ABB Sace

ABB AC Brushless Servodrives
DGV Converters

PROFIBUS Guide

ABB AC Brushless Servodrives
DGV Converters

PROFIBUS Guide

MANIU20.0507 E

EFFECTIVE: 01.07.2005
SUPERSEDES: 14.04.2005

Safety Instructions

General

This chapter states the safety instructions that must be followed when configuring the DGV Converters. The material in this chapter must be studied before attempting any work on, or with, the device.

Since DGV integrates a PROFIBUS adapter module within its components, the safety instructions to be followed are basically the same enlisted in *Chapter 9 - Standards and Safety* of the *Installation Manual*.

Warnings and Notes

This manual distinguishes two sorts of safety instructions. Warnings are used to inform of conditions which can, if proper steps are not taken, lead to a serious fault condition, physical injury and death. Notes are used when the reader is required to pay special attention or when there is additional information available on the subject. Notes are less crucial than Warnings, but should not be disregarded.

Warnings

Readers are informed of situations that can result in serious physical injury and/or serious damage to equipment with the following symbols:

WARNING! Dangerous Voltage: warns of situations in which a high voltage can cause physical injury and/or damage equipment. The text next to this symbol describes ways to avoid the danger.

WARNING! General Warning: warns of situations which can cause physical injury and/or damage equipment by means other than electrical. The text next to this symbol describes ways to avoid the danger.

Electrostatic Discharge Warning: warns of situations in which an electrostatic discharge can damage equipment. The text next to this symbol describes ways to avoid the danger.

Notes

Readers are notified of the need for special attention or additional information available on the subject with the following symbol:

CAUTION! **Caution** aims to draw special attention to a particular issue.

Note: **Note** gives additional information or points out more information available on the subject.

General Safety Instructions

WARNING! The contents of this guide refer to DGV converters correctly installed as described in the *Installation Manual*.

Only properly qualified electricians who are familiar with operation on converters are allowed to perform the commissioning and operation activities of the DGV Converters described in this Guide.

WARNING! For no reason should any person access the internal part of the converter or the terminals of the servomotor, before at least four minutes from the power outage.

Potentially lethal voltages are present on a DC intermediate circuit and on the associated circuits.

WARNING! The machine manufacturer who commissions the converter, must install proper additional protection functions to avoid damages to health or equipment when the machine is operating.

Neglecting these instructions can cause physical injury and death.

More Warnings and Notes are printed at appropriate instances along the text.

Table of Contents

Chapter 1 - General Information

Introduction

This document *PROFIBUS Guide* is part of the DGV Converters manual, code MANIU20.0507 E , provided by ABB Sace S.p.a. The material in this chapter must be studied before attempting any work on, or with, the device.

Before You Start

This Guide contains the technical specifications of the PROFIBUS-DP communication interface module built into DGV Converters.

The reader is expected to have an appropriate knowledge of electrical fundamentals, electrical wiring practices, the drive, the use of the drive control panel, and the PROFIBUS protocol family.

What this Guide contains

This document guides the user to the commissioning and operating of DGV Converter using the standard communication protocol PROFIBUS-DP.

It is assumed that the drive is installed and ready for the configuring procedures. For more information please refer to the *Installation Manual*.

Safety Instructions are featured in the first few pages of this Guide. Safety Instructions describe the formats for various warnings and notations used within this Guide. This chapter also states the safety instructions which apply to the operation of the DGV Converters.

Chapter 1 - General Information contains a short description of this Guide and the conventions adopted for the PROFIBUS profile description.

Chapter 2 - Introduction to PROFIBUS contains a short description of the PROFIBUS protocol and the PROFIBUS-DP interface module of DGV Converters.

Chapter 3 - Electrical Installation shows a schematic example of a PROFIBUS network with several stations.

Chapter 4 - Programming DGV explains how to configure the drive before the communication through the interface module can be started.

Chapter 5 - PROFIBUS Communication contains a description of the data structure of the PROFIBUS communication standard and the specifications used on DGV.

Chapter 6 - Description of Functions introduces the operating modes supported by DGV Converters.

Appendix A presents the PROFIBUS Parameters.

Appendix B presents the error codes.

Appendix C contains Technical Data.

Related Documentation

In addition to the present *PROFIBUS Guide*, please consult the complete technical documentation of the DGV, which includes:

- The *Installation Manual* of DGV Converters
- The *Firmware Manual* of DGV Converters.

Conventions used in this Guide

PROFIBUS Module

The "PROFIBUS Module" is hardware and software interface equipment through which a converter can be connected to an external serial communication network.

DGV is equipped with a built in PROFIBUS-DP interface module for communication and remote control. The communication through the interface module is activated with a drive parameter.

Parameter

A parameter is a coded operating instruction sent to the drive. Parameters can be read and programmed through the PROFIBUS Module.

Master – Slave

PROFIBUS is a communication protocol conceived to connect up to 127 devices over the same network. It is a ***master–slave*** protocol, that is one or more ***master*** stations control and supervise the ***slave*** stations connected to the network. The master station is an external control system, usually a PLC, with field bus interface modules. DGV is a slave, or passive, station.

Data Sets and Data Words

Data sets are clusters of data sent through the PROFIBUS link. Each data set consists of three 16-bit words, i.e. data words. The Control Word and the Status Word, References and Actual Values (see Chapter 5) are types of data words; the contents of some data words are user-definable.

Further Information

Further information is available on the worldwide website of the PROFIBUS association www.profibus.com

Chapter 2 - Introduction to PROFIBUS

Introduction

This chapter contains a short description of the PROFIBUS standard communication protocol and the formal reference documents used for the development of the PROFIBUS-DP interface module of DGV.

PROFIBUS

PROFIBUS is an open serial communication standard that enables data exchange between all kinds of automation components. There are three main variations of PROFIBUS: PROFIBUS-FMS (Fieldbus Message Specification), PROFIBUS-DP (Decentralized Periphery) and PROFIBUS-PA (Process Automation).

The physical transmission medium of the bus is a twisted pair cable (according to the RS 485 standard). The maximum length of the bus cable is 100 to 1200 meters, depending on the selected transmission rate (see Appendix C). Up to 31 stations can be connected to the same PROFIBUS system without the use of repeaters. With repeaters, it is possible to connect 127 stations (including the repeaters, and the master station) to the system.

In PROFIBUS communication, the master station – usually a programmable logic controller (PLC) – polls the slaves which respond and take the actions requested by the master. It is also possible to send a command to several slaves at the same time; in this case the slaves send no response message to the master. Communication between the slaves is not possible on a PROFIBUS link.

The PROFIBUS protocol family is specified in the **EN 50170** Standard. The communication with a drive is discussed in *PROFIDRIVE – PROFIBUS Profile for Adjustable Speed Drives* doc. nr. 3.072. For further information on PROFIBUS, refer to the above-mentioned standards.

The PROFIBUS-DP Interface Module

DGV Converters are equipped with a PROFIBUS-DP interface module. The interface module enables the connection of the drive to a PROFIBUS network. The drive is a slave station. Through this module it is possible for the DGV to:

- Receive the control commands, *Control Word*
- Receive and execute the speed, position and torque reference setpoints
- Send the status information, *Status Word*, and the process actual values from the drive to the master station
- Change the drive parameter values
- Reset a drive fault

Being this interface module built into the DGV case and ready for operation, the EMC compatibility of the module is the one related to the drive itself described in Chapter 9 of the *Installation Manual*, valid for DGV in general.

The technical specifications for commissioning the PROFIBUS communication and the remote control of DGV are explained in *Chapter 4 - Programming DGV* and *Chapter 5 - PROFIBUS Communication* of the present Guide.

The instructions of the later chapters assume that the drive is mechanically and electrically installed (see the *Installation Manual*).

Chapter 3 - Electrical Installation

Introduction

This chapter contains the instructions for:

- cabling
- field bus connection.

WARNING! Switch off the drive power supply when installing or cabling the drive. Wait four minutes to ensure that the capacitor bank of the drive is discharged.

Cabling

Arrange the bus and signals cables physically separated from the power and motor cables.

Avoid parallel runs.

If necessary, use metal wire channels and metal sheaths.

Power and signals cables must be accurately shielded.

Concerning the maximum length allowed for power and signal cables please refer to the *Installation Manual*.

Setting the Node Address

The selection of node address can be either software or hardware.

Selection of the node address on DGV300 Converters may be only software, through the Browser or an external controller.

Selection of the node address on DGV700 Converters depends on the setting of the rotary dip-switches located on the converter front panel.

- Setting the switches to FF hex enables to select the node number by Browser or by a remote controller. In this case the node address is a read/write parameter.
- Setting the switches to any value from 0x00 (i.e. 0) to 0x7F (i.e. 127) makes the hardware selection of the node address, therefore the node address parameter is read-only.

PROFIBUS Connections

DGV700

The bus cable is connected to terminals X2 and X3 (sub-D 9 female) on the converter front panel.

These terminals are internally connected. The installer can use both terminals (one input and one output), or one terminal only by preparing an input/output cable.

For pin-out of terminals X2 and X3, and the wiring scheme of the field bus cable, see Chapter 7 of the *Installation Manual*.

DGV300

The bus cable is connected to terminals X4 (sub-D 9 female) on the converter front panel.

For pin-out of terminal X4 and the wiring scheme of the field bus cable, see Chapter 8 of the *Installation Manual*.

Chapter 4 - Programming DGV

Introduction

This chapter contains the information for configuring the DGV as a PROFIBUS-DP *slave* station.

Configuring the system

Once the drive is mechanically and electrically installed according with the instructions in the *Installation and Start-up Guide* and the *Firmware Manual*, the user has to configure the system and set up the communication between the master station and the drives connected to the PROFIBUS network.

Please refer to the master station documentation for additional information on configuring the communication with the DGV interface module.

Configuring the drive

The GSD file provided by ABB Sace for DGV is compatible with master devices from various manufacturers.

The procedure for activating the communication between the master and the converters is to configure the *PROFIBUS Profile-Specific Parameters*, i.e. the parameters specific of the PROFIBUS profile for variable speed drives.

To make the communication effective:

- The master station must send/receive PPO Type 2 telegrams
- The user must assign the node address to any drive connected to the PROFIBUS network, either by the converter parameters (Node Address) or by the switch selectors on the front panel.
- The parameter *Control Mode* has to be properly set (see Chapter 6).

If the node address was assigned using the converter parameters, it is possible to change the address through parameter PNU 918, Node Address.

The full list of parameters having read/write access through the PROFIBUS network is available in *Appendix A - Parameter List*.

As the communication is established, always check the parameters before enabling the drive operation.

The value of some parameters may depend on the size of the converter and/or be peculiar for the application configured (see the *Installation Manual* and *Firmware Manual*).

In order to avoid undesired modifications of parameters, protect the access to your system data and the source files of the master station.

PROFIBUS Profile-Specific Parameters

These parameters are necessary for the communication, the device identification and for FMA/FMS protocol compatibility.

PNU	Data Type	Description
900	Octet-String12	PPO-type 1 write (FMS compatibility)
901	Octet-String20	PPO-type 2 write
904	Octet-String4	Current PPO-write
907	Unsigned16	PPO-type 1 read (FMS compatibility)
908	Octet-String12	PPO-type 2 read
911	Octet-String20	Current PPO-read
918	Unsigned16	Node address (1-127)
922	Unsigned16	Telegram Selection. Selection of the structure of telegram: 101 Standard Telegram 101 102 Standard Telegram 102
930	Unsigned16	Modes of Operation. Selection switch for operating mode: - 3 Digital Torque - 2 Analog Torque - 1 Analog Speed 0 N.A. 1 Speed Mode 2 Positioning Mode
945	Array[64] Unsigned16	Fault Number: index 0 contains the fault code also displayed on the front panel (see *Appendix B - Error Codes*)
953	Unsigned16	Alarm. Bit 0 set to 1 means I·t alarm present Bit 1 set to 1 means I^2·t alarm present Bit 2 set to 1 means axis exceeded SW negative limit switch Bit 3 set to 1 means axis exceeded SW positive limit switch Bit 4 set to 1 means axis not referenced Bit 5 set to 1 means absolute position modulo error Bit 6 set to 1 means invalid table selection Bit 7 set to 1 means concurrect activation Jog1-Jog2
964	Visible-String46	Device Identification. Short description of the device.
965	Octet-String2	Software Version
966	Octet-String4	(FMA compatibility)
967	Unsigned16	Control Word
968	Unsigned16	Status Word
971	Unsigned16	Freeze Configuration. Parameter value set to 1 stores the configuration parameters into the non volatile flash memory. ***Note.*** When a Freeze command has been executed, **PNU 971 must be reset to value 0**.

Chapter 5 - PROFIBUS Communication

Introduction

This chapter describes the content of the PROFIBUS messages used for the communication with the drive, and the specifics for the remote control of DGV.

The PROFIBUS communication protocol allows the cyclic data transfer and the remote control of a large number of peripherals and field devices.

For data transferring the PROFIBUS protocol uses the so-called PPO messages (*Parameter/Process Data Object*), that is data telegrams with which the master station commands and controls the distributed periphery. The content and the meaning of the telegrams are predefined by the PROFIBUS standard protocol depending on the device type.

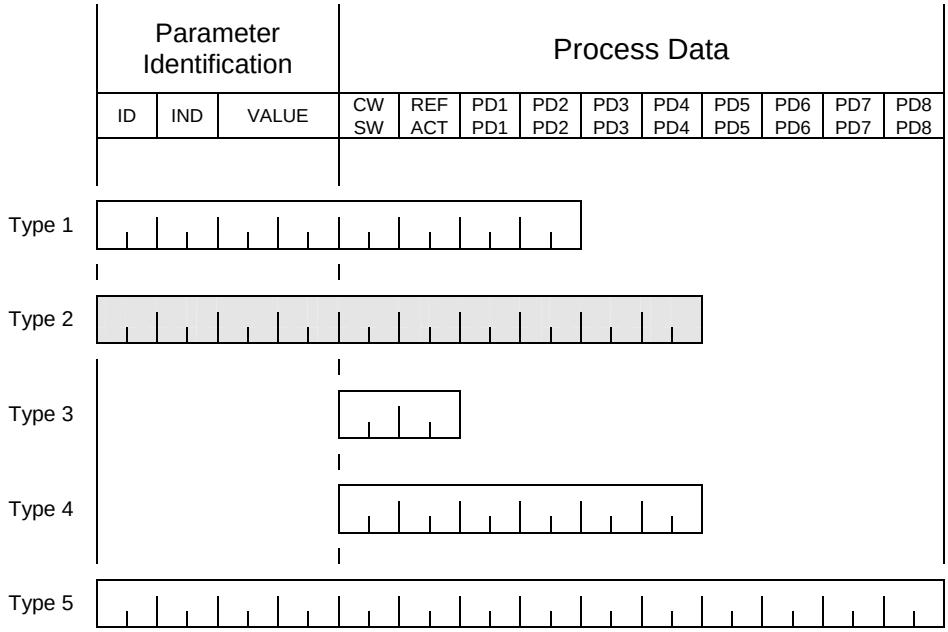
PPO Message

The PROFIBUS profile defines five possible messages of different lengths. A minimum length of two words for PPO Type 3, to a maximum length of fourteen words for PPO Type 5.

The PPO telegram consists of

- the *Parameter Identification* field, for reading/writing parameters
- and the *Process Data* field for transferring process data information.

DGV Converters equipped with PROFIBUS-DP Modules use PPO Type 2, for a maximum length of ten words.



Abbreviations

Parameter Identification

ID – *Identification*, request/response label and number of the parameter

IND – parameter *Sub-Index* for array parameters

VALUE – value of the parameter in double word precision

Process Data

In the master-slave PPO telegram:

CW – *Control Word*

REF – process digital reference setpoint

PD1 ÷ PD8 – process data manufacturer-specific

In the slave-master PPO telegram:

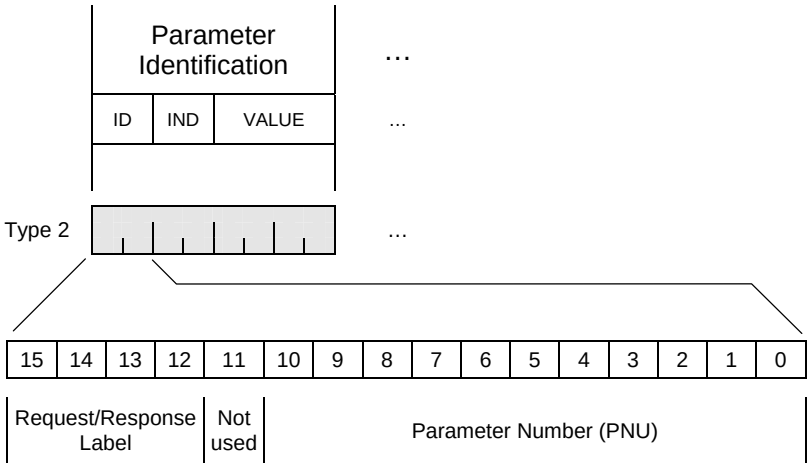
SW – *Status Word*

ACT – process actual value

PD1 ÷ PD8 – process data manufacturer-specific

Parameter Identification

The Parameter Identification area of the PPO telegram is reserved for transmitting parameter values. It consists of eight bytes, i.e. one word for the ID area, one word for the IND area, two words for VALUE.



The ID area contains

- either the request label when the master is transmitting data to the slave, or the response label when vice versa the slave is transmitting,
- and the parameter number (PNU).

The IND area contains into the high byte the sub-index (0..31) of the parameter, which is being investigated or modified.

The VALUE area contains the parameter value, which is being investigated or modified depending on the request/response label.

The tables below show the request/response ID label.

Request Label

Request Label	Meaning	Positive Response	Negative Response
0	No task	0	7 / 8
1	Request parameter value	2	7 / 8
3	Change parameter value (double word)	2	7 / 8
Other	…	-	7 / 8

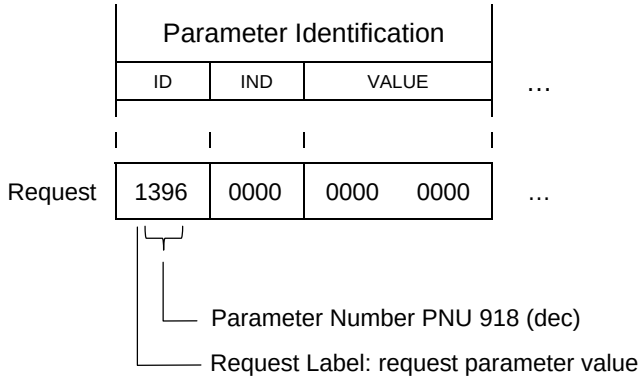
Response Label

Response Label	Meaning
0	No response
2	Transfer parameter value (double word)
7	Task cannot be executed, followed by the general error code 18 in the VALUE area.
8	Task not executable: no service of Parameter Identification area

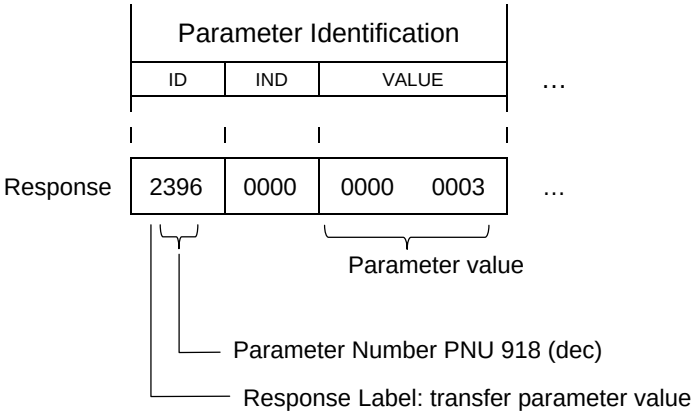
Example: Read

The master station transfers the task request “read a parameter value” to the slave with PPO write. The slave provides the parameter value with PPO read.

In this example, the master station enquires the parameter value of PNU 918 (396h), Node Address.



The slave returns the parameter value, i.e. its station number.



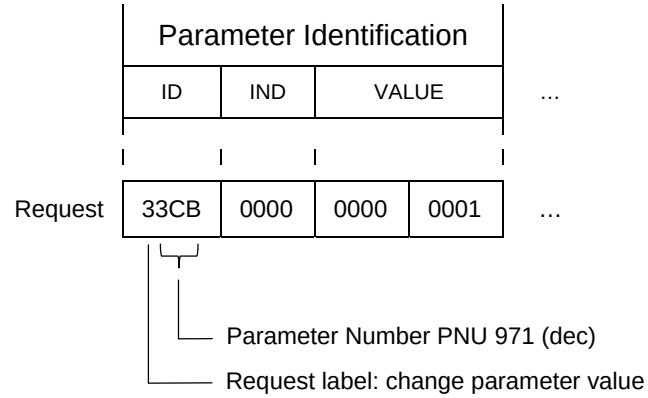
Note that the converter (slave) constantly observes the master task request and it responds to any valid request transmitting the status information.

Example: Write

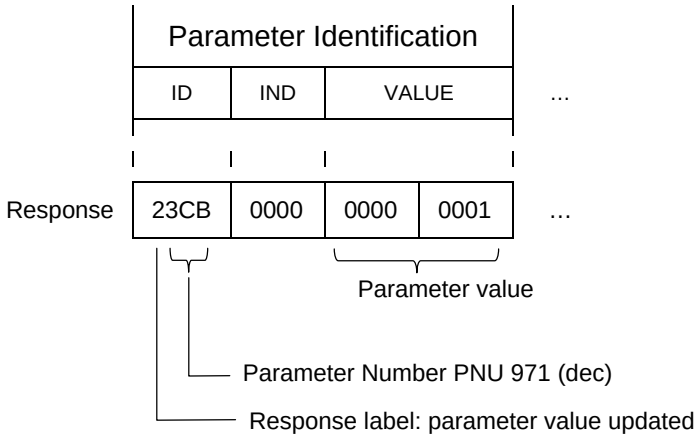
The master station transfers the task request “change a parameter value” to the slave with PPO write. The slave executes the task request and responds with PPO read.

In this example, the parameter PNU 971 (3CBh), Freeze Configuration, stores the drive configuration into non-volatile flash memory.

Setting the parameter value from 0 to 1



the drive transfers the configuration data into the non-volatile flash memory. It responds transmitting the parameter value updated:



Once you have frozen the configuration, remember to **reset the parameter value of PNU 971 to 0**.

Process Data

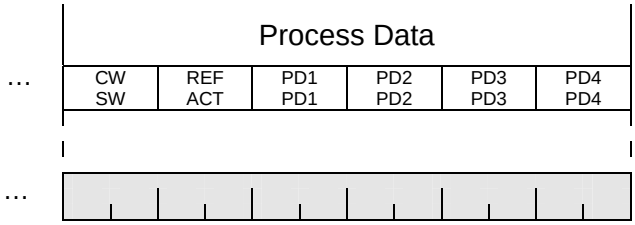
The Process Data field is used to transfer the process status information. It consists of six words for PPO Type 2 telegram, which is adopted with DGV.

In the PPO write from master to slave the Process Data contains

- the Control Word (CW), that is the bit-coded information for controlling the drive status
- and other words (REF, PD1 ÷ PD4) for transferring the digital reference setpoints of speed, position or torque depending on the operating mode currently selected (PNU 930, Modes of Operation).

In the PPO read from slave to master the Process Data returns

- the Status Word (SW), that is the bit-coded status information of the drive
- and other words (ACT, PD1 ÷ PD4) with process actual values.



Control Word

The Control Word (PROFIBUS parameter 967, or PNU 967) is the principal means for controlling the drive operation. It is sent by the field bus master station to the drive through the bus link cable.

Status Word

When receiving the PPO message from the master station, the drive switches between its states according with the bit-coded instructions in the Control Word, and returns the status bit-coded information to the master in the Status Word (PROFIBUS parameter 968, or PNU 968).

References and Actual Values

The digital references (REF, PD1 ÷ PD4) and the process actual values (ACT, PD1 ÷ PD4) may be a 16-bit word precision or a 32-bit double word precision. The scaling of these variables as well as the meaning of the Control Word and Status Word depend on the operating mode selected.

Content of the Process Data is dependent on the operating mode (PNU 930 “Operating Mode”) and on the telegram structure (PNU 922 “Telegram Selection”). See *Configuration of Process Data*.

Speed Mode

Enabling the Speed Mode is achieved by following a proper assigned sequence of bits commutation in the Control Word. For any bit commutation in the Control Word the drive switches into the associated state, hence a bit commutation comes in the Status Word. The *State Machine for Speed Mode* represents the proceed conditions for the drive state switching.

