ABB Sace

ABB AC Brushless Servodrives
DGV Converters

CANOpen Guide

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Safety Instructions

General

This chapter states the safety instructions that must be followed when operating DGV CANOpen Servodrives.

The material in this chapter and in the *Installation Manual* must be studied before attempting any work on, or with, the device.

Installation Manual of DGV Converters provides a complete safety instruction list to be observed.

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

The drive and adjoining equipment must be properly earthed.

WARNING! Do not attempt any work on a powered drive. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before working on the frequency converter, the motor or the motor cable.

It is good practice to check (with a voltage indicating instrument) that the drive is in fact discharged before beginning work.

The motor cable terminals of the drive are at a dangerously high voltage when mains power is applied, regardless of motor operation.

There can be dangerous voltages inside the drive from external control circuits even when the drive mains power is shut off. Exercise appropriate care when working with the unit. Neglecting these instructions can cause physical injury and death.

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.

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

Table of Contents

Chapter 1 - General Information

Overview

This document *CANOpen Guide* is part of the DGV Converters manual, cod. MANIU20.0410 E, provided by ABB Sace S.p.a.

Before You Start

This Guide contains the technical specifications of the CANOpen communication interface module built into DGV.

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

What this Guide contains

The commissioning and operating of DGV Servodrives using CANOpen standard communication protocol are introduced in this Guide.

It is assumed that the drive is properly installed and ready for operation. 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 CANOpen profile description.

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

Chapter 3 - Electrical Installation contains wiring instructions and terminations of the bus cable.

Chapter 4 - Programming DGV explains how to program the master station and the drive before the communication through the interface module can be started.

Chapter 5 - CANOpen Communication contains a description of data transmission through the interface module.

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

Appendix A presents the EDS (Electronic Data Sheet) file of DGV, together with a sample file listing.

Appendix B contains the reference table for decoding CANOpen error messages.

Appendix C contains Technical Data.

Related Documentation

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

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

Terms and Abbreviations used in this Guide

CAN Controller Area Network.

CAL CAN Application Layer

CANOpen Family of profiles for embedded networking in industrial machinery, medical equipment, building automation (e.g. lift control systems, electronically controlled doors, integrated room control systems), railways, maritime electronics, truck-based superstructures, off-highway and off-road vehicles, etc.

CiA CAN in Automation International Users and Manufacturers Group.

COB Communication Object; a unit of transportation on a CAN network. Data is sent across a network inside a COB. The COB itself is part of the CAN message frame.

CAN Module The “CAN Module” is a hardware and software interface equipment through which a converter can be connected to an external CAN network.

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

Data Sets and Data Words Data sets are clusters of data sent through the CAN 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.

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

EDS Electronic Data Sheet; a node-specific ASCII-format file required when configuring the CAN network. The EDS file contains general information on the node and its dictionary objects (parameters).

LMT Layer Management; one of the service elements of the CAN Application Layer in the CAN Reference Model. It serves to configure parameters for each layer in the CAN Reference Model.

NMT Network Management; one of the service elements of the CAN Application Layer in the CAN Reference Model. It performs initialisation, configuration and error handling on a CAN network.

Object Dictionary A local storage of all Communication Objects (COB) recognized by a device.

OSI Open Systems Interconnection.

PDO Process Data Object; a type of COB. Used for transmitting time-critical data, such as control commands, references and actual values.

RO Denotes read-only access.

RW Denotes read/write access.

SDO Service Data Object; a type of COB. Used for transmitting non-timecritical data, such as parameters.

Further information Further information are available from the CAN in Automation worldwide website www.can-cia.org .

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Chapter 2 - Introduction to CANOpen

Overview

This chapter contains a short description of the CANOpen protocol and the formal reference documents used for the development of the CAN interface module of DGV.

CANOpen

CANOpen is a higher-layer protocol based on the CAN (Control Area Network) serial bus system and the CAL (CAN Application Layer). CANOpen assumes that the hardware of the connected device has a CAN transceiver and a CAN controller as specified in ISO 11898.

The CANOpen Communication Profile, CiA DS-301, includes both cyclic and event-driven communication, which makes it possible to reduce the bus load to minimum while still maintaining extremely short reaction times. High communication performance can be achieved at relatively low baud rates, thus reducing EMC problems and cable costs.

CANOpen device profiles define both direct access to drive parameter and time-critical process data communication. The CAN interface module of DGV fulfils CiA (CAN in Automation) standard DSP-402 (Drives and Motion Control).

The physical medium of CANOpen is a differentially-driven two-wire bus line with common return according to ISO 11898. The maximum length of the bus is limited by the communication speed as follows:

Baudrate		Maximum Bus Length	
1	Mbit/s	25	m
500	kbit/s	100	m
250	kbit/s	250	m
125	kbit/s	500	m
100	kbit/s	1000	m
50	kbit/s	1000	m

The maximum theoretical number of nodes is 127. However, in practice, the maximum number depends on the capabilities of the CAN-transceivers used.

The CANOpen Interface Module

DGV Converters are equipped with a CANOpen interface module. The interface module enables the connection of the drive to a CANOpen system. Through this module it is possible for the DGV to:

- Receive the control commands, *Control Word*
- Receive speed, position and torque remote references
- 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 discussed in Chapter 9 of the *Installation Manual*, and it is valid for DGV in general.

The Communication Objects and functions supported by DGV with CANOpen interface module are discussed in Chapter 5 and 6 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

Overview

This chapter contains the instructions for:

- cabling
- field bus connections and termination.

WARNING! Switch off the drive power supply when installing or cabling the drive. Wait five 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 *Chapter 7* of the *Installation Guide*.

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 selectors located on the converter front panel.

- By setting the selectors to FF hex, the node address can be selected by Browser or by an external controller. In this case the node address is a read/write parameter.
- By setting the selectors to any value in the range 0x00 (i.e. 0) to 0x7F (i.e. 127), the node address will be hardware selected, therefore the node address parameter is read-only.

CAN Connections

DGV700 The bus cable is connected to terminals X2 and X3 (sub-D 9 male) on the converter front panel.

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 male) 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

Overview

This chapter contains the information for configuring DGV Converters on the CAN network.

Configuring the CAN Controller and the Network

Once the drive is mechanically and electrically installed according with the instructions in the *Installation Manual* 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 CAN network.

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

EDS

The EDS (Electronic Data Sheet) file contains general information on the node and its dictionary objects, required when configuring the network. A key to the EDS file of DGV together with a sample listing can be found in Appendix A.

Configuring the Drive

The procedure for activating the communication between the master and the converters is to adjust a few parameters.

To make the communication effective:

- A node address (NODE-ID) must be assigned to any device connected to the CAN network, through the drive parameter and/or the DIP switches on the drive front panel.
- The communication protocol and the bus transmission rate must be set compatible with all CAN nodes.
- For DGV Converters, the *Control Mode* parameter must be properly set (see Chapter 6).

As the communication is established, always check the drive 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.

Modes of Operation – Overview

The operating mode defines the behaviour of the drive. The following operating modes can be selected on DGV drives:

Analog Torque Mode	Torque Control with analogue reference signal.
Analog Speed Mode	Speed Control with analogue reference signal.
Profile Velocity Mode	It is used to control the velocity of the drive with no special regard of the position. It supplies limit functions and Trajectory Generation (profile).
Profile Position Mode	It provides the positioning of the drive. Speed, position and acceleration can be limited and profiled moves using a Trajectory Generator are possible as well.
Profile Torque Mode	A torque control mode with all related parameters is provided.
Homing Mode	Providing various methods to find a home position (also: reference point, datum, zero point).
Jogging Mode	Function for adjustment of the axis position with short steps.
Synchronization Mode	Speed or position synchronization of axles. It supplies limit and monitoring functions.
Interpolated Position Mode	Time interpolation of single axles and spatial interpolation of coordinated axles.

Details of the operating modes supported are provided in Chapter 6.

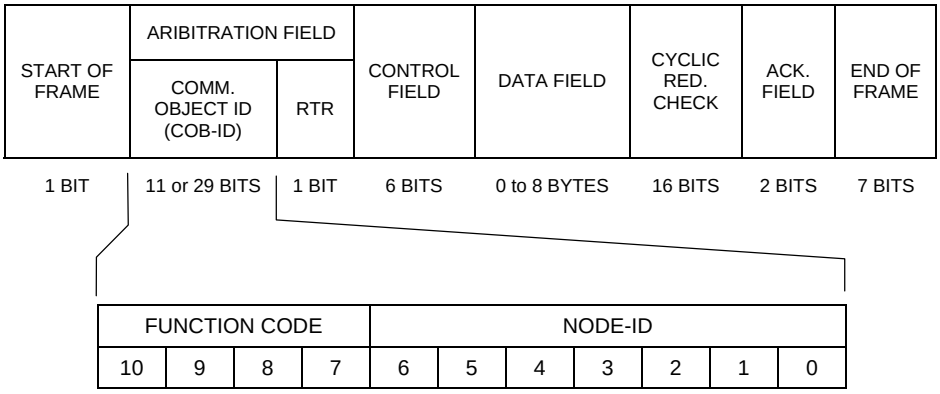
Chapter 5 - CANOpen Communication

Overview

This chapter describes the communication on CAN network.

