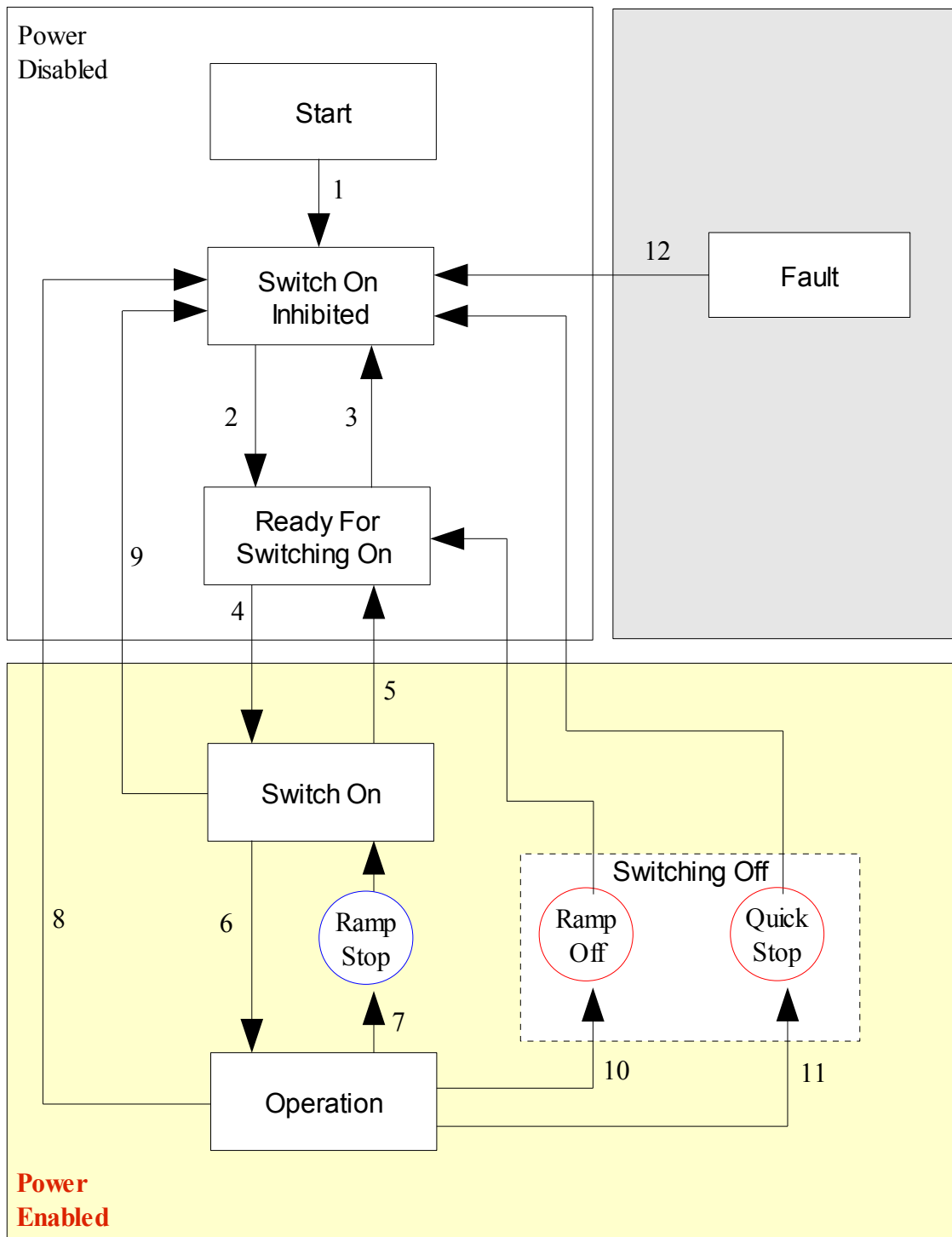


Diagram 5: State Machine

4.2 Control variables

As well as **control word** and **status word**, a set of variables is implemented that make it possible to manage the type of control, the setting of common regulations and the behaviour of the drive in case of *fault*.

PNU	Name	Type	Attributes
967	Control word	UINT16	rw
968	Status word	UINT16	r
930	Operation mode	UINT16	rw
12	Alarm datum	UINT32	r
15	Communication error mode	UINT16	rw
16	Remote control mode OFF	UINT16	rw
18	Deceleration communication error	UINT32	rw
19	Deceleration remote control OFF	UINT32	rw
20	Deceleration OFF1	UINT32	rw
21	Deceleration quick stop	UINT32	rw
22	Deceleration operational	UINT32	rw
23	Deceleration positioner	UINT32	rw
30	Current limit	UINT16	rw
31	Null speed window	UINT16	rw
32	Null speed time	UINT16	rw
39	Measured values averages	UINT16	rw
40	Kp speed regulator	UINT16	rw
41	Ki speed regulator	UINT16	rw
42	Kp position regulator	UINT16	rw
64	Speed reference window	UINT16	rw
65	Speed reference time	UINT16	rw
918	Node address	UINT8	r
922	Telegram selection	UINT16	r
964	Device Identification	(ARRAY) UINT16	r
965	Profile number	(ARRAY) UINT16	r

Table 18: Control parameters

4.3 Control word – PNU 967

PNU	Name	Type	Range	Default	Unit	Attributes
967	Control word	UINT16	0..FFFFh	0		rw

The **control word** can be written using the PKW structure. As this variable is always present in the PZD section, it is advisable to set it in this structure.

The **control word** is a 16 bit unsigned variable that is used to manage the drive states through bit settings. Some bits are common for the various operation modes, others are specific according to the mode set at the parameter at the address PNU=930.

Bit	Value	Meaning	Control Word description
0	1	ON1	Takes the drive to the “ Switch On ” state and supplies power. The drive remains stopped in torque.
	0	OFF1	Stops the power supply and moves to the “ Ready for Switch On ” state. If the drive is in the “ Operation ” state with a speed that is not zero a stop in ramp is actuated on the basis of the deceleration OFF1 PNU=20 parameter
1	1	ON2	OFF2 not active, ready for operation
	0	OFF2	The power supply is stopped and the drive moves to the “ Switching On Inhibited ” state. If moving, the motor stops through inertia
2	1	ON3	OFF3 not active, ready for operation
	0	OFF3 (Quick Stop)	Stops the power supply and moves to the “ Switching On Inhibited ” state. If the drive is in the “ Operation ” state with a speed that is not zero, a stop in ramp is actuated on the basis of the deceleration quick stop PNU=21 parameter
3	1	Enable “Operation”	Moves to the “ Operation ” state, the bits relative to the operation mode set on the basis of the operation mode PNU=930 parameter are enabled
	0	Disable “Operation”	Moves to the “ Switch On ” state. If the motor is moving a stop in ramp is actuated on the basis of the deceleration operational PNU=22 parameter and the power remains enabled.
7	1	Fault Acknowledge (0->1)	The alarms reset command is executed by switching this bit from 0 to 1
	0	-----	
10	1	Valid references	Remote control from PLC is active, the PZD process data sent by the PLC are engaged, the drive follows the references that were sent
	0	Non valid	The references sent by the PLC are ignored. If the drive is

		references	moving during the commutation of this bit from 1 to 0, the action set in the remote control mode OFF PNU=16 parameter is undertaken
--	--	------------	--

Table 19: Control word bit description, common bits for all operation modes

4.3.1 Control word bits 0..3

Bits 0..3 manage the commands for state machine state commutation on the basis of the following table:

State Machine Transitions			Transition Number(*)	Bit control word								
				b0	b1	b2	b3		b0	b1	b2	b3
Switch On Inhibited	➡	Ready for Switching On	2	0	1	0	0	➡	0	1	1	0
Switch On Inhibited	➡	Ready for Switching On	2	0	0	1	0	➡	0	1	1	0
Ready for Switching On	➡	Switch On Inhibited	3	0	1	1	0	➡	0	0	1	0
Ready for Switching On	➡	Switch On Inhibited	3	0	1	1	0	➡	0	1	0	0
Ready for Switching On	➡	Switch On	4	0	1	1	0	➡	1	1	1	0
Switch On	➡	Ready for Switching On	5	1	1	1	0	➡	0	1	1	0
Switch On	➡	Switch On Inhibited	9	1	1	1	0	➡	1	0	1	0
Switch On	➡	Switch On Inhibited	9	1	1	1	0	➡	1	1	0	0
Switch On	➡	Operation	6	1	1	1	0	➡	1	1	1	1
Operation	➡	Switch On Inhibited	10	1	1	1	1	➡	0	1	1	1
Operation	➡	Switch On Inhibited	11	1	1	1	1	➡	1	1	0	1
Operation	➡	Switch On Inhibited	8	1	1	1	1	➡	1	0	1	1
Operation	➡	Switch on	7	1	1	1	1	➡	1	1	1	0
Fault	➡	Switch On Inhibited	12	X	X	X	X	➡	X	X	X	X

Table 20: State machine transition

Notes:

- (*) The transition number is shown in the state machine drawing
- The symbol "X" means that the bit value is irrelevant for the indicated transition.

4.3.2 Control word bits 4,5,6,8,9,11,12,13,14,15

Bits relative to the operation mode:

Bit	Control word – Operation Mode					
		Digital Speed	Positioner	Analogue speed	Digital torque	Analogue torque
4	1	RFG On	Position accepted	RFG On	---	---
	0	RFG Off	Position refused	RFG Off	---	---
5	1	RFG Lock On	Position enabled	RFG Lock Off	---	---
	0	RFG Lock Off	Stop position	RFG Lock On	---	---
6	1	Speed Ref. on	Start position (0->1)	Speed ref. on	Torque ref. on	Torque ref. on
	0	Speed Ref. off	Start position (1->0)	Speed ref. off	Torque ref. off	Torque ref. off
8	1	---	Jog 1 On	---	---	---
	0	---	Jog 1 Off	---	---	---
9	1	---	Jog 2 On	---	---	---
	0	---	Jog 2 Off	---	---	---
11	1	---	Start Home Pos. (0->1)	---	---	---
	0	---	Stop Home Pos. (1->0)	---	---	---
12	1	---	Relative position	---	---	---
	0	---	Absolute position	---	---	---
13..15	--	---	---	---	---	---

Table 21: **Control word** – operative mode bit

Notes:

- RFG = Ramp Function Generator

4.4 Status word – PNU 967

PNU	Name	Type	Range	Default	Unit	Attributes
968	Status word	UINT16	0..FFFFh	0		r

The **status word** can be read using the PKW structure. This variable is also always sent to the PZD section, therefore it is advisable to read it in this structure.

The **status word** is a 16 bit unsigned variable that contains indications on the general state of the drive. Some bits are common for all the operation modes, others are specific according to the mode set in the parameter at the PNU=930 address.