Selection of the Speed Mode is possible by setting parameter PNU 930 to “1 - Speed Mode”. See *Appendix A - Parameters List* for DGV specific parameters.

Control Word

The table below shows the detailed allocation of the Control Word bits for Speed Mode and a short description of the bits meaning. The star sign denotes that the meaning of that bit is specific for the Speed Mode, otherwise the bit meaning is common to the Positioning Mode. The upper case boldface text refers to the states shown in the state machine.

Bit	Name	Value	State	Description
0	ON / READY	1	**READY FOR OPERATION**	Enter the **READY FOR OPERATION** state.
	OFF1	0	**OFF1 ACTIVE**	Emergency stop by the deceleration ramp Quick Stop Deceleration, PNU 1205. Proceed **READY TO SWITCH ON** unless other interlocks **OFF2**, **OFF3** are active.
1	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF2 not active, operating condition.
	OFF2	0	**OFF2 ACTIVE**	Emergency stop, pulses inhibited, converter disabled. Enter **OFF2 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
2	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF3 not active, operating condition.
	OFF3	0	**OFF3 ACTIVE**	Emergency stop, dynamic braking. Enter **OFF3 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
3	OPERATION ENABLED	1	**OPERATION ENABLED**	Enter **OPERATION ENABLED**
	OPERATION INHIBITED	0	**OPERATION INHIBITED**	Enter **OPERATION INHIBITED**, dynamic braking active. Switch to **READY FOR OPERATION**
4	OPERATION ENABLED	1	**OPERATION ENABLED**	Operating condition
	* INHIBIT RAMP	0	**INHIBIT RAMP-FUNCTION GENERATOR**	Inhibit ramp-function generator, ramp set to 0
5	* RAMP ENABLE	1	**RAMP-GENERATOR ENABLED**	Enable the ramp-function generator
	* STOP RAMP	0	**STOP RAMP-GENERATOR**	Stop ramp-function generator, freeze current setpoint from the ramp-function generator
6	* RAMP_ REF ENABLE	1	**REFERENCE SETPOINT ENABLE**	Selected value at the ramp-function generator input is switched in.
	* RAMP_ REF INHIBIT	0	**REFERENCE SETPOINT INHIBITED**	Selected value at the ramp-function generator input is set to 0.
7	ACKNOW-LEDGE	0 → 1	**SWITCH-ON INHIBITED**	Fault acknowledge with a positive edge. When the fault is removed, proceed to **SWITCH-ON INHIBITED**
	OK	0		(normal operating condition)
8	* Not used			--

9	* Not used		--
10	ENABLE REMOTE CONTROL	1	Field bus control enabled
	INHIBIT REMOTE CONTROL	0	Field bus control disabled. Local control via RS232 enabled.
11	* Not used		--
12	* Not used		--
13	* Not used		--
14	* Not used		--
15	ACTIVATE DIRECT MOTION TASK	1	Case “Telegram 102”. The drive applies digital references from field bus, i.e. “direct” commands.
	INTERNAL MOTION TASK	0	Case “Telegram 102”. The drive applies internal references programmed into the motion tables, i.e. “internal” commands.

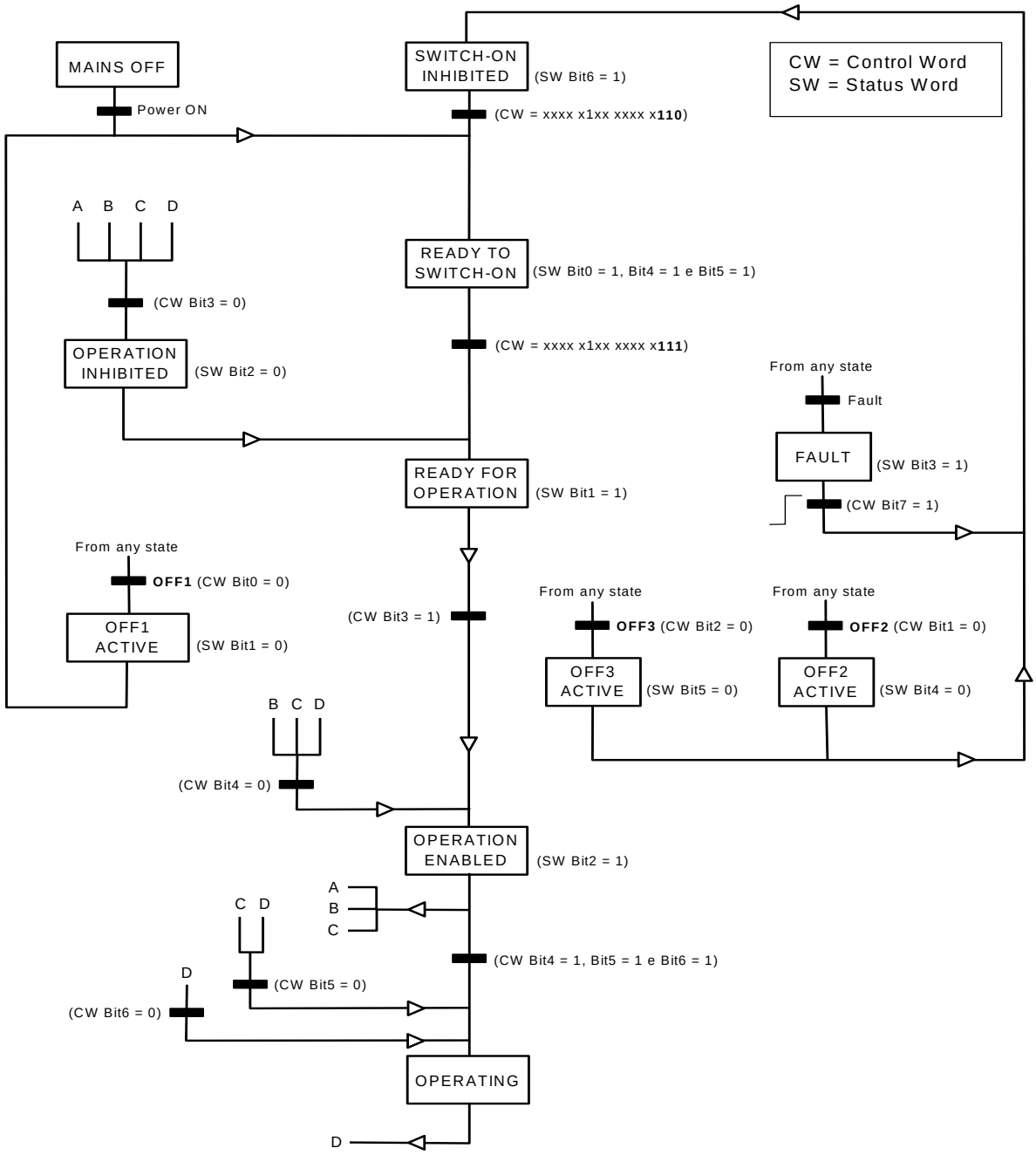
Status Word In the PPO read telegram the drive returns the Status Word to the master station. The bit-coded status information represents the drive current state.

The table below shows the detailed allocation of the Status Word bits for Speed Mode and a short description of the bits meaning. The star sign denotes that the meaning of that bit is specific for the Speed Mode, otherwise the bit meaning is common to the Positioning Mode. The upper case boldface text refers to the states shown in the state machine.

Bit	Name	Value	State	Description
0	READY	1	**READY TO SWITCH ON**	Power on, pulses inhibited
	NOT READY	0	**SWITCH-ON INHIBITED**	Not ready
1	OPERATING CONDITION	1	**READY FOR OPERATION**	Refer to Control Word bit 0 set to 1
	OFF1	0	**OFF1 ACTIVE**	Not ready
2	OPERATING CONDITION	1	**OPERATION ENABLED**	Operating condition
	DISABLED	0	**READY FOR OPERATION**	Drive disabled
3	FAULT	1	**FAULT**	Fault. Drive disabled
	OK	0		
4	OK	1		
	OFF2	0	**OFF2 ACTIVE**	Not ready
5	OK	1		
	OFF3	0	**OFF3 ACTIVE**	Not ready
6	OPERATION INHIBITED	1	**SWITCH-ON INHIBITED**	**SWITCH-ON INHIBITED**, drive inhibited, re-close only with **OFF1 ACTIVE** then ON / READY, bit 0 of the control word set to 1.
	OK	0		
7	ALARM	1		Warning/Alarm. See PNU 953 to investigate the alarm code.
	NO ALARM	0		Ok
8	* AT SETPOINT	1	**OPERATING CONDITION**	Speed actual value within tolerance range set with parameters Speed Monitoring Time, PNU 1107, and Speed Window, PNU 1108.
	* OUT OF RANGE	0		Speed actual value out of the range set with Speed Monitoring Time and Speed Window
9	REMOTE	1		Field bus control enabled, refer to bit 10 control word set to 1.
	LOCAL	0		Local control enabled
10	* MIN SPEED REACHED	1		Actual speed exceeds the supervision limit preset with parameter Min Speed, PNU 1106.
	* MIN SPEED NOT REACHED	0		Actual speed is within the supervision limit preset with parameter Min Speed, PNU 1106.
11	* REFERENCE	1		Reference point set
	* NO REFERENCE	0		No reference point set
12	* Not used			--
13	* Not used			--

14	*	Not used	--
15	*	Not used	--

State Machine for Speed Mode



Positioning Mode

Enabling the Positioning Mode is possible following a proper assigned sequence of bits commutation in the Control Word. For any bit commutation in the Control Word the drive switches in the associated state, hence a bit commutation comes in the Status Word. The *State Machine for Positioning Mode* represents the proceed conditions for the drive state switching.

Parameter PNU 930 set to “2 - Positioning Mode” selects the Positioning Mode. See *Appendix A - Parameters List* for DGV specific parameters.

Control Word

The table below shows the detailed allocation of the Control Word bits for Positioning Mode and a short description of the switching states. The star sign denotes that the meaning of that bit is specific for the Positioning Mode, otherwise the bit meaning is common to the Speed Mode. The upper case boldface text refers to the states shown in the state machine.

Bit	Meaning	Value	State	Description
0	ON / READY	1	**READY FOR OPERATION**	Enter the **READY FOR OPERATION** state.
	OFF1	0	**OFF1 ACTIVE**	Emergency stop by the deceleration ramp Quick Stop Deceleration, PNU 1205. Proceed **READY TO SWITCH ON** unless other interlocks **OFF2**, **OFF3** are active.
1	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF2 not active, operating condition.
	OFF2	0	**OFF2 ACTIVE**	Emergency stop, pulses inhibited, converter disabled. Enter **OFF2 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
2	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF3 not active, operating condition.
	OFF3	0	**OFF3 ACTIVE**	Emergency stop, dynamic braking. Enter **OFF3 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
3	OPERATION ENABLED	1	**OPERATION ENABLED**	Enter **OPERATION ENABLED**
	OPERATION INHIBITED	0	**OPERATION INHIBITED**	Enter **OPERATION INHIBITED**, dynamic braking active. Switch to **READY FOR OPERATION**
4	OPERATION ENABLED	1	**OPERATION ENABLED**	Operating condition. A drive task is activated with edge in bit 6.
	* STOP		**STOP**	Drive brakes from an active motion task with maximum acceleration to speed 0. The current drive task is canceled.
5	* OPERATION ENABLED	1	**OPERATION ENABLED**	Operating condition for positioning
	* INTERME-DIATE STOP	0	**INTERMEDIATE STOP**	Drive brakes from an active task on ramp to 0 speed and remains stationary with the stopping moment. The drive task is not canceled; it is continued when a change to bit 5 = 1 occurs.
6	* ACTIVATE DRIVE TASK	1 → 0 0 → 1	**DRIVE TASK ACTIVE**	Each edge enables a drive task or a new setpoint. A change in edge may only occur when acknowledgment that the previous drive task was accepted was performed with bit 12 of the status word and bit 11 (i.e., reference point) is set.
7	ACKNOW-LEDGE	0 → 1	**SWITCH-ON INHIBITED**	Fault acknowledge with a positive edge. When the fault is removed, proceed to **SWITCH-ON INHIBITED**
	OK	0		(normal operating condition)

8	*	INCHING1 ON	1	**INCHING**	Prerequisite: Operation is enabled and no positioning procedure is active. Drive travels with speed setpoint Jogging Speed 1, PNU 1255.
	*	INCHING1 OFF	0	**INCHING**	Jogging1 off
9	*	INCHING2 ON	1	**INCHING**	Prerequisite: Operation is enabled and no positioning procedure is active. Drive travels with speed setpoint Jogging Speed 2, PNU 1256.
	*	INCHING2 OFF	0	**INCHING**	Jogging2 off
10		ENABLE REMOTE CONTROL	1		Field bus control enabled
		INHIBIT REMOTE CONTROL	0		Field bus control disabled, local control via RS 232 enabled
11	*	START REFERENC-ING	0 → 1	**REFERENCING**	When READY FOR OPERATION, referencing is started with edge from 0 to 1. Bit 11 of the status word is set to 0 and switches to 1 at referencing performed. Prerequisite: Operation is enabled.
	*	STOP REFERENC-ING	0	**REFERENCING**	A running referencing procedure is canceled. Drive stops on the ramp.
12	*	RELATIVE POSITION-ING	1	**OPERATING STATUS**	Relative positioning mode. A drive task is executed with edge in bit 6, ACTIVATE DRIVE TASK
	*	ABSOLUTE POSITION-ING	0	**OPERATING STATUS**	Absolute positioning mode. Drive task is executed when the operation is enabled
13	*	CHANGE SET IMMEDIATE LY	1	**OPERATING STATUS**	Apply new setpoint immediately after reaching the last one.
	*	SINGLE SETPOINT	0	**OPERATING STATUS**	Complete previous operation before taking in new setpoint.
14	*	SYNCHRO NIZE	1	**OPERATING STATUS**	Start synchronization instantly and maintain synchronization. This function is effective when PNU 304, Encoder Interface Emulation, set to 2-Reference Input, or 3- Feedback Input.
	*	STOP SYNCHRO NIZATION	0	**OPERATING STATUS**	Stop synchronization.
15		ACTIVATE DIRECT MOTION TASK	1		Case “Telegram 102”. The drive applies digital references from field bus, i.e. “direct” commands.
		INTERNAL MOTION TASK	0		Case “Telegram 102”. The drive applies internal references programmed into the motion tables, i.e. “internal” commands.

Status Word

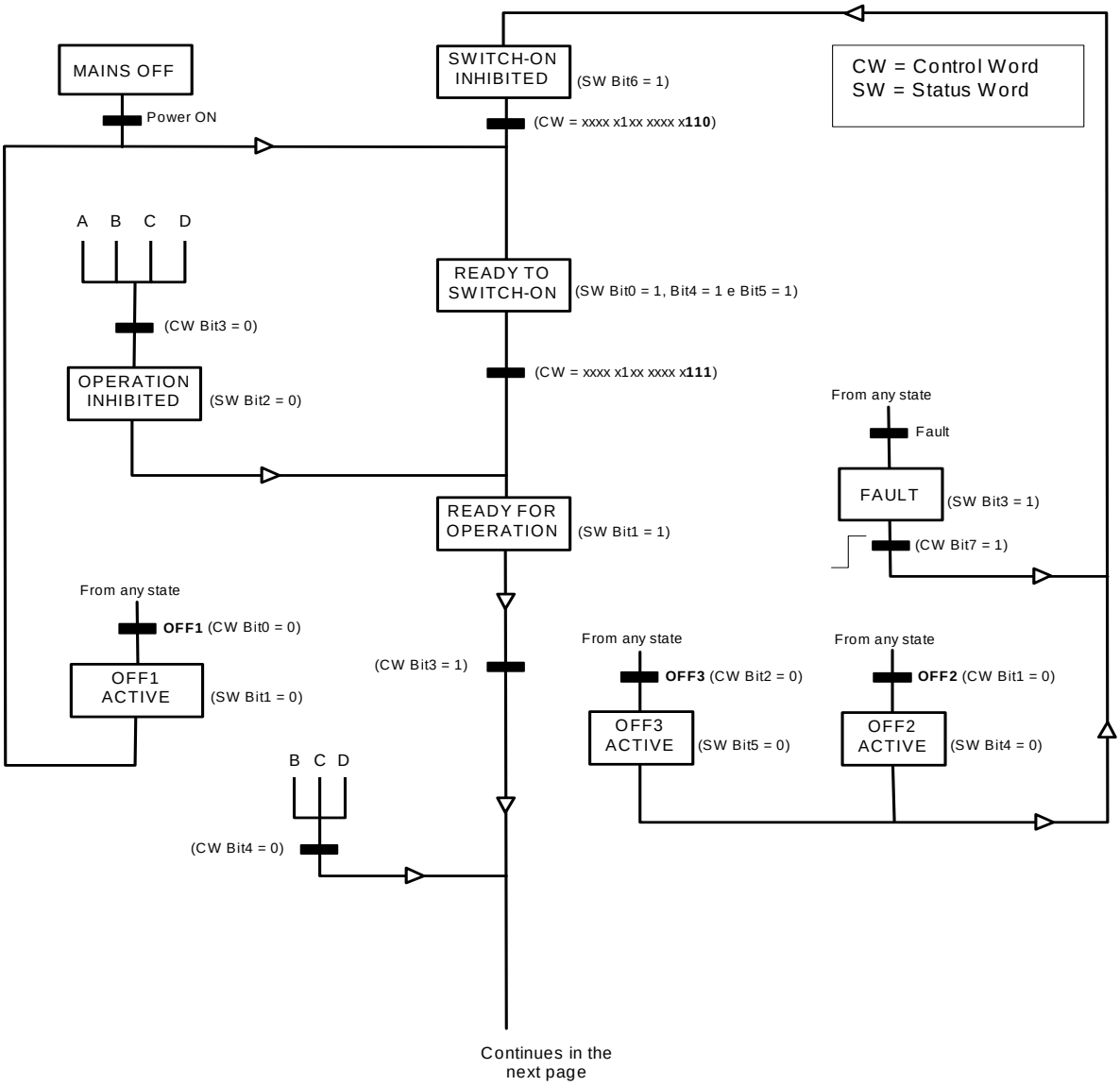
In the PPO read telegram the drive returns the Status Word to the master station. The bit-coded status information represents the drive current state.

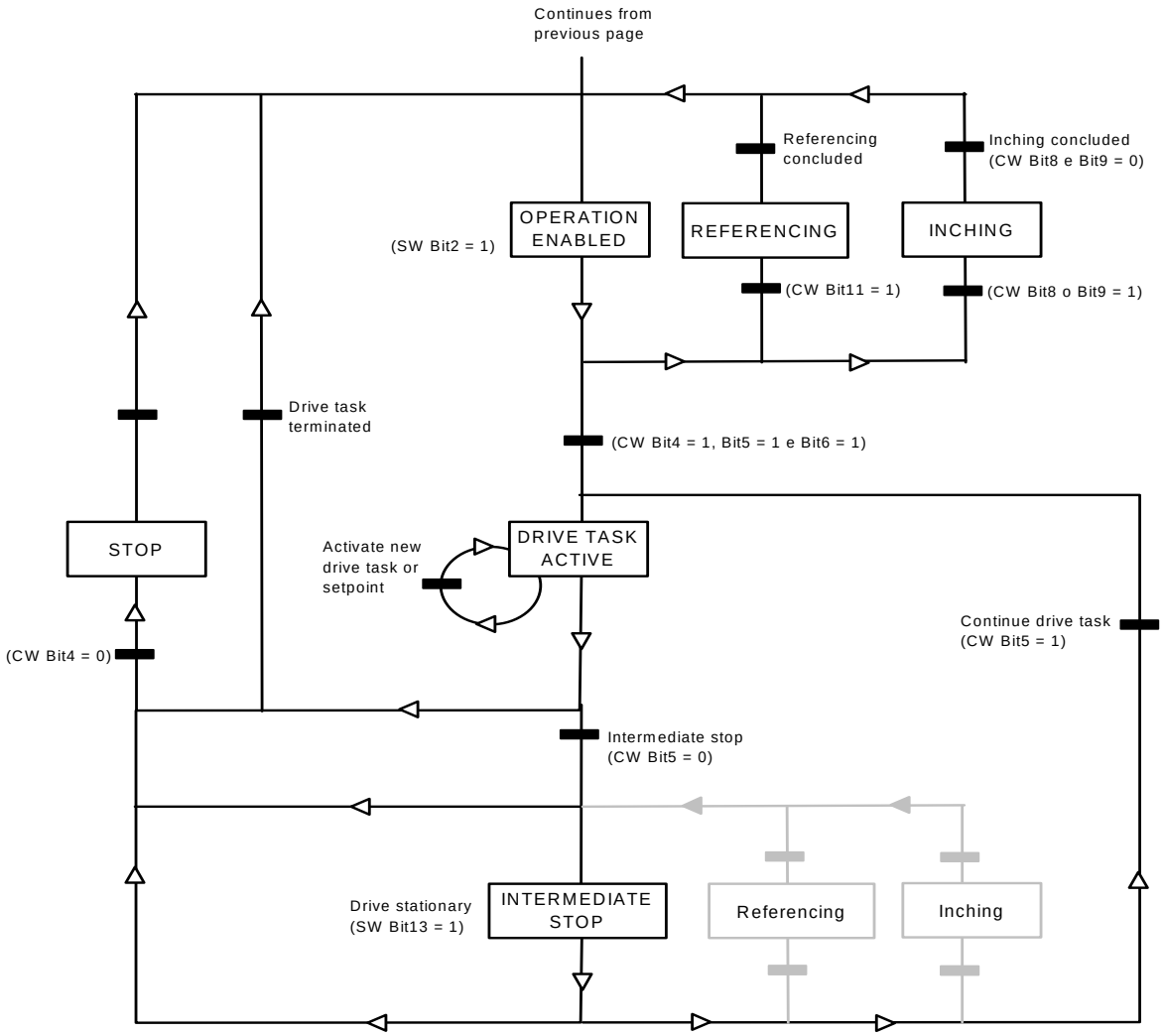
The table below shows the detailed allocation of the Status Word bits for Positioning Mode and a short description of the bit meaning. The star sign denotes that the meaning of that bit is specific for the Positioning Mode, otherwise the bit meaning is common to the Speed Mode. The upper case boldface text refers to the states shown in the state machine.

Bit	Name	Value	State	Description
0	READY	1	**READY TO SWITCH ON**	Power on, pulses inhibited
	NOT READY	0	**SWITCH-ON INHIBITED**	Not ready
1	OPERATING CONDITION	1	**READY FOR OPERATION**	Refer to Control Word bit 0 set to 1
	OFF1	0	**OFF1 ACTIVE**	Not ready
2	OPERATING CONDITION	1	**OPERATION ENABLED**	Operating condition
	DISABLED	0	**READY FOR OPERATION**	Drive disabled
3	FAULT	1	**FAULT**	Fault. Drive disabled
	OK	0		
4	OK	1		
	OFF2	0	**OFF2 ACTIVE**	Not ready
5	OK	1		
	OFF3	0	**OFF3 ACTIVE**	Not ready
6	OPERATION INHIBITED	1	**SWITCH-ON INHIBITED**	Drive inhibited, re-close only with **OFF1 ACTIVE** then ON / READY, bit 0 of the Control Word set to 1.
	OK	0		
7	ALARM	1		Warning/Alarm. See PNU 953 to investigate the alarm code.
	NO ALARM	0		Ok
8	* OK	1		The dynamic setpoint/actual position comparison is within the defined contouring error window, parameter Following Error Window, PNU 1209.
	* CONTOURING ERROR	0	**FAULT**	Contouring error. See parameter Following Error Window, PNU 1209.
9	REMOTE	1		Field bus control enabled, refer to bit 10 control word set to 1.
	LOCAL	0		Local control enabled
10	* SETPOINT POSITION	1	**OPERATING**	Setpoint position reached. The actual position value is within the positioning window defined with parameters Position Monitoring Time, PNU 1215, and Position Window, PNU 1210.
	* POSITION ERROR	0	**FAULT**	Outside setpoint position. See parameters Position Monitoring Time, PNU 1215, and Position Window, PNU 1210.
11	* REFERENCE	1	**REFERENCING**	Reference point set
	* NO REFERENCE	0	**REFERENCING**	No reference point set

12	*	ACKNOW-LEDGE	1 → 0 0 → 1	**OPERATING**	Each edge is used to acknowledge that a drive task or setpoint was accepted. Same level as bit 6 in the control word.
13	*	DRIVE STATIONARY	1		Drive stationary. Actual speed is within the supervision limit set with parameter Min Speed, PNU 1106.
	*	DRIVE MOVING	0		Drive moving. Actual speed exceeds the supervision limit set with parameter Min Speed, PNU 1106.
14	*	REFERENCING ERROR	1	**REFERENCING**	An error occurred during referencing procedure.
	*	OK	0		
15	*	SYNC REACHED	1	**OPERATING**	Axis synchronization reached, speed or position synchronization depending on PNU 1240, Synchronization Type.
	*	NO SYNC	0		Synchronization not reached.