CAN Data Frame

CAN employs data frames for transferring data between the host (controller) and the nodes on the bus. The following figure presents the structure of the data frame.



Communication Object	Function Code (Binary)	COB ID (hex)	COB ID (dec)
NMT	0000	0x00	0
SYNC	0001	0x80	128
TIME STAMP	0010	0x100	256
EMERGENCY	0001	0x81 … 0xFF	129 … 255
PDO 1 (tx)	0011	0×181 … 0×1FF	385 … 511
PDO 1 (rx)	0100	0×201 … 0×27F	513 … 639
PDO 2 (tx)	0101	0×281 … 0×2FF	641 … 767
PDO 2 (rx)	0110	0×301 … 0×37F	769 … 895
PDO 3 (tx)	0111	0x381 … 0x3FF	897 … 1023
PDO 3 (rx)	1000	0×401 … 0×47F	1025 … 1151
PDO 4 (tx)	1001	0x481 … 0x4FF	1153 … 1279
PDO 4 (rx)	1010	0×501 … 0×57F	1281 … 1407
SDO (tx)	1011	0×581 … 0×5FF	1409 … 1535
SDO (rx)	1100	0×601 … 0×67F	1537 … 1663
NODEGUARD	1110	0×701 … 0×77F	1793 … 1919

Communication Objects

Inside the CANOpen data frame, different types of Communication Objects are used to convey the data. Process Data Objects (PDO) are used for transmitting time-critical process data (references, control commands, status information); Service Data Objects (SDO) are used for less time-critical data, e.g. parameters. In addition, there are Special Function Objects and Network Management Objects.

Network Management (NMT)

The Network Management (NMT) is used to control the network behaviour. The mechanism used for NMT is based on a master/slave relationship. The NMT requires that during start up/runtime there is only one master at the very same time.

DGV Converters support the Network Management (NMT) Slave State Machine, as required by the CANOpen Communication Profile. There are four main state defined:

- Initialisation
- Pre-Operational
- Operational
- Stopped

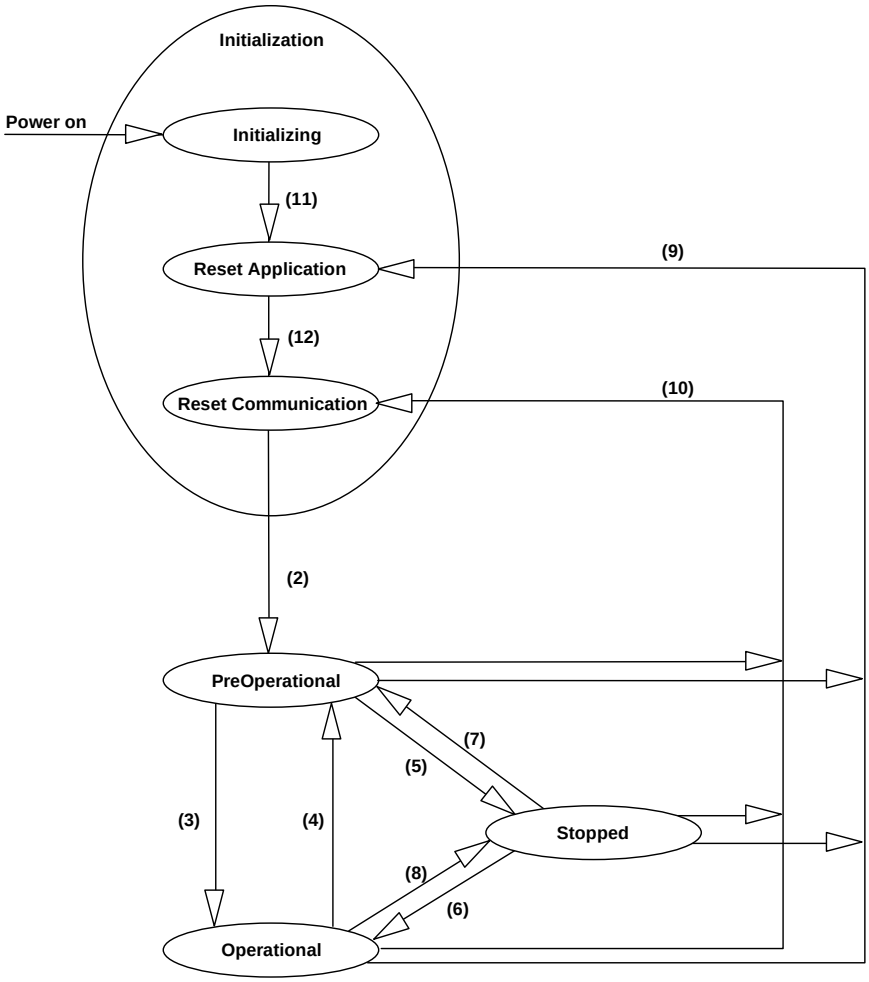
The Initialisation state is entered automatically after power on as well as after a reset command. After Initialisation is completed, the device enters automatically into the Pre-Operational state and transmits a Boot-up message.

Within the Pre-Operational state parameterisation and ID-allocation is possible. SDO communication, node guarding (error control) and emergency messages are also allowed. Then the device can be switched to the Operational state.

Within the Operational state the device is able to communicate actively and all CAN message types are allowed. The device can perform the application actions.

Any time during operation the NMT master can force the device into the Stopped state. Communication is stopped except node guarding.

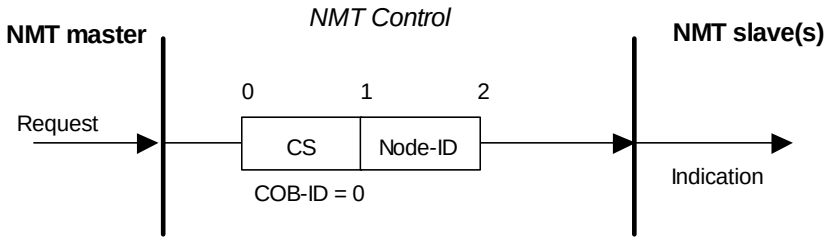
NMT Slave State Machine



(2) Initialisation finished – enter Pre-Operational automatically
(3) (6) Start_Remote_Node indication
(4) (7) Enter_Pre-Operational_State indication
(5) (8) Stop_Remote_Node indication
(9) Reset_Node indication
(10) Reset_Communication indication
(11) Initialising finished – Reset_Application state is entered autonomously
(12) Reset_Application is finished – Reset_Communication is entered autonomously

NMT Control Protocol

Through this protocol, the NMT master controls the state of the NMT slave.



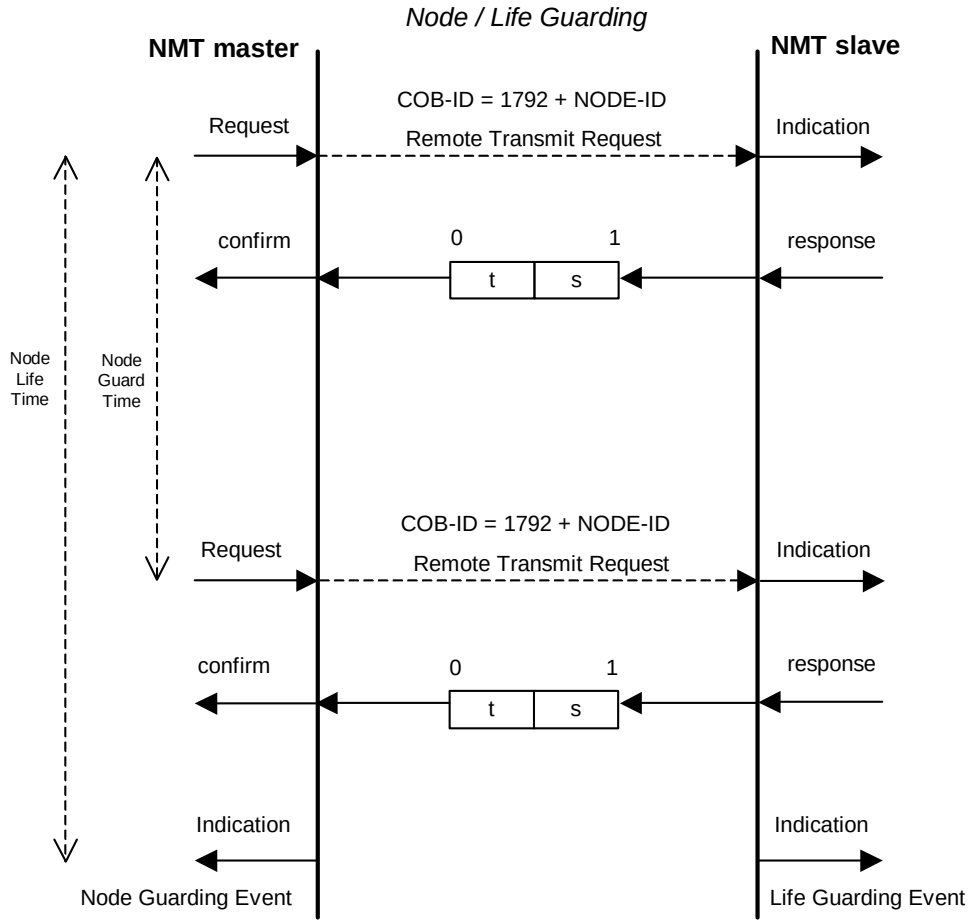
The NMT command specifiers (CS) used for controlling the node are:

NMT Protocol	Command Specifier	Remarks
Start_Remote_Node	001	Change to NMT Operational state
Stop_Remote_Node	002	Change to NMT Stop state
Enter_Pre-Operational_State	128	Enter the Pre-Operational State
Reset_Node	129	Reset Node
Reset_Communication	130	Reset Communication

Note. If Node-ID equals 0, all NMT slaves are addressed.

Node Guarding Protocol

This protocol is used to detect errors in the network. Each node uses one remote COB for the Node Guarding Protocol.



The node state **s** indications are as follows:

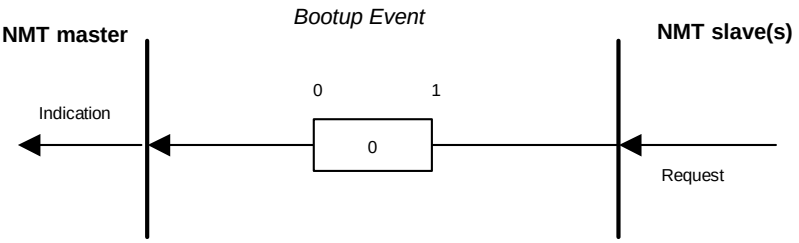
Indication	State
4	Stopped
5	Operational
127	Pre-Operational

The value of the toggle bit **t** alternates between two consecutives responses of the NMT slave.

The Node Guard Time (Index 100Ch) is the regular time interval for slave polling.

The Node Life Time is given by the guard time multiplied by the Life Time Factor (Index 100Dh).

Bootup Protocol The NMT slave uses this protocol to signal that it has entered the state Pre-Operational after Initialisation.



One data byte is transmitted with value 0.

Process Data Objects (PDO)

PDOs are messages in an unconfirmed service.

They are used for the transfer of real-time data to and from the drive. Each PDO contains three 16-bit words.

The COB Ids for PDOs are:

- PDO1 Rx (Master to Slave): 200h + Node-ID
- PDO2 Rx (Master to Slave): 300h + Node-ID
- PDO3 Rx (Master to Slave): 400h + Node-ID
- PDO4 Rx (Master to Slave): 500h + Node-ID
- PDO1 Tx (Slave to Master): 180h + Node-ID
- PDO2 Tx (Slave to Master): 280h + Node-ID
- PDO3 Tx (Slave to Master): 380h + Node-ID
- PDO4 Tx (Slave to Master): 480h + Node-ID

There are two kinds of use of PDOs: Transmit-PDO (PDO Tx) used for data transmission, and Receive-PDO (PDO Rx) used for data reception.

Communication Parameters

PDO Communication Parameters describe the communication capabilities of PDOs, and they are:

- *Receive-PDO Communication Parameters*, Indexes 1400h to 1404h,
- *Transmit-PDO Communication Parameters*, Indexes 1800h to 1804h.

Mapping Parameters

The PDO Mapping Parameters describe the content of PDOs available for the device (drive variables):

- *Receive-PDO Mapping Parameters* Indexes 1600h to 1604h,
- *Transmit-PDO Mapping Parameter*, Indexes 1A00h to 1A04h.

Transmission Modes

Two transmission modes are distinguished for PDOs:

- Synchronous Transmission (Synchronous PDOs)
- Asynchronous Transmission (Asynchronous PDOs)

Synchronous transmission is used for synchronizing devices by the SYNC Object, which is periodically transmitted by the SYNC producer. Synchronous PDOs are transmitted within a predefined time-window immediately after the SYNC Object.

Asynchronous PDO are transmitted without any relation to the SYNC Object and they are event-driven or remotely requested.

The following table gathers the transmission types for PDOs.

Tipo di Trasmissione	Ciclica	Aciclica	Sincrona	Asincrona	Solo RTR
0		x	x		
1 – 124	x		x		
241 – 251			Riservati		
252			x		x
253				x	x
254				x	
255				x	

For PDO-Rx:

- a transmission type of 0 up to 240 means Synchronous PDO, i.e. data are immediately updated with the following SYNC;
- a transmission type of 255 (FFh) means Asynchronous PDO, i.e. data are immediately updated.

For Synchronous PDO-Tx:

- a transmission type of 0 means acyclic (non-periodic), event-driven PDO, transmitted after the following SYNC;
- a transmission type of 1 means cyclic PDO (periodic), transmitted with every SYNC Object;
- a transmission type of “n” means cyclic PDO (periodic), transmitted with every SYNC Object.

A transmission type of 255 (FFh) means Asynchronous event-driven PDO-Tx.

The transmission type of a PDO is defined in the index of the PDO communication parameter. See the *Object Dictionary* later in this Chapter (C*ommunication Profile Area*, Index 1400h onwards).

PDO Mapping

DGV supports several operating modes, therefore more standard PDOs are defined. In addition, all PDOs are freely programmable using the *Communication Parameters* and the *Mapping Parameters*.

Receive PDOs

Receive PDOs (PDO Rx) are used for transferring control information to the drive. The following table describes the default PDO Mapping of Receive PDOs for DGV Converters.

PDO Rx	Mapping Object Index	Object Name	Description
1	6040h 2020h	*Control Word* *Control Word 2*	Controls the CANOpen State Machine and the Control Word 2 for additional features.
2	6040h 2020h 6060h	*Control Word* *Control Word 2* *Modes of Operation*	Controls the CANOpen State Machine, the Control Word 2 for additional features and the operating modes.
3	6040h 2020h 2130h	*Control Word* *Control Word 2* *Direct Target Position*	Profile Position Mode. Controls the CANOpen State Machine, the Control Word 2 for additional features and the position setpoint.
4	6040h 2020h 2131h	*Control Word* *Control Word 2* *Direct Target Velocity*	Profile Velocity Mode. Controls the CANOpen State Machine, the Control Word 2 for additional features and the speed setpoint.
5	6040h 2020h 2132h	*Control Word* *Control Word 2* *Direct Target Torque*	Profile Torque Mode. Controls the CANOpen State Machine, the Control Word 2 for additional features and the torque setpoint.
6	6040h 2020h 606Ch-1	*Control Word* *Control Word 2* *Setpoint Position*	Interpolated Position Mode. Controls the CANOpen State Machine, the Control Word 2 for additional features and the position setpoint for linear interpolation.
7	6040h 2020h 60FEh	*Control Word* *Control Word 2* *Digital Outputs*	Controls the CANOpen State Machine, the Control Word 2 for additional features and digital outputs. (reserved)
8	6040h 2020h 6060h	*Control Word* *Control Word 2* *Modes of Operation*	Controls the CANOpen State Machine, the Control Word 2 for additional features and the operating modes. (Broadcast PDO)

The sub-indexes of PDO Mapping Parameters, however, are read-write, therefore all Receive PDOs are freely programmable. Each PDO can be freely mapped with up to 4 Objects.

Transmit PDOs

Transmit PDOs are used for monitoring the drive behaviour. The following table describes the default PDO Mapping of Transmit PDOs for DGV Converters.