Bit	Value	Meaning	Status Word Description
0	1	Ready to be enabled	Drive ready to move to the “ Switch On ” state
	0	Not ready to be enabled	Drive not ready for moving to the “ Switch On ” state
1	1	Drive ready to work	Drive ready for moving to the “ Operation ” state
	0	Drive ready to work	Drive not ready for moving to the “ Operation ” state
2	1	Operation mode enabled	The drive is in the “ Operation ” state, ready to follow the references sent by the master
	0	Operation mode disabled	Operation mode disabled
3	1	Fault Present	Fault condition, in this case the power supply is stopped and the drive moves to the “ Switch On Inhibited ” state.
	0	No Fault Present	No alarm present
4	1	OFF2 command disabled	Condition for operation
	0	OFF2 command active	The OFF2 command (bit 1 control word at 0) is active, the power is stopped and the drive moves to the “ Switch On Inhibited ” state.
5	1	OFF3 command disabled	Condition for operation
	0	OFF3 command active	The OFF3 command (bit 2 control word at 0) is active, stop in ramp on the basis of the Deceleration quick stop PNU=21 parameter, subsequently the drive moves to the “ Switch On Inhibited ” state.
6	1	Switching On Inhibited	Power is disabled and the drive moves to the “ Switch On Inhibited ” state.
	0	Switching On Not Inhibited	Drive ready for operation
7	1	Warning present	Warning present
	0	No Warning present	No Warning present
8	--	--	Specific bit on the basis of the operation mode that is set

9	1	Control request	The master is being urged to take control
	0	Local operation	The master does not have management priority
10..15	--	--	Specific bits on the basis of the operation mode that is set

Table 22: Status word

4.4.1 Status Word bits 8,10,11,12,13,14,15

Bits relative to the operation mode:

Bit		Status Word Operation Mode				
		Digital speed	Positioner	Analogue speed	Digital torque	Analogue torque
8	1	Reference Ok	Position Ok	Reference Ok	---	---
	0	Out of range	Position error	Out of range	---	---
10	1	Minimum speed reached	Position reached	Minimum speed reached	Minimum speed reached	Minimum speed reached
	0	Minimum speed not reached	Position not reached	Minimum speed not reached	Minimum speed not reached	Minimum speed not reached
11	1	---	Home position carried out	---	---	---
	0	---	Home position not carried out	---	---	---
12	0->1	---	Confirm position reference	---	---	---
	1->0	---	Confirm position reference	---	---	---
13	1	---	Drive stopped	---	---	---
	0	---	Drive moving	---	---	---
14	---	---	---	---	---	---
15	---	---	---	---	---	---

Table 23: controlword – operation mode bit

4.5 Operation mode - PNU 830

PNU	Name	Type	Range	Default	Unit	Attributes
930	Operation mode	UINT16	1, 2, -1, -2, -3	1		rw

This parameter can be used to set the type of control and cannot be modified if the drive is in the “**Operation**” state.

As already specified, the PZD structure depends on the type of control set. When the control type is modified, the firmware automatically prepares itself to receive the specific references of the set control sent by the master from the PZD structure. The corresponding values of the prepared measured data are set in the PZD data sent to the master.

Values	Operation mode description
1	Digital Speed
2	Positioner
-1	Analogue speed
-2	Digital torque
-3	Analogue torque

Table 24: Operation mode

4.6 Alarm datum – PNU 12

PNU	Name	Type	Range	Default	Unit	Attributes
12	Alarm datum	UINT32	0..FFFFFFFFh	0		r

The **alarm datum** parameter holds all the alarms that are present on the DGM drive. The presence of an alarm is reported in the **status word** when bit 3 is set at 1. Each single bit identifies an alarm, and if the alarm is present the corresponding bit is placed at 1.

Bit	DGM alarm bit description	Code on the DGM display
0	Parameter saving error	1
1	Hall effect sensors not set	2
2	Power Overcurrent	3
3	DC BUS overvoltage	4
4	No network voltage	5
5	No Phase	6
6	Resolver error	7
7	(reserved)	-
8	Motor overheating	9
9	Braking Resistance	10
10	No 24V	11
11	DC BUS undervoltage	12
12	Position Error	13
13	Home Position Error	14
14	Inverter I2t warning	15
15	Motor I2t warning	16
16	Overspeeding warning	17
17	(reserved)	-
18	Out of Position warning	19
19	Communication error	20
20	Memory Fault	21
21..31	(reserved)	

Table 25: DGM alarm bit

4.7 Communication error mode – PNU 15

PNU	Name	Type	Range	Default	Unit	Attributes
15	Communication error mode	UINT16	0..1	0		rw

The **communication error mode** indicates the action to be taken if communication with the Profibus network is lost.

Values	Communication error mode
0	The power supply is disabled and the drive moves to the “ Switch On Inhibited ” state.
1	If the drive is moving, deceleration is actuated based on a set ramp (deceleration communication error PNU=18). Once stopped, the drive moves to the “ Switch On Inhibited ” state.

Table 26: Communication error mode

4.8 Remote control OFF mode – PNU 16

PNU	Name	Type	Range	Default	Unit	Attributes
16	Remote control OFF mode	UINT16	0..2	0		rw

The **remote control OFF** mode determines the action to be undertaken when bit 10 of the **control word** commutes from 1 to 0. The following values can be set for the DGM drive:

Values	Remote control OFF mode
0	The power supply is stopped and the drive moves to the “ Switch On Inhibited ” state.
1	If the drive is moving, deceleration is actuated based on a set ramp (deceleration remote control OFF PNU=19 parameter). Once stopped, the drive moves to the “ Switch On Inhibited ” state.

Table 27: Emergency mode

4.9 Communication error deceleration – PNU 18

PNU	Name	Type	Range	Default	Unit	Attributes
18	Deceleration communication error	UINT32	0..6000000	100000	rpm/s	rw

The **deceleration communication error** indicates the deceleration value for the speed stop in ramp if a communication *timeout* is found in the drive. The stop in ramp is only carried out if the **communication error mode** parameter is set at 1. The *timeout* time is set by the master at the start of communication.

4.10 Deceleration remote control OFF – PNU 19

PNU	Name	Type	Range	Default	Unit	Attributes
19	Deceleration remote control OFF	UINT32	0..6000000	100000	rpm/s	rw

The **deceleration remote control OFF** parameter is used to set deceleration for the speed stop in ramp when bit 10 of the **control word** commutes from 1 to 0.

4.11 Deceleration OFF1 – PNU 20

PNU	Name	Type	Range	Default	Unit	Attributes
20	Deceleration OFF1	UINT32	0..6000000	100000	rpm/s	rw

The **deceleration OFF1** parameter is set when the 0 bit in the **control word** commutes from 1 to 0. If the drive is moving, a deceleration ramp is set according to the value set in this parameter. At ramp termination the drive moves to the "**Switch On Inhibited**" state.

4.12 Deceleration quick stop – PNU 21

PNU	Name	Type	Range	Default	Unit	Attributes
21	Deceleration quick stop	UINT32	0..6000000	100000	rpm/s	rw

The **deceleration quick stop** parameter defines the deceleration value for the stop in ramp when bit 2 (OFF3) of the **control word** commutes from 1 to 0. At ramp termination the drive moves to the "**Switch On Inhibited**" state.

4.13 Deceleration operational – PNU 22

PNU	Name	Type	Range	Default	Unit	Attributes
22	Deceleration operational	UINT32	0..6000000	100000	rpm/s	rw

The **deceleration operational** parameter indicates the deceleration value for the stop in ramp when bit 3 (Operational) of the **control word** commutes from 1 to 0. At ramp termination the drive moves to the "**Switch On**" state.

4.14 Deceleration positioner – PNU 23

PNU	Name	Type	Range	Default	Unit	Attributes
23	Deceleration positioner	UINT32	0..6000000	100000	rpm/s	rw

The **deceleration positioner** parameter is only active when set in the positioner operative mode. The value of this variable indicates deceleration for the stop in ramp when one of the following bits of the **control word** commutes from 1 to 0:

- Bit 4 (accept/refuse position).
- Bit 5 (stop position).
- Bit 11 (start/stop Home position).

4.15 Current limit – PNU 30

PNU	Name	Type	Range	Default	Unit	Attributes
30	Current limit	UINT32	0..250	250	%	rw

The **current limit** parameter is expressed as a percentage of the drive nominal current and indicates the maximum limit of current that the DGM drive can supply.

4.16 Null speed window – PNU 31

PNU	Name	Type	Range	Default	Unit	Attributes
31	Null speed window	UINT16	0..1000	20	rpm	rw

Null speed window indicates a speed interval used to verify if the measured speed remains within a determined range as to the zero. This condition is given in the **status word**. If the speed remains within the set interval for a set time, a specific **status word** bit is set at 1, otherwise it is set at 0.

- Bit 13 (Positioner): Drive stopped / Drive moving
- Bit 10 (In other cases): Minimum speed reached / Minimum speed not reached

4.17 Null speed time – PNU 32

PNU	Name	Type	Range	Default	Unit	Attributes
32	Null speed time	UINT16	1..2000	50	ms	rw

The **Null speed time** parameter concurs together with the **Null speed window** parameter to manage the “**null speed**” condition of the **status word**. It indicates the time during which the speed must remain within the set limit so that a specific **status word** bit is positioned at 1, otherwise it remains at 0.

4.18 Measured value averages – PNU 39

PNU	Name	Type	Range	Default	Unit	Attributes
39	Measured value averages	UINT16	0..7	5		rw

This parameter sets the dynamic average of the measured sizes, which are sent to the master in the PZD structure.

Value	Description – Measured value averages
0	No average
1	Dynamic average 2 samples in 1 ms
2	Dynamic average 4 samples in 2 ms
3	Dynamic average 8 samples in 4 ms
4	Dynamic average 16 samples in 8 ms
5	Dynamic average 32 samples in 16 ms
6	Dynamic average 64 samples in 32 ms
7	Dynamic average 128 samples in 64 ms

Table 28: Measured value averages

4.19 Kp speed regulator – PNU 40

PNU	Name	Type	Range	Default	Unit	Attributes
40	Kp speed regulator	UINT16	1..3000	1000		rw

The ***Kp speed regulator*** modifies the proportional gain of the speed regulator.

4.20 Ki speed regulator – PNU 41

PNU	Name	Type	Range	Default	Unit	Attributes
41	Ki speed regulator	UINT16	0..3000	300		rw

The ***Ki speed regulator*** modifies the integral gain of the speed regulator.

4.21 Kp position regulator – PNU 42

PNU	Name	Type	Range	Default	Unit	Attributes
42	Kp position regulator	UINT16	1..4000	512		rw

The **Kp position regulator** modifies the proportional gain of the position regulator.

4.22 Speed reference window – PNU 64

PNU	Name	Type	Range	Default	Unit	Attributes
64	Speed reference window	UINT16	0..1000	20	rpm	rw

This parameter is used when control in digital or analogue speed is active. It indicates a speed interval used to verify if the measured speed remains within a specific range as to the speed reference. When this condition is verified for a specific time, bit 8 (**reference Ok**) of the **status word** is set at 1, otherwise it is set at 0.