State Machine for Positioning Mode




Continues from previous page
Referencing concluded
Inching concluded (CW Bit8 e Bit9 = 0)
OPERATION ENABLED
(SW Bit2 = 1)
REFERENCING
INCHING
(CW Bit11 = 1)
(CW Bit8 o Bit9 = 1)
Drive task terminated
(CW Bit4 = 1, Bit5 = 1 e Bit6 = 1)
STOP
Activate new drive task or setpoint
DRIVE TASK ACTIVE
Continue drive task (CW Bit5 = 1)
(CW Bit4 = 0)
Intermediate stop (CW Bit5 = 0)
Drive stationary (SW Bit13 = 1)
INTERMEDIATE STOP
Referencing
Inching

Torque Mode

Beside the Speed and Positioning Mode, brushless servo drives usually have the so-called Torque-Current control function.

This function is hereby named **Torque Mode** for the PROFIBUS remote control. As for the previous Speed and Position Mode, the Torque Mode selection is possible through parameter PNU 930 set to "-3 - Torque Mode", in this case.

The state machine of Speed Mode is used here.

Control Word

The table below shows the detailed allocation of the Control Word bits for Torque Mode and a short description of the bits meaning. The star sign denotes the meaning of that bit is specific for the Torque Mode, otherwise the bit meaning is common to Speed and Position Modes as well.

Bit	Meaning	Value	State	Description
0	ON / READY	1	**READY FOR OPERATION**	Enter the **READY FOR OPERATION** state.
	OFF1	0	**OFF1 ACTIVE**	Emergency stop by the deceleration ramp Quick Stop Time, PNU 1105. Proceed **READY TO SWITCH ON** unless other interlocks **OFF2**, **OFF3** are active.
1	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF2 not active, operating condition.
	OFF2	0	**OFF2 ACTIVE**	Emergency stop, pulses inhibited, converter disabled. Enter **OFF2 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
2	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF3 not active, operating condition.
	OFF3	0	**OFF3 ACTIVE**	Emergency stop, dynamic braking. Enter **OFF3 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
3	OPERATION ENABLED	1	**OPERATION ENABLED**	Enter **OPERATION ENABLED**
	OPERATION INHIBITED	0	**OPERATION INHIBITED**	Enter **OPERATION INHIBITED**, dynamic braking active. Switch to **READY FOR OPERATION**
4	* Not used			--
5	* Not used			--
6	* ENABLE SETPOINT	1	**REFERENCE SETPOINT ENABLE**	Enable torque digital setpoint
	* INHIBIT SETPOINT	0	**REFERENCE SETPOINT INHIBITED**	Torque digital setpoint set to 0.
7	ACKNOW-LEDGE	0 → 1	**SWITCH-ON INHIBITED**	Fault acknowledge with a positive edge. When the fault is removed, proceed to **SWITCH-ON INHIBITED**
	OK	0		(normal operating condition)
8	* Not used			--
9	* Not used			--
10	ENABLE REMOTE CONTROL	1		Field bus control enabled
	INHIBIT REMOTE CONTROL	0		Field bus control disabled, local control via RS 232 enabled
11	* Not used			--
12	* Not used			--

13	* Not used		--
14	* Not used		--
15	ACTIVATE DIRECT MOTION TASK	1	Case “Telegram 102”. The drive applies digital references from field bus, i.e. “direct” commands.
	INTERNAL MOTION TASK	0	Case “Telegram 102”. The drive applies internal references programmed into the motion tables, i.e. “internal” commands.

Status Word The table below shows the detailed allocation of the Status Word bits for Torque Mode and a short description of the bit meaning. The star sign indicating the meaning of that bit is specific for the Torque Mode, whereas the other states are common to Speed and Position mode.

Bit	Name	Value	State	Description
0	READY	1	**READY TO SWITCH ON**	Power on, pulses inhibited
	NOT READY	0	**SWITCH-ON INHIBITED**	Not ready
1	OPERATING CONDITION	1	**READY FOR OPERATION**	Refer to Control Word bit 0 set to 1
	OFF1	0	**OFF1 ACTIVE**	Not ready
2	OPERATING CONDITION	1	**OPERATION ENABLED**	Operating condition
	DISABLED	0	**READY FOR OPERATION**	Drive disabled
3	FAULT	1	**FAULT**	Fault. Drive disabled
	OK	0		
4	OK	1		
	OFF2	0	**OFF2 ACTIVE**	Not ready
5	OK	1		
	OFF3	0	**OFF3 ACTIVE**	Not ready
6	OPERATION INHIBITED	1	**SWITCH-ON INHIBITED**	**SWITCH-ON INHIBITED**, drive inhibited, re-close only with **OFF1 ACTIVE** then ON / READY, bit 0 of the control word set to 1.
	OK	0		
7	ALARM	1		Warning/Alarm. See PNU 953 to investigate the alarm code.
	NO ALARM	0		Ok
8	* Not used			--
9	REMOTE	1		Field bus control enabled, refer to Control Word bit 10 set to 1.
	LOCAL	0		Local control enabled
10	* MIN SPEED REACHED	1		Actual speed exceeds the supervision limit preset with parameter Min Speed, PNU 1106.
	* MIN SPEED NOT REACHED	0		Actual speed is within the supervision limit preset with parameter Min Speed, PNU 1106.
11	* Not used			--
12	* Not used			--
13	* Not used			--
14	* Not used			--
15	* Not used			--

Analog Torque Mode

The Torque-Current control function is available with the *Analog Torque Mode* as well. When this mode is operated (PNU 930 set to "-2 - Analogue Torque Mode"), DGV is activated by the Control Word and monitored through the Status Word, whereas the torque command may only come from the analog input.

The state machine of Speed Mode is used here.

Control Word

The table below shows the detailed allocation of the Control Word bits for Analog Torque Mode and a short description of the bits meaning. The star sign denotes the meaning of that bit is specific for this operating mode.

Bit	Meaning	Value	State	Description
0	ON / READY	1	**READY FOR OPERATION**	Enter the **READY FOR OPERATION** state.
	OFF1	0	**OFF1 ACTIVE**	Emergency stop by the deceleration ramp Quick Stop Time, PNU 1105. Proceed **READY TO SWITCH ON** unless other interlocks **OFF2**, **OFF3** are active.
1	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF2 not active, operating condition.
	OFF2	0	**OFF2 ACTIVE**	Emergency stop, pulses inhibited, converter disabled. Enter **OFF2 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
2	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF3 not active, operating condition.
	OFF3	0	**OFF3 ACTIVE**	Emergency stop, dynamic braking. Enter **OFF3 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
3	OPERATION ENABLED	1	**OPERATION ENABLED**	Enter **OPERATION ENABLED**
	OPERATION INHIBITED	0	**OPERATION INHIBITED**	Enter **OPERATION INHIBITED**, dynamic braking active. Switch to **READY FOR OPERATION**
4	* Not used			--
5	* Not used			--
6	* ENABLE SETPOINT	1	**REFERENCE SETPOINT ENABLE**	Execute the torque command given at analog input
	* INHIBIT SETPOINT	0	**REFERENCE SETPOINT INHIBITED**	Analog torque setpoint set to 0.
7	ACKNOW-LEDGE	0 → 1	**SWITCH-ON INHIBITED**	Fault acknowledge with a positive edge. When the fault is removed, proceed to **SWITCH-ON INHIBITED**
	OK	0		(Normal operating condition)
8	* Not used			--
9	* Not used			--
10	ENABLE REMOTE CONTROL	1		Field bus control enabled
	INHIBIT REMOTE CONTROL	0		Field bus control disabled, local control via RS 232 enabled
11	* Not used			--
12	* Not used			--

13	* Not used	--
14	* Not used	--
15	* Not used	--

Status Word

The table below shows the detailed allocation of the Status Word bits for *Analog Torque Mode* and a short description of the bit meaning. The star sign indicating the meaning of that bit is specific for this operating mode.

Bit	Name	Value	State	Description
0	READY	1	**READY TO SWITCH ON**	Power on, pulses inhibited
	NOT READY	0	**SWITCH-ON INHIBITED**	Not ready
1	OPERATING CONDITION	1	**READY FOR OPERATION**	Refer to Control Word bit 0 set to 1
	OFF1	0	**OFF1 ACTIVE**	Not ready
2	OPERATING CONDITION	1	**OPERATION ENABLED**	Operating condition
	DISABLED	0	**READY FOR OPERATION**	Drive disabled
3	FAULT	1	**FAULT**	Fault. Drive disabled
	OK	0		
4	OK	1		
	OFF2	0	**OFF2 ACTIVE**	Not ready
5	OK	1		
	OFF3	0	**OFF3 ACTIVE**	Not ready
6	OPERATION INHIBITED	1	**SWITCH-ON INHIBITED**	**SWITCH-ON INHIBITED**, drive inhibited, re-close only with **OFF1 ACTIVE** then ON / READY, bit 0 of the control word set to 1.
	OK	0		
7	ALARM	1		Warning/Alarm. See PNU 953 to investigate the alarm code.
	NO ALARM	0		Ok
8	* Not used			--
9	REMOTE	1		Field bus control enabled, refer to Control Word bit 10 set to 1.
	LOCAL	0		Local control enabled
10	* MIN SPEED REACHED	1		Actual speed exceeds the supervision limit preset with parameter Min Speed, PNU 1106.
	* MIN SPEED NOT REACHED	0		Actual speed is within the supervision limit preset with parameter Min Speed, PNU 1106.
11	* Not used			--
12	* Not used			--
13	* Not used			--
14	* Not used			--
15	* Not used			--

Analog Speed Mode

The Speed control function is available with the *Analog Speed Mode* as well. When this mode is operated (PNU 930 set to "-1 - Analog Speed Mode"), DGV is activated by the Control Word and monitored through the Status Word, whereas the speed command may only come from the analog input.

The state machine of Speed Mode is used here.

Control Word

The table below shows the detailed allocation of the Control Word bits for Analog Speed Mode and a short description of the bits meaning. The star sign denotes the meaning of that bit is specific for this operating mode.

Bit	Meaning	Value	State	Description
0	ON / READY	1	**READY FOR OPERATION**	Enter the **READY FOR OPERATION** state.
	OFF1	0	**OFF1 ACTIVE**	Emergency stop by the deceleration ramp Quick Stop Time, PNU 1105. Proceed **READY TO SWITCH ON** unless other interlocks **OFF2**, **OFF3** are active.
1	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF2 not active, operating condition.
	OFF2	0	**OFF2 ACTIVE**	Emergency stop, pulses inhibited, converter disabled. Enter **OFF2 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
2	OPERATING CONDITION	1	**READY TO SWITCH ON**	OFF3 not active, operating condition.
	OFF3	0	**OFF3 ACTIVE**	Emergency stop, dynamic braking. Enter **OFF3 ACTIVE** and proceed to **SWITCH-ON INHIBITED**
3	OPERATION ENABLED	1	**OPERATION ENABLED**	Enter **OPERATION ENABLED**
	OPERATION INHIBITED	0	**OPERATION INHIBITED**	Enter **OPERATION INHIBITED**, dynamic braking active. Switch to **READY FOR OPERATION**
4	* Not used			--
5	* Not used			--
6	* ENABLE SETPOINT	1	**REFERENCE SETPOINT ENABLE**	Execute the speed command given at analog input.
	* INHIBIT SETPOINT	0	**REFERENCE SETPOINT INHIBITED**	Analog speed setpoint set to 0.
7	ACKNOW-LEDGE	0 → 1	**SWITCH-ON INHIBITED**	Fault acknowledge with a positive edge. When the fault is removed, proceed to **SWITCH-ON INHIBITED**
	OK	0		(Normal operating condition)
8	* Not used			--
9	* Not used			--
10	ENABLE REMOTE CONTROL	1		Field bus control enabled
	INHIBIT REMOTE CONTROL	0		Field bus control disabled, local control via RS 232 enabled
11	* Not used			--
12	* Not used			--

13	* Not used	--
14	* Not used	--
15	* Not used	--

Status Word The table below shows the detailed allocation of the Status Word bits for Analog Speed Mode and a short description of the bit meaning. The star sign indicating the meaning of that bit is specific for this operating mode.

Bit	Name	Value	State	Description
0	READY	1	**READY TO SWITCH ON**	Power on, pulses inhibited
	NOT READY	0	**SWITCH-ON INHIBITED**	Not ready
1	OPERATING CONDITION	1	**READY FOR OPERATION**	Refer to Control Word bit 0 set to 1
	OFF1	0	**OFF1 ACTIVE**	Not ready
2	OPERATING CONDITION	1	**OPERATION ENABLED**	Operating condition
	DISABLED	0	**READY FOR OPERATION**	Drive disabled
3	FAULT	1	**FAULT**	Fault. Drive disabled
	OK	0		
4	OK	1		
	OFF2	0	**OFF2 ACTIVE**	Not ready
5	OK	1		
	OFF3	0	**OFF3 ACTIVE**	Not ready
6	OPERATION INHIBITED	1	**SWITCH-ON INHIBITED**	**SWITCH-ON INHIBITED**, drive inhibited, re-close only with **OFF1 ACTIVE** then ON / READY, bit 0 of the control word set to 1.
	OK	0		
7	ALARM	1		Warning/Alarm. See PNU 953 to investigate the alarm code.
	NO ALARM	0		Ok
8	* Not used			--
9	REMOTE	1		Field bus control enabled, refer to Control Word bit 10 set to 1.
	LOCAL	0		Local control enabled
10	* MIN SPEED REACHED	1		Actual speed exceeds the supervision limit preset with parameter Min Speed, PNU 1106.
	* MIN SPEED NOT REACHED	0		Actual speed is within the supervision limit preset with parameter Min Speed, PNU 1106.
11	* REFERENCE	1		No reference point set
	* NO REFERENCE	0		Reference point set
12	* Not used			--
13	* Not used			--
14	* Not used			--
15	* Not used			--

Configuration of Process Data

Structure of Process Data can be selected between two standard configurations using PNU 922 “Telegram Selection”.

Telegram 101

When PNU 922 = 101, control and status Process Data have the standard structure of “Telegram 101”, predefined for each operating mode[12].

Speed Mode (PNU 930 = 1)

Process Data					
CW	REF	PD1	PD2	PD3	PD4
SW	ACT	PD1	PD2	PD3	PD4
Control Word PNU 967	Direct Target Velocity PNU 1111		-	-	Control Word 2 PNU 1010
Status Word PNU 968	Actual Velocity PNU 1101		Actual Position PNU 1201		Status Word 2 PNU 1011

Positioning Mode (PNU 930 = 2)

Process Data					
CW	REF	PD1	PD2	PD3	PD4
SW	ACT	PD1	PD2	PD3	PD4
Control Word PNU 967	Direct Target Position PNU 1231		Direct Profile Velocity PNU 1232		Control Word 2 PNU 1010
Status Word PNU 968	Actual Position PNU 1201		Actual Velocity PNU 1101		Status Word 2 PNU 1011

[1] Note that, in any case the drive can be controlled by “direct” commands from field bus (“Direct Target Position”, “Direct Target Velocity", etc.), or “internal” commands from motion tables (PNU 1200 “Target Position”, PNU 1010 “Target Velocity”, etc.) selected through Control Word 2. When using “Telegram 101”, PNU 1223 “Motion Type Selection” allows for switching between direct/internal commands: PNU 1223 set to “1 - Internal", internal data of motion tables are applied; PNU 1223 set to “2 - Fieldbus", direct digital references are applied. See *Chapter 6 – “Direct” / “Internal” Commands*.

[2] For all operating modes, units of speed and position depend on PNU 1214 “Axis Type”: [meters/second] and [meters] for linear axis, [degrees] and [degrees/seconds] for rotational axis.

Analog Speed Mode (PNU 930 = -1)

Process Data					
CW	REF	PD1	PD2	PD3	PD4
SW	ACT	PD1	PD2	PD3	PD4
Control Word PNU 967	-	-	-	-	Control Word 2 PNU 1010
Status Word PNU 968	Actual Velocity PNU 1101		Actual Position PNU 1201		Status Word 2 PNU 1011

Note. Telegram 101 provides extra-functions with both “Analog Torque Mode” and “Torque Mode”. Process data PD3 can be used for remote control of additional devices by setting a number of the DGV’s digital I/O as “0 - Disabled” (see Appendix A, PNU 1400 and PNU 1401).

Analog Torque Mode (PNU 930 = -2)

Process Data						
CW	REF	PD1	PD2	PD3		PD4
SW	ACT	PD1	PD2	PD3		PD4
Control Word PNU 967	-	-	-	-	PNU 1401	Control Word 2 PNU 1010
Status Word PNU 968	Actual Torque PNU 1301	Actual Velocity PNU 1101		PNU 1400	PNU 1401	Status Word 2 PNU 1011

Torque Mode (PNU 930 = -3)

Process Data						
CW	REF	PD1	PD2	PD3		PD4
SW	ACT	PD1	PD2	PD3		PD4
Control Word PNU 967	Direct Target Torque PNU 1303	-	-	-	PNU 1401	Control Word 2 PNU 1010
Status Word PNU 968	Actual Torque PNU 1301	Actual Velocity PNU 1101		PNU 1400	PNU 1401	Status Word 2 PNU 1011

Telegram 102 When PNU 922 = 102, control and status Process Data have the standard structure of “Telegram 102”, predefined for each operating mode [1].

Speed Mode (PNU 930 = 1)

Process Data					
CW	REF	PD1	PD2	PD3	PD4
SW	ACT	PD1	PD2	PD3	PD4
Control Word PNU 967	Direct Target Velocity PNU 1111		Direct Accele-ration Override PNU 1233	Torque Reduction PNU 1110	Control Word 2 PNU 1010
Status Word PNU 968	Actual Velocity PNU 1101		Actual Torque PNU 1301	Average Torque PNU 1302	Status Word 2 PNU 1011

Positioning Mode (PNU 930 = 2)

Process Data					
CW	REF	PD1	PD2	PD3	PD4
SW	ACT	PD1	PD2	PD3	PD4
Control Word PNU 967	Direct Target Position PNU 1231		Velocity Override PNU 1230	Direct Accele-ration Override PNU 1233	Control Word 2 PNU 1010
Status Word PNU 968	Actual Position PNU 1201		Actual Velocity PNU 1101		Status Word 2 PNU 1011

[1] Note that, in any case the drive can be controlled by “direct” commands or “internal” commands. When “Telegram 102”, Bit 15 of the Control Word allows for switching between direct/internal commands: Bit 15 set to 0, internal data of motion tables are applied; Bit 15 set to 1, direct digital references are applied. See *Chapter 6 – “Direct” / “Internal” Commands*.

Analog Speed Mode (PNU 930 = -1)

Process Data					
CW	REF	PD1	PD2	PD3	PD4
SW	ACT	PD1	PD2	PD3	PD4
Control Word PNU 967	Torque Reduction PNU 1110	-	-	-	Control Word 2 PNU 1010
Status Word PNU 968	Actual Velocity PNU 1101		Actual Torque PNU 1301	Average Torque PNU 1302	Status Word 2 PNU 1011

Analog Torque Mode (PNU 930 = -2)

Process Data					
CW	REF	PD1	PD2	PD3	PD4
SW	ACT	PD1	PD2	PD3	PD4
Control Word PNU 967	-	-	-	-	Control Word 2 PNU 1010
Status Word PNU 968	Actual Torque PNU 1301	Actual Velocity PNU 1101		Average Torque PNU 1302	Status Word 2 PNU 1011

Torque Mode (PNU 930 = -3)

Process Data					
CW	REF	PD1	PD2	PD3	PD4
SW	ACT	PD1	PD2	PD3	PD4
Control Word PNU 967	Direct Target Torque PNU 1303	-	-	-	Control Word 2 PNU 1010
Status Word PNU 968	Actual Torque PNU 1301	Actual Velocity PNU 1101		Average Torque PNU 1302	Status Word 2 PNU 1011

This page has been intentionally left blank.

Chapter 6 - Description of Functions

Introduction

This chapter introduces functions and features of the operating modes available with DGV.

Operating Modes

DGV with PROFIBUS-DP interface can operate different modes (PNU 930), each mode suiting a particular application

- *Analog Torque Mode* performs torque control using the torque reference given to the drive through the Analog Input (+VREF, -VREF) on the converter front panel.
- *Analog Speed Mode* performs speed control using the speed reference given to the drive through the Analog Input (+VREF, -VREF) on the converter front panel.
- *Positioning Mode* performs position control using digital position targets. The positioning is point-to-point with fixed targets. Additional positioning functions are available such as *Absolute*/*Relative Positioning*, *Position Modulo*, and different methods for targets processing (*Single Setpoint*, *Change Set Immediately*), etc. *Homing*, *Jogging* and *Synchronization* can be also performed selecting this mode.
- *Speed Mode* performs speed control using digital speed targets.
- *Torque Mode* performs torque control using digital torque targets.

Note. Control Mode (PNU 260) must be set to “2 - Field Bus” for activating field bus external control and afterwards selecting the operating mode (PNU 930).

Note. Each mode, however, can be operated locally as well by setting Control Mode to “1 - Local”, selecting the operating mode with parameter Local Operating Mode (PNU 258) and in case configuring the motion tables. In details,

- *Analogue Torque Mode* can be operated locally setting PNU 258 to “1 - Analog Torque” and feeding the Analog Input +VREF, -VREF or activating the Waveform Generator in the Waveform page of the Browser application tool (see *Firmware Manual*);
- *Analogue Speed Mode* can be operated locally setting PNU 258 to “1 - Analog Speed” and feeding the Analog Input +VREF, -VREF or activating the Waveform Generator in the Waveform page of the Browser application tool (see *Firmware Manual*);
- *Torque Mode* can be operated locally setting PNU 258 to “3 - Digital Torque” and setting the torque setpoint into parameter “Target Torque” (PNU 1300);
- *Speed Mode* can be operated locally setting PNU 258 to “4 - Digital Speed” and setting the speed setpoint into parameter “Target Velocity” (PNU 1100);
- *Positioning Mode* can be operated setting PNU 258 to “5 - Digital Position" and setting the position setpoint into parameter “Target Position” (PNU 1200). This mode includes the Homing, Jogging and Synchronization.

"Direct" / "Internal" Commands

By this function it is possible to manage mixed applications, which require to control the drive applying digital references from fieldbus, called "direct", or "internal" references programmed into the 32 motion tables.

This function is available in the operating modes *Positioning Mode*, *Speed Mode* and *Torque Mode*.

As featured in *Configuration of the Process Data*, it is possible to choose between two predefined configuration of the telegram (*Telegram 101* and *Telegram 102*) using PNU 922 "Telegram Selection".

Switching among "direct" and "internal" commands is achieved through:

- PNU 1223 "Motion Type Selection" when using Telegram 101
- Bit 15 of the Control Word when using Telegram 102

When using Telegram 101,

- by setting PNU 1223 to "0 - Internal" internal data of the motion tables are applied;
- by setting PNU 1223 to "1 - Fieldbus", direct digital references are applied.