PDO Tx	Mapping Object Index	Object Name	Description
1	6041h 2021h	*Status Word* *Status Word 2*	Shows the drive status information.
2	6041h 2021h 6061h	*Status Word* *Status Word 2* *Modes of Operation display*	Shows the drive status information and the operating mode currently selected.
3	6041h 2021h 6064h	*Status Word* *Status Word 2* *Position actual value*	Profile Position Mode. Shows the drive status information and the actual position.
4	6041h 2021h 606Ch	*Status Word* *Status Word 2* *Velocity actual value*	Profile Velocity Mode. Shows the drive status information and the actual speed.
5	6041h 2021h 6077h	*Status Word* *Status Word 2* *Torque actual value*	Profile Torque Mode. Shows the drive status information and the actual torque.
6	6041h 2021h 6064h	*Status Word* *Status Word 2* *Position actual value*	Interpolated Position Mode. Shows the drive status information and the actual position. (reserved)
7	6041h 2021h 60FDh	*Status Word* *Status Word 2* *Digital Inputs*	Shows the drive status information and the status of digital inputs.

The PDO Tx 1, 2 and 7 are event driven (transmission type 255). The following events may cause the transmission of these PDOs:

- PDO-Tx 1 : alteration of the Status Word (Index 6041h) and of the Status Word 2 (Index 2021h)
- PDO-Tx 2 : alteration of the Status Word (Index 6041h), of the Status Word 2 (Index 2021h) and the operating mode (Index 6061h)
- PDO-Tx 2 : alteration of the Status Word (Index 6041h), of the Status Word 2 (Index 2021h) and the digital inputs (Index 60FDh).

The sub-indexes of PDO Mapping Parameters, however, are read-write, therefore all Transmit PDOs are freely programmable. Each PDO can be freely mapped with up to 4 Objects at choice.

The other PDOs are synchronous.

PDO1 Rx The PDO1 Rx Object is received by the drive. The content of PDO1 Rx is as follows:

Master to Slave

Header	Byte					
	0	**1**	**2**	**3**	**4**	**5**
0100xxxxxxxryyyy	Control Word (6040h)		Control Word 2 (2020h)		Not used	

0100 = COB ID Function code
xxxxxxx = Node-ID
r = RTR (Remote Transmit Request) bit
yyyy = Data length

The drive switches between the states of the *CANOpen State Machine* (shown further below) according to the bits of the Control Word.

Control Word

Bit	Description
0	Switch on
1	Disable voltage
2	Quick stop
3	Enable operation
4	MODE SPECIFIC (see Chapter 6)
5	MODE SPECIFIC (see Chapter 6)
6	MODE SPECIFIC (see Chapter 6)
7	Reset fault
8	Not used
9	Not used
10	Not used
11	External control location
12	MODE SPECIFIC (see Chapter 6)
13	Not used
14	Not used
15	Not used

PDO1 Tx The PDO1 Tx Object is transmitted by the drive. The contents of PDO1 Tx is as follows:

Slave to Master

Header	Byte					
	0	1	2	3	4	5
0011xxxxxxryyyy	Status Word (6041h)		Status Word 2 (2021h)		Not used	

0011 = COB ID Function code
xxxxxxx = Node-ID
r = RTR (Remote Transmit Request) bit
yyyy = Data length

The drive indicates its state in the *CANOpen State Machine* (shown further below) with the bits of the Status Word.

Status Word

Bit	Description
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop
6	Switch-on disabled
7	Warning
8	External control location (ABB drives)
9	Remote
10	Target reached
11	Internal limit active
12	MODE SPECIFIC (see Chapter 6)
13	MODE SPECIFIC (see Chapter 6)
14	MODE SPECIFIC (see Chapter 6)
15	Not used

PDO1 Tx is automatically transmitted to the CAN bus master every 50 milliseconds. (Transmission is stopped when communication with the master is lost, or the node is in the Pre-Operational state.) The master can also request for new values at shorter intervals.

PDO2 Rx The PDO2 Rx Object is received by the drive. The contents of PDO2 Rx are as follows:

Master to Slave

Header	Byte					
	0	**1**	**2**	**3**	**4**	**5**
0110xxxxxxxryyyy	Control Word (6040h)		Control Word 2 (2020h)		Modes of Operation (6060h)	

0110 = COB ID Function code
xxxxxxx = Node-ID
r = RTR bit
yyyy = Data length

PDO2 Tx The PDO2 Tx object is transmitted by the drive. The contents of PDO2 Tx are as follows:

Slave to Master

Header	Byte					
	0	**1**	**2**	**3**	**4**	**5**
0101xxxxxxryyyy	Status Word (6041h)		Status Word 2 (2021h)		Modes of Operation display (6061h)	

0101 = COB ID Function code
xxxxxxx = Node-ID
r = RTR (Remote Transmit Request) bit
yyyy = Data length

Other PDOs

The contents of mapped PDOs Rx and Tx are by default:

- Form master to slave: the Control Word, the Control Word 2 and the Reference Value
- Form slave to master: the Status Word, the Status Word 2 and the Actual Value

Master to Slave

Header	Byte				
	0	1	2	3	4 … 7
Bbbbxxxxxxxryyyy	Control Word (6040h)		Control Word 2 (2020h)		Reference

bbbb = COB ID Function code
xxxxxxx = Node-ID
r = RTR bit
yyyy = Data length

Slave to Master

Header	Byte				
	0	1	2	3	4 … 7
Bbbbxxxxxxxryyyy	Status Word (6041h)		Status Word 2 (2021h)		Actual Value

bbbb = COB ID Function code
xxxxxxx = Node-ID
r = RTR bit
yyyy = Data length

See paragraphs *PDO Mapping*, *Receive PDOs* and *Transmit PDOs*.

Service Data Objects (SDO)

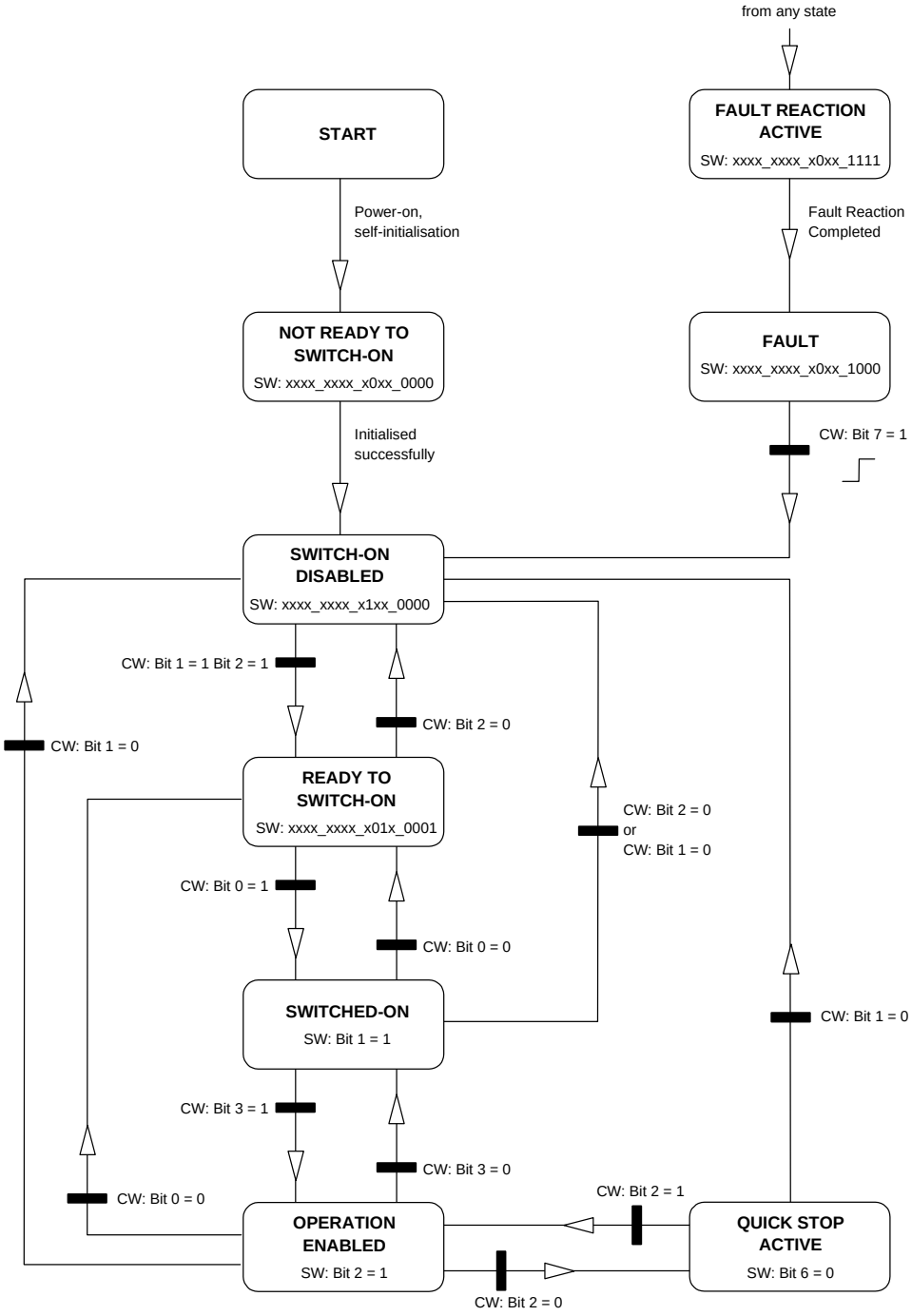
Service Data Objects are mainly used for transferring non-time-critical data, e.g. parameter values. SDOs provide access to the entries in the device Object Dictionary.