4.23 Speed reference time – PNU 64

PNU	Name	Type	Range	Default	Unit	Attributes
65	Speed reference time	UINT16	1..2000	50	ms	rw

Active parameter in digital or analogue speed control; together with the **Speed reference window** parameter it concurs to manage bit 8 (**reference Ok**) of the **status word**. It indicates the time during which the speed must remain within the set range so that bit 5 of the **status word** is set at 1, otherwise it remains at 0.

4.24 Node address – PNU 918

PNU	Name	Type	Range	Default	Unit	Attributes
918	Node address	UINT16	1..125	3		r

The value of the slave node can be read in the **node address** parameter.

4.25 Telegram selection – PNU 922

PNU	Name	Type	Range	Default	Unit	Attributes
922	Telegram selection	UINT16	-----	101		r

The **Telegram selection** parameter is read only and indicates the default setting values for managing the PZD structure.

4.26 Device Identification – PNU 964

PNU	Ind	Name	Type	Range	Default	Unit	Attributes
964		Device Identification	ARRAY				
	0	Manufacturer	UINT16	0..FFFFh			r
	1	Device type	UINT16	0..FFFFh			r
	2	Version (Software)	UINT16	0..FFFFh			r
	3	Firmware date (year)	UINT16	0..FFFFh			r
	4	Firmware date (day/month)	UINT16	0..FFFFh			r

Device Identification is a vector that gives some data relative to the DGM drive.

4.27 Profile number – PNU 965

PNU	Ind	Name	Type	Range	Default	Unit	Attributes
965		Profile number	ARRAY				
	0	Profile number (high)	UINT8	0..FFh	03		r
	1	Profile number (low)	UINT8	0..FFh	02		r

The **Profile number** indicates the relative version of the Profidrive Profile

5 Inputs - Outputs

The DGM drive has inputs, digital outputs and an analogue input, and through the profibus protocol the master can access the following peripherals:

- **8 digital inputs:** these inputs are read by the DGM drive and sent to the master through the PZD structure. If the homing procedure is enabled, three of these inputs are reserved for managing the CW, CCW and Home limit switches; in other cases these inputs can be used as generic inputs.
- **6 digital outputs:** these generic outputs can be set by the master through the PZD structure.
- **1 16-bit analogue input:** this analogue input is sent to the master in the PZD data; in the analogue speed and analogue torque control mode it is used as a reference input. In other cases it can be used as a generic analogue input.

PNU	Name	Type	Attributes
200	Digital inputs	UINT16	r
201	Digital outputs	UINT16	rw
202	Input output setting	UINT16	rw
210	Analogue input	INT16	r

Table 29: Measured value averages

5.1 Digital inputs – PNU 200

PNU	Name	Type	Range	Default	Unit	Attributes
200	Digital inputs	UINT16	0..FFh			r

This read-only parameter gives the value of the 8 digital inputs present on the DGM drive. The remaining 8 bits are not used. This datum is sent to the master through the PZD structure.

Input bit	Digital input description	
0	Generic input	
1	Generic input	Generic input for all types of control except when the homing procedure is carried out.
	CW limit switch	Used as a CW limit switch if a method that requires the CW limit switch was selected in the home search procedure
2	Generic input	Generic input for all types of control except when the homing procedure is carried out.
	CCW limit switch	Used as a CCW limit switch if a method that requires the CCW limit switch was selected in the home search procedure
3	Generic input	
4	Generic input	
5	Generic input	
6	Generic input	Generic input for all types of control except when the homing procedure is carried out.
	Home limit switch	Used as a Home limit switch if a method that requires the Home limit switch was selected in the homing procedure.
7	Generic input	
15..8	null	

Table 30: DGM Drive inputs

5.2 Digital outputs - PNU 201

PNU	Name	Type	Range	Default	Unit	Attributes
201	Digital outputs	UINT16	0..3Fh			rw

This parameter contains the value of the 6 digital outputs of the DGM drive; the remaining 10 bits of the parameter are not used. This datum is sent by the master to the DGM drive through the PZD structure.

Input bit	Digital output description
0	Generic output
1	Generic output
2	Generic output
3	Generic output
4	Generic output
5	Generic output
15..6	null

Table 31: DGM Drive outputs

5.3 Input output settings – PNU 202

PNU	Name	Type	Range	Default	Unit	Attributes
202	Input output setting	UINT16	0..3Fh			rw

This parameter assigns the function of limit switch to some preset inputs, while for the outputs, it can be decided if they are to be zeroed or if they are to maintain the assigned value when a communication timeout occurs

Bit	Digital Input output setting	
0	0	Input 1 is considered as a generic input.
	1	Input 1 is considered as a CW limit switch, the drive blocks if this input is active.
1	0	Input 2 is considered as a generic input.
	1	Input 2 is considered as a CCW limit switch, the drive blocks if this input is active.
2	0	If input 1 is set as the CW limit switch, the limit switch is considered active when a voltage of 0 V is supplied to the input.
	1	If input 1 is set as the CW limit switch, the limit switch is considered active when a voltage of 24 V is supplied to the input.
3	0	If input 2 is set as the CCW limit switch, the limit switch is considered active when a 0 V voltage is supplied to the input.
	1	If input 2 is set as the CCW limit switch, the limit switch is considered active when a 24 V voltage is supplied to the input.
4	0	If input 6 is used as a home sensor for homing, it is considered active when a 0 V voltage is supplied to the input.
	1	If input 6 is used as a home sensor for homing, it is considered active when a 24 V voltage is supplied to the input.
5	0	All 6 outputs of the DGM drive are zeroed if there is a communication timeout.
	1	The value of the 6 DGM drive outputs is maintained even if there is a communication timeout.
15..6	reserved	

Table 32: Input output setting

5.4 Digital outputs - PNU 210

PNU	Name	Type	Range	Default	Unit	Attributes
210	Digital inputs	INT16	-32768..32767			W

This read only parameter represents the value of the 16 bit analogue input present in the DGM drive. This datum is received by the master through the PZD structure.

6 Digital speed control

When the operative mode (PNU=930) parameter is set at 1 the speed loop is active and in this mode the speed reference is acquired by the master via profibus. It is also possible to condition the speed datum with acceleration and deceleration ramps.

PNU	Name	Type	Attributes
60	Speed reference	INT16	rw
61	Measured speed	INT16	r
62	Digital speed acceleration	UINT32	rw
63	Digital speed deceleration	UINT32	rw

Table 33: Digital speed control parameters

6.1.1 Setting the *control word* bit in digital speed

Bit	Digital speed control word bit description	
0	OFF1 / ON1 command: (for managing state machine)	
1	OFF2 / ON2 command: (for managing state machine)	
2	OFF3 / ON3 command: (for managing state machine)	
3	Operation enable/disable command: (for managing state machine)	
4	RFG On/Off (RFG = Ramp Function Generator)	
	Value	Description
	1	Speed loop reference enabled and corresponding to the output variable of the function for generating the acceleration and deceleration ramps.
	0	The drive is stopped in torque with null speed.
5	RFG unlock On/Off	
	Value	Description
	1	Output variable of the ramps enabled, updated by the function that generates the acceleration or deceleration ramps on the basis of the digital speed acceleration (PNU=62) and digital speed deceleration (PNU=63) parameters.
	0	Blocks the output variable of the ramps at the actual value.
6	On/Off speed reference	
	Value	Description
	1	The speed reference (PNU=60) value is assigned as an input to the functions for generating the speed ramps.
	0	Places the function input that generates the ramps at zero.
7	Fault Acknowledge (0->1) : alarm reset.	
8..9	----	
10	References (PZD) valid / not valid : enables or disables references from PLC.	
15..11	----	

Table 34: Digital speed *control word* bit

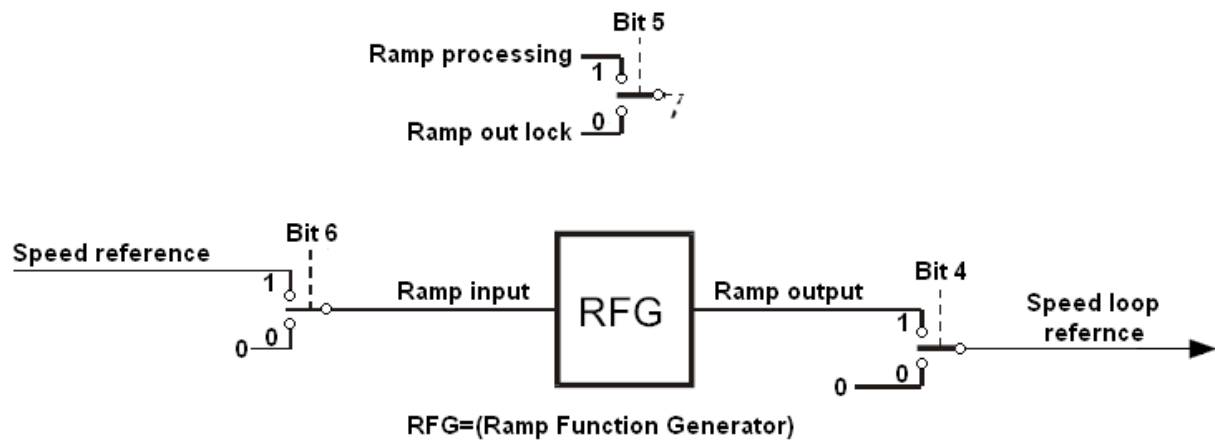


Diagram 6: Bit 4,5,6 *control word* digital speed

6.1.2 Setting the *control word* status bit in digital speed

Bit	Digital speed <i>status word</i> bit description	
0	Value	(common bit in all modes) “Switch On” ready indication
	1	Ready for “Switch On”
	0	Not ready for “Switch On”
1	value	(common bit in all modes) “Operation” ready indication
	1	Ready for “Operation”
	0	Not ready for “Operation”
2	value	(common bit in all modes) “Operation” state indication
	1	“Operation” state enabled
	0	“Operation” state disabled
3	value	(common bit in all modes) “Fault” state indication
	1	Fault present
	0	No Fault present
4	value	(common bit in all modes) OFF2 command indication
	1	OFF2 command disabled
	0	OFF2 command active
5	value	(common bit in all modes) OFF3 command indication
	1	OFF3 command disabled
	0	OFF3 command active
6	value	(common bit in all modes) “Switching On Inhibited” state indication
	1	“Switching On Inhibited” state
	0	“Switching On Inhibited” state not present
	value	(common bit in all modes) Warning state indication

7	1	Warning present
	0	No Warning present
8	value	Speed reference control (digital speed mode specific)
	1	Reference Ok: indicates that the speed reference is within the limits set by the Speed reference window (PNU=64) and the Speed reference time (PNU=63) parameters.
	0	Reference out of range
9	value	(common bit in all modes) “Remote control” indication
	1	The master is urged to take control
	0	The master does not have management priority
10	value	Minimum speed control (digital speed mode specific)
	1	Minimum speed reached: indicates that the speed is within the limits set by the Null speed window (PNU=31) and the Null speed time (PNU=32) parameters.
	0	Minimum speed not reached
11..15	----	

Table 35: *status word* digital speed

6.2 Speed reference – PNU 60

PNU	Name	Type	Range	Default	Unit	Attributes
60	Speed reference	INT16	±9999	0	rpm	rw

This parameter represents the input speed value of the function that generates the acceleration and deceleration ramps. The unit of measurement for this datum is rpm. Once the digital speed control has been set, this parameter is read by the DGM drive in the PZD structure sent by the master.