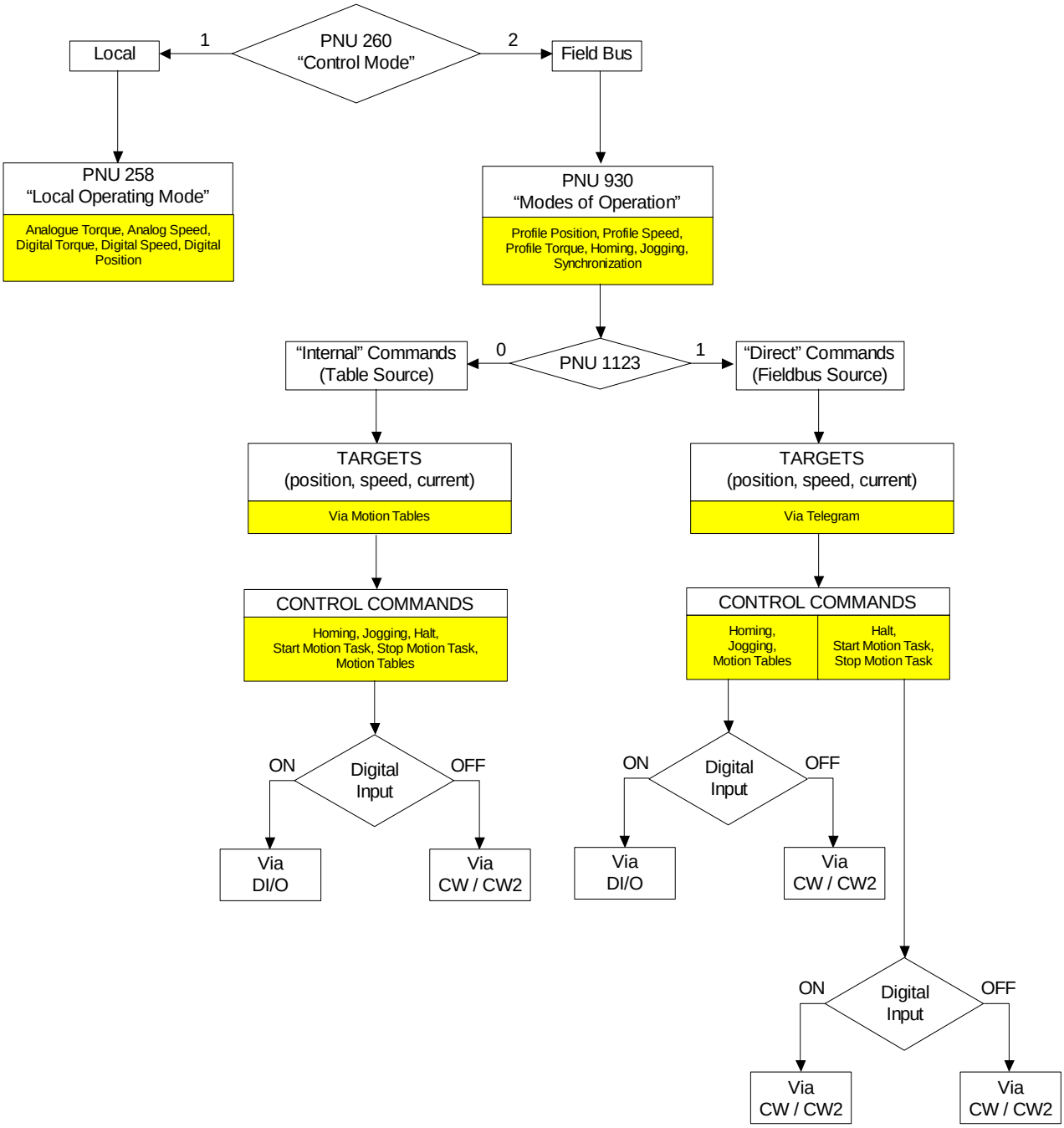
When using Telegram 102,

- by setting Bit 15 to 0, internal data of the motion tables are applied;
- by setting Bit 15 to 1, direct digital references are applied.

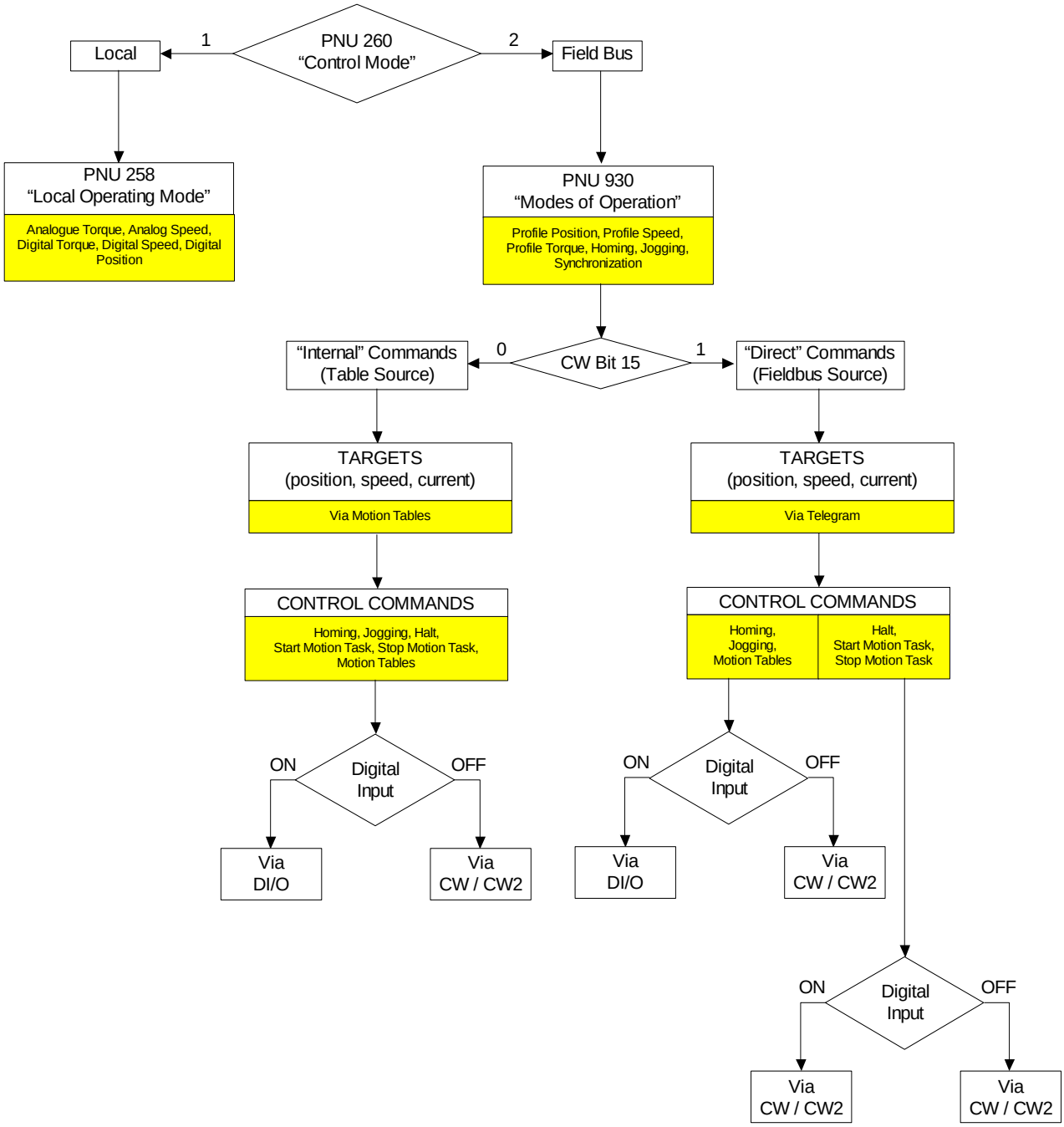
Hence, different parameters are employed for "direct" and "internal" control.

Data	**Direct Commands**		**Internal Commands (32 Tables)**
	Telegram 101 and PNU 1223=1	Telegram 102 and Bit 15 = 1	• Telegram 101 and PNU1223=0 • Telegram 102 and Bit 15 = 0
Velocity Target (Speed Mode)	PNU 1111	PNU 1111	PNU 1100
Position Target (Positioning Mode)	PNU 1231	PNU 1231	PNU 1200
Profile Velocity (Positioning Mode)	PNU 1232	PNU 1230 (% PNU 1232)	PNU 1202
Profile Acceleration (Speed and Position. Mode)	PNU 1203	PNU 1233 (% PNU 1222)	PNU 1203
Profile Deceleration (Speed and Position. Mode)	PNU 1204	PNU 1233 (% PNU 1221)	PNU 1204
Torque Target (Torque Mode)	PNU 1303	PNU 1303	PNU 1300

Commands Flowchart for Telegram 101



Commands Flowchart for Telegram 102



Analog Torque Mode

Selecting Analog Torque Mode (PNU 930 set to -2) activates torque control using analog setpoint. The device can only be activated by the Control Word and monitored through the Status Word.

The current command, which produces torque at the motor shaft, is the reference signal at Analog Input (+VREF, -VREF). The Analog Input signal can be scaled adjusting the scaling factors “Torque Numerator” (PNU 339) and “Torque Denominator” (PNU 363). See also paragraph *Analog I/O* of *Firmware Manual*.

The scaled signal feeds directly the internal control loop of DGV to provide a PI current control.

WARNING! In order to avoid faults or motor damages, **special care must be taken using this mode**.

Basic Settings for Analog Torque Mode

After first configuration of DGV Servodrives has been performed as illustrated in Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted.

Basic Settings for Analog Torque Mode

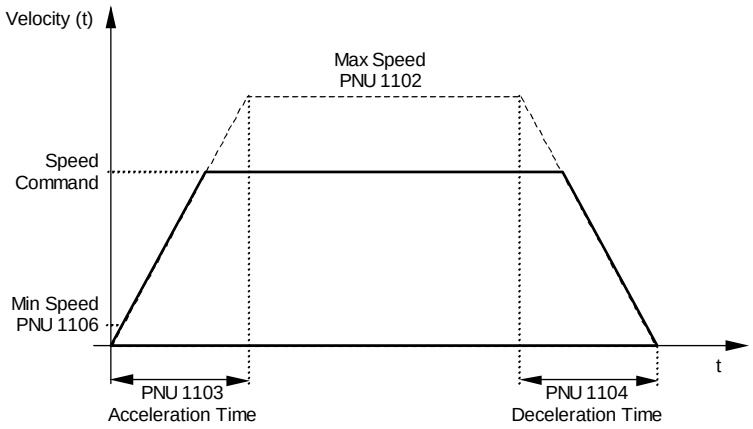
PNU	Name	Value	Comments
930	Modes of Operation	-2	Analog Torque Mode
1106	Min Speed	Custom	Threshold for bit 10 of SW
339	Torque Numerator	Custom	Scaling of Analog Input
363	Torque Denominator	Custom	+VREF -VREF
343	Brake Current	Custom	Current for dynamic braking
379	Kp Current Gain Level	Default	Parameters of the current
380	Tn Current	Default	internal control loop

Analog Speed Mode

Selecting Analog Speed Mode (PNU 930 set to -1) activates control of the motor speed. The device can only be activated by the Control Word and monitored through the Status Word.

The speed command is the reference signal at Analog Input (+VREF, -VREF). The Analog Input signal can be scaled adjusting the scaling factors “Speed Numerator” (PNU 336) and “Speed Denominator” (PNU 338). See also paragraph *Analog I/O* of *Firmware Manual*.

The speed command signal goes through the ramp function generator and then feeds directly the speed control loop of DGV to provide a PI speed control.



When the ramp function generator is active,

- the speed command is limited by “Max Speed” (PNU 1102)
- “Acceleration Time” (PNU 1103) and “Deceleration Time” (PNU 1104) fix ramps for accelerating and decelerating regardless amplitude of the speed command
- “Min Speed” (PNU 1106) fixes the minimum speed for bit 10 of the Status Word.

Basic Settings for Analog Speed Mode

After first configuration of DGV Servodrives has been performed as illustrated in Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted.

Basic Settings for Analog Speed Mode

PNU	Name	Value	Comments
930	Modes of Operation	-1	Analog Speed Mode
337	Maximum Speed	Custom	Motor maximum speed
336	Speed Numerator	Custom	Scaling of Analog Input
338	Speed Denominator	Custom	+VREF -VREF
343	Brake Current	Custom	Current for dynamic braking
357	Overspeed Threshold Level	Custom	-
373	Kp Speed Gain Level	Custom	Parameters of the PI internal
374	Tn Speed	Custom	speed control loop
1102	Max Speed	Custom	Limitation of speed command
1103	Acceleration Time	Custom	Ramp for accelerating
1104	Deceleration Time	Custom	Ramp for decelerating
1105	Quick Stop Time	Custom	Emergency stop ramp
1106	Min Speed	Custom	Threshold for bit 10 of SW
1109	Ramp Function Generator Enable	1 - On	Enable internal ramp generator
1206	Min Software Position Limit	Custom	Set the positive and negative
1207	Max Software Position Limit	Custom	software limit switch
1213	Limit Switch Enable	000**1**b	Enable HW negative limit switch
		00**1**0b	Enable HW positive limit switch
		0**1**00b	Enable SW negative limit switch
		1000b	Enable SW positive limit switch
1214	Axis Type	1 / 2	1 - Rotary / 2 - Linear Axis

Positioning Mode

Positioning Mode (PNU 930 set to 2) performs single-axis position control.

When a position setpoint is applied, the drive is controlled from its start position to the defined target position using the trajectory generator, that is, using the speed and position profiles internally generated. The position target is generally a field bus reference. However, motion tables previously configured with fixed targets can be operated, while the drive is externally controlled. For this purpose Control Word 2 (PNU 1010) and Digital Inputs can be used.

Profile parameters, motion parameters and parameters of the position and speed control loops must be adjusted depending on the application.

Note. When positioning by direct commands, any change of state (0-1-0…) in Bit 6 of the Control Word enables the new position target given into the specific field of the process data (see *Configuration of the Process Data*).

When positioning by internal commands, positive edges only (0 → 1) in Bit 6 of the Control Word enable the position target set into the motion table currently selected.

Basic Setting for Positioning

After first configuration of DGV Servodrives has been performed as illustrated in Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted.

Note also that axis referencing is necessary before any positioning can be executed.

Basic Settings for Positioning

PNU	Name	Value	Comments
930	Modes of Operation	2	Positioning Mode
1010	Control Word 2	Custom	Selection of motion tables
1106	Min Speed	Custom	Threshold for bit 12 of SW
1200	Target Position	Custom	-
1202	Profile Velocity	Custom	-
1203	Profile Acceleration	Custom	-
1204	Profile Deceleration	Custom	-
1205	Quick Stop Deceleration	Custom	Emergency stop deceleration
1206	Min Software Position Limit	Custom	Set the positive and negative
1207	Max Software Position Limit	Custom	software limit switch
1208	Polarity	Custom	-
1209	Following error window	Custom	See *Monitoring Functions*
1210	Position Window	Custom	See *Monitoring Functions*
1211	Position Conversion Numerator	65536	Conversion of axis position
1212	Position Conversion Denominator	Custom	into internal units
1213	Limit Switch Enable	000**1**b	Enable HW negative limit switch
		00**1**0b	Enable HW positive limit switch
		0**1**00b	Enable SW negative limit switch
		1000b	Enable SW positive limit switch
1214	Axis Type	1 / 2	1 - Rotary / 2 - Linear Axis
1215	Position Monitoring Time	Custom	See *Monitoring Functions*
1216	Position Modulo	Custom	For ex. 1000.000 [deg]
1217	Positioning Mode	000**0**b	Absolute Positioning
		000**1**b	Relative Positioning
		00**0**0b	Single setpoint
		00**1**0b	Change Set Immediately
		0**0**00b	Positive direction
		0**1**00b	Negative direction
		1000b	Run shortest trip to target
1218	Modulo Conversion Activation	1 / 0	On / Off
1219	Motion Profile Type	0	Trapezoidal Profile
1220	Max Profile Velocity	Custom	-
1221	Max Acceleration	Custom	-
1222	Max Deceleration	Custom	-
1223	Motion Type Selection	0 / 1	0 - Table (Internal) / 1- FieldBus
1224	Jerk-limiting Time Constant	Custom	Smooth profile generator
1225	Enable Table	On / Off	Set On when PNU 1223 = 0
1227	Next Running Table	Custom	Select when Index 2119 = 0
1228	Delay before Running Next Table	Custom	-

Positioning Functions

When the drive is position-controlled, the position target is approached through one of the following positioning methods:

- Absolute positioning
- Relative positioning
- Positioning functions (position modulo, single setpoint, set of setpoints)
- Jogging

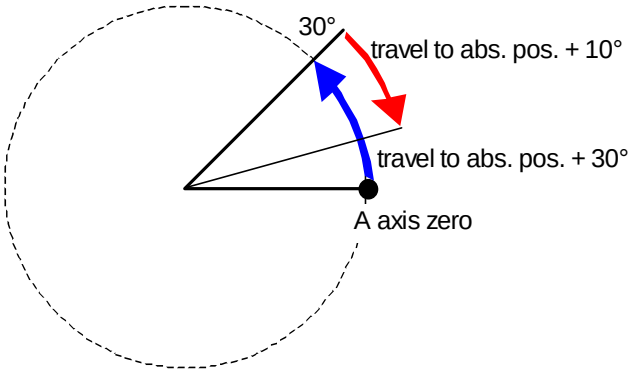
In addition monitoring functions can be programmed, such as hardware and software limit switches, following error monitoring, positioning and speed monitoring, standstill monitoring.

Absolute Positioning

When Positioning Mode is selected, Bit 12 of the Control Word set to zero specifies that the drive must interpret the position target as absolute, after the drive has been referenced.

For example:

- axis zero is point A and position target is 30 degrees, then the system approaches to absolute position + 30 degrees (blue arrow); if a second position target were 10 degrees, the system would drive back to absolute position + 10 degrees (red arrow).

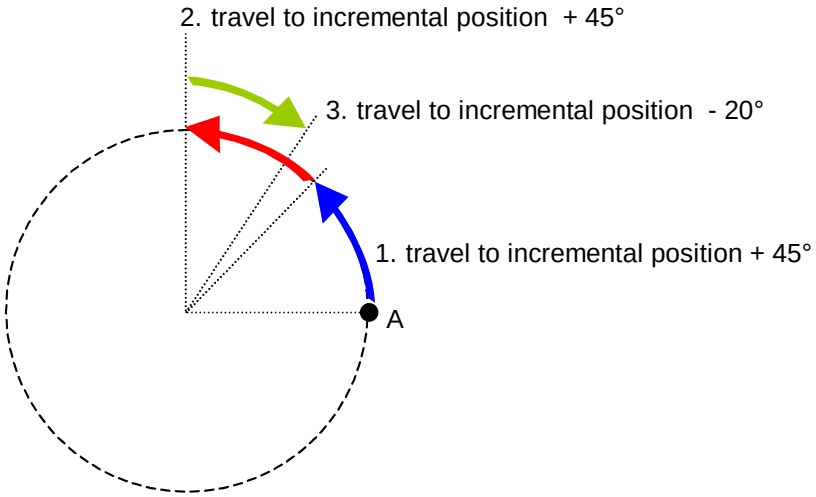


Relative Positioning

When Positioning Mode is selected, Bit 12 of the Control Word set to one specifies that the drive must interpret any position target as referenced to the last position target approached. Therefore motions are only incremental positions.

For example:

- axis zero is point A and first position target is + 45 degrees (blue arrow); if new position target is + 45 degrees, then the system travels 45 further degrees (red arrow). If new position target is - 20 degrees, the axis moves 20 degrees back from last position, whatever it be.



Note that in any case of absolute and relative positioning, approaching direction to the target depends on sign of position setpoint: clockwise rotation when positive setpoint, counterclockwise rotation when negative setpoint.

Note. Sending incremental position references in one direction can cause saturation of computation on the actual position. In this case we recommend to adopt the function *Position Modulo*, in order to avoid saturation of the actual position.

Position Modulo

The Positioning Mode provides also the Position Modulo function for rotary axis.

Activation of positioning with Position Modulo is possible setting the following parameters:

- PNU 1218 “Modulo Conversion Activation” set to 1 activates the Position Modulo function. Setting to 0, instead, restores standard positioning.
- PNU 1216 “Position Modulo” parameterize the position modulo range.
- PNU 1217 “Positioning Mode” sets positioning functions.

Note that when position modulo is activated both absolute and relative positioning methods are available for parameterization, and direction of approach to target depends on sign of position setpoint.

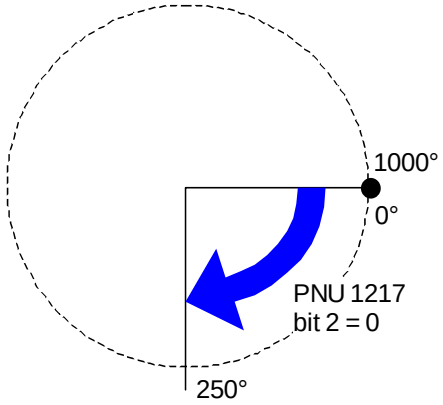
As further feature, position modulo can be programmed to run the shortest trip to target.

WARNING! When position modulo is active hardware and software limit switches are switched off.

…when positive direction

When absolute position modulo in positive direction is selected (PNU 1217, bit 2 = 0), any position target within the position modulo range (PNU 1216) is approached moving forward clockwise.

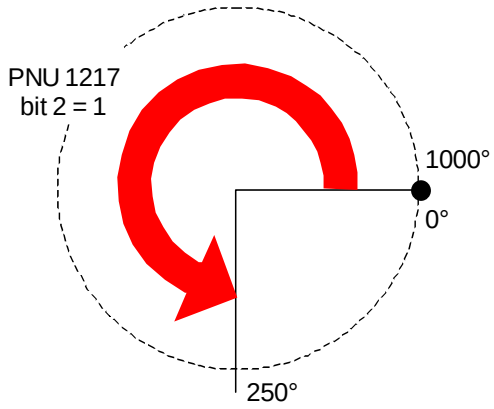
For example, assuming that modulo range is equal to 1000 degrees (PNU 1216 = 1000) and position target is 250 degrees, axis will approach target moving clockwise.



Note that when absolute positioning largest position target is equal to position modulo.

…when negative direction

As for the positive direction, opposite however, when negative direction is selected (PNU 1217, bit 2 = 1), any position target within the position modulo range (PNU 1216) is approached moving forward counterclockwise.



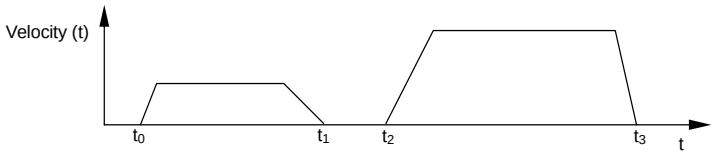
…running shortest trip to target

When bit 3 of PNU 1217 is set, the drive approaches the position target running the shortest trip within the position modulo range (PNU 1216), regardless the direction of motion.

Single Setpoint

This function is controlled by PNU 1217 “Positioning Mode” (bit 1 = 0) when Control Mode is “1 - Local”, or by bit 13 of the Control Word when Control Mode is “2 - Field Bus”.

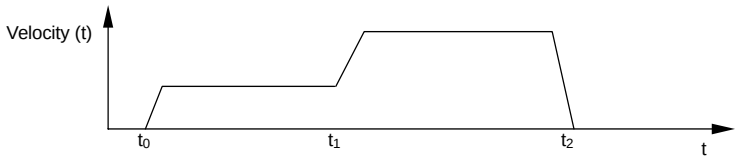
The drive unit is controlled by single setpoints processed one at a time. The drive unit signals the target was reached (bit 10 of the Status Word) and then waits for the next position setpoint. Hence drive speed is reduced to zero before accepting a new setpoint.



Change Set Immediately

This function is controlled by PNU 1217 “Positioning Mode” (bit 1 = 1) when Control Mode is “1 - Local”, or by bit 13 of the Control Word when Control Mode is “2 - Field Bus”.

The drive unit applies a set of setpoints, that is setpoints are processed one by one immediately. The drive speed is not reduced to zero after reaching targets.



Positioning Signals

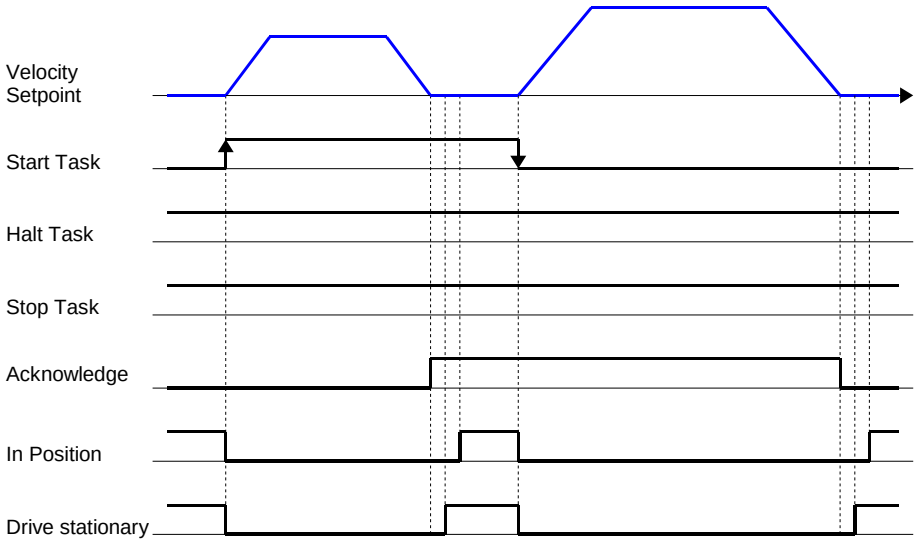
In the following, diagrams of control and status signals during positioning are presented. These diagrams are valid in field bus control. (Diagrams for local control, see *CANopen Manual*, *Positioning Signals*).