If 4 bytes or less data is to be transmitted, an ‘expedited’ SDO message can be used. Larger quantities of data can be segmented, i.e. split between several CAN messages.

The COB Ids for SDO communication are:

- Master to Slave: 600h + Node-ID
- Slave to Master: 580h + Node-ID.

CANOpen State Machine



CW: Control Word

SW: Status Word

Drive States The drive states are here presented:

State	Description
NOT READY TO SWITCH ON	Auxiliary power has been applied to the drive. The drive is being initialised or is running self test. The drive function is disabled.
SWITCH ON DISABLED	Drive initialisation is complete. The drive parameters have been set up. Drive parameters may be changed. The drive function is disabled.
READY TO SWITCH ON	High voltage may be applied to the drive. The drive parameters may be changed. The drive function is disabled.
SWITCHED ON	High voltage has been applied to the drive. The power amplifier is ready. The drive parameters may be changed. The drive function is disabled.
OPERATION ENABLED	No faults have been detected. The drive function is enabled and power is applied to the motor. The drive parameters may be changed.
QUICK STOP ACTIVE	The quick stop function is being executed. The drive parameters may be changed. The drive function is enabled and power is applied to the motor.
FAULT REACTION ACTIVE	A fault has occurred in the drive. The quick stop function is being executed. The drive parameters may be changed. The drive function is enabled and power is applied to the motor.
FAULT	A fault has occurred in the drive. The drive parameters may be changed. The drive function is disabled. High voltage switch-on/-off depends on the application.

Object Index 6040h: Control Word

The following table provides the detailed bit allocation of the Control Word for each operating mode. The upper case text refers to states of the *CANOpen Stat Machine*.

Empty cells in this table mean "bit not used in this mode".

The "Start" indication (Start New Setpoint, Start Homing, Start Synchronization) means start task on the positive edge (0 → 1) of bit.

Bit 0 to 3, bit 7 and 11 are specific of the CANOpen drive profile, i.e. they are valid for each operating mode. These bits are basically necessary for controlling the *CANOpen State Machine*.

Other bits are operation mode specific, that is, they have different meaning for each operating mode. Detailed description of these bits is given in the relevant paragraph of each operating mode.

Bit \ Mode		*Analog Torque Mode*	*Analog Speed Mode*	*Profile Position Mode*	*Profile Velocity Mode*	*Profile Torque Mode*	*Homing Mode*	*Jogging Mode*	*Synchronization Mode*	*Interpolated Position Mode*
0	0	READY TO SWITCH-ON								
	1	SWITCHED-ON								
1	0	SWITCH-ON DISABLED								
	1	READY TO SWITCH-ON								
2	0	SWITCH-ON DISABLED								
	1	READY TO SWITCH-ON								
3	0	SWITCHED-ON								
	1	ENABLE OPERATION								
4	0			No Setpoint				Stop Jogging 1	Stop Synchronization	Interpolation disabled
	1			Start New Setpoint			Start Homing	Enable Jogging 1	Start Synchronization	Interpolation enabled
5	0			Single Setpoint				Stop Jogging 2		
	1			Change Set Immediately				Enable Jogging 2		
6	0			Absolute Positioning						
	1			Relative Positioning						
7	0→1	RESET FAULT								
8	0	Execute Motion								
	1	HALT								
9	-									
10	-									
11	0	Local Control Active								
	1	Field Bus Control Active								
12	0			Internal Motion Task						
	1			Activate Direct Motion Task						
13	-									
14	-									
15	-									

Object Index 6041h: Status Word

The following table provides the detailed bit allocation of the Status Word for each operating mode. The upper case text refers to states of the *CANOpen Stat Machine*.

Empty cells in this table mean "bit not used in this mode".

The indication "0 → 1" means, mutation of this bit occurring on the positive edge of signal.

Bit 0 to 9, and bit 11 are specific of the drive profile, i.e. they are valid to each operating mode. These bits are basically necessary for controlling the *CANOpen State Machine*.

Other bits are operation mode specific, that is, they have different meaning for each operating mode. Detailed description of these bits is given in the relevant paragraph of each operating mode.

Bit \ Mode		Analog Torque Mode	Analog Speed Mode	Profile Position Mode	Profile Velocity Mode	Profile Torque Mode	Homing Mode	Jogging Mode	Synchronization Mode	Interpolated Position Mode
0	0	SWITCH-ON DISABLED								
	1	READY TO SWITCH-ON								
1	0	READY TO SWITCH-ON								
	1	SWITCHED-ON								
2	0	SWITCHED-ON								
	1	OPERATION ENABLED								
3	0	No Error								
	1	FAULT REACTION ACTIVE								
4	0	Voltage Disabled								
	1	Voltage Enabled								
5	0	No Quick Stop								
	1	Performing Quick Stop								
6	0	QUICK STOP ACTIVE								
	1	SWITCH-ON DISABLED								
7	0	No Warning								
	1	Warning								
8	0	Local Control Active								
	1	Field Bus Control Activated (response to CW bit11 = 1)								
9	0	Local								
	1	Remote								
10	0			Target not Reached	Target not Reached		Target not Reached	Target not Reached		
	1			Target Reached	Target Reached		Target Reached	Target Reached		
11	0	No Limitation								
	1	Internal Limit Active								
12	0	Min Speed not reached	Min Speed not reached		Min Speed not reached	Min Speed not reached	Homing not completed		Synchronization not reached	Interpolation enabled
	1	Min Speed reached	Min Speed reached	Setpoint acknowledge 0 → 1	Min Speed reached	Min Speed reached	Homing completed		Synchronization reached	Interpolation disabled
13	0			No following error			No homing error		No following error	No following error
	1			Following error			Homing error		Following error	Following error
14	-									
15	-									

Object Dictionary

A listing of the Object Dictionary of DGV Converters is given below.

The *Communication Profile Area* (Object Index 1000h-1FFFh) contains the parameters for the communication profile on the CANOpen network. These entries are common to any device equipped with a CAN interface module.

The *Manufacturer-Specific Profile Area* (Object Index 2000h-5FFFh) contains all the parameters which are manufacturer-specific.

The *Standardised Device Profile Area* (Object Index 6000h-9FFFh) contains the parameters common to a class of devices, i.e. drives in this case.

Communication Profile Area: Object Index 1000h - 1FFFh

<table>
<tr><th>Index (Hex)</th><th>Sub-index</th><th>Name</th><th>Type</th><th>Access</th><th>Description</th></tr>
<tr><td>1000</td><td>00</td><td>Device Type</td><td>Unsigned32</td><td>RO</td><td>Describes the type of device. Composed of two 16-bit fields (one for device profile, the other for additional information). The object value of DGV is 0×02192, which corresponds to drive profile DSP-402 (0×192), and to additional information Servo Converter (0×02).</td></tr>
<tr><td>1001</td><td>00</td><td>Error Register</td><td>Unsigned8</td><td>RO</td><td>Bit-encoded Error Register according to DS-301. Structure of the register is:
<table>
<tr><th>Bit</th><th>Meaning</th></tr>
<tr><td>0</td><td>Generic error</td></tr>
<tr><td>1</td><td>Current</td></tr>
<tr><td>2</td><td>Voltage</td></tr>
<tr><td>3</td><td>Temperature</td></tr>
<tr><td>4</td><td>Communication error</td></tr>
<tr><td>5</td><td>Device profile specs.</td></tr>
<tr><td>6</td><td>Reserved</td></tr>
<tr><td>7</td><td>Manufacture specific</td></tr>
</table>
Bit value 1 = error occurred</td></tr>
<tr><td>1005</td><td>00</td><td>COB ID SYNC Message</td><td>Unsigned32</td><td>RW</td><td>Identifier of the SYNC message. The SYNC message controls the actions of PDOs that have the transmission type Synchronous.</td></tr>
</table>