6.3 Measured Speed – PNU 61

PNU	Name	Type	Range	Default	Unit	Attributes
61	Measured speed	INT16	±9999		rpm	r

This parameter represents the speed measured at the motor axis. The value found is filtered on the basis of the **Measured value average** (PNU=39) parameter. Once the digital speed control has been set, this parameter is sent to the master in the PZD structure.

6.4 Digital speed acceleration – PNU 62

PNU	Name	Type	Range	Default	Unit	Attributes
62	Digital speed acceleration	UINT32	0..6000000	10000	rpm/s	rw

This parameter is used to set acceleration in the function that manages the speed ramps.

6.5 Digital speed deceleration – PNU 63

PNU	Name	Type	Range	Default	Unit	Attributes
63	Digital speed deceleration	UINT32	0..6000000	10000	rpm/s	rw

This parameter is used to set deceleration in the function that manages the speed ramps.

7 Positioner control

When the operation mode (PNU=930) is set at 2 the position loop is active. Three different use modes can be set in this operation mode using the **control word**:

- Position
- Homing
- Jog

Commutation from one mode to the other is carried out through some bits of the **control word**. It is the duty of the master to verify that the motor is stopped before varying the setting mode.

Positioner			
PNU	Name	Type	Attributes
80	Position reference	INT32	rw
81	Position speed	UINT16	rw
82	Position acceleration	UINT32	rw
83	Position deceleration	UINT32	rw
84	Position Jerk	UINT32	rw
85	Position profile type	UINT32	rw
86	Drive reference position	INT32	r
87	Position memory	INT32	r
88	Measured position	INT32	r
90	Position Error	INT32	rw
91	Position error time	UINT16	rw

Table 36: Positioner control parameters

Jog			
PNU	Name	Type	Attributes
92	Jog 1 speed	INT16	rw
93	Jog 2 speed	INT16	rw
94	Jog acceleration	UINT32	rw
95	Jog deceleration	UINT32	rw

Table 37: Jog parameters

Home Position			
PNU	Name	Type	Attributes
120	Home position method	UINT16	rw
121	Sensor search speed	UINT16	rw
122	Sensor output speed	UINT16	rw
123	Home position acceleration	UINT32	rw

Table 38: Home position parameters

7.1 Setting the positioner *control word* bit

Bit	Control word bit in positioner description	
0	OFF1 / ON1 command: (for state machine management)	
1	OFF2 / ON2 command: (for state machine management)	
2	OFF3 / ON3 command: (for state machine management)	
3	Operation enable/disable command: (for state machine management)	
4	Enable position acquisition	
	Value	Description
	1	Position accepted: enables acquisition of the position sent by the master
5	0	Position refused: the position sent by the master is refused; if the drive is carrying out a position during commutation from 1 to 0 of this bit, a stop in speed ramp is actuated with deceleration set on the basis of the deceleration positioner (PNU=23) parameter
	Enable/Disable position	
	Value	Description
6	1	Enable position: condition for enabling position execution
	0	Disable position: the commutation of this bit from 1 to 0 during the positioning phase causes a stop in speed ramp with deceleration set on the basis of the deceleration positioner (PNU=23) parameter; commuting this bit from 0 to 1, the interrupted position is terminated and this operation is carried out even if bit 4 is at 1.
	Start position	
7	Value	Description
	0->1 1->0	Start position: the commutation of this bit enables execution of the set position. Movement occurs only if the drive is not already carrying out a position, the home position procedure is not active and the jog 1 and jog 2 commands are disabled.
	Fault Acknowledge (0->1): reset alarms	
8	Jog 1 command	
	Value	Description
	1	Enable Jog 1 speed: the speed control is activated and the drive moves to the speed set in the jog 1 speed (PNU=92) parameter; acceleration depends on the jog acceleration (PNU=94) parameter. The jog is only activated if the drive is not carrying out a position, the home position procedure is not active and the jog 2 command is disabled.
9	0	Disable Jog 1 speed: the commutation from 1 to 0 commands a stop in speed ramp with deceleration set by the deceleration jog (PNU=95) parameter.
	Jog 2 command	
	Value	Description
	1	Enable Jog 2 speed: the speed control is activated and the drive moves to the speed set in the jog 2 speed (PNU=93) parameter; acceleration depends on the jog acceleration (PNU=94) parameter. The jog is only activated if the drive is not carrying out a position, the home position procedure is not active and the jog 1 command is disabled.

	0	Disable Jog 2 speed: commutation from 1 to 0 commands a stop in speed ramp with deceleration set by the deceleration jog (PNU=95) parameter
10	References (PZD) valid / not valid: enables or disables references from PLC.	
11	Start/Stop home position	
	Value	Description
	1	Start home position: commutation from 0 to 1 causes the home position procedure to start. The function is activated only if the drive is not carrying out a position, and the jog 1 and jog 2 commands are disabled.
	0	Stop home position: commutation from 1 to 0 of this bit causes the drive to stop in ramp on the basis of the deceleration positioner (PNU=23) parameter.
12	Absolute/relative position setting	
	Value	Description
	1	Relative position: setting for carrying out relative position
	0	Absolute position: setting for carrying out absolute position
15..13	----	

Table 39: **Control word** bit in positioner

7.2 Setting the positioner *status word* bit

Bit	Status word bit in positioner description	
0	value	(common bit in all modes) “Switch On” ready indication
	1	“Switch On” ready
	0	“Switch On” not ready
1	value	(common bit in all modes) “Operation” ready indication
	1	“Operation” ready
	0	“Operation” not ready
2	value	(common bit in all modes) “Operation” state indication
	1	“Operation” state enabled
	0	“Operation” state disabled
3	value	(common bit in all modes) “Fault” state indication
	1	Fault present
	0	No Fault present
4	value	(common bit in all modes) OFF2 command indication
	1	OFF2 command disabled
	0	OFF2 command active
5	value	(common bit in all modes) OFF3 command indication
	1	OFF3 command disabled
	0	OFF3 command active

6	value	(common bit in all modes) “Switching On Inhibited” state indication
	1	“Switching On Inhibited” state
	0	“Switching On Inhibited” state not present
7	value	(common bit in all modes) Warning state indication
	1	Warning present
	0	No Warning present
8	value	Position error control (positioner mode specific)
	1	Position OK: confirms that the position is within the limits set by the <i>position error</i> (PNU=90) and the <i>position error time</i> (PNU=91) parameters.
	0	Position error: position following error, the drive activates the fault bit to signal the position alarm.
9	value	(common bit in all modes) “Remote control” indication
	1	The master is urged to take control
	0	The master does not have management priority
10	value	Position control (positioner mode specific)
	1	Position reached: indicates that position has been reached
	0	Position not reached: position in execution phase or the drive could not complete the position following a stop.
11	value	Home Position state (positioner mode specific)
	1	Home position carried out: home position carried out correctly
	0	Home position not carried out: home position not yet carried out, or not carried out correctly, or interrupted.
12	value	Confirm position reference (positioner mode specific)
	0->1 1->0	Confirm position reference: the commutation of this bit indicates that the position has been acquired.
13	value	Drive stopped/moving (positioner mode specific)
	1	Drive stopped: indicates that the drive has stopped because the speed is within the limits set by the <i>null speed window</i> (PNU=31) and <i>null speed time</i> (PNU=32) parameters.
	0	Drive moving: drive moving because carrying out a position, or one of the jog commands is active, or the home position procedure has been launched.
14..15	----	

Table 40: *Status word* positioner

7.3 Positioner

Positioner management parameter description:

7.3.1 Position reference – PNU 80

PNU	Name	Type	Range	Default	Unit	Attributes
80	Position reference	INT32	-8FFFFFFFh..7FFFFFFFh	0		rw

This parameter represents the reference position expressed in resolver impulses, where one motor revolution corresponds to 65536 impulses.

Once the positioner control has been set, this parameter is read by the DGM drive in the PZD structure sent by the master.

7.3.2 Position speed – PNU 81

PNU	Name	Type	Range	Default	Unit	Attributes
81	Position speed	UINT16	1..9999	500	rpm	rw

The ***position speed*** represents the maximum speed of the movement position.

Once the positioner control has been set, this parameter is read by the DGM drive in the PZD structure sent by the master.

7.3.3 Position acceleration – PNU 82

PNU	Name	Type	Range	Default	Unit	Attributes
82	Position acceleration	UINT32	0..6000000	10000	rpm/s	rw

Parameter used for setting position acceleration.

7.3.4 Position deceleration – PNU 83

PNU	Name	Type	Range	Default	Unit	Attributes
83	Position deceleration	UINT32	0..6000000	10000	rpm/s	rw

Parameter used for setting position deceleration.

7.3.5 Position Jerk – PNU 84

PNU	Name	Type	Range	Default	Unit	Attributes
84	Position Jerk	UINT32	0..6000000	10000	rpm/s ²	rw

The **position jerk** is used to gather the position speed profile, in order to obtain a quadratic type continuous speed profile without discontinuity points.

7.3.6 Position profile type – PNU 85

PNU	Name	Type	Range	Default	Unit	Attributes
85	Position profile type	UINT16	0..1	1		rw

This parameter makes it possible to select which type of profile to use for carrying out the movements of a position.

values	Position profile type	Description
0	<i>Continuous mode – Trapezoidal Ramps</i>	<ul style="list-style-type: none"> With this setting the control allows the immediate change of position (position reference PNU=80) and speed (position speed PNU=81). The speed and position profiles are adapted instantly; the acceleration ramps (position acceleration PNU=82) and deceleration ramps (position deceleration PNU=83) are changed when the speed zeroes. In this case bit 13 "absolute/relative position" of the control word is not considered and the movements are carried out in absolute mode.
1	<i>Ramps with jerk</i>	<ul style="list-style-type: none"> With this setting acceleration and deceleration vary in a trapezoidal manner; the result is a quadratic speed profile and cubic type position progress. The characteristic of these profiles causes the mechanical stress to decrease as regards the position with trapezoidal ramps, and in addition there is better precision during deceleration when the drive reaches the set position.