The control signals Start Task, Halt Task and Stop Task refer to the command bits of the Control Word or to digital inputs configured as “Start Motion Task”, “Halt” and “Stop Motion Task”.

The status signals Acknowledge, In Position and Drive Stationary refer to the bits of the Status Word (Acknowledge, Target Reached, Drive Stationary) or to digital outputs configured as “Positioning Ack” e “Target Reached”.

Single Positioning Tasks

Diagram of signals for single positioning tasks (function *Single Setpoint*).

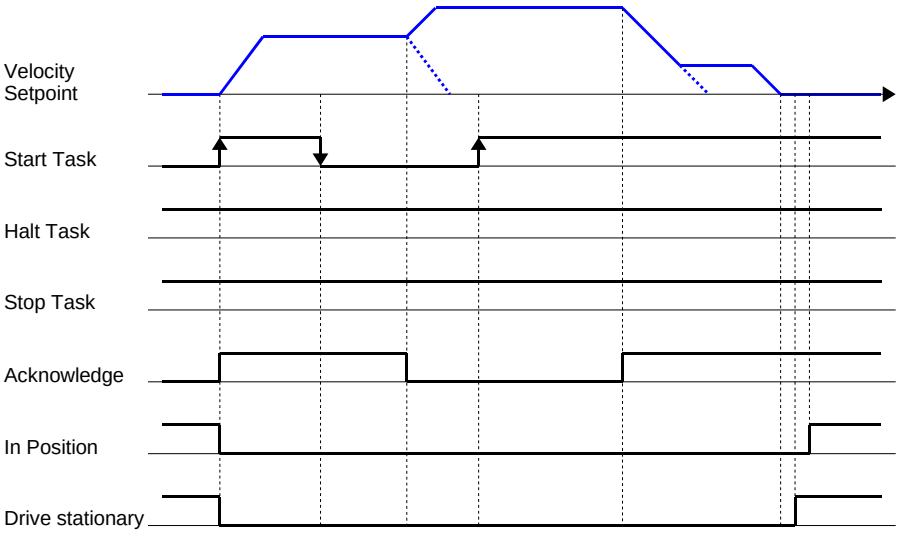


Each transition of command “Start Task” activates a new positioning task; status signal “Acknowledge” indicates when the unit may accept a new Start command.

Status signal “In Position” indicates when the positioning is over. Status signal “Drive Stationary” indicates when axis is stationary.

Multiple Positioning Tasks

Diagram of signals for multiple positioning tasks with on-the-fly change of the position target (function *Change Set Immediately*).



Each transition of command signal “Start Task! activates a new positioning task; status signal “Acknowledge” indicates that a new positioning task is being executed.

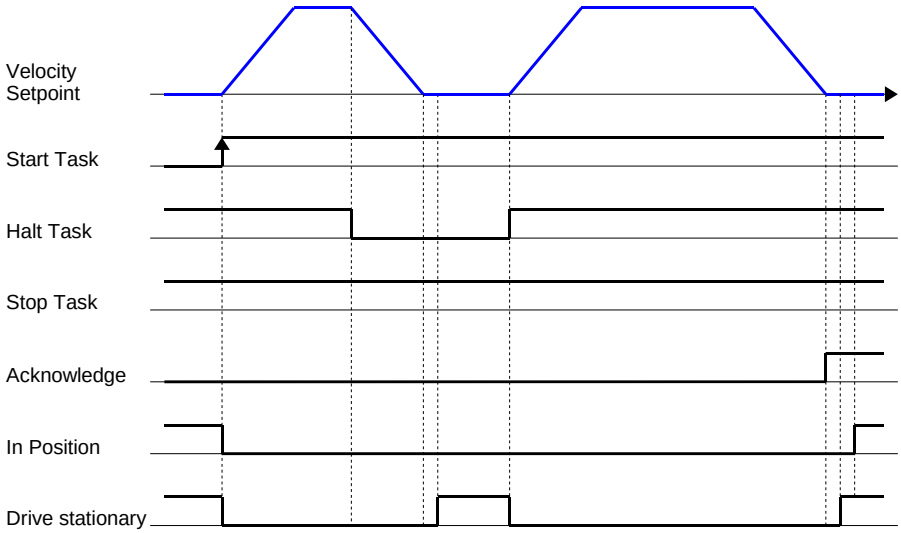
In this case, status signal “In Position” indicates the beginning and the end of a sequence of positioning tasks. Status signal “Drive Stationary” indicates when axis is stationary.

Note. Behavior of status signal “Acknowledge” changes if motion tables are used to program an automatic sequence of positioning tasks. In this case:

- command “Start Task” starts the automatic sequence
- “Acknowledge” signals only when the automatic sequence is over; after that, the unit may accept a start command for a new positioning task or a new sequence of positioning tasks.

Intermediate Stop

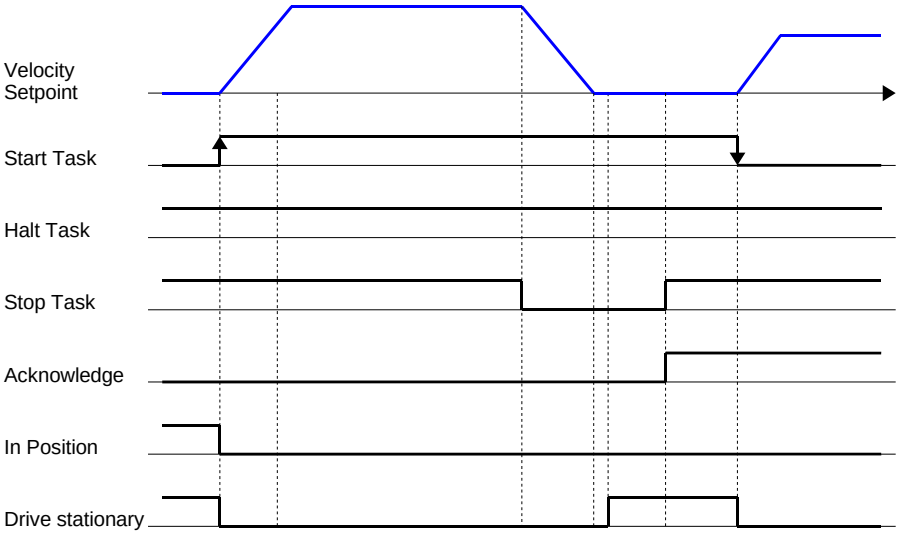
Diagram of signals for intermediate stop during a positioning task (Intermediate Stop).



As a command Halt Task is activated, the unit halts the positioning task and sets the signal “In Position”. As Halt command is released, the unit restarts and finishes positioning.

Interrupting a Positioning Task

Diagram of signals when interrupting and aborting a positioning task.



As a command Stop Task is activated, the positioning task is aborted. The unit stops and sets the signal “In Position”. As Stop command is released, the unit may be restarted with a new “Start Task” command.

In this case, status signal “In Position” indicates that a positioning task is being executed.

Note. In case of relative positioning, the residual distance is retained; i.e. when starting a new positioning task, the unit executes not only the new distance but also the distance missing from the previous positioning.

Jogging

Jogging (called Inching as well) is used for short motion such as moving out of hardware and software limit switches, adjusting axis position, etc.

When inching is used, DGV is position-controlled (PNU 930 must be set to 2).

Parameters Jogging Speed and Jogging Acceleration must be adjusted.

Note that two inching procedure can be programmed, one for large moves, for instance, and one for very short moves:

- Jogging 1 using Jogging Speed 1 (PNU 1255) and Jogging Acceleration (PNU 1257), as long as Control Word bit 8 is high
- Jogging 2 using Jogging Speed 2 (PNU 1256) and Jogging Acceleration (PNU 1257), as long as Control Word bit 9 is high.

Homing

Homing is used for axis referencing. When homing is used, DGV is position-controlled (PNU 930 must be set to 2).

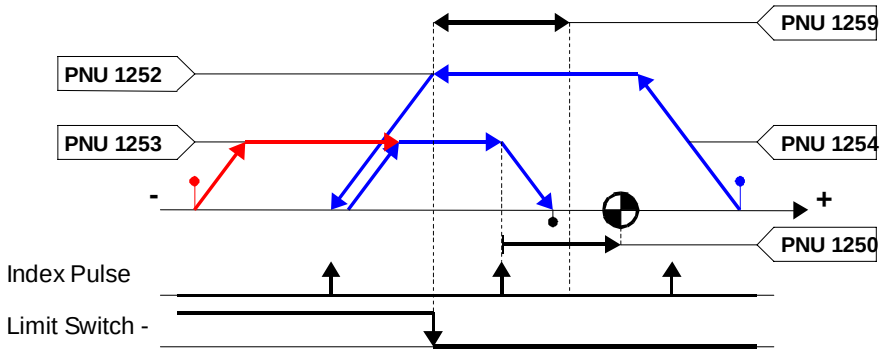
Once the homing procedure is over, it is possible to cancel axis zero by Bit 8 of “Control Word 2”, PNU 1010.

Homing Methods

The following homing methods are available for executing the homing procedure using the limit switches and/or the index pulse.

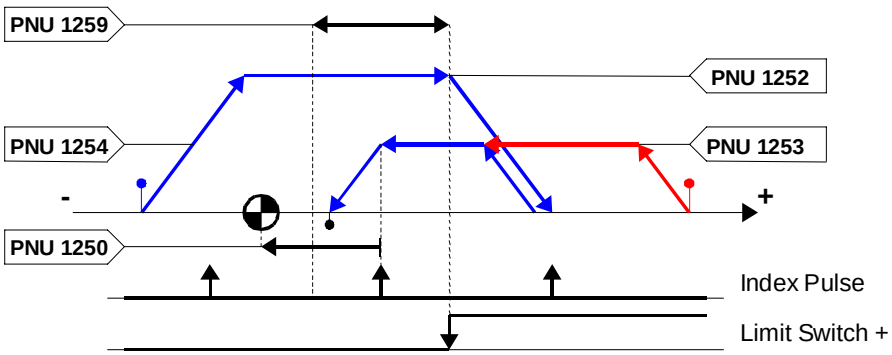
Method 1 **Homing on the negative limit switch and index pulse**

Using this method the initial direction of movement is leftward if the negative limit switch is inactive (here shown as low). The home position is at the first index pulse to the right of the position where the negative limit switch becomes inactive.



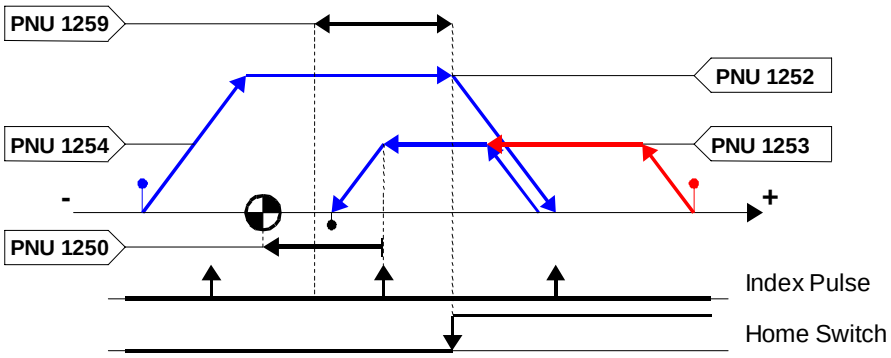
Method 2 **Homing on the positive limit switch and index pulse**

Using this method the initial direction of movement is rightward if the positive limit switch is inactive (here shown as low). The position of home is at the first index pulse to the left of the position where the positive limit switch becomes inactive.



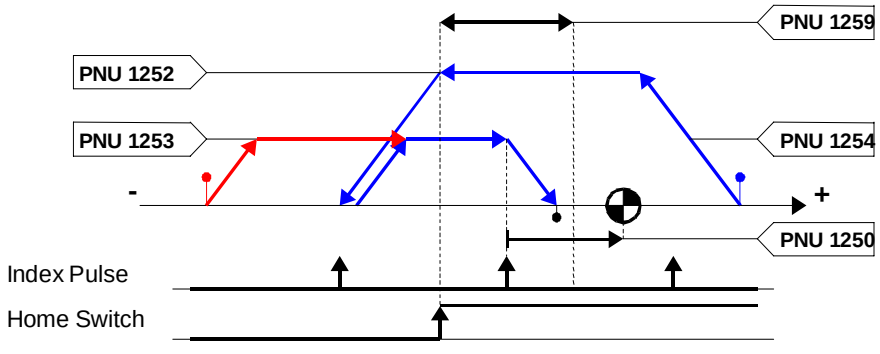
Method 3 **Homing on the falling edge of the positive home switch and index pulse**

The initial direction of movement is dependent on the state of the home switch. The home position is at the index pulse to either to the left or the right of the point where the positive home switch changes to the low state. If the initial position is sited so that the direction of movement must reverse during homing, the point at which the reversal takes place is after the falling edge of the positive home switch.



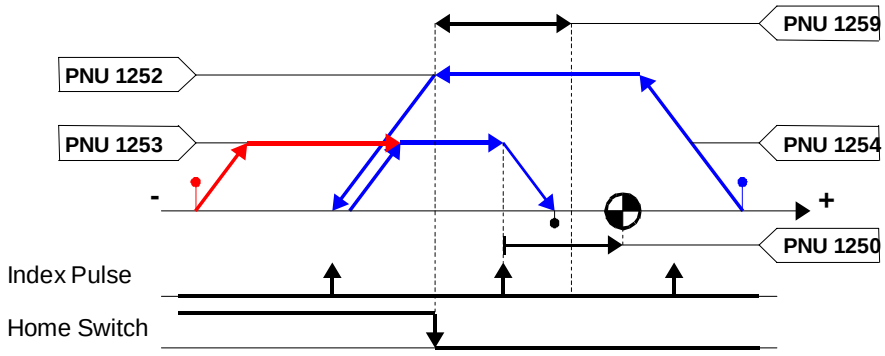
Method 4 **Homing on the rising edge of the positive home switch and index pulse**

The initial direction of movement is dependent on the state of the home switch. The home position is at the index pulse to either to the left or the right of the point where the positive home switch changes to the high state. If the initial position is sited so that the direction of movement must reverse during homing, the point at which the reversal takes place is after the rising edge of the positive home switch.



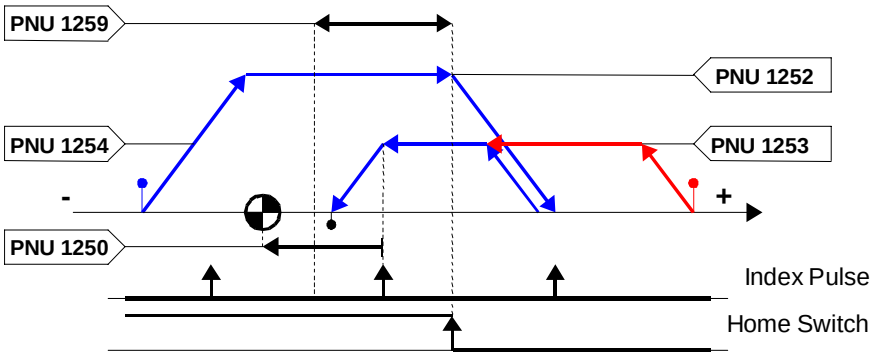
Method 5 **Homing on the falling edge of the negative home switch and index pulse**

The initial direction of movement is dependent on the state of the home switch. The home position is at the index pulse to either to the left or the right of the point where the negative home switch changes to the low state. If the initial position is sited so that the direction of movement must reverse during homing, the point at which the reversal takes place is after the falling edge of the negative home switch.



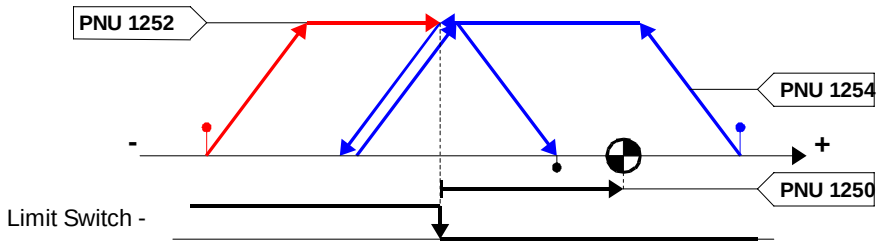
Method 6 **Homing on the rising edge of the negative home switch and index pulse**

The initial direction of movement is dependent on the state of the home switch. The home position is at the index pulse to either to the left or the right of the point where the negative home switch changes to the low state. If the initial position is sited so that the direction of movement must reverse during homing, the point at which the reversal takes place is after the rising edge of the negative home switch.



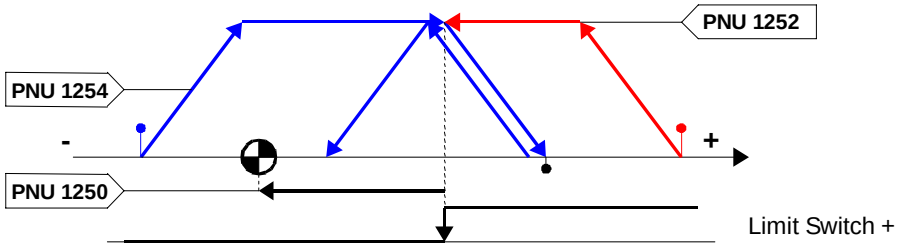
Method 17 **Homing on the negative limit switch**

The initial direction of movement is dependent on the state of the limit switch. The home position is at the negative limit switch transition. If the initial position is sited so that the direction of movement must reverse during homing, the reversal takes place after the rising edge of the negative limit switch and then it references on the negative limit switch.



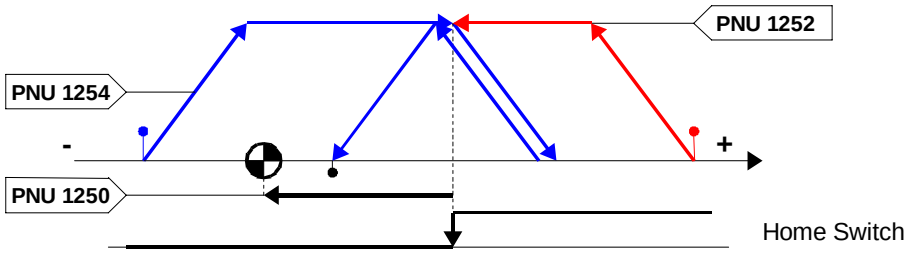
Method 18 **Homing on the positive limit switch**

The initial direction of movement is dependent on the state of the limit switch. The home position is on the positive limit switch transition. If the initial position is sited so that the direction of movement must reverse during homing, the reversal takes place after the falling edge of the positive limit switch and then it references on the positive limit switch.



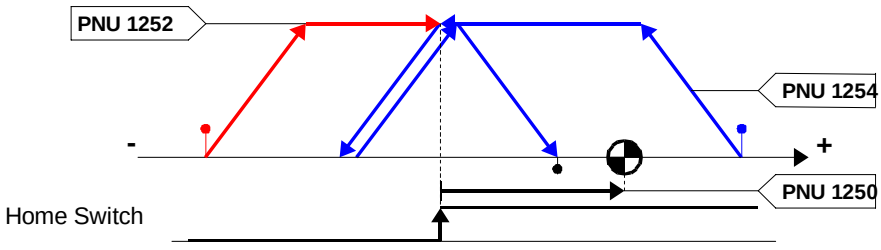
Method 19 **Homing on the falling edge of the positive home switch**

The initial direction of movement is dependent on the state of the home switch. The home position is on the home switch transition. If the initial position is sited so that the direction of movement must reverse during homing, the reversal takes place after the transition of the positive home switch and then it references on the positive home switch.



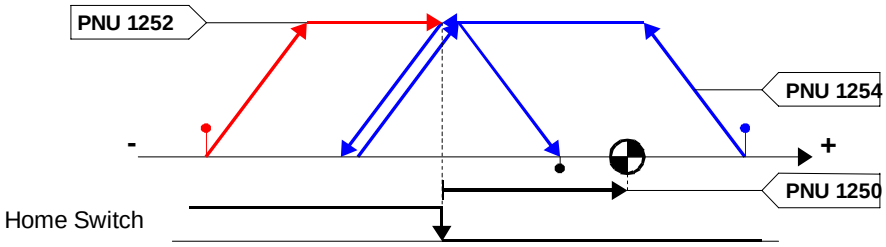
Method 20 **Homing on the rising edge of the positive home switch**

The initial direction of movement is dependent on the state of the home switch. The home position is on the home switch transition. If the initial position is sited so that the direction of movement must reverse during homing, the reversal takes place after the transition of the positive home switch and then it references on the positive home switch.



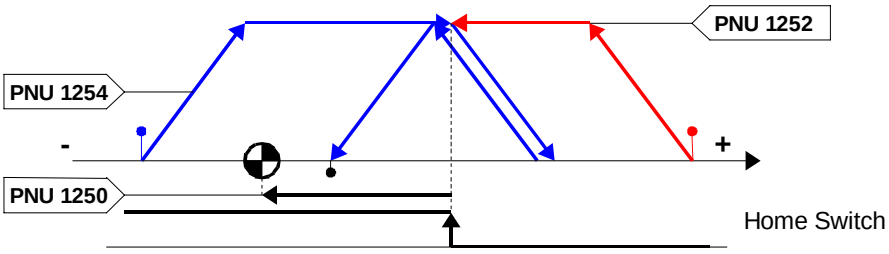
Method 21 **Homing on the falling edge of the negative home switch**

The initial direction of movement is dependent on the state of the home switch. The home position is on the falling edge of the negative home switch. If the initial position is sited so that the direction of movement must reverse during homing, the reversal takes place after the home switch transition and then it references on the home switch itself.



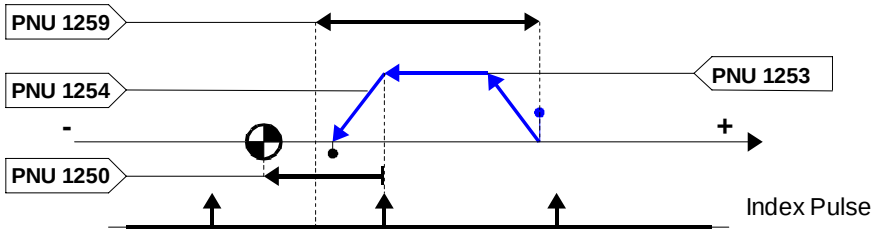
Method 22 **Homing on the rising edge of the negative home switch**

The initial direction of movement is dependent on the state of the home switch. The home position is on the rising edge of the negative home switch. If the initial position is sited so that the direction of movement must reverse during homing, the reversal takes place after the home switch transition and then it references on the home switch itself.



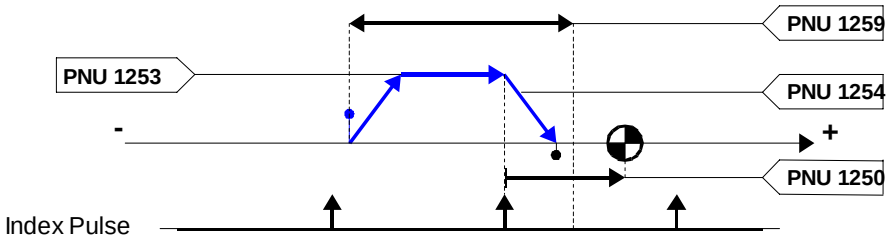
Method 33 **Homing on the index pulse in the negative direction**

Using this method, the axis references on the first index pulse found moving in the negative direction.



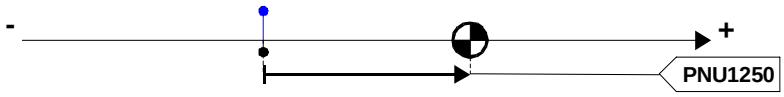
Method 34 **Homing on the index pulse in the positive direction**

Using this method, the axis references on the first index pulse found moving in the positive direction.



Method 35 **Homing on the current position**

The current position is taken to be the home position.



Basic Settings for Referencing

Minimal settings for referencing are illustrated below.