1006	00	Communication Cycle Period	Unsigned32	RW	Time between SYNC messages.
1008	00	Manufacturer Device Name	Visible string	RO	Module name. The constant string is “ABB DGV300” or “ABB DGV700”.
1009	00	Manufacturer Hardware Version	Visible string	RO	Hardware version of the module.
100A	00	Manufacturer Software Version	Visible string	RO	Software version of the module.
100B	00	Node-ID	Unsigned32	RW	Generally this entry has read-write access. On the contrary, it cannot be changed through an SDO service if the node address is set through the DIP switches (see Chapter 3).
100C	00	Guard Time	Unsigned8	RW	Guard time (ms) × Life time factor = Life time for the Node Guarding Protocol.
100D	00	Life Time Factor	Unsigned32	RW	
1010	00	Store Parameters	Unsigned32	RW	Number of entries.
	01	Save all parameters	Unsigned32	RW	When reading, code 0x00000001 means storing is possible. Writing code 0x65766173 will save all parameters into the non-volatile memory.
1012	00	COB-ID Time Stamp Object	Unsigned32	RW	Defines the COB ID of the Time-Stamp Object (TIME).
1014	00	COB-ID Emergency Message	Unsigned32	RW	Defines the COB ID of the Emergency Object (EMCY). 80h + Node-ID.
1018	00	Identity Object	Unsigned8	RO	Number of entries.
	01	Vendor ID	Unsigned32	RW	The ABB Sace Vendor ID is 0x00011C.
1200	00	Server SDO Parameter	Unsigned8	RO	Number of entries.
	01	Server SDO Parameter COB-ID Rx	Unsigned32	RO	COB-ID Rx Client to Server. 600h + Node-ID.
	02	Server SDO Parameter COB-ID Tx	Unsigned32	RO	COB-ID Tx Server to Client. 580h + Node-ID.
1400	00	1st Receive PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	200h + Node-ID.
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).

1401	00	2nd Receive PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	300h + Node-ID.
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1402	00	3rd Receive PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	400h + Node-ID.
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1403	00	4th Receive PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	500h + Node-ID.
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1404	00	5th Receive PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	5th Received PDO COB-ID
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1405	00	6th Receive PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	6th Received PDO COB-ID
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1406	00	7th Receive PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	7th Received PDO COB-ID
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1407	00	8th Receive PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	8th Received PDO COB-ID
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1600	00	1st Receive PDO Mapping	Unsigned32	RO	Number of mapped objects
	01	Control Word	Unsigned32	RW	Mapping Object Index 6040h
	02	Control Word 2	Unsigned32	RW	Mapping Object Index 2020h
	03	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.

1601	00	2nd Receive PDO Mapping	Unsigned32	RO	Number of mapped objects
	01	Control Word	Unsigned32	RW	Mapping Object Index 6040h
	02	Control Word 2	Unsigned32	RW	Mapping Object Index 2020h
	03	Modes of Operation	Unsigned32	RW	Mapping Object Index 6060h
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1602	00	3rd Receive PDO Mapping	Unsigned32	RO	Number of mapped objects
	01	Control Word	Unsigned32	RW	Mapping Object Index 6040h
	02	Control Word 2	Unsigned32	RW	Mapping Object Index 2020h
	03	Direct Target Position	Unsigned32	RW	Mapping Object Index 2130h
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1603	00	4th Receive PDO Mapping	Unsigned32	RO	Number of mapped objects
	01	Control Word	Unsigned32	RW	Mapping Object Index 6040h
	02	Control Word 2	Unsigned32	RW	Mapping Object Index 2020h
	03	Direct Target Velocity	Unsigned32	RW	Mapping Object Index 2131h
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1604	00	5th Receive PDO Mapping	Unsigned32	RO	Number of mapped objects
	01	Control Word	Unsigned32	RW	Mapping Object Index 6040h
	02	Control Word 2	Unsigned32	RW	Mapping Object Index 2020h
	03	Direct Target Torque	Unsigned32	RW	Mapping Object Index 2132h
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1605	00	6th Receive PDO Mapping	Unsigned32	RO	Number of mapped objects
	01	Control Word	Unsigned32	RW	Mapping Object Index 6040h
	02	Control Word 2	Unsigned32	RW	Mapping Object Index 2020h
	03	Setpoint Position	Unsigned32	RW	Mapping Object Index 60C1h-1
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1606	00	7th Receive PDO Mapping	Unsigned32	RO	Number of mapped objects
	01	Control Word	Unsigned32	RW	Mapping Object Index 6040h
	02	Control Word 2	Unsigned32	RW	Mapping Object Index 2020h
	03	Digital Outputs	Unsigned32	RW	Mapping Object Index 60FEh
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.

1607	00	8th Receive PDO Mapping	Unsigned32	RO	Number of mapped objects
	01	Control Word	Unsigned32	RW	Mapping Object Index 6040h (Broadcast)
	02	Control Word 2	Unsigned32	RW	Mapping Object Index 2020h
	03	Modes of Operation	Unsigned32	RW	Mapping Object Index 6060h (Broadcast)
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1800	00	1st Transmit PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	180h + Node-ID.
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1801	00	2nd Transmit PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	280h + Node-ID.
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1802	00	3rd Transmit PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	380h + Node-ID.
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1803	00	4th Transmit PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	480h + Node-ID.
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1804	00	5th Transmit PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	5th Transmit PDO COB-ID
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1805	00	6th Transmit PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	6th Transmit PDO COB-ID
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).
1806	00	7th Transmit PDO Parameter	Unsigned8	RO	Number of entries.
	01	PDO COB-ID	Unsigned32	RW	7th Transmit PDO COB-ID
	02	Transmission Type	Unsigned8	RW	FF (asynchronous transmission).

1A00	00	1st Transmit PDO Mapping	Unsigned32	RO	Number of mapped application objects.
	01	Status Word	Unsigned32	RW	Mapping Object Index 6041h
	02	Status Word 2	Unsigned32	RW	Mapping Object Index 2021h
	03	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1A01	00	2nd Transmit PDO Mapping	Unsigned32	RO	Number of mapped application objects.
	01	Status Word	Unsigned32	RW	Mapping Object Index 6041h
	02	Status Word 2	Unsigned32	RW	Mapping Object Index 2021h
	03	Modes of Operation display	Unsigned32	RW	Mapping Object Index 6061h
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1A02	00	3rd Transmit PDO Mapping	Unsigned32	RO	Number of mapped application objects.
	01	Status Word	Unsigned32	RW	Mapping Object Index 6041h
	02	Status Word 2	Unsigned32	RW	Mapping Object Index 2021h
	03	Position actual value	Unsigned32	RW	Mapping Object Index 6064h
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1A03	00	4th Transmit PDO Mapping	Unsigned32	RO	Number of mapped application objects.
	01	Status Word	Unsigned32	RW	Mapping Object Index 6041h
	02	Status Word 2	Unsigned32	RW	Mapping Object Index 2021h
	03	Velocity actual value	Unsigned32	RW	Mapping Object Index 606Ch
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1A04	00	5th Transmit PDO Mapping	Unsigned32	RO	Number of mapped application objects.
	01	Status Word	Unsigned32	RW	Mapping Object Index 6041h
	02	Status Word 2	Unsigned32	RW	Mapping Object Index 2021h
	03	Torque actual value	Unsigned32	RW	Mapping Object Index 6077h
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.
1A05	00	6th Transmit PDO Mapping	Unsigned32	RO	Number of mapped application objects.
	01	Status Word	Unsigned32	RW	Mapping Object Index 6041h
	02	Status Word 2	Unsigned32	RW	Mapping Object Index 2021h
	03	Position actual value	Unsigned32	RW	Mapping Object Index 6064h
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.

1A06	00	7th Transmit PDO Mapping	Unsigned32	RO	Number of mapped application objects.
	01	Status Word	Unsigned32	RW	Mapping Object Index 6041h
	02	Status Word 2	Unsigned32	RW	Mapping Object Index 2021h
	03	Digital Inputs	Unsigned32	RW	Mapping Object Index 60FDh
	04	Dynamic mapping	Unsigned32	RW	Not used by default. See *PDO Mapping*.

Manufacturer-Specific Profile Area: Object Index 2000h - 5FFFh

Index (Hex)	Sub-index	Name	Units	Access	Range
2010	00	Device Communication Speed Rate	KBaud	RW	50..12000
	• Defines the communication speed rates on the CANOpen network. DGV performs automatic detection of the bus communication rate.				
2020	00	Control Word 2	-	RW	$-2^{31}..2^{31}-1$

- Bit 0 to Bit 4 select motion table 0 to 31.
- Bit 5 performs Absolute Position Modulo
- Bit 6 performs Absolute Position Modulo running shortest trip to target
- Bit 7 enables the function Freeze Position using digital input "Freeze Position" while operating.