Table 41: **Position profile type** setting

7.3.6.1 Start position management

The way to enable position starting varies according to the **Position profile type** parameter:

- Setting at **0** (continuous mode – trapezoidal ramps): In this mode if bit 6 of the **control word** is taken to 1 the DGM drive continually follows the movement assigned at the indicated speed and following the acceleration and deceleration ramps that are set. If bit 6 of the **control word** is taken to 0, the drive stops the position on the basis of the last movement value acquired before bit 6 became null.
- Setting at **1** (ramps with jerk): In this case the position is followed when bit 6 of the

control word changes from 0 to 1 or from 1 to 0, and only if the drive is not already carrying out a position movement.

7.3.7 Drive reference position – PNU 86

PNU	Name	Type	Range	Default	Unit	Attributes
86	Drive reference position	INT32	-8FFFFFFFh..7FFFFFFFh	0		r

This read only parameter supplies the internal reference position of the drive. If working with absolute position the value of this variable corresponds to the position that has actually been reached.

When the DGM drive is switched on, to avoid anomalies in the position control loop the **drive reference position** is set to be the same as that of the measured position. This can cause a deviation as regards the last position carried out.

7.3.8 Position memory – PNU 87

PNU	Name	Type	Range	Default	Unit	Attributes
87	Position memory	INT32	-8FFFFFFFh..7FFFFFFFh			r

Read-only parameter giving the value of the last position as regards the home.

7.3.9 Measured position – PNU 88

PNU	Name	Type	Range	Default	Unit	Attributes
88	Measured position	INT32	-8FFFFFFFh..7FFFFFFFh			r

This parameter indicates the measured position in resolver impulses as regards the home, where one motor revolution corresponds to 65536 impulses. This variable at most can count 32767 motor revolutions in a positive sense and -32768 in a negative sense.

7.3.10 Position error – PNU 90

PNU	Name	Type	Range	Default	Unit	Attributes
90	Position Error	UINT32	1..32767	910		r

This parameter indicates the maximum position error that can be tolerated in an application that works in position control. The unit of measurement is resolver impulses, the same as the **position reference**.

7.3.11 Position error time – PNU 91

PNU	Name	Type	Range	Default	Unit	Attributes
91	Position error time	UINT16	10..10000	50	ms	r

This parameter indicates the maximum time interval during which the position error can exceed the value set in the ***position error*** (PNU=90) variable. When this occurs the ***fault*** bit in the ***status word*** is activated.

7.4 Jog

Parameter description for jog management:

7.4.1 Jog 1 speed – PNU 92

PNU	Name	Type	Range	Default	Unit	Attributes
92	Jog 1 speed	INT16	-9999..9999	100	rpm	rw

The **jog 1 speed** indicates the reference speed when the jog 1 command is enabled

7.4.2 Jog 2 speed – PNU 93

PNU	Name	Type	Range	Default	Unit	Attributes
93	Jog 2 speed	INT16	-9999..9999	100	rpm	rw

The **jog 2 speed** indicates the reference speed when the jog 2 command is enabled

7.4.3 Jog acceleration – PNU 94

PNU	Name	Type	Range	Default	Unit	Attributes
94	Jog acceleration	UINT32	0..6000000	10000	rpm/s	rw

Parameter used for setting acceleration in **jog** mode.

7.4.4 Jog deceleration – PNU 95

PNU	Name	Type	Range	Default	Unit	Attributes
95	Jog deceleration	UINT32	0..6000000	10000	rpm/s	rw

Parameter used for setting deceleration in **jog** mode

7.5 Home Position

Description of parameters for managing the home position procedure:

7.5.1 Home position method – PNU 120

PNU	Name	Type	Range	Default	Unit	Attributes
120	Home position method	UINT16	0..35 (except 15, 16, 31 and 32)	0		rw

The ***homing method parameter*** can be used to select which method to use for carrying out homing.

Home position methods		
Method with index pulse	Method without index pulse	Sensor used
1	17	CCW sensor
2	18	CW sensor
3	19	Home sensor (on the front)
4	20	Home sensor (on the front)
5	21	Home sensor (on the front)
6	22	Home sensor (on the front)
7	23	Home sensor (on the level) positive search speed
8	24	Home sensor (on the level) positive search speed
9	25	Home sensor (on the level) positive search speed
10	26	Home sensor (on the level) positive search speed
11	27	Home sensor (on the level) negative search speed
12	28	Home sensor (on the level) negative search speed
13	29	Home sensor (on the level) negative search speed
14	30	Home sensor (on the level) negative search speed
15	31	reserved
16	32	reserved
33		Without sensor (at index pulse) negative search speed
34		Without sensor (at index pulse) positive search speed
35		Home position on actual position

Table 42: Home position methods

7.5.1.1 Method 0 - No homing operation required

At switch on, the value of the measured position is zeroed and set as the drive home position.

7.5.1.2 Method 1 - Homing on the negative limit switch and index pulse

The drive carries out the homing procedure moving in a negative direction towards the CCW limit switch sensor.

Once it has touched the sensor it continues its run to exit from the limit switch sensor at low speed. It always moves in the opposite direction on the index pulse of the resolver.

The point reached in this manner becomes the drive home.

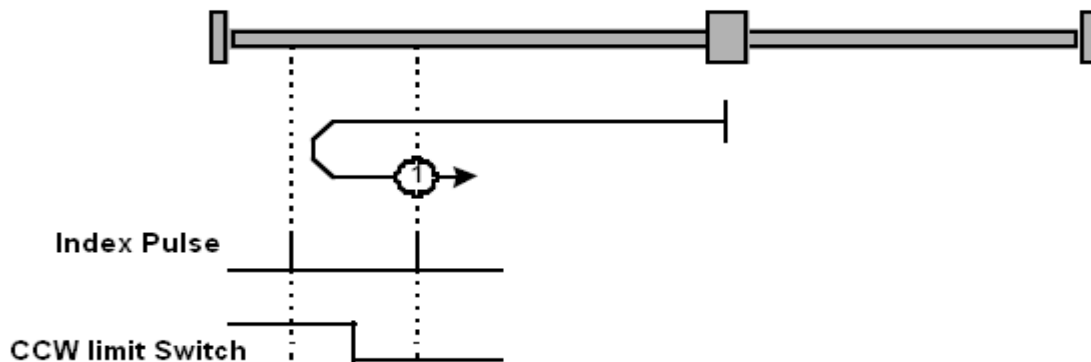


Diagram 7: Method 1 – Homing on CCW limit switch and zero resolver impulse

7.5.1.3 Method 2 - Homing on the positive limit switch and index pulse

The drive carries out homing moving in a positive direction towards the CW limit switch sensor.

Once it has touched the sensor it continues its run to exit from the limit switch sensor at low speed. It always moves in the opposite direction on the index pulse of the resolver.

The point reached in this manner becomes the drive home.

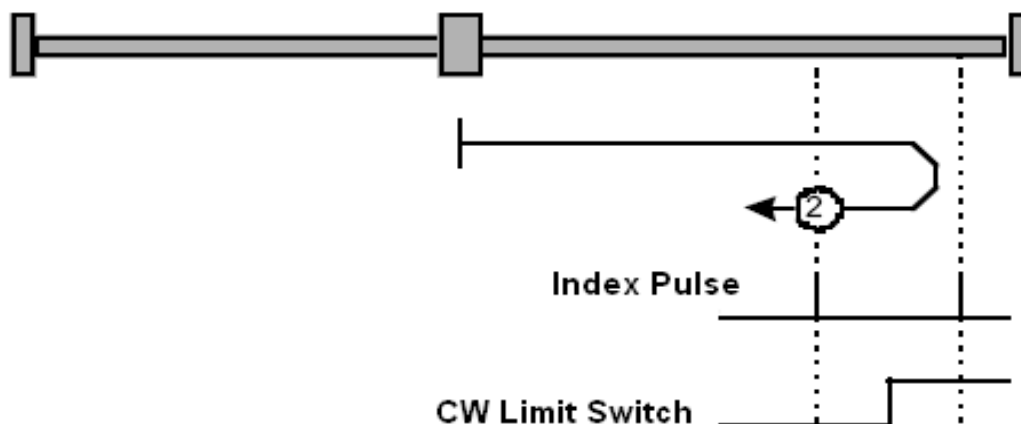


Diagram 8: Method 2 – Homing on CW limit switch and zero resolver impulse

7.5.1.4 Method 3 - Homing on the positive home switch and index pulse

The home sensor input state determines the search direction of the sensor.

If the home input is low, the motor is actuated to rotate clockwise. When home sensor commutation is found, the motor is stopped and subsequently positioned at the resolver index pulse with an anticlockwise movement.

If the home input is high, the motor is actuated to rotate anticlockwise. When home sensor commutation is found, the motor is stopped and subsequently positioned at the resolver index pulse with a clockwise movement.

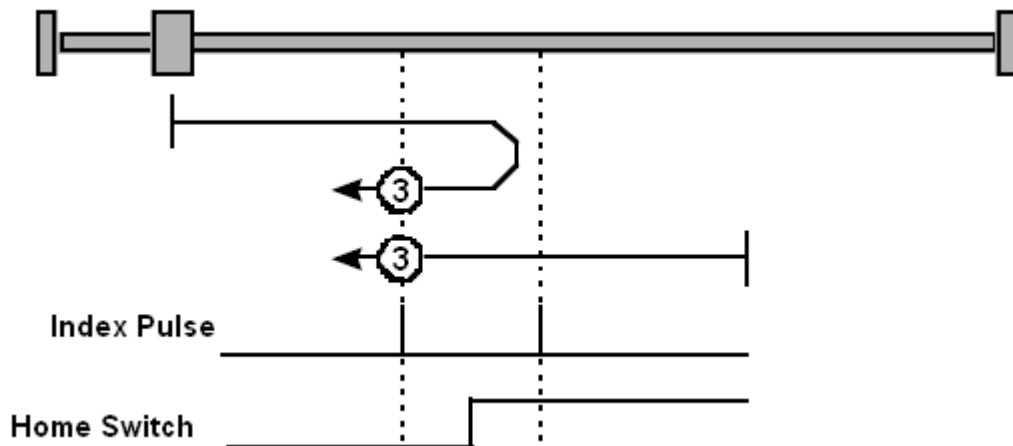


Diagram 9: Method 3 – Homing with home sensor

7.5.1.5 Method 4 - Homing on the positive home switch and index pulse

The home sensor input state determines the search direction of the sensor.

If the home input is high, the motor is actuated to rotate anticlockwise. When home sensor commutation is found, the motor is stopped and subsequently positioned at the resolver index pulse with a clockwise movement.

If the home input is low, the motor is actuated to rotate clockwise. When home sensor commutation is found, the motor is stopped and subsequently positioned at the resolver index pulse with a clockwise movement.