Basic Settings for Referencing			
PNU	**Name**	**Value**	**Comments**
930	Modes of Operation	2	Positioning Mode
1206	Min Software Position Limit	Custom	Set the positive and negative
1207	Max Software Position Limit	Custom	software limit switch
1208	Polarity	Custom	-
1209	Following error window	Custom	See *Monitoring Functions*
1210	Position Window	Custom	See *Monitoring Functions*
1211	Position Conversion Numerator	65536	Conversion of axis position
1212	Position Conversion Denominator	Custom	into internal units
1213	Limit Switch Enable	000**1**b	Enable HW negative limit switch
		00**1**0b	Enable HW positive limit switch
		0**1**00b	Enable SW negative limit switch
		1000b	Enable SW positive limit switch
1214	Axis Type	1 / 2	1 - Rotary / 2 - Linear Axis
1250	Homing offset	Optional	-
1251	Homing method	1	Neg. Lim. Sw. + Index Pulse
		2	Pos. Lim. Sw. + Index Pulse
		3	Pos. Home Sw. + Index Pulse
		4	Pos. Home Sw. + Index Pulse
		5	Neg. Home Sw. + Index Pulse
		6	Neg. Home Sw. + Index Pulse
		17	Negative Limit Switch
		18	Positive Limit Switch
		19	Positive Home Switch
		20	Positive Home Switch
		21	Negative Home Switch
		22	Negative Home Switch
		33	Index Pulse neg. direction
		34	Index Pulse pos. direction
		35	Reference on current position
1252	Homing speed for Switch	Custom	-
1253	Homing speed for Zero	Custom	-
1254	Homing acceleration	Custom	-
1258	Max Travel for Switch	Custom	-
1259	Max Travel for Zero	Custom	-

Speed Mode

Speed Mode (PNU 930 set to 1) performs remote control of the motor speed.

When a speed setpoint is applied, the drive is speed-controlled to reach and maintain the target speed. “Profile Acceleration” and “Profile Deceleration” (PNU 1203, 1204) are used to generate a speed motion profile. The speed setpoint is generally a field bus reference. However, motion tables externally controlled and previously configured with fixed targets can be operated. For this purpose “Control Word 2” (PNU1010) and Digital Inputs can be used.

Profile parameters, motion parameters and parameters of the speed control loops must be adjusted depending on the application.

Basic Settings for Speed Mode

After first automatic configuration of DGV using the Browser has been performed (see Chapter 5 in *Firmware Manual*), the following parameters must be adjusted.

Basic Settings for Speed Mode

PNU	Name	Value	Comments
930	Modes of Operation	1	Speed Mode
1108	Speed Window	Custom	See *Speed Monitoring*
1107	Speed Monitoring Time	Custom	See *Speed Monitoring*
1106	Min Speed	Custom	-
1100	Target Velocity	Custom	-
1202	Profile Velocity	Custom	-
1203	Profile Acceleration	Custom	-
1204	Profile Deceleration	Custom	-
1205	Quick Stop Deceleration	Custom	Emergency stop deceleration
1206	Min Software Position Limit	Custom	Set the positive and negative
1207	Max Software Position Limit	Custom	software limit switch
1208	Polarity	Custom	-
1209	Following error window	Custom	See *Monitoring Functions*
1210	Position Window	Custom	See *Monitoring Functions*
1211	Position Conversion Numerator	65536	Conversion of axis position
1212	Position Conversion Denominator	Custom	into internal units
1213	Limit Switch Enable	0001b	Enable HW negative limit switch
		0010b	Enable HW positive limit switch
		0100b	Enable SW negative limit switch
		1000b	Enable SW positive limit switch
1214	Axis Type	1 / 2	1 - Rotary / 2 - Linear Axis
1220	Max Profile Velocity	Custom	Limitation of Target Velocity
1221	Max Acceleration	Custom	-
1222	Max Deceleration	Custom	-
1223	Motion Type Selection	0 / 1	0 - Table (Internal) / 1- FieldBus
1224	Jerk-limiting Time Constant	Custom	Smooth profile generator

Torque Mode

Torque Mode (PNU 930 set to -3) performs remote torque control at the motor shaft.

When a torque setpoint is applied, the drive is current-controlled to reach and maintain the target torque. Note that measuring unit of the target torque is Arms, hence target torque is indeed a current setpoint.

The torque setpoint is a percentage of the Continuous Current (PNU 341). Range of this setpoint is -1000% to 1000% of the Continuous Current.

WARNING! In order to avoid faults or motor damages, **special care must be taken using this mode**.

The torque setpoint is generally a field bus reference. However, motion tables externally controlled and previously configured with fixed targets can be operated. For this purpose Control Word 2 (PNU 1010) and Digital Inputs are to be used.

Basic Settings for Torque Mode

After first configuration of DGV Servodrives has been performed (see Chapter 5 in *Firmware Manual*), the following parameters must be adjusted.

Basic Settings for Torque Mode

PNU	Name	Value	Comments
930	Modes of Operation	-3	Torque Mode
1106	Min Speed	Custom	-
1300	Target Torque	Custom	-1000 to 1000 % of PNU 341
1208	Polarity	Custom	Sign of the torque target
341	Continuous Current	Default	-
342	Peak Current	Default	-
343	Brake Current	Custom	Current for emergency stop

Synchronization

The synchronization function performs axes synchronization (PNU 930 must be set to 2), one device acting as master and one or more devices acting as slaves. *Velocity Synchronization* and *Position Synchronization* are available. The setpoints come from a moving target. Speed or position targets may come straight from an external encoder or from the emulated encoder interface of a DGV acting as the master device.

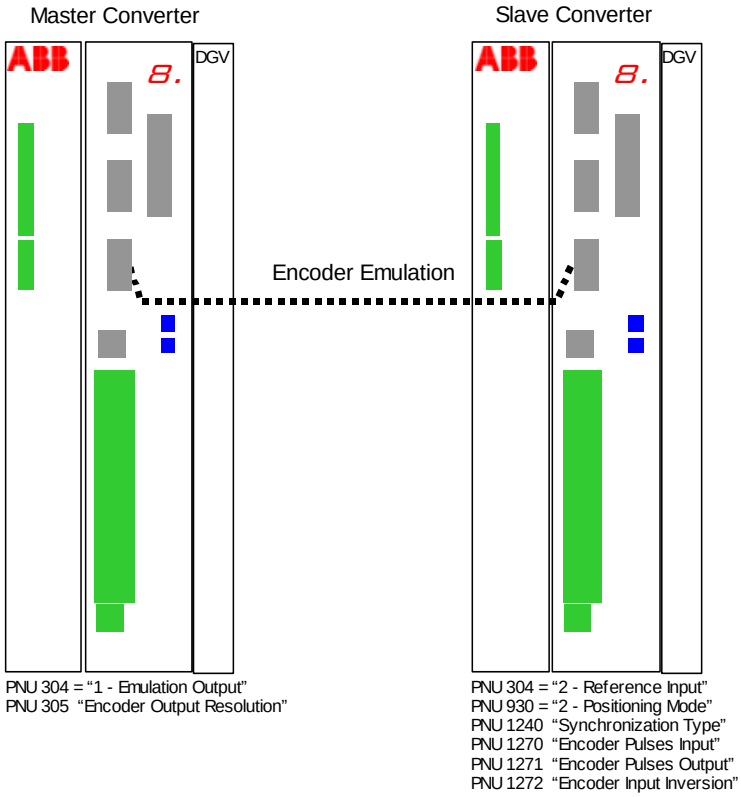
Profile parameters, motion parameters and parameters of the position and speed control loops must be adjusted to suit the application.

Accuracy of the synchronization performances can be programmed. See paragraph *Monitoring Functions* for details.

For the Control Word, on the positive edge of the **Bit 14** (0 → 1) the slave device starts performing synchronisation to the moving target.

For the Status Word, **Bit 15** is set when synchronization has been reached, i.e. axes are synchronised;

Consider, for example, a system composed of two DGV servodrives. The cable for connecting master and slave device must be prepared as illustrated in paragraph *Encoder Emulation* of the *Installation Manual*.



The DGV master converter (PNU 304 = "1 - Emulation Output") provides an encoder-emulated output signal. Resolution of this signal can be parameterized using PNU 305 "Encoder Output Resolution".

The DGV slave converter (PNU 304 = "2 - Reference Input") is supplied with the encoder-emulated input signal from the master converter.

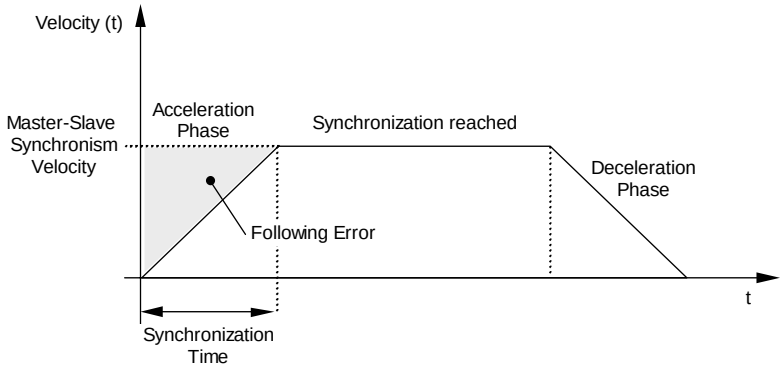
Position and speed synchronization between master and slaves devices can be performed setting the "Synchronization Type": PNU 1240 set to "1 - Speed Sync" for *Velocity Synchronization*, set to "2 - Position Sync" for *Position Synchronization*.

In the following types of synchronization are described.

Velocity Synchronization

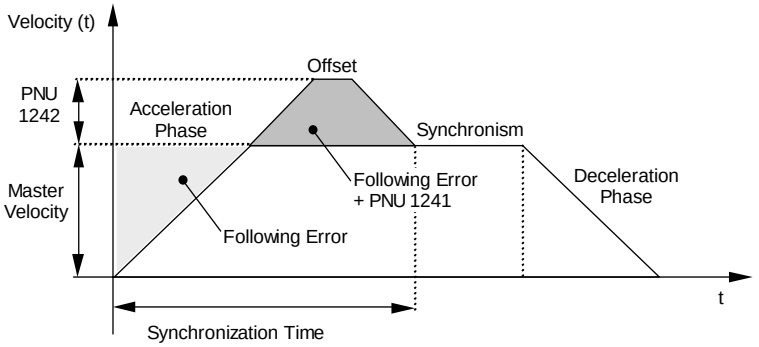
When PNU 1240 is set to “1 - Speed Sync”, Velocity Synchronization is performed. Therefore as a synchronization command is given, the drive accelerates with “Profile Acceleration” (PNU 1203) up to the master velocity. Once the speed synchronism is reached, there will be a constant position difference between master and slave due to initial different speeds.

The synchronization command may be bit 4 of the Control Word or the digital input “Start Sync”.



Position Synchronization

When PNU 1240 is set to 2, Position Synchronization is performed. Therefore when a synchronization input command is given, the drive accelerates with “Profile Acceleration” (PNU 1203) up to the master velocity. As the speed synchronization is reached, the following error between master and slave is reduced to zero by further acceleration tuning the “Synchronization Offset Position” (PNU 1241) and “Synchronization Offset Velocity” (PNU 1242).



“Synchronization Offset Position” (PNU 1241) is a fixed offset position, which is added to the actual position.

“Synchronization Offset Velocity” (PNU 1242) is an offset velocity, which allows fast synchronization of the slave to the master device.

Note that in any case state of slave synchronism can be instantly controlled through configuration of digital I/Os present on DGV front panel. One digital input D-IN has to be parameterized as “Start Sync“. One of digital output D-OUT can be parameterized as “Sync Reached“ when needed.

Basic Settings for Synchronization

Basic settings for Master-Slave synchronization using DGV Servodrives.

Basic Settings for Master-Slave Synchronization			
PNU	**Name**	**Master DGV**	**Slave DGV**
304	Encoder Interface Configuration	1	2
930	Modes of Operation	2	2
1203	Profile Acceleration	Custom	Custom
1204	Profile Deceleration	Custom	Custom
1206	Min Software Position Limit	Custom	Custom
1207	Max Software Position Limit	Custom	Custom
1208	Polarity	Custom	-
1209	Following error window	Custom	Custom
1211	Position Conversion Numerator	65536	65356
1212	Position Conversion Denominator	Custom	Custom
1213	Limit Switch Enable	Custom	Custom
1214	Axis Type	1-Rotary / 2-Linear	1-Rotary / 2-Linear
1221	Max Acceleration	Custom	Custom
1222	Max Deceleration	Custom	Custom
1225	Enable Table	Custom	Custom
1240	Synchronization Type	Not used Not used	1 - Speed Sync 2 - Position Sync
1241	Synchronization Offset Position	Not used	Custom
1242	Synchronization Offset Velocity	Not used	Custom
1243	Synchronization Window	Not used	Custom
1244	Synchronization Monitoring Time	Not used	Custom
1270	Encoder Pulses Input	Not used	65536
1271	Encoder Pulses Output	Not used	Custom
1272	Encoder Input Inversion	Not used	Optional

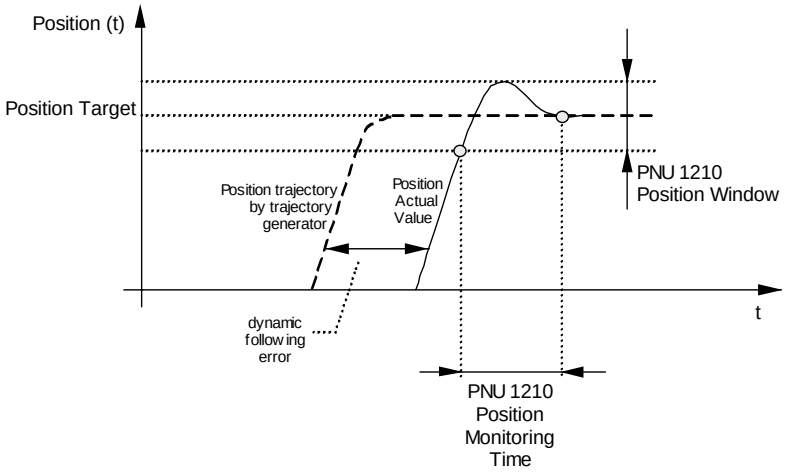
Monitoring Functions

Monitoring functions for position and speed modes are always active and can be freely parameterized.

Position Monitoring

When position-controlled, DGV keeps on monitoring that the position actual value lies within the Position Window (PNU 1210) before the Position Monitoring Time expires (PNU 1215).

Position Window defines the maximum error allowed on the position actual value as to the position target. As the profile generator reaches the position target, the position monitoring function starts counting Position Monitoring Time.



The positioning is successfully completed when the position actual value lies within the Position Window before the Position Monitoring Time expires.

Following Error

Following Error Window (PNU 1209) fixes the maximum dynamic following error, that is maximum position fluctuation or delay allowed during positioning dynamics. The dynamic following error is the difference between the position reference value, provided by the profile generator, and the position actual value, measured by motor position transducer.

Position Standstill Monitoring

When the positioning is over, however, the drive keeps on monitoring displacements. In the Status Word:

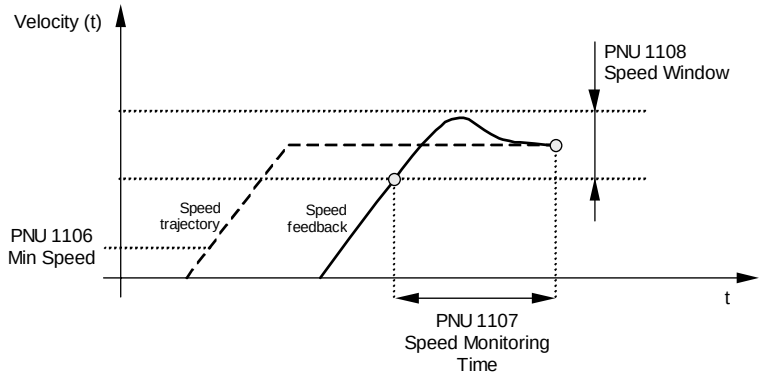
- Bit 8 notifies whenever the motor position exceeds the Position Window.
- Bit 10 notifies when axis comes outside the setpoint position.
- Bit 13 notifies whether axis is stationary or moving according to parameter Min Speed.

Note. Besides mechanical characteristics of the whole system, following error depends on the stability of the position control loop, that is, on a proper tuning of the loop gains.

Speed Monitoring

When speed-controlled, DGV monitors that the speed actual value lies within the Speed Window before the Speed Monitoring Time expires.

Speed Window defines the maximum speed error allowed on the speed actual value as to the speed target. As the profile generator reaches the speed target, the Speed Monitoring Time function starts counting. The task is successfully completed when the speed actual value lies within the Speed Window before the Speed Monitoring Time expires.



Speed Standstill Monitoring

When speed target has been reached, the drive keeps on monitoring speed fluctuations around the speed target at steady state, i.e. whether the drive speed exceeds Min Speed and Speed Window.

Note. Besides mechanical characteristics of the whole system, speed fluctuations depend on the stability of the speed control loop, i.e. proper tuning of the speed loop gains.

Synchronization Monitoring

Monitorino of synchronization is performed as for previous cases, through parameterization of Synchronization Window and Synchronization Monitoring Time.

Synchronization Window defines the maximum fluctuation of speed (*Velocity Synchronization*) or position (*Position Synchronization*) allowed for synchronizing. DGV monitors that speed or position actual value lies within the Synchronization Window before the Synchronization Monitoring Time expires.

Axis-Coupling

PNU 304 “Encoder Interface Configuration” allows configuring the encoder emulated interface of the converter, in order to perform master-slave axis coupling (terminal X8 of the frontal panel, see *Installation Manual*).

PNU 304 may assume one of the following values:

- “1 - Emulation Output”, the converter sends out through the encoder interface the position feedback signal of the internal control loop;
- “4 - Reference Output”, the converter sends out through the encoder interface the position reference signal of the internal control loop;
- “2 - Reference Input”, the input signal to the encoder interface feeds the position loop as position reference signal;
- “3 - Feedback Input”, the input signal to the encoder interface feeds the position loop as position feedback signal.

For cases 1 and 4, resolution of the output signal can be adjusted using PNU 305 “Encoder Output Resolution”.

- PNU 305 set to 1, resolution 128 pulses/turn
- PNU 305 set to 2, resolution 256 pulses/turn
- PNU 305 set to 3, resolution 512 pulses/turn
- PNU 305 set to 4, resolution 1024 pulses/turn

For cases 2 and 3, it is possible to set the transmission rate of the input signal using PNU 1270 “Encoder Pulses Input” and PNU 1271 “Encoder Pulses Output”.

Standard Coupling

Standard coupling means that the position feedback of the master-axis (PNU 304 set to “1 - Emulation Output”) is the position reference of the slave-axis (PNU 304 set to “2 - Reference Input”).

Virtual Master-Axis

As an alternative to standard coupling, the function Virtual Master-Axis is available. In this case, the position reference signal of the master-axis (PNU 304 set to “4 - Reference Output”) supplies one or more slave-axes (PNU 304 set to “2 - Reference Input”).

Note. Since the position reference is withdrawn downstream the jerk limiting filter block (PNU 1224), the same value of jerk limiting filter must be set both on master and slave.

The homing procedure on the master-axis must be always performed before coupling axes.

Virtual Cams

These functions allow simulating cams, i.e. a digital signal which assumes the value 0 or 1 as a function of the axis position.

There are two functions of simulated or “virtual” cam. For each function two parameters define the switch-ON position and switch-OFF position of the cam:

- PNU 1235 “Cam 1 Switch-on Position”
- PNU 1236 “Cam 1 Switch-off Position”
- PNU 1237 “Cam 2 Switch-on Position”
- PNU 1238 “Cam 2 Switch-off Position”

Besides, it is possible to combine a function of virtual cam and the function “4 - Zero Speed” of a digital output. By setting the configuration register PNU 1239 “Cam Switches Configuration” the user obtains the logic AND between a function of cam and the function of “Zero Speed”.

- Bit 0 = 0: Digital Output = “Cam switch 1”
- Bit 0 = 1: Digital Output = “Cam switch 1” AND “Zero Speed”
- Bit 1 = 0: Digital Output = “Cam switch 2”
- Bit 1 = 1: Digital Output = “Cam switch 2” AND “Zero Speed”
- Bit 2 … 7: reserved.

Note. The condition of the cam outputs depends on the axis absolute position; therefore the homing procedure must be performed before using these functions on digital outputs.

Inversion of the Digital I/Os

PNU 486 “Digital Input Inversion” and PNU 487 “Digital Output Inversion” are configuration registers, which allow to invert the condition of the digital inputs and outputs (D-IN, D-OUT). Each bit allows the inversion of the corresponding digital I/O (0 = not inverted, 1= inverted).

For digital inputs, PNU 486

- Bit 0: inversion of D-IN1
- Bit 1: inversion of D-IN2
- Bit 2: inversion of D-IN3
- Bit 3: inversion of D-IN4
- Bit 4: inversion of D-IN5
- Bit 5: inversion of D-IN6
- Bit 6: inversion of D-IN7
- Bit 7: inversion of D-IN8
- Bit 8 …15: reserved.

For digital outputs, PNU 487

- Bit 0: inversion of D-OUT1
- Bit 1: inversion of D-OUT2
- Bit 2: inversion of D-OUT3
- Bit 3 … 7: reserved.

Note. Changes to configuration parameters of I/Os are effective after restart of the converter (see *Firmware Manual – Software re-boot*).

Appendix A - Parameter List

Parameters (PNU) are hereunder enlisted in a numerical sequence as they appear within *Expert Parameters* window. See *Firmware Manual*.

Parameter numbering is compatible with PROFIBUS standard drive profile.

Brief explication remarks are provided among parameter rows.

PNU	Name	Units	Access	Value Range
Info00	Servodrive Model	-	RO	DGV PRO-DP
Info01	Servodrive Serial Number	-	RO	DGxx..xx-xx
Info06	Firmware Version	-	RO	x.x.xx.. PRO-DP
Info07	Application Description	-	RW	$0..2^{16}$
Info08	Last Freeze Date and Time	-	RO	$0..2^{16}$
Info09	Motor Code	-	RW	$0..2^{16}$
256	Drive Capabilities	-	RO	-
257	Actual Selected Table	-	RO	0..31
258	Local Operating Mode	-	RW	1..5
	• When Control Mode is set to 1 - Local, this parameter sets the local operating mode "1 - Analog Current" "2 - Analog Speed" "3 - Digital Torque" "4 - Digital Speed" "5 - Digital Position"			
259	General Enable	-	RW	0 - Off / 1 - On
	• Drive software general enable. Set On/Off the Software Enable button located within the Browser toolbar .			
260	Control Mode	-	RW	1 / 2
	• Select drive control location, i.e. "1 - Local" enables local control of the drive through RS232. "2 - Field Bus" enables external control through field bus.			
261	Number of Motor Poles	-	RW	2..24
	• Show the number of motor poles automatically detected during autophasing procedure.			