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 of digital input “Freeze Position”. Position is frozen in Index 2120.
8 9 10 11 12 13 14 15	Not Used

<table>
<tr><td>2021</td><td>00</td><td>Status Word 2</td><td>-</td><td>RO</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="5">

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

<table>
<tr><th>Bit</th><th>Meaning</th></tr>
<tr><td>0
1
2
3
4</td><td>Display motion table currently operating</td></tr>
<tr><td>5</td><td>Actual Position frozen in Index 2120.</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>2040</td><td>00</td><td>Torque Average Value</td><td>%</td><td>RO</td><td>0.. 10000</td></tr>
<tr><td></td><td colspan="5">

Average value of the drive output current, which is expressed as a percentage of the Continuous Current (Index 2255). Range is:
0 … 1000,0 % Continous Current (Index 2255)

</td></tr>
<tr><td>2100</td><td>00</td><td>Position Conversion Numerator</td><td>-</td><td>RW</td><td>0.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="5">

Conversion of axis position into DGV internal units. See also Appendix C.

</td></tr>
<tr><td>2101</td><td>00</td><td>Position Conversion Denominator</td><td>-</td><td>RW</td><td>0.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="5">

Conversion of axis position into DGV internal units. See also Appendix C.

</td></tr>
<tr><td>2102</td><td>00</td><td>Axis Type</td><td>-</td><td>RW</td><td>1 / 2</td></tr>
<tr><td></td><td colspan="5">

Set axis type rotative or linear. This parameter will affect conversion of position actual value into DGV internal units. See also Appendix C.

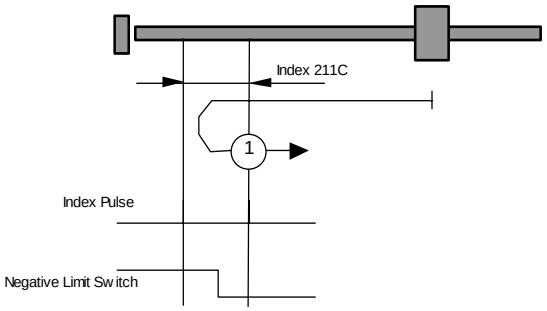
</td></tr>
<tr><td>2103</td><td>00</td><td>Encoder Pulses Input</td><td>-</td><td>RW</td><td>0.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="5">

When Object Index 2230 is equal to 2, i.e. Reference Input, this parameter together with Index 2103 has to be properly set using the following formula. Assuming that the transmission rate is
number of master’s revolutions : number of slave’s revolutions
Index 2103 = number of master’s rev. * number of input-pulses * 4
Index 2104 = number of slave’s revolutions * 2^{16}
For example, the master device provides 1024 encoder pulses per revolution and the transmission rate is 1 : 5, then
Index 2103 = 1* 1024 * 4 = 4096
Index 2104 = 5 * 2^{16}

</td></tr>
</table>

2104	00	Encoder Pulses Output	-	RW	0.. 2^{31}-1
	• When Object Index 2230 is equal to 2, i.e. Reference Input, this parameter together with Index 2103 has to be properly. See Index 2103 for the conversion formula.				
2105	00	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 Object Index 2230 and Chapter 6 for more details. 0 = Not Inverted 1 = Inverted				
2106	00	Synchronization Type	-	RW	1 / 2
	• Select synchronization mode for coupling master-slave axes. See Chapter 6, *Synchronization Mode*, for more details. Index 2106 = 1 sets Velocity Synchronization Index 2106 = 2 sets Position Synchronization				
2107	00	Synchronization Offset Position	deg	RW	- 2^{31}.. 2^{31}-1
	• Parameterization of synchronization mode. See Chapter 6, *Synchronization Mode*, for more details.				
2108	00	Synchronization Offset Velocity	deg/s	RW	- 2^{31}.. 2^{31}-1
	• Parameterization of synchronization mode. See Chapter 6, *Synchronization Mode*, for more details.				
210A	00	Limit Switch Enable	-	RW	0..255
	• 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				
210B	00	Synchronization Window	deg	RW	- 2^{31}.. 2^{31}-1
	• Monitoring of synchronization performance. See Chapter 6, *Synchronization Mode*, for more details.				
210C	00	Synchronization Monitoring Time	ms	RW	0..60000
	• Monitoring of synchronization performance. See Chapter 6, *Synchronization Mode*, for more details.				
2110	00	Jogging Speed 1	deg/s	RW	- 2^{31}.. 2^{31}-1
	• Jogging speed. See Chapter 6.				
2111	00	Jogging Speed 2	deg/s	RW	- 2^{31}.. 2^{31}-1
	• Jogging speed. See Chapter 6.				
2112	00	Jogging Acceleration	deg/s^2	RW	- 2^{31}.. 2^{31}-1
	• Set acceleration and deceleration ramp for jogging mode.				
2113	00	Position Modulo	deg	RW	- 2^{31}.. 2^{31}-1
	• Set position modulo range, or modulo range for endless positioning. See Chapter 6				
2115	00	Modulo Conversion Activation	-	RW	0 - Off / 1 - On
	• Parameter set to 1 activates Position Modulo. Parameter set to 0 turns to standard positioning mode.				

<table>
<tr><td>2116</td><td>00</td><td>Positioning Mode</td><td>-</td><td>RW</td><td>0..15</td></tr>
<tr><td></td><td colspan="5">• Configure different positioning functions
<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 new setpoint immediately
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 shortest trip 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>2117</td><td>00</td><td>Enable Table</td><td>-</td><td>RW</td><td>0 - Off / 1 - On</td></tr>
<tr><td></td><td colspan="5">• Enable/Disable current table.</td></tr>
<tr><td>2118</td><td>00</td><td>Active Tables</td><td>-</td><td>RO</td><td>- 2^{31}.. 2^{31}-1</td></tr>
<tr><td></td><td colspan="5">• Number of tables currently enabled.</td></tr>
</table>

2119	00	Motion Type Selection	-	RW	0 / 1
	• Select source for motion command and setpoint, that is Index 2119 set to “0 - Table" means setpoints from local or internal source, Index 2119 set to “1- Field bus" means setpoints from external control location.				
211A	00	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 acting. Large values of this filter will dampen the trapezoidal motion profile and lengthen positioning time. This function is available in: Profile Position Mode, Interpolated Position Mode, Synchronization, Jogging Mode, Homing Mode.				
211B	00	Max Travel for Switch	deg	RW	$-2^{31}..2^{31}-1$
	• Max traversing distance while limit switch searching (reserved).				
211C	00	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  				
211D	00	Next Running Table	-	RW	-1..31
	• Select next table to be executed.				
211E	00	Delay before running next table	ms	RW	-
	• Delay time before running next table.				
2120	00	Captured Position	deg	RO	$-2^{31}..2^{31}-1$
	• Contains the last actual position frozen through digital input “Freeze Position”.				
2122	00	Velocity Override	%	RW	$-2^{31}..2^{31}-1$
	• On-the-fly change of the axis velocity as a percentage of the Index 2133.				
2123	00	Torque Reduction	%	RW	0..100
	• Reduction of the peak current supplied by the drive.				
2125	00	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.				
2126	00	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.				

2127	00	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.				
2128	00	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.				
2129	00	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”				
2130	00	Direct Target Position	deg	RW	$-2^{31}..2^{31}-1$
	• Position setpoint from external control location (see *Chapter 6*).				
2131	00	Direct Target Velocity	Deg/s	RW	$-2^{31}..2^{31}-1$
	• Speed setpoint from external control location (see *Chapter 6*).				
2132	00	Direct Target Torque	Arms	RW	$-2^{31}..2^{31}-1$
	• Torque setpoint from external control location (see *Chapter 6*).				
2133	00	Direct Profile Velocity	deg/s	RW	$-2^{31}..2^{31}-1$
	• Profile speed setpoint from external control location (see *Chapter 6*).				
2134	00	Direct Acceleration Override	%	RW	$-2^{31}..2^{31}-1$
	• Profile acceleration setpoint from external control location (see *Chapter 6*), which is expressed as a percentage of Max Acceleration (Index 60C5h).				
2135	00	Direct Deceleration Override	%	RW	$-2^{31}..2^{31}-1$
	• Profile deceleration setpoint from external control location (see *Chapter 6*), which is expressed as a percentage of Max Deceleration (Index 60C6h).				
2140	00	Max Speed	deg/s	RW	$-2^{31}..2^{31}-1$
	• Limitation of drive speed command to saturation level Max Speed.				
2141	00	Acceleration Time	deg/s^2	RW	$-2^{31}..2^{31}-1$
	• Acceleration time (ramp) from 0 rpm up to Max Speed.				
2142	00	Deceleration Time	deg/s^2	RW	$-2^{31}..2^{31}-1$
	• Deceleration time (ramp) from Max Speed up to 0 rpm.				
2143	00	Quick Stop Time	deg/s^2	RW	$-2^{31}..2^{31}-1$
	• Emergency stop ramp.				
2144	00	Ramp Function Generator Enable	-	RW	0 - Off / 1 - On
	• Enable ramp function generator. When ramp function generator is set off, a step command is imposed to the motor.				
2200	00	Drive Capabilities	-	RO	-
2201	00	Actual Selected Table	-	RO	0..31