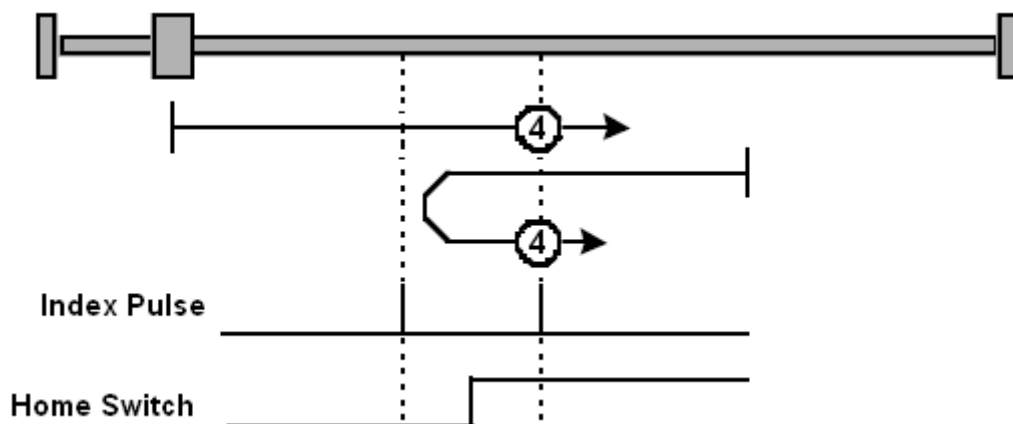


Diagram 10: Method 4 – Homing with home sensor

7.5.1.6 Method 5 - Homing on the negative home switch and index pulse

The home sensor input state determines the search direction of the sensor.

If the home input is low, the motor is actuated to rotate anticlockwise. When home sensor commutation is found the motor is stopped and subsequently positioned at the resolver index pulse with a clockwise movement.

If the home input is high, the motor is actuated to rotate clockwise. When home sensor commutation is found, the motor is stopped and subsequently positioned at the resolver index pulse with a clockwise movement.

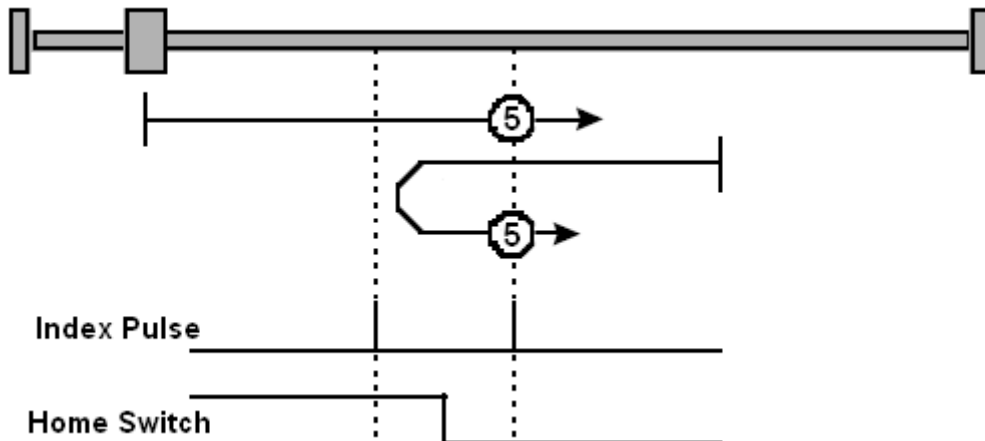


Diagram 11: Method 5 – Homing with home sensor

7.5.1.7 Method 6 - Homing on the negative home switch and index pulse

The home sensor input state determines the search direction of the sensor.

If the home input is high, the motor is actuated to rotate clockwise. When home sensor commutation is found the motor is stopped and subsequently positioned at the resolver index pulse with an anticlockwise movement.

If the home input is low, the motor is actuated to rotate anticlockwise. When home sensor commutation is found, the motor is stopped and subsequently positioned at the resolver index pulse with an anticlockwise movement.

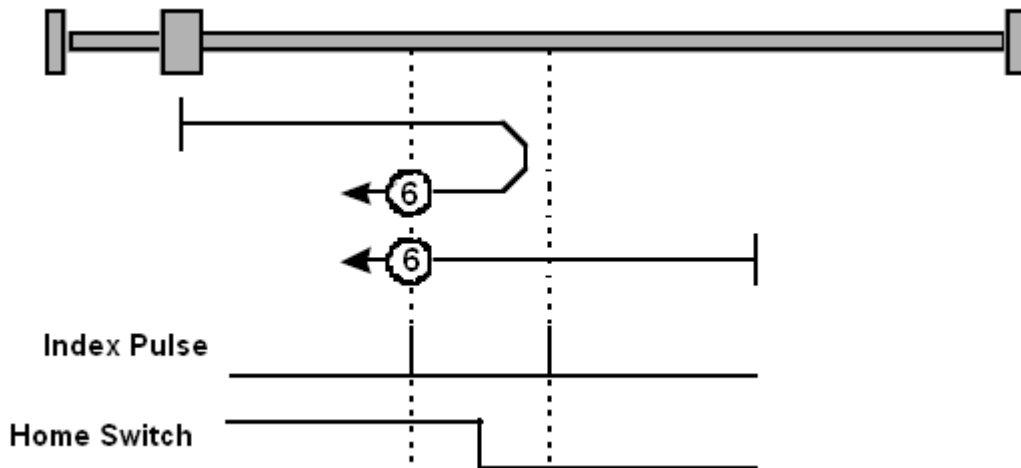


Diagram 12: Method 6 – Homing with home sensor

7.5.1.8 Method 7 - *Homing on the home switch and index pulse*

The search direction of the home sensor is clockwise. Once the home sensor has been found, the drive moves the motor at low speed and in an anticlockwise direction to exit from the sensor. After this it moves anticlockwise on the resolver index pulse. If the CW limit switch is touched, the sense of rotation is inverted in order to take the motor to the home sensor.

7.5.1.9 Method 8 - *Homing on the home switch and index pulse*

The search direction of the home sensor is clockwise. Once the home sensor has been found, the drive moves the motor at low speed and in an anticlockwise direction to exit from the sensor. After this it moves anticlockwise on the resolver index pulse. If the CW limit switch is touched, the sense of rotation is inverted in order to take the motor to the home sensor.

7.5.1.10 Method 9 - *Homing on the home switch and index pulse*

The search direction of the home sensor is clockwise. Once the home sensor has been found, the drive moves the motor at low speed and in a clockwise direction to exit from the sensor. After this it moves anticlockwise on the resolver index pulse. If the CW limit switch is touched, the sense of rotation is inverted in order to take the motor to the home sensor.

7.5.1.11 Method 10 - *Homing on the home switch and index pulse*

The search direction of the home sensor is clockwise. Once the home sensor has been found, the drive moves the motor at low speed and in a clockwise direction to exit from the sensor. After this it moves clockwise on the resolver index pulse. If the CW limit switch is touched, the sense of rotation is inverted in order to take the motor to the home sensor.

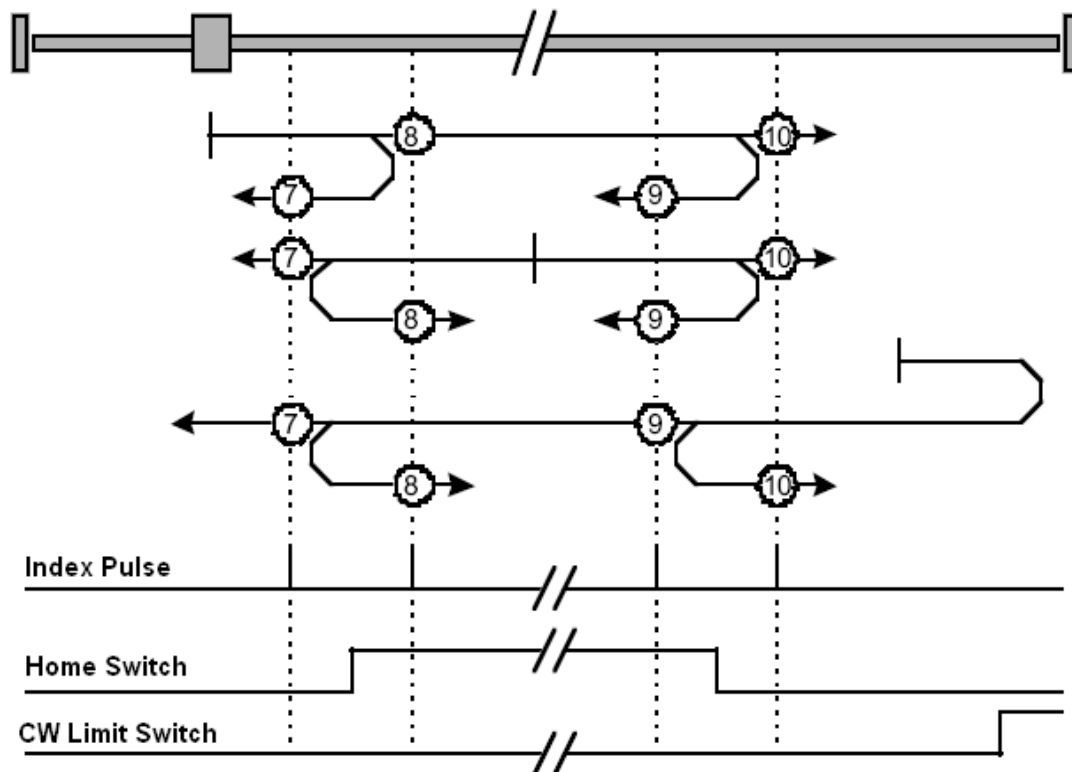


Diagram 13: Methods 7,8,9,10 – Homing with the home sensor

7.5.1.12 Method 11 - Homing on the home switch and index pulse

The search direction of the home sensor is anticlockwise. Once the home sensor has been found the drive moves the motor at low speed and in a clockwise direction to exit from the sensor. After this it moves clockwise on the resolver index pulse.

If the CCW limit switch is touched, the sense of rotation is inverted in order to take the motor to the home sensor.

7.5.1.13 Method 12 - Homing on the home switch and index pulse

The search direction of the home sensor is anticlockwise. Once the home sensor has been found, the drive moves the motor at low speed and in a clockwise direction to exit from the sensor. After this it moves anticlockwise on the resolver index pulse.

If the CCW limit switch is touched, the sense of rotation is inverted in order to take the motor to the home sensor.

7.5.1.14 Method 13 - Homing on the home switch and index pulse

The search direction of the home sensor is anticlockwise. Once the home sensor has been found, the drive moves the motor at low speed and in an anticlockwise direction to exit from the sensor. After this it moves clockwise on the resolver index pulse.

If the CCW limit switch is touched, the sense of rotation is inverted in order to take the motor to the home sensor.