262	Drive Size Code	-	RO	0..1000
	• Shows the converter size by one of the following size codes Single-phase DGV300 Converters: 0 size 3.00/6.00 1 size 5.00/10.00 Three-phase DGV300 Converters: 0 size 3.00/6.00 1 size 5.00/10.00 2 size 7.00/14.00 DGV700 Converters: 0 size 3.00/6.00 1 size 5.00/10.00 2 size 9.00/18.00 3 size 13.00/26.00 4 size 18.00/36.00 5 size 25.00/50.00			
263	External Reference Enable	-	RW	0 - Off / 1 - On
	• Enable of the analog input +/- VREF located on the converter front panel.			
264	Sensor Type	-	RW	0..2
	• Type of the motor position transducer "1 - Resolver" "2 - SinCos Encoder" "3 - TTL Encoder" (Reserved)			
266	Encoder Pulses Number	-	RW	1..30000
267	Motor Activ. Threshold Temperature	-	RO	1..1023
268	Motor Disctiv. Threshold Temperature	-	RO	1..1023
269	Drive Activ. Threshold Temperature	-	RO	1..1023
270	Drive Disctiv. Threshold Temperature	-	RO	1..1023
271	Thermal Sensor Type	-	RO	0..3
272	Motor Continuous Current	Arms	RW	$0..2^{16}$
	• PNU 272 to 280 show the servomotors plate ratings as loaded from servomotor model or entered manually by the user.			
273	Motor Maximum Current	Arms	RW	$0..2^{16}$
274	Motor Rated Speed	rpm	RW	$0..2^{16}$
275	Moment of Inertia	kgm^2	RW	$0..2^{16}$
276	Torque Constant	Nm/Arms	RW	$0..2^{16}$
277	Back EMF Constant	Vrms/krpm	RW	$0..2^{16}$
278	Max Motor Speed	rpm	RW	$0..2^{16}$
279	Winding Resistance	ohm	RW	$0..2^{16}$
280	Winding Inductance	mH	RW	$0..2^{16}$
281	Pole Pair Width	mm	RW	$0..2^{16}$

287	Motor Type	-	RW	1 / 2
	• Set the motor type: "1 - Rotative Motor" "2 - Linear Motor"			
289	Bus Overvoltage Level	V	RW	0..1000
	 WARNING! Reserved, for Service Support only. Altering this parameter can cause serious physical injury.			
290	Bus Undervoltage Level	V	RW	0..1000
291	Clamp Voltage Threshold	V	RW	0..1000
	• Set voltage operating threshold for clamp braking resistor.			
292	Mains Voltage	Vrms	RW	0..1000
	• Show drive supply mains voltage level. This value has to be strictly consistent with voltage level of the drive power supply. Usually the following ac supply voltages are available in the industrial environment: • Single-phase DGV300 Converters: Single-phase 110 ÷ 230 Vac • Three-phase DGV300 Converters: Three-phase 110 ÷ 230 Vac • DGV700 Converters (three-phase): 110 Vac 230 Vac 400 Vac 440 Vac  **WARNING! Please contact Customer Service before using this option.** 480 Vac  **WARNING! Please contact Customer Service before using this option.**			
293	Drive Max Current	Arms	RO	0..300
294	Drive Peak Current	Arms	RO	0..300
295	Drive Continuous Current	Arms	RO	0..300
296	Maximum Mains Voltage	V	RO	40..480
297	Minimum Mains Voltage	V	RO	40..480
300	Internal Clamp Resistor Value	ohm	RO	1..500
301	Internal Clamp Power Threshold	W	RO	1..10000
302	Internal Clamp Thermal Time Constant	s	RO	1..600

304	Encoder Interface Configuration	-	RW	1..3
	• The following functions can be selected: "1 - Emulation Output", DGV servodrive sends out its actual position to a slave device. The slave device may be a DGV servodrive having PNU 304 set to "2 - Reference Input". "2 - Reference Input", DGV servodrive is slave axis coupled with a master, from which it receives an encoder signal. "3 - Feedback Input", position feedback of DGV internal control loop comes from a second encoder, which is for example mounted on the motor shaft. "4 - Reference Output", DGV servodrive sends out its internal position reference to a slave device. The slave device may be a DGV servodrive having PNU 304 set to "2 - Reference Input".			
305	Encoder Output Resolution	-	RW	1..4
	• Encoder emulation output. DGV servodrive performs the conversion of the motor position feedback into emulated encoder output. When using a resolver transducer, DGV provides 1024 pulses/turn. The output signal can have one of the following resolutions: PNU 305 = 1 1024 / 8 , i.e. 128 pulses/turn PNU 305 = 2 1024 / 4 , i.e. 256 pulses/turn PNU 305 = 3 1024 / 2 , i.e. 512 pulses/turn PNU 305 = 4 1024 / 1 , i.e. 1024 pulses/turn			
311	Autophasing Current	Arms	RW	0..300
	• Motor current for autophasing. This value is usually lower than Motor Continuous Current since autophasing procedure should be performed with no load.			
312	RPI	-	RW	0 - Off / 1 - On
313	Encoder Type	-	RW	0..10
314	Fine Synchronization to Index	-	RW	0 - Off / 1 - On
315	Autophasing Time	s	RW	0,1..10
	• Maximum time allowed to complete autophasing procedure.			
317	Linear Scale Resolution	µm	RW	0..600
320	Waveform Start Command	-	RW	0 - Off / 1 - On
	• PNU 302 to 330 show settings of the waveform generator and the oscilloscope function.			
321	Waveform Wave Type	-	RW	1..4
322	Waveform Wave Frequency	Hz	RW	0,05..100
323	Waveform Wave Amplitude	A - rpm	RW	-12000.. 12000
324	Oscilloscope Trigger Channel	-	RW	1..8
325	Oscilloscope Show Channel	-	RW	0..8
326	Trigger Threshold Level	A - rpm	RW	-300..300
327	Trigger Slope	-	RW	0 / 1
328	Trigger Position	-	RW	0..2
329	Time Window Sampling	-	RW	1..4
330	Oscilloscope Command	-	RW	1..4

336	Speed Command Gain Numerator	rpm	RW	-12000.. 12000
	• Gain of the speed command entered through the analog reference input +/- VREF. See also parameter Speed Denominator within the Analog IO page of Browser.			
337	Maximum Speed	rpm	RW	-12000.. 12000
	• Maximum axis speed allowed for your application.			
338	Speed Denominator	V	RW	1..10
	• Scaling of the voltage/speed command entered through the analog reference input +/- VREF. See also parameter Speed Numerator within the Analog IO page of Browser.			
339	Torque Numerator	Arms	RW	-300..300
	• Gain of the current command entered through the analog reference input +/- VREF. See also parameter Torque Denominator available within the Analog IO page of Browser.			
340	Reference Offset Compensation	mV	RW	-500..500
	• Gain for offset compensation of the voltage analog reference input +/- VREF. See parameter Reference Offset available within the Analog IO page of Browser.			
341	Continuous Current	Arms	RW	0..300
	• Continuous Current of the servodrive current control loop. See parameter Continuous Current within the Current page of Browser.			
342	Peak Current	Arms	RW	0..300
	• Peak Current of the servodrive current control loop. See parameter Peak Current within the Current page of Browser.			
343	Brake Current	Arms	RW	0..300
	• Set current for dynamic braking of the servodrive. See parameter Brake Current within the Current page of Browser.			
344	Ixt Threshold Level	Arms	RO	0..300
	• Internal protection of the converter against thermal power dissipation.			
345	Clamp Resistor Type	-	RW	0..2
	• Set type of clamp braking resistor. “0 - Internal” “1 - External” “2 - External only” For all drive sizes 3.00/6.00, 5.00/10.00, 9.00/18.00 and 13.00/26.00, clamp resistor may be internal or external depending on the load cycle of the servodrive during operation. For largest drive size 25.00/50.00, clamp resistor may be external only.			
346	I^2xt Threshold Level	Arms	RW	0..300
	• Protection of the motor against thermal power dissipation on the motor windings.			

347	Clamp Delta	V	RO	0..10
	• Threshold level for deactivation of the clamp braking operation.			
348	External Clamp Resistor Value	ohm	RW	1..500
	• Set resistance of external clamp resistor. This parameter is effective when PNU 345 is set to “1 - External" or “2 - External only”.			
349	External Clamp Power Threshold	W	RW	1..10000
	• Set maximum average power allowed for dissipation on external clamp resistor. This parameter is effective when PNU 345 is set to “1 - External" or “2 - External only”.			
350	External Clamp Thermal Time Constant	s	RW	1..600
	• Set thermal time constant of external clamp resistor. This parameter is effective when PNU 345 is set to “1 - External" or “2 - External only”.			
351	External Clamp max ON Time	ms	RW	1..150
	• Set maximum time for power dissipation over clamp resistor. This parameter is effective for both internal and external.			
352	Position Proportional Gain	1/s	RW	0..1000
	• Proportional Gain of the position control loop. See also Position Proportional Gain within Position page of the browser.			
353	Speed Feedforward Gain	%	RW	0..100
	• Feedforward Gain of the servodrive position control loop. See also Speed Feedforward Gain within Position page of the browser.			
356	Resolver Phase Offset	deg	RW	0..359,99
	• Show the phase offset stored after the autophasing procedure.			
357	Overspeed Threshold Level	rpm	RW	0..12000
	• Show the servodrive overspeed threshold level. This parameter is effective during drive operation and generates the Overspeed fault displayed on the browser main page and on the converter front panel.			
358	Holding Brakes Delay	ms	RW	0..10000
360	Resolver Sine Gain	-	RW	$0..2^{16}$
	• Gain for resizing amplitude of the resolver sine signal. For Service Support only.			
361	Resolver Cosine Gain	-	RW	$0..2^{16}$
	• Gain for resizing amplitude of the resolver cosine signal. For Service Support only.			
362	Fault Resolver	-	RO	$0..2^{16}$
363	Torque Denominator	V	RW	1..10
	• Scaling of the voltage/current command entered through the analog reference input +/- VREF. See also parameter Torque Numerator within the Analog IO page of Browser.			

368	Motor Thermal Time Constant	s	RW	$0..2^{16}$
	• Thermal time constant of the servomotor. This is a manufacturing characteristic parameter of the servomotors.			
373	Kp Speed Gain Level	As/rad	RW	0..32,767
	• Proportional gain of the speed control loop of DGV.			
374	Tn Speed Integrative Time Constant	ms	RW	0..327,67
	• Integrative time constant gain of the speed control loop of DGV.			
379	Kp Current Gain Level	V/A	RW	0..3276,7
	• Proportional gain of the current control loop of DGV.			
380	Tn Current Integrative Time Constant	ms	RW	0..32,767
	• Integrative time constant gain of the current control loop of DGV.			
385	Speed Command Filter	Hz	RW	5..4000
	• Frequency filter on the speed command of DGV.			
389	Speed Command Filter Enable	-	RW	0 - Off / 1 - On
	• Enable filtering of DGV speed command.			
390	Feedforward Speed Filter Enable	-	RW	0 - Off / 1 - On
391	Feedforward Speed Filter	Hz	RW	5..4000
392	Resolver Speed Filter	Hz	RW	100..1000
	• Frequency filter on the resolver speed feedback.			
393	Encoder Speed Filter	Hz	RW	100..1000
	• Filtering of the encoder speed feedback.			
427	Current Filter 1 Frequency	Hz	RW	0..8000
428	Current Filter 1 Damping	0.0001	RW	1..10000
429	Current Filter 1 Depth	dB	RW	-100..100
430	Current Filter 1 Width	dec	RW	0,0001..3
431	Current Filter 1 Type	-	RW	0..2
	• Enabling Filter 1 on the current command of DGV. "0 - Off" "1 - Low Pass" "2 - Band Reject"			
443	Current Filter 2 Frequency	Hz	RW	0..8000
444	Current Filter 2 Damping	0.0001	RW	1..10000
445	Current Filter 2 Depth	0.1 dB	RW	-100..100
446	Current Filter 2 Width	0.01 dec	RW	0,0001..3
447	Current Filter 2 Type	-	RW	0..2
	• Enabling Filter 2 on the current command of DGV. "0 - Off" "1 - Low Pass" "2 - Band Reject"			

459	Current Filter 3 Frequency	Hz	RW	0..8000
460	Current Filter 3 Damping	0.0001	RW	1..10000
461	Current Filter 3 Depth	0.1 dB	RW	-100..100
462	Current Filter 3 Width	0.01 dec	RW	0,0001..3
463	Current Filter 3 Type	-	RW	0..2
	• Enabling Filter 3 on the current command of DGV. "0 - Off" "1 - Low Pass" "2 - Band Reject"			
480-0	Input 1 Configuration	-	RW	0..17
	• Sub-index 0 of PNU 480 is dedicated to configuration of digital input D-IN 1 located on DGV front panel. "0 - Disabled" "1 - Table N° [Bit0]" "2 - Table N° [Bit1]" "3 - Table N° [Bit2]" "4 - Table N° [Bit3]" "5 - Table N° [Bit4]" "6 - Table Strobe" "7 - Freeze Position [Input 8 ONLY]" "8 - Limit Switch +" "9 - Limit Switch -" "10 - Home Switch [Input 3 ONLY]" "11 - Start Sync" "12 - Halt [Active LOW]" "13 - Start Homing" "14 - Start Jog 1" "15 - Start Jog 2" "16 - Start Motion Task" "17 - Break Inhibit" "18 - Stop Motion Task [Active LOW]"			
480-1	Input 2 Configuration	-	RW	0..17
	• Sub-index 1 of PNU 480 is dedicated to configuration of digital input D-IN 2 located on DGV front panel: same functions as Input 1 Configuration.			
480-2	Input 3 Configuration	-	RW	0..17
	• Sub-index 2 of PNU 480 is dedicated to configuration of digital input D-IN 3 located on DGV front panel: same functions as Input 1 Configuration.			
480-3	Input 4 Configuration	-	RW	0..17
	• Sub-index 3 of PNU 480 is dedicated to configuration of digital input D-IN 4 located on DGV front panel: same functions as Input 1 Configuration.			
480-4	Input 5 Configuration	-	RW	0..17
	• Sub-index 4 of PNU 480 is dedicated to configuration of digital input D-IN 5 located on DGV front panel: same functions as Input 1 Configuration.			
480-5	Input 6 Configuration	-	RW	0..17
	• Sub-index 5 of PNU 480 is dedicated to configuration of digital input D-IN 6 located on DGV front panel: same functions as Input 1 Configuration.			
480-6	Input 7 Configuration	-	RW	0..17
	• Sub-index 6 of PNU 480 is dedicated to configuration of digital input D-IN 7 located on DGV front panel: same functions as Input 1 Configuration.			
480-7	Input 8 Configuration	-	RW	0..17
	• Sub-index 7 of PNU 480 is dedicated to configuration of digital input D-IN 8 located on DGV front panel: same functions as Input 1 Configuration.			

481-0	Output 1 Configuration	-	RW	0..9
	• Sub-index 0 of PNU 481 is dedicated to configuration of digital output D-OUT 1 located on DGV front panel. "0 - Disabled" "1 - Drive Enable" "2 - Target Reached" "3 - Drive Ready" "4 - Zero Speed" "5 - Homing OK" "6 - Motor I2xT" "7 - Converter IxT" "8 - Positioning Ack" "9 - Sync Reached"			
481-1	Output 2 Configuration	-	RW	0..9
	• Sub-index 1 of PNU 481 is dedicated to configuration of digital output D-OUT 2 located on DGV front panel: same functions as Output 1 Configuration.			
481-2	Output 3 Configuration	-	RW	0..9
	• Sub-index 2 of PNU 481 is dedicated to configuration of digital output D-OUT 3 located on DGV front panel: same functions as Output 1 Configuration.			
484	Analog Output Configuration	-	RW	0..22
	• Show functions for configuration of Analog Configurable Output A-OUT located on DGV front panel. "0 - Disabled" "1 - Phase U Current" "2 - Phase V Current" "3 - Phase W Current" "4 - Iq Command" "5 - Id Feedback" "6 - Iq Feedback" "7 - Ud Command" "8 - Uq Command" "9 - Eq Command" "10 - Vd Command" "11 - Vq Command" "12 - Speed Command" "13 - Speed Feedback" "14 - Position Reference" "15 - Speed Reference" "16 - Position Feedback" "17 - Position Error" "18 - Motor Position" "19 - Resolver Sine" "20 - Resolver Cosine" "21 - IxT Current" "22 - I2xT Current"			

485	Analog Output Scale	-	RW	0..31
	• Scaling function for Analog Configurable Output signal. "X1" full scale "X2" full scale / 2 "X4" full scale / 4 "X8" full scale / 8 "X16" full scale / 16 "X32" full scale / 32 "X2^6" full scale / 2^6 "X2^7" full scale / 2^7 "X2^8" full scale / 2^8 . . . . "X2^29" full scale / 2^29 "X2^30" full scale / 2^30 "X2^31" full scale / 2^31			
486	Digital Input Inversion	BIN	RW	$0..2^{16}$
	• Register for inverting the condition of the digital inputs: "0000_0001" inversion of D-IN1 "0000_0010" inversion of D-IN2 "0000_0100" inversion of D-IN3 "0000_1000" inversion of D-IN4 "0001_0000" inversion of D-IN5 "0010_0000" inversion of D-IN6 "0100_0000" inversion of D-IN7 "1000_0000" inversion of D-IN8			
487	Digital Output Inversion	BIN	RW	$0..2^{8}$
	• Register for inverting the condition of the digital outputs: "0000_0001" inversion of D-OUT1 "0000_0010" inversion of D- OUT2 "0000_0100" inversion of D- OUT3			
900	PPO-type 1 write	-	RW	-
901	PPO-type 2 write	-	RW	-
904	Current PPO-write	-	RW	-
907	PPO-type 1 read	-	RO	-
908	PPO-type 2 read	-	RO	-
911	Current PPO-read	-	RO	-
918	Device Node ID	-	RW	1..127
	• Set drive node address on the field bus network. Note that changing node address is possible only when switch selectors on the converter front panel are set to FF.			
922	Telegram Selection	-	RW	$0..2^{16}$
	• Selection of the telegram structure (*Telegram 101* or *Telegram 102*).			
930	Modes of Operation	-	RW	-3..2
	• Selection of the drive operating mode: "-3 - Torque Mode" "-2 - Analog Torque Mode" "-1 - Analog Speed Mode" "0 - N.A." "1 - Speed Mode" "2 - Positioning Mode"			

945	Fault Register	-	RO	-
	• Fault code: index 0 contains the fault code displayed on the front panel of DGV (see Appendix B - Error Codes).			
953	Alarm Register	-	RO	-
	• Alarm code: parameter value not zero means alarm present. – Bit 0 set to 1 means I·t alarm present – Bit 1 set to 1 means I^2·t alarm present – Bit 2 set to 1 means axis exceeded SW negative limit switch – Bit 3 set to 1 means axis exceeded SW positive limit switch – Bit 4 set to 1 means axis not referenced – Bit 5 set to 1 means absolute position modulo error – Bit 6 set to 1 means invalid table selection – Bit 7 set to 1 means concurrect activation Jog1-Jog2			
964	Device Identification	-	RO	-
	• Short description of device.			
965	Software Version	-	RO	-
	• Show firmware version of device.			
966	FMA Service	-	RO	-
967	Control Word	-	RW	0..65536
968	Status Word	-	RO	0..65536
969	Drive Option	Bin	RW	0..65536
	• Device optional features.			
971	Freeze Configuration	-	RW	0..1
	• Parameter value set to 1 stores the drive configuration into the non-volatile flash memory. ***Note.*** When a Freeze command has been executed, PNU 971 must be reset to value 0.			
1000	Device Communication Speed Rate	KBaud	RW	50..12000
	• Communication speed rates supported: 19,8 to 12000 KBaud. DGV detects automatically the bus communication speed rate.			

1010	Control Word 2	-	RW	- 2^{31}.. 2^{31}-1

- Bit 0 to Bit 4 select motion table 0 to 31.
- Bit 5 performs Position Modulo
- Bit 6 performs Position Modulo running shortest trip to target
- Bit 7 enables the function “Freeze Position” through digital input "Freeze Position”.

Bit	Meaning
0 1 2 3 4	Select tables: = 00000bin selects Table 0 ⋮ = 11111bin selects Table 31
5	= 0 Absolute Position Modulo, positive direction = 1 Absolute Position Modulo, negative direction
6	= 0 control submitted to bit 5 = 1 when bit 5 = 0, performs Absolute Position Modulo running shortest trip to target.
7	= 0 Freeze Position disabled = 1 Freeze Position enabled, that is, axis position can be steadily updated while operating, on the positive edge digital input “Freeze Position”. Position is frozen in PNU 1229.
8	= 0 a new homing procedure and axis zeroing are carried out with a positive edge of Bit11 in the Control Word = 1 axis zero is cancelled with a positive edge of Bit11 in the Control Word; Bit11 of the Status Word is reset zero.
9 10 11 12 13 14 15	Not Used

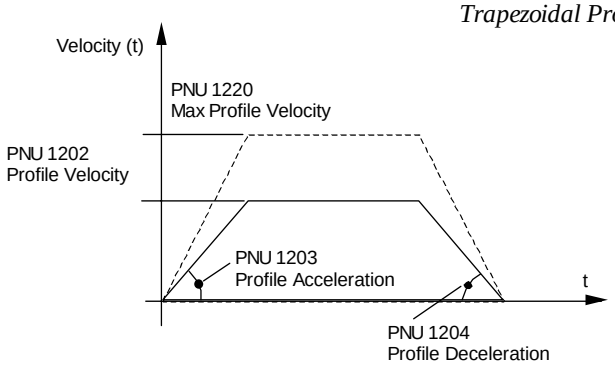
<table>
<tr><td>1011</td><td>Status Word 2</td><td>-</td><td>RO</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="4">

Bits 0 to 4 display the motion table currently selected.
Bit 5 set to 1 in response to bit 7 of the Control Word 2 denotes when the position has been frozen.

<table>
<tr><th>Bit</th><th>Descrizione</th></tr>
<tr><td>0
1
2
3
4</td><td>Display motion table currently selected</td></tr>
<tr><td>5</td><td>Position frozen in PNU 1229.</td></tr>
<tr><td>6
7
8
9
10
11
12
13
14
15</td><td>Not Used</td></tr>
</table>
</td></tr>
<tr><td>1100</td><td>Velocity Target</td><td>deg/s</td><td>RW</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="4">• Velocity target when using motion tables for local/”internal” control.</td></tr>
<tr><td>1101</td><td>Actual Velocity</td><td>deg/s</td><td>RW</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="4">• Instantaneous velocity of the motor shaft.</td></tr>
<tr><td>1102</td><td>Max Speed</td><td>rpm</td><td>RW</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="4">• Limitation of drive speed command to saturation level Max Speed.</td></tr>
<tr><td>1103</td><td>Acceleration Time</td><td>ms</td><td>RW</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="4">• Acceleration time (ramp) from 0 rpm up to Max Speed.</td></tr>
<tr><td>1104</td><td>Deceleration Time</td><td>ms</td><td>RW</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="4">• Deceleration time (ramp) from Max Speed up to 0 rpm.</td></tr>
<tr><td>1105</td><td>Quick Stop Time</td><td>ms</td><td>RW</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="4">• Emergency stop ramp of drive status OFF1 for Torque Mode, Analog Torque Mode e Analog Speed Mode.</td></tr>
<tr><td>1106</td><td>Min Speed</td><td>rpm</td><td>RW</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="4">

Set minimum speed for standstill monitoring.
When speed mode is active, bit 10 of Status Word set to 1 (min speed reached) shows that drive is actually moving.
When positioning mode is active, bit 13 of Status Word set to 1 (min speed reached) shows that drive is actually moving.

</td></tr>
<tr><td>1107</td><td>Speed Monitoring Time</td><td>ms</td><td>RW</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="4">• Bit 8 of Status Word set to 1 denotes target reached when velocity actual value lies within Speed Window before Speed Monitoring Time expires.</td></tr>
</table>

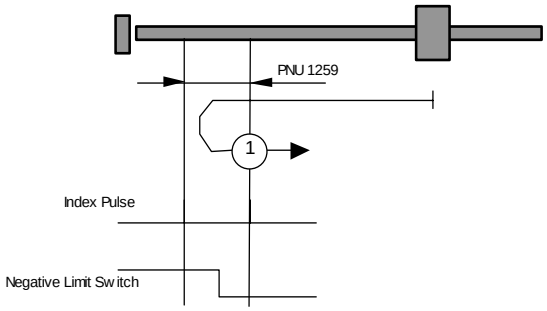
1108	Speed Window	rpm	RW	- 2^{31}.. 2^{31}-1
	• Bit 8 of Status Word set to 1 denotes target reached when velocity actual value lies within Speed Window before Speed Monitoring Time expires.			
1109	Ramp Function Generator Enable	-	RW	0 - Off / 1 - On
	• Enable ramp function generator. When ramp function generator is off a step command is imposed to the motor.			
1110	Torque Reduction	%	RW	0..100
	• Reduction of the peak current supplied by the drive.			
1111	Direct Target Velocity	deg/s	RW	- 2^{31}.. 2^{31}-1
	• Velocity target for “direct” control when using Telegram 101 and 102.			
1200	Position Target	deg	RW	- 2^{31}.. 2^{31}-1
	• Position target when using motion tables in local/”internal” mode.			
1201	Actual Position	deg	RW	- 2^{31}.. 2^{31}-1
	• Instantaneous position of the axis.			
1202	Profile Velocity	deg/s	RW	- 2^{31}.. 2^{31}-1
	• Set velocity target of trapezoidal motion profile type. Parameterizing this value will affect the ramp function generator as well. *Trapezoidal Profile*  			
1203	Profile Acceleration	deg/s^2	RW	- 2^{31}.. 2^{31}-1
	• Acceleration of trapezoidal motion profile.			
1204	Profile Deceleration	deg/s^2	RW	- 2^{31}.. 2^{31}-1
	• Deceleration of trapezoidal motion profile.			
1205	Quick Stop Deceleration	deg/s^2	RW	- 2^{31}.. 2^{31}-1
	• Emergency stop ramp of drive status OFF1 for Speed Mode and Positioning Mode. As fault occurs, the drive is stopped braking with Quick Stop Deceleration ramp, when braking is still possible.			
1206	Min Position Limit	deg	RW	- 2^{31}.. 2^{31}-1
	• This parameter defines the absolute position for the software negative limit switch, acting on both position target and the position actual value. See also PNU 1213, Limit Switch Enable.			
1207	Max Position Limit	deg	RW	- 2^{31}.. 2^{31}-1
	• This parameter defines the absolute position for the software positive limit switch, acting on both position target and the position actual value. See also PNU 1213, Limit Switch Enable.			