2202	00	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 (Torque target) 4 - Digital Speed (speed target) 5 - Digital Position (position target)				
2203	00	General Enable	-	RW	0 - Off / 1 - On
	• Drive software general enable. Set On/Off the Software Enable button located within the Browser interface toolbar .				
2204	00	Control Mode	-	RW	1 / 2
	• Select drive control interface, i.e. Set to “1 - Local" enables external control through RS232 serial interface and configuration of motion tables, analog and digital inputs located on the converter front panel. Set to “2 - Field Bus” enables external control through CANOpen field bus interface.				
2205	00	Number of Motor Poles	-	RW	2..24
	• Show the number of motor poles automatically detected during autophasing procedure.				
2206	00	Drive Size Code	-	RO	0..6
	• Shows the drive size using one of the following 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				
2207	00	External Reference Enable	-	RW	0 - Off / 1 - On
	• Enable of the external analog reference input +/- VREF located on the converter front panel				
2208	00	Sensor Type	-	RW	0..2
	• Type of the motor position transducer 1 - Resolver 2 - SinCos Encoder 3 - TTL Encoder (Reserved)				
220A	00	Encoder Pulses Number	-	RW	1..30000

220B	00	Motor Active Threshold Temperature	-	RO	1..1023
220C	00	Motor Disctiv. Threshold Temperature	-	RO	1..1023
220D	00	Drive Active Threshold Temperature	-	RO	1..1023
220E	00	Drive Disctiv. Threshold Temperature	-	RO	1..1023
220F	00	Thermal Sensor Type	-	RO	0..3
2210	00	Motor Continuous Current	Arms	RW	$0..2^{16}$
	• Index 2210 to Index 221F show the servomotors plate ratings as loaded from servomotor model or entered manually by the user.				
2211	00	Motor Maximum Current	Arms	RW	$0..2^{16}$
2212	00	Motor Rated Speed	rpm	RW	$0..2^{16}$
2213	00	Moment of Inertia	kgm²	RW	$0..2^{16}$
2214	00	Torque Constant	Nm/Arms	RW	$0..2^{16}$
2215	00	Back EMF Constant	Vrms/krpm	RW	$0..2^{16}$
2216	00	Max Motor Speed	rpm	RW	$0..2^{16}$
2217	00	Winding Resistance	ohm	RW	$0..2^{16}$
2218	00	Winding Inductance	mH	RW	$0..2^{16}$
2219	00	Pole Pair Width	mm	RW	$0..2^{16}$
221F	00	Motor Type	-	RW	1 / 2
	• Set the motor type: 1 - Rotative Motor 2 - Linear Motor				
2221	00	Bus Overvoltage Level	V	RW	0 … 1000
	 **WARNING! Reserved, for Service Support only. Altering this parameter can cause serious physical injury.**				
2222	00	Bus Undervoltage Level	V	RW	0 … 1000
2223	00	Clamp Voltage Threshold	V	RW	0 … 1000
	• Set voltage operating threshold for clamp braking resistor.				

2224	00	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.**			
2225	00	Drive Max Current	Arms	RO	0..300
2226	00	Drive Peak Current	Arms	RO	0..300
2227	00	Drive Continuous Current	Arms	RO	0..300
2228	00	Maximum Mains Voltage	V	RO	40..480
2229	00	Minimum Mains Voltage	V	RO	40..480
222C	00	Internal Clamp Resistor Value	ohm	RO	1..500
222D	00	Internal Clamp Power	W	RO	1..10000
222E	00	Internal Clamp Thermal Time	s	RO	1..600
2230	00	Encoder Interface Configuration	-	RW	1..3
	• Parameter for configuration of the servodrive's encoder interface: "1 - Emulation Output", DGV sends out its actual position through the encoder interface. "2 - Reference Input", DGV receives references through the encoder interface. "3 - Feedback Input", the input signal on the encoder interface becomes the position feedback of internal control loop; this signal may come for example from a DGV configured with "1 - Emulation Output", or from a second encoder mounted on the motor shaft. "4 - Reference Output", DGV sends out through the encoder interface the position reference signal applied to the position control loop.				

2231	00	Encoder Output Resolution	-	RW	1..4
	• Resolution of the encoder interface output. The axis position is converted into an emulated encoder output. Resolution of the output signal can be one of the following: Index 2231 = 1 , i.e. 128 pulses/turn Index 2231 = 2 , i.e. 256 pulses/turn Index 2231 = 3 , i.e. 512 pulses/turn Index 2231 = 4 , i.e. 1024 pulses/turn				
2237	00	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.				
2238	00	RPI	-	RW	0 - Off / 1 - On
2239	00	Encoder Type	-	RW	0..10
223A	00	Fine Synchronization to Index	-	RW	0 - Off / 1 - On
223B	00	Autophasing Time	s	RW	0,1..10
	• Maximum time allowed to complete autophasing procedure.				
223D	00	Linear Scale Resolution	µm	RW	0..600
2240	00	Waveform Generator Enable	-	RW	0 - Off / 1 - On
	• Index 2240 to Index 224A show settings of the waveform generator and the oscilloscope function.				
2241	00	Waveform Wave Type	-	RW	1..4
2242	00	Waveform Wave Frequency	Hz	RW	0,05..100
2243	00	Waveform Wave Amplitude	A - rpm	RW	-12000.. 12000
2244	00	Trigger Channel	-	RW	1..8
2245	00	Show Channel	-	RW	0..8
2246	00	Trigger Threshold Level	A - rpm	RW	-300..300
2247	00	Trigger Slope	-	RW	0 / 1
2248	00	Trigger Position	-	RW	0..2
2249	00	Time Window Sampling	-	RW	1..4
224A	00	Oscilloscope Command	-	RW	1..4
2250	00	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 and the *Analog IO* page of Browser.				
2251	00	Maximum Speed	rpm	RW	-12000.. 12000
	• Maximum axis speed allowed for your application.				
2252	00	Speed Denominator	V	RW	1..10
	• Scaling of the voltage/speed command entered through the analog reference input +/- VREF. See also parameter Speed Numerator and the *Analog IO* page of Browser.				

2253	00	Torque Numerator	Arms	RW	-300..300
	• Scaling of the voltage command entered through the analog reference input +/- VREF. See also parameter Torque Denominator and the *Analog IO* page of Browser.				
2254	00	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.				
2255	00	Continuous Current	Arms	RW	0..300
	• Continuous Current of the servodrive current control loop. See parameter Continuous Current within the Current page of Browser.				
2256	00	Peak Current	Arms	RW	0..300
	• Peak Current of the servodrive current control loop. See parameter Peak Current within the Current page of Browser.				
2257	00	Brake Current	Arms	RW	0..300
	• Set current for dynamic braking of the servodrive. See parameter Brake Current within the Current page of Browser.				
2258	00	Ixt Threshold Level	Arms	RO	0..300
	• Internal protection of the converter against power dissipation.				
2259	00	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.				
225A	00	I^2xt Threshold Level	Arms	RW	0..300
	• Protection algorithm of the motor against power dissipation on the motor windings.				
225B	00	Clamp Delta	V	RO	0..10
	• Threshold level for deactivation of the clamp braking operation.				
225C	00	External Clamp Resistor Value	ohm	RW	1..500
	• Set resistance of external clamp resistor. This parameter is effective when Index 2259 is set to 1 - External or 2 - External only.				
225D	00	External Clamp Power Threshold	W	RW	1..10000
	• Set maximum average power allowed for dissipation on external clamp resistor. This parameter is effective when Index 2259 is set to “1 – External” or “2 - External only”.				

225E	00	External Clamp Thermal Time Constant	s	RW	1..600
	• Set thermal time constant of external clamp resistor. This parameter is effective when Index 2259 is set to 1 - External or 2 - External only.				
225F	00	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.				
2260	00	Position Proportional Gain	1/s	RW	0..1000
	• Proportional Gain of the servodrive position control loop. See also Position Proportional Gain within Position page of the browser.				
2261	00	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.				
2264	00	Resolver Phase Offset	deg	RW	0..359,99
	• Show the phase offset stored after the autophasing procedure.				
2265	00	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.				
2266	00	Holding Brakes Delay	ms	RW	0 ... 10000
2268	00	Resolver Sine Gain	-	RW	$0..2^{16}$
	• Gain for resizing amplitude of the resolver sine signal. For Service