7.5.1.15 Method 14 - *Homing on the home switch and index pulse*

The search direction of the home sensor is anticlockwise. Once the home sensor has been found, the drive moves the motor at low speed and in an anticlockwise direction to exit from the sensor. After this it moves anticlockwise on the resolver index pulse. If the CCW limit switch is touched, the sense of rotation is inverted in order to take the motor to the home sensor.

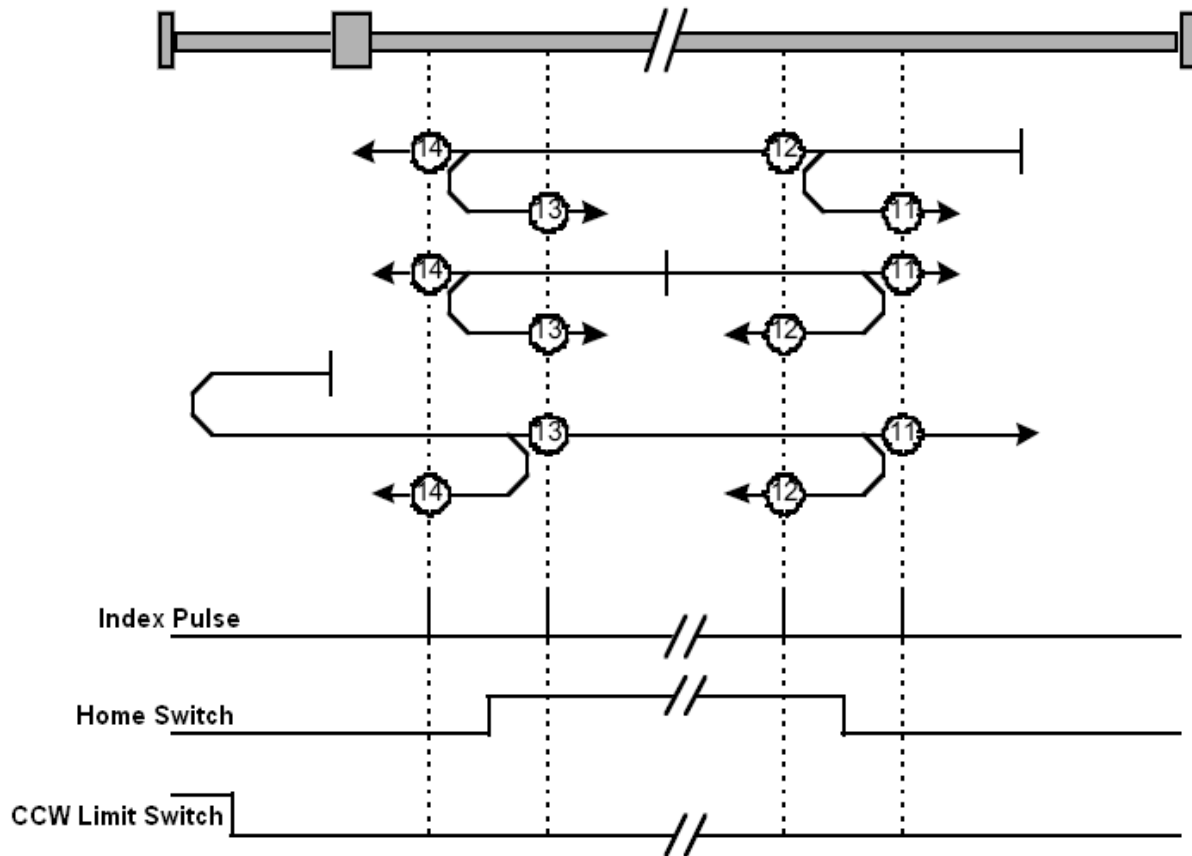


Diagram 14: Methods 11,12, 13, 14 – Homing with the home sensor

7.5.1.16 Methods from 17 to 30

The homing methods that go from 17 to 30 correspond respectively to the methods that go from 1 to 14, with the difference being that in this case the sensor index pulse is not searched for. As an example, methods 17 and 18 are carried out as shown in the drawings that follow.

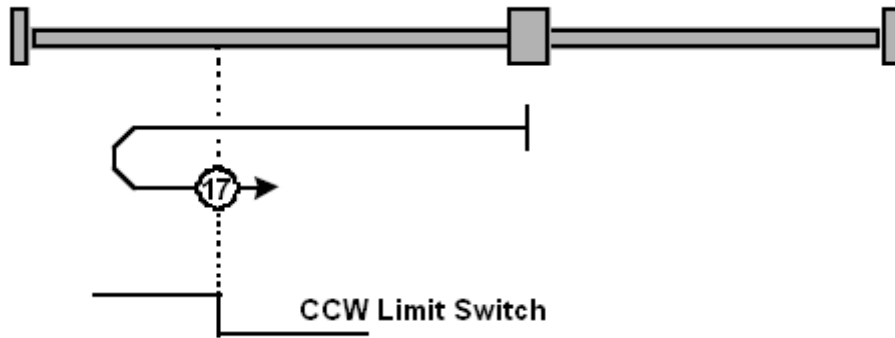


Diagram 15: Method 17 – Homing with the CCW limit switch

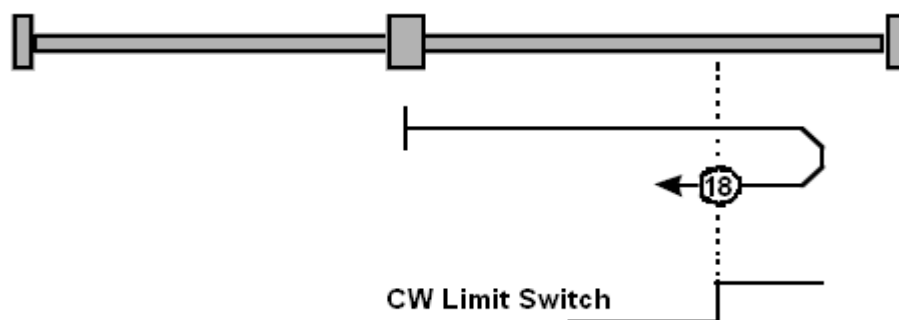


Diagram 16: Method 18 – Homing with the CW limit switch

7.5.1.17 Method 33 - Homing on index pulse (negative direction)

Starting from the point it is in, the drive moves negatively on the resolver index pulse. The point reached in this way becomes the drive home.

7.5.1.18 Method 34 - Homing on index pulse (positive direction)

Starting from the point it is in, the drive moves positively on the resolver index pulse. The point reached in this way becomes the drive home.

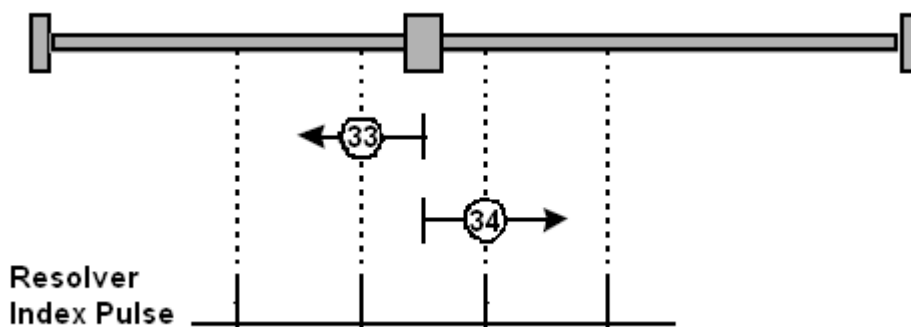


Diagram 17: Methods 3,4 – Homing on resolver zero impulse

7.5.1.19 Method 35 - Homing on the current position

The current position is taken as the drive home.

7.5.2 Sensor search speed – PNU 121

PNU	Name	Type	Range	Default	Unit	Attributes
121	Sensor search speed	UINT16	1..9999	100	rpm	rw

This parameter sets the search speed of the limit switch.

7.5.3 Sensor output speed – PNU 122

PNU	Name	Type	Range	Default	Unit	Attributes
122	Sensor output speed	UINT16	1..9999	10	rpm	rw

The sensor output speed parameter sets the speed used by the drive to move backwards in order to exit from the sensor once it has touched the limit switch.

7.5.4 Home position acceleration – PNU 123

PNU	Name	Type	Range	Default	Unit	Attributes
123	Home position acceleration	UINT32	0..6000000	10000	rpm/s	rw

Parameter used for setting acceleration in the homing procedure.

7.6 Limit switch for home position procedure

The limit switches used depend on the type of homing set (**home position method** at address PNU=120). The firmware automatically activates the limit switch, which must be cabled at the preset inputs. The activation voltage of the limit switch can be set modifying bits 2, 3 and 4 of the **Input output setting** (PNU=202).

Number Input	Limit switch wiring
1	Input for CW limit switch
2	Input for CW limit switch
6	Input for home end

Table 43: Inputs set for limit switch

Bit	Setting bits 2, 3, 4 <i>Input output setting (PNU=202) parameter</i>	
2	0	If input 1 is used as a CW limit switch, the limit switch is considered active when a 0V voltage is supplied to the input.
	1	If input 1 is set as the CW limit switch, the limit switch is considered active when a 24 V voltage is supplied to the input.
3	0	If input 2 is set as the CCW limit switch, the limit switch is considered active when a 0 V is supplied to the input.
	1	If input 2 is set as the CCW limit switch, the limit switch is considered active when a 24 V voltage supplied to the input.
4	0	If input 6 is used as a home sensor for home search, it is considered active when a 0 V voltage is supplied to the input.
	1	If input 6 is used as a home sensor for home search, it is considered active when a 24 V voltage is supplied to the input.

Table 44: Limit switch voltage setting

8 Analogue speed control

The speed loop is active when the **operation mode** (PNU=930) is set at -1. The operation mode of the analogue speed control is the same as that of the digital speed control, excluding the speed reference that is acquired from the 16 bit analogue input present in the DGM drive.