1208	Polarity	-	RW	0..255
	• Invert sign of setpoints. When Speed Mode is active and Polarity is set to 64, then sign of digital speed setpoint is inverted. When Positioning Mode is active and Polarity is set to 128, then sign of digital position setpoint is inverted.			
1209	Following Error Window	deg	RW	$-2^{31}..2^{31}-1$
	• Fixes the maximum dynamic following error, that is maximum fluctuation of position actual value allowed during positioning dynamics. It is obtained as the difference between the position setpoint, provided by the profile generator, and the position actual value, measured by motor position transducer. This parameters affects Bit 8 of the Status Word. The protection against the following error is disabled by setting PNU 1209 to zero.			
1210	Position Window	deg	RW	$-2^{31}..2^{31}-1$
	• Bit 10 of Status Word set to 1 denotes target position reached when position actual value lies within Position Window before Position Monitoring Time expires.			
1211	Position Conversion Numerator	-	RW	$0..2^{31}-1$
	• Conversion of axis position into DGV internal units.			
1212	Position Conversion Denominator	-	RW	$0..2^{31}-1$
	• Conversion of axis position into DGV internal units.			
1213	Limit Switch Enable	-	RW	$-2^{31}..2^{31}-1$
	• Enable/disable of limit switches: – bit0 =1 enables the HW negative limit switch – bit1 =1 enables the HW positive limit switch – bit2 =1 enables the SW negative limit switch – bit3 =1 enables the SW positive limit switch Hardware and software limit switches can be programmed in *Positioning Mode*, *Speed Mode* and *Analog Speed Mode* (see Chapter 5 and 6).			
1214	Axis Type	-	RW	1 / 2
	• Set axis type rotative or linear. Parameterizing this value will affect conversion of position actual value into DGV internal units. See also Appendix C.			
1215	Position Monitoring Time	ms	RW	$-2^{31}..2^{31}-1$
	• Bit 10 of Status Word set to 1 denotes target position reached when position actual value lies within Position Window before Position Monitoring Time expires.			
1216	Position Modulo	deg	RW	$-2^{31}..2^{31}-1$
	• Set the position modulo range for endless positioning.			

<table>
<tr><td>1217</td><td colspan="2">Positioning Mode</td><td>-</td><td>RW</td><td>1..15</td></tr>
<tr><td></td><td colspan="5">
• Configure different positioning functions for local control
<table>
<tr><th>Bit</th><th>Meaning</th></tr>
<tr><td>0</td><td>Select Absolute / Relative Positioning
= 0 Absolute Positioning
= 1 Relative Positioning
Direction of approach to target depends on sign of position setpoint.</td></tr>
<tr><td>1</td><td>Select Positioning function, Single Setpoint or Change Set Immediately
= 0 Single Setpoint, i.e. complete previous operation before running next target.
= 1 Change set immediately, i.e. run immediately any new setpoint.
See Chapter 6 for more details.</td></tr>
<tr><td>2</td><td>Select Absolute Position Modulo
= 0 Absolute Position Modulo, positive direction
= 1 Absolute Position Modulo, negative direction</td></tr>
<tr><td>3</td><td>Select Absolute Position Modulo running the direction closer to target.
= 0 control submitted to bit 2
= 1 when bit 2 set to 0, performs Absolute Position Modulo running the direction closer to target, i.e. running the shorter distance between target and actual axis position.</td></tr>
<tr><td>4
5
6
7</td><td>Not used</td></tr>
</table>
</td></tr>
<tr><td>1218</td><td colspan="2">Modulo Conversion Activation</td><td>-</td><td>RW</td><td>0 - Off / 1 - On</td></tr>
<tr><td></td><td colspan="5">• Parameter set to 1 activates Position Modulo. Parameter set to 0 turns back to standard positioning mode.</td></tr>
<tr><td>1219</td><td colspan="2">Motion Profile Type</td><td>-</td><td>RO</td><td>0</td></tr>
<tr><td></td><td colspan="5">• Trapezoidal profile available at the moment. See PNU 1202, Profile Velocity, for more details.</td></tr>
<tr><td>1220</td><td colspan="2">Max Profile Velocity</td><td>deg/s</td><td>RW</td><td>$-2^{31}..2^{31}-1$</td></tr>
<tr><td></td><td colspan="5">• Limitation of axis velocity. This parameter will saturate process velocity and therefore also trapezoidal profile velocity.</td></tr>
<tr><td>1221</td><td colspan="2">Max Acceleration</td><td>deg/s^2</td><td>RW</td><td>$-2^{31}..2^{31}-1$</td></tr>
<tr><td></td><td colspan="5">• Limitation of axis acceleration.</td></tr>
<tr><td>1222</td><td colspan="2">Max Deceleration</td><td>deg/s^2</td><td>RW</td><td>$-2^{31}..2^{31}-1$</td></tr>
<tr><td></td><td colspan="5">• Limitation of axis deceleration.</td></tr>
</table>

1223	Motion Type Selection	-	RW	0 / 1
	• Select source for motion command and setpoint, that is PNU 1223 set to “0 - Table (Internal)" means internal or local source of setpoints, PNU 1223 set to “1- Field bus" means that an external controller is source of setpoints.			
1224	Jerk-Limiting Time Constant	ms	RW	0..200
	• Time constant of a first order filter which operates on speed and position setpoints when position control is active. Large values of this filter will dampen the trapezoidal motion profile and lengthen positioning time.			
1225	Enable Table	-	RW	0 - Off / 1 - On
	• Enable/Disable current table.			
1226	Active Tables	-	RO	$-2^{31}..2^{31}-1$
	• Number of tables currently enabled.			
1227	Next Running Table	-	RW	-1..31
	• Select next table to be executed.			
1228	Delay Before Next Running Table	ms	RW	-
	• Delay time before running next table.			
1229	Captured Position	deg	RO	$-2^{31}..2^{31}-1$
	• Position frozen with digital input “Freeze Position”.			
1230	Speed Override	%	RW	0..100,0
	• On-the-fly change of axis speed, as a percentage of PNU 1232, for “direct” control when using Telegram 102.			
1231	Direct Target Position	deg	RW	$-2^{31}..2^{31}-1$
	• Position target for “direct” control when using Telegram 101 and 102.			
1232	Direct Profile Velocity	deg/s	RW	$-2^{31}..2^{31}-1$
	• Velocity of the trapezoidal motion profile for “direct” control when using Telegram 101 and 102.			
1233	Direct Acceleration Override	%	RW	0..100,00
	• Acceleration and deceleration, as a percentage of PNU 1221 and 1222, for “direct” control when using Telegram 102.			
1235	Cam 1 Switch-ON Position	deg	RW	$-2^{31}..2^{31}-1$
	• Switch-on position of the function “Virtual Cam 1”. Limits of the cam range are +/-2000000,000 deg.			
1236	Cam 1 Switch-OFF Position	deg	RW	$-2^{31}..2^{31}-1$
	• Switch-off position of the function “Virtual Cam 1”. Limits of the cam range are +/-2000000,000 deg.			
1237	Cam 2 Switch-ON Position	deg	RW	$-2^{31}..2^{31}-1$
	• Switch-on position of the function “Virtual Cam 2”. Limits of the cam range are +/-2000000,000 deg.			
1238	Cam 2 Switch-OFF Position	deg	RW	$-2^{31}..2^{31}-1$
	• Switch-off position of the function “Virtual Cam 2”. Limits of the cam range are +/-2000000,000 deg.			

1239	Cam Switches Configuration	BIN	RW	0 .. 2^8
	• Configuration register for conditioning the function virtual cam with the function “4 - Zero Speed” of a digital input. “0000_0000” Digital Output = “Cam Switch 1” “0000_0001” Digital Output = “Cam Switch 1” AND “Zero Speed” “0000_0000” Digital Output = “Cam Switch 2” “0000_0010” Digital Output = “Cam Switch 2” AND “Zero Speed”			
1241	Synchronization Offset Position	-	RW	- 2^{31}.. 2^{31}-1
	• Parameterization of synchronization function. See Chapter 6.			
1242	Synchronization Offset Velocity	-	RW	- 2^{31}.. 2^{31}-1
	• Parameterization of synchronization function. See Chapter 6.			
1243	Synchronization Window	-	RW	- 2^{31}.. 2^{31}-1
	• Monitoring of synchronization function. See Chapter 6.			
1244	Synchronization Monitoring Time	-	RW	0..60000
	• Monitoring of synchronization function. See Chapter 6.			
1250	Home Offset	-	RW	- 2^{31}.. 2^{31}-1
	• Programmable offset for referencing.			
1251	Homing Method	-	RW	0..255
	• Select referencing method: “1 - Homing on the negative HW limit switch and index pulse” “2 - Homing on the positive HW limit switch and index pulse” “3 - Homing on the falling edge of the positive home switch and index pulse” “4 - Homing on the rising edge of the positive home switch and index pulse” “5 - Homing on the falling edge of the negative home switch and index pulse” “6 - Homing on the rising edge of the negative home switch and index pulse” “17 - Homing on the negative limit switch” “18 - Homing on the positive limit switch” “19 - Homing on the falling edge of the positive home switch” “20 - Homing on the rising edge of the positive home switch” “21 - Homing on the falling edge of the negative home switch” “22 - Homing on the rising edge of the negative home switch” “33 - Homing on the index pulse in the negative direction” “34 - Homing on the index pulse in the positive direction” “35 - Homing on the current position”			
1252	Homing Speed For Switch	deg/s	RW	- 2^{31}.. 2^{31}-1
	• Parameterize homing speed during search for switch.			
1253	Homing Speed For Zero	deg/s	RW	- 2^{31}.. 2^{31}-1
	• Parameterize homing speed during search for zero.			
1254	Homing Acceleration	deg/s^2	RW	- 2^{31}.. 2^{31}-1
	• Parameterize acceleration and deceleration ramp for referencing procedure.			
1255	Jogging Speed 1	deg/s	RW	- 2^{31}.. 2^{31}-1
	• Speed for jogging. See Chapter 6.			
1256	Jogging Speed 2	deg/s	RW	- 2^{31}.. 2^{31}-1
	• Speed for jogging. See Chapter 6.			
1257	Jogging Acceleration	-	RW	- 2^{31}.. 2^{31}-1
	• Set acceleration and deceleration ramp for jogging. See Chapter 6.			

1258	Max Travel for Switch	deg	RW	$-2^{31}..2^{31}-1$
	• Max traversing distance while limit switch searching (reserved).			
1259	Max Travel for Zero	deg	RW	$-2^{31}..2^{31}-1$
	• Max traversing distance while zero searching For example, when referencing with homing method 1  			
1270	Encoder Pulses Input	-	RW	$0..2^{31}-1$
	• When PNU 304 is equal to 2, i.e. Reference Input, this parameter together with PNU 1271 has to be properly set using the following formula. Assuming that the transmission gear ratio is number of master's revolutions : number of slave's revolutions PNU 1270 = number of master's rev. * number of input-pulses * 4 PNU 1271 = number of slave's revolutions * 2^{16} For example, the master device provides 1024 encoder pulses per revolution and the transmission gear ratio is 1 : 5, then PNU 1270 = 1* 1024 * 4 = 4096 PNU 1271 = 5 * 2^{16}			
1271	Encoder Pulses Output	-	RW	$0..2^{31}-1$
	• When PNU 304 is equal to 2, i.e. Reference Input, this parameter together with PNU 1270 has to be properly. See explanation remark of PNU 1270 for the conversion formula.			
1272	Encoder Input Inversion	-	RW	0 / 1
	• Invert sign of encoder emulation input when encoder interface of DGV is set as Reference Input or Feedback Input. See PNU 304 and Appendix C for more details. 0 = Not Inverted 1 = Inverted			
1300	Torque Target	%	RW	$-10^3... 10^3$
	• Set torque (current) setpoint to be executed using motion tables.			
1301	Torque Actual Value	%	RO	$-10^3... 10^3$
	• Instantaneous current supplied by the converter as a percentage of the continuous current PNU 341.			
1302	Torque Average Value	%	RO	0..10000
	• Average current supplied by the converter as a percentage of the continuous current PNU 341.			
1303	Direct Target Torque	%	RW	$-2^{16}..2^{16}-1$
	• Current target for "direct" control when using Telegram 101 and 102, expressed as a percentage of the continuous current PNU 341.			

1400	Digital Input Status	-	R	-
	• Status of the digital inputs: 0000 0001 → D-IN1 On 0000 0010 → D-IN2 On 0000 0100 → D-IN3 On 0000 1000 → D-IN4 On 0001 0000 → D-IN5 On 0010 0000 → D-IN6 On 0100 0000 → D-IN7 On 1000 0000 → D-IN8 On			
1401	Digital Output Status	-	RW	-
	• It allows to change the status of the digital outputs set to "*0 - Disabled*": 0000 0001 → D-OUT1 On 0000 0010 → D-OUT2 On 0000 0100 → D-OUT3 On			

Appendix B - Error Codes

The tables below shows respectively alarm and error codes of DGV Converters.

- DGV300 display the codes by the status LED (LED Code Legend: G stands for green, R stands for red, Y stands for yellow).
- DGV700 display the code by the display on the front panel (first digit of fault codes is F, first digit of alarm codes is A).

Alarm	LED Code	Description
A01	GGGGY	IxT Protection
A02	GGGYG	I^2T Protection
A03	GGGYY	Software Negative Limit Switch
A04	GGYGG	Software Positive Limit Switch
A05	GGYGY	Axis not referenced
A06	GGYYG	Absolute Position Modulo error
A07	GGYYY	Invalid table selection
A08	GYGGG	Jog1-Jog2 concurrent activation

Error	LED Code	Description
F01	GGRGG	Overcurrent of the IGBT module
F02	GGGGR	Overvoltage
F03	GRRGG	Mains
F04	GGGRG	Undervoltage
F05	-	-
F06	-	-
F07	GRGGG	Converter Thermal Protection
F08	GGRRR	Motor Thermal Protection
F09	-	-
F10	GGRGR	Resolver Fault
F11	GRRGR	Sincos Encoder Fault
F12	GRRRG	Sincos Encoder Interpolation Fault
F13	-	-
F14	-	-
F15	GGRRG	Overspeed
F16	-	-
F17	-	-
F18	-	-
F19	GRGRG	Following Error
F20	GRRRR	Hardware Negative Limit Switch
F21	RGGGG	Hardware Positive Limit Switch
F22	-	-
F23	-	-
F24	RGGGR	Clamp Overload
F25	GGGRR	Field bus Fault
F26	RGGRR	Max Travel for Switch
F27	RGRGG	Max Travel for Zero
F28	GRGGR	Internal Error
F29	RGGRG	Clamp Ovetime
F30	GRGRR	Computation Overflow
F31	RRRRG	24 V Bake Supply Fault (DGV300 only)
F32	RRGGG	Invalid table

Note. The alarm code can also be detected by PNU 953 “Alarm Register”.

The fault code can also be detected by PNU 945 “Fault Code”.

This page has been intentionally left blank.

Appendix C - Technical Data

PROFIBUS Network

Protocol PROFIBUS-DP

Profile PROFIDRIVE, PROFIBUS profile for variable speed drive

Compatible Masters Any field bus master-DP device that supports PROFIBUS-DP communication protocol

PPO Telegram PPO Type-2

Network Size Up to 127 stations using repeaters

Medium

- Shielded, twisted pair RS 485 cable, EN 50170
- Bus Termination
- Bus Cable Parameters:

Parameter	Value	M.U.
Impedance	135 ÷ 165 (3 ÷ 20 MHz)	Ω
Capacitance	max. 30	pF/m
Resistance	max. 110	Ω /km
Diameter	min. 0,64	mm
Cross Section	min. 0,34	mm^2

- Bus Cable Length:

Baud rate [kbit/s]	Max. Length [m]
12000	100
6000	100
3000	100
1500	200
500	400
187,5	1000
93,75	1200
45,45	1200
19,2	1200
9,6	1200

Fieldbus Connections Terminals X2 / X3 on the front panel of DGV.

Switch Settings Through drive parameter and/or DIP switches on the drive front panel.

Control Word

The following table resumes the detailed bit allocation of the Control Word for each operating mode.

Bit		*Analog Torque Mode*	*Analog Speed Mode*	*Speed Mode*	*Positioning Mode*	*Torque Mode*
0	0	OFF1				
	1	ON				
1	0	OFF2				
	1	Operating Condition				
2	0	OFF3				
	1	Operating Condition				
3	0	Operation Inhibited				
	1	Operation Enabled				
4	0			Inhibit ramp-function generator	Cancel drive task	
	1			Operating Condition	Operating Condition	
5	0			Stop ramp-function generator	Intermediate stop	
	1			Enable ramp-function generator	Operating Condition	
6	0			Inhibit setpoint		Inhibit setpoint
	1			Enable setpoint	Activate drive task (edge)	Enable setpoint
7	0					
	1	Acknowledge				
8	0				Inching1 OFF	
	1				Inching1 ON	
9	0				Inching2 OFF	
	1				Inching2 ON	
10	0	Inhibit Remote Control				
	1	Enable Remote Control				
11	0				Stop referencing	
	1				Start referencing	
12	0				Relative Positioning	
	1				Absolute Positioning	
13	0				Single Setpoint	
	1				Change Set Immediately	
14	0				Stop Synchronization	
	1				Perform Synchronization	
15	0			Internal Motion Task		
	1			Activate Direct Motion Task		

Status Word

The following table resumes the detailed bit allocation of the Status Word for each operating mode.

Bit		*Analog Torque Mode*	*Analog Speed Mode*	*Speed Mode*	*Positioning Mode*	*Torque Mode*
0	0	Switch-on inhibited				
	1	Ready to switch-on				
1	0	OFF1 ACTIVE				
	1	Operating condition				
2	0	Operation inhibited				
	1	Operation enabled				
3	0	No fault				
	1	Fault				
4	0	No OFF2				
	1	OFF2 ACTIVE				
5	0	No OFF3				
	1	OFF3 ACTIVE				
6	0	Operating condition				
	1	Switch-on inhibited				
7	0	No alarm				
	1	Alarm				
8	0			Actual speed out of tolerance range	Contouring error	
	1			Actual speed within tolerance range	No contouring error	
9	0	Remote Control Inhibited				
	1	Remote Control Enabled				
10	0	Min Speed not reached			Outside setpoint position	Min Speed not reached
	1	Min Speed reached			Setpoint position reached	Min Speed reached
11	0		No reference point set			
	1		Reference point set			
12	0					
	1				Setpoint acknow-ledgment (edge)	
13	0				Drive moving	
	1				Drive stationary	
14	0				No error	
	1				Referencing error	
15	0				No synchronization	
	1				Synchronization Reached	

Basic Data Types

UNSIGNEDn is a non-negative integer value in the range: 0, …, 2^n-1 which is represented by a sequence of n bits as:

$$b = b_0\, b_1 \ldots b_{n-1}$$

the value of an UNSIGNEDn(b) data type is

$$\text{UNSIGNEDn}(b) = b_{n-1}\, 2^{n-1} + \ldots + b_1\, 2^1 + b_0\, 2^0$$

INTEGERn is an integer value in the range -2^{n-1}, … , 2^{n-1}-1 which is represented by a sequence of n bits as:

$$b = b_0\, b_1 \ldots b_{n-1}$$

the value of an INTEGERn(b) data type is

$$\text{INTEGERn}(b) = b_{n-2}\, 2^{n-2} + \ldots + b_1\, 2^1 + b_0\, 2^0 \quad \text{if } b_{n-1} = 0$$

and, the two's complement INTEGERn(b) if $b_{n-1} = 1$.

Units

Note that axis variables are Axis Type dependent.

Therefore axis units are for rotary axis:

Position	[mdeg]
Speed	[mdeg/s]
Acceleration	[deg/s^2]

And for linear axis:

Position	[μm]
Speed	[μm/s]
Acceleration	[mm/s^2]

Note. Special regard should be taken when drive configuration is carried out using the Browser (Control Mode set to Local) and changes monitored through field bus, or vice versa (Control Mode set to Field Bus).

When control mode is Field Bus, axis variables which are Axis Type dependent, such as axis position, velocity and acceleration, have to be converted into internal units and set as integers.

DGV Internal Units

Process variables in their units can be transformed into DGV internal units using conversion factors PNU 1211 “Position Conversion Numerator” and PNU 1212 “Position Conversion Denominator”.

When a resolver transducer with 65536 counts/turn is used, then conversion factors must be set as follows:

- when rotary axis

  1 rotor-turn = 360000 [mdeg] = 65536 [counts]

  and gear ratio is

  nr. of axis-turns : nr. of rotor-turns.

  Hence, “Position Conversion Numerator” is

  PNU 1211 = nr. of rotor-turns * 65536

  and “Position Conversion Denominator” is

  PNU 1212 = nr. of axis-turns * 360000

  For example:

  Assuming gear ratio is 3:10, then

  PNU 1211 = 10 * 65536

  PNU 1212 = 3 * 360000

- when linear axis, for example using a screw-pitch of 20000 μm

  1 rotor-turn = 20000 [μm] = 65536 [counts]

  gear ratio is always

  nr. of axis-turns : nr. of rotor-turns

  Hence “Position Conversion Numerator” is

  PNU 1211 = nr. of rotor-turns * 65536

  and “Position Conversion Denominator” is

  PNU 1212 = nr. of axis-turns * 20000

Example.

Extract parameter PNU 1202 “Profile Velocity” from *Appendix A - Parameters List*.

PNU	Name	Units	Access	Value Range
1202	Profile Velocity	deg/s	RW	$-2^{31}..2^{31}-1$

The parameter unit is “mdeg/s“ when rotary axis, and “µm/s“ when linear axis.

- Would you set a profile speed of 10 deg/s, the conversion in internal units be:

  10 deg/s ≡ 10*1000 mdeg/s, that is 10000 dec

  i.e. PNU 1202 has to be set to “ 10000 dec “ .

- If PNU 1202 parameter value were equal to 5000000 dec for a linear axis, the following conversion returns that:

  5000000 dec ≡ 5000000 µm/s that is 5m/s

  i.e. the profile speed is set to 5 m/s.

PROFIBUS Definitions

Technical definitions currently used in this Guide concerning the PROFIBUS protocol.

Warning	Signal caused by an existing alarm which does not interrupt drive operation. Internal limitation and protection functions are automatically activated
Request Label	Coded information specifying the required service for the parameter part sent from master to slave
Response Label	Coded information specifying the required service for the parameter part sent from slave to master
Control Word	16-bit word coded information sent from master to slave containing control and command information
Description	Parameter description: short description of the parameter and its use
Fault	Error event that leads to interrupting drive operation
GSD File	ASCII-format device description file in a specified form. Each PROFIBUS device (active and passive station) has its own GSD file containing the device communication properties. The GSD file of DGV is suitable for any kind of master-DP device
Master	Control system with bus initiative. In PROFIBUS terminology a master device is also called active station
Parameter Name	Parameter symbolic name
Parameter Number	In PROFIBUS terminology it indicates the parameter address
Parameter	Value that can be accessed through the PROFIBUS link, e.g. variable, constant, signal
PPO Telegram	PPO (Parameter/Process Data Object): data set that contains Parameter and Process Data
Parameter Identification	Data set within the PPO telegram for transferring parameter values
Process Data	Data set within the PPO telegram containing the Control Word and reference values or the Status Word and actual values
Profile	Adaptation of the protocol for certain application field, e.g. drives
Profile-specific	Peculiar of a certain profile
Slave	Passive bus participant. In PROFIBUS terminology, slave stations are also called passive stations
Status Word	16-bit coded information sent from slave to master containing status information

PROFIBUS Abbreviations

Abbreviations used in this Guide.

ACT	Actual Value
CW	Control Word
DP	Decentralized Periphery
FMA	Fieldbus Management
FMS	Fieldbus Message Specification
HW	Hardware
ID	(Request) Identification
IND	Sub-Index
PA	Process Automation
PD	Process Data
PNO	PROFIBUS User Organization (*PROFIBUS Nutzerorganisation*)
PNU	Parameter Number
PPO	Parameter/Process Data Object
REF	Reference Value
RS 485	(EIA Standard for data transmission)
SW	Status Word
SW	Software
VALUE	(Parameter) Value

DGV
MANIU20.0507 E

ABB Sace S.p.a.
Linea S (Servomotors & Servodrives)
Headquarters and Offices
Frazione Stazione Portacomaro, 97/C
I - 14100 Asti
ITALY
Telephone: +39 0141 276 111
Fax: +39 0141 276 294
E-mail: sace.ssg@it.abb.com
Internet: www.abb.com
Servomotors & Servodrives

ABB Sace S.p.a.
Linea S (Servomotors & Servodrives)
Export
Via Luciano Lama, 33
I - 20090 Sesto San Giovanni (MI)
ITALY
Telephone: +39 02 2414 3562
Fax: +39 02 2414 3972
E-mail: sace.ssg@it.abb.com