PNU	Name	Type	Attributes
140	Analogue speed bottom scale	UINT16	rw
141	Analogue speed acceleration	UINT32	rw
142	Analogue speed deceleration	UINT32	rw

Table 45: Analogue speed control parameters

8.2 Setting the control word in analogue speed bit

Bit	Analogue speed control word bit description	
0	OFF1 / ON1 command: (for state machine management)	
1	OFF2 / ON2 command: (for state machine management)	
2	OFF3 / ON3 command: (for state machine management)	
3	Operation enable/disable command: (for state machine management)	
4	RFG On/Off (RFG = Ramp Function Generator)	
	Value	Description
	1	Speed loop reference enabled and corresponds to the output variable of the function that generates the acceleration and deceleration ramps.
	0	The drive remains stopped in torque with null speed.
5	RFG unlock On/Off	
	Value	Description
	1	Output variable of the enabled ramps, updated by the function for generating the acceleration or deceleration ramps on the basis of the analogue speed acceleration (PNU=141) and analogue speed deceleration (PNU=142) parameters.
	0	Blocks the output variable of the ramps at the current value.
6	On/Off speed reference	
	Value	Description
	1	The analogue input value converted on the basis of the analogue speed bottom scale (PNU=140) parameter is assigned as an input to the function set for generating the speed ramps.
	0	The input of the function that generates the ramp is positioned at zero.
7	Fault Acknowledge (0->1) : reset alarms	
8..9	----	
10	References (PZD) valid / not valid : enables or disables references from PLC	
15..11	----	

Table 46: Analogue speed *control word* bit

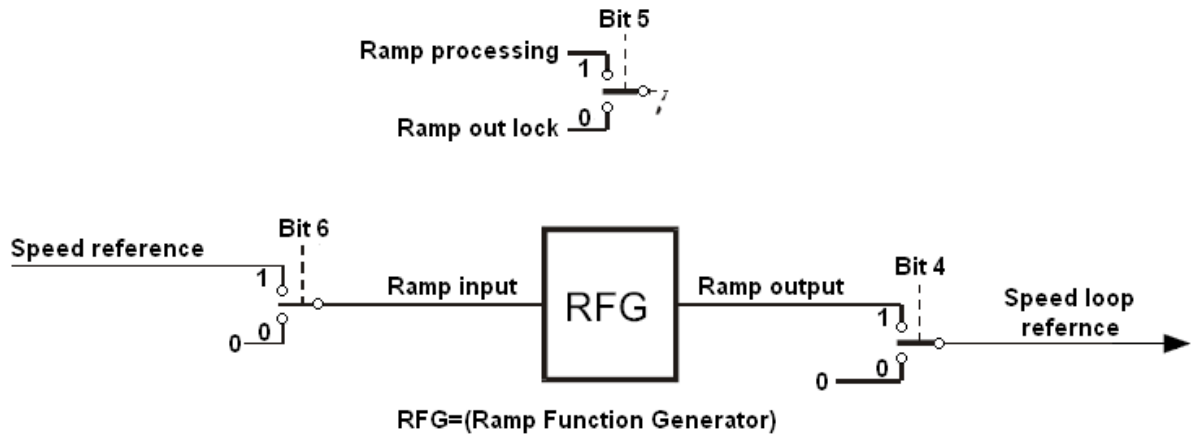


Diagram 18: **control word** bits 4, 5 and 6 in analogue speed

8.3 Setting the status word bit in analogue speed

Bit	Setting the status word bit in analogue speed	
0	Value	(common bit in all modes) “Switch On” ready indication
	1	“Switch On” ready
	0	“Switch On” not ready
1	value	(common bit in all modes) “Operation” ready indication
	1	“Operation” ready
	0	“Operation” not ready
2	value	(common bit in all modes) “Operation” state indication
	1	“Operation” state enabled
	0	“Operation” state disabled
3	value	(common bit in all modes) “Fault” state indication
	1	Fault present
	0	No Fault present
4	value	(common bit in all modes) OFF2 command indication
	1	OFF2 command disabled
	0	OFF2 command active
5	value	(common bit in all modes) OFF3 command indication
	1	OFF3 command disabled
	0	OFF3 command active
6	value	(common bit in all modes) “Switching On Inhibited” state indication
	1	“Switching On Inhibited” state
	0	“Switching On Inhibited” not present

7	value	(common bit in all modes) Warning state indication
	1	Warning present
	0	No Warning present
8	value	Speed reference control (analogue speed mode specific)
	1	Reference Ok : indicates that the speed reference is within the limits set by the Speed reference window (PNU=64) parameter and the Speed reference time (PNU=63) parameter.
	0	Reference out of range
9	value	(common bit in all modes) “ Remote control ” indication
	1	The master is urged to take control
	0	The master does not have management priority
10	value	Minimum speed control (analogue speed mode specific)
	1	Minimum speed reached : indicates that the speed is within the limits set in the Null speed window (PNU=31) parameter and the Null speed time (PNU=32) parameter.
	0	Minimum speed not reached
11..15	----	

Table 47: *status word* in digital speed

8.4 Speed reference – PNU 140

PNU	Name	Type	Range	Default	Unit	Attributes
140	Analogue speed bottom scale	UINT16	1..9999	3000	rpm	rw

The **analogue speed bottom scale** parameter represents the speed value when the input voltage of the analogue reference is equal to 10 V. For a voltage of -10 V the converted speed assumes the value **–analogue speed bottom scale**. For intermediate voltage values the speed is converted proportionally.

8.5 Analogue speed acceleration – PNU 141

PNU	Name	Type	Range	Default	Unit	Attributes
141	Analogue speed acceleration	UINT32	0..6000000	10000	rpm/s	rw

This parameter is used to set acceleration in the function that manages the speed ramps.

8.6 Analogue speed deceleration – PNU 142

PNU	Name	Type	Range	Default	Unit	Attributes
142	Analogue speed deceleration	UINT32	0..6000000	10000	rpm/s	rw

This parameter is used to set deceleration in the function that manages the speed ramps.

9 Digital torque control

The torque loop activates when the *operation mode* (PNU=930) parameter is set at -2.

PNU	Name	Type	Attributes
160	Digital torque reference	INT16	rw
162	Measured torque percentage	INT16	r

Table 48: Digital torque control parameters

9.1 Setting the control word bit in digital torque

Bit	Control word bit description in digital torque	
0	OFF1 / ON1 command: (for state machine management)	
1	OFF2 / ON2 command: (for state machine management)	
2	OFF3 / ON3 command: (for state machine management)	
3	Operation enable/disable command: (for state machine management)	
4..5	----	
6	On/Off Torque Reference	
	Value	Description
	1	Torque loop reference enabled.
	0	The drive does not move with null torque
7	Fault Acknowledge (0->1) : reset alarms	
8..9	----	
10	References (PZD) valid / not valid : enables or disables reference from PLC	
15..11	----	

Table 49: *control word* bit digital torque

9.2 Digital torque status word bit setting

Bit	Status word bit in digital torque description	
0	value	(common bit in all modes) “Switch On” ready indication
	1	“Switch On” ready
	0	“Switch On” not ready
1	value	(common bit in all modes) “Operation” ready indication
	1	“Operation” ready
	0	“Operation” not ready
2	value	(common bit in all modes) “Operation” state indication
	1	“Operation” state enabled
	0	“Operation” state disabled
3	value	(common bit in all modes) “Fault” state indication
	1	Fault present
	0	No Fault present
4	value	(common bit in all modes) OFF2 command indication
	1	OFF2 command disabled
	0	OFF2 command active

5	value	(common bit in all modes) OFF3 command indication
	1	OFF3 command disabled
	0	OFF3 command active
6	value	(common bit in all modes) “ Switching On Inhibited ” state indication
	1	“ Switching On Inhibited ” state
	0	“ Switching On Inhibited ” state not present
7	value	(common bit in all modes) Warning state indication
	1	Warning present
	0	No Warning present
8	----	
9	value	(common bit in all modes) “ Remote control ” indication
	1	The master is urged to take control
	0	The master does not have management priority
10	value	Minimum speed control (digital torque mode specific)
	1	Minimum speed reached : indicates that the speed is within the limits set by the <i>Null speed window</i> (PNU=31) parameter and by the <i>Null speed time</i> (PNU=32) parameter.
	0	Minimum speed not reached
11..15	----	

Table 50: *status word* in digital torque

9.3 Digital torque reference – PNU 160

PNU	Name	Type	Range	Default	Unit	Attributes
160	Digital torque reference	INT16	-250..250	0	%	rw

The **digital torque reference** sets the torque value. This variable is expressed as a percentage of the nominal torque value of the motor.

Once the digital torque control has been set, this parameter is read by the DGM drive in the PZD structure sent by the master.

9.4 Measured torque percentage – PNU 162

PNU	Name	Type	Range	Default	Unit	Attributes
162	Measured torque percentage	INT16			%	r

This parameter represents the measured torque value expressed as a percentage of the nominal torque value of the motor.

Once the digital torque control has been set, this parameter is sent to the master in the PZD structure.

10 Analogue torque control

The torque loop is active when the **operation mode** (PNU=930) is set at -3. The operation mode of the analogue torque control is the same as that of the digital torque control, excluding the torque reference that is acquired from the 16 bit analogue input present in the DGM drive.

PNU	Name	Type	Attributes
161	Analogue torque bottom scale	UINT16	rw

Table 51: Analogue torque control parameters

10.1 Setting the *control word* bit in analogue torque

Bit	Control word bit description in analogue torque	
0	OFF1 / ON1 command: (for state machine management)	
1	OFF2 / ON2 command: (for state machine management)	
2	OFF3 / ON3 command: (for state machine management)	
3	Operation enable/disable command: (for state machine management)	
4..5	----	
6	Torque reference On/Off	
	Value	Description
	1	Torque loop reference enabled.
	0	The drive remains stopped with null torque
7	Fault Acknowledge (0->1) : reset alarms	
8..9	----	
10	References (PZD) valid / not valid : enables or disables references from PLC	
15..11	----	

Table 52: *control word* bit in analogue torque

10.2 Setting the *status word* bit in analogue speed

Bit	Status word bit description in analogue torque	
0	value	(common bit in all modes) “Switch On” ready indication
	1	“Switch On” ready
	0	“Switch On” not ready
1	value	(common bit in all modes) “Operation” ready indication
	1	“Operation” ready
	0	“Operation” not ready
2	value	(common bit in all modes) “Operation” state indication
	1	“Operation” state enabled
	0	“Operation” state disabled
3	value	(common bit in all modes) “Fault” state indication
	1	Fault present
	0	No Fault present
4	value	(common bit in all modes) OFF2 command indication
	1	OFF2 command disabled
	0	OFF2 command active
	value	(common bit in all modes) OFF3 command indication

5	1	OFF3 command disabled
	0	OFF3 command active
6	value	(common bit in all modes) “ Switching On Inhibited ” state indication
	1	“ Switching On Inhibited ” state
	0	“ Switching On Inhibited ” state not present
7	value	(common bit in all modes) Warning state indication
	1	Warning present
	0	No Warning present
8	----	
9	value	(common bit in all modes) “ Remote Control ” indication
	1	The master is urged to take control
	0	The master does not have management priority
10	value	Minimum speed control (analogue torque mode specific)
	1	Minimum speed reached : indicates that the speed is within the limits set by the Null speed window (PNU=31) parameter and by the Null speed time (PNU=32) parameter
	0	Minimum speed not reached
11..15	----	

Table 53: *Status word* in analogue torque

10.3 Analogue torque bottom scale – PNU 161

PNU	Name	Type	Range	Default	Unit	Attributes
161	Analogue torque bottom scale	UINT16	0..250	100	%	rw

The **analogue torque bottom scale** parameter represents the torque value (expressed as a percentage of the motor nominal torque) when the input voltage of the analogue reference is equal to 10 V. For a voltage of -10 V the converted torque takes on the percentage value **–analogue speed bottom scale**. For intermediate voltage values the speed is converted proportionally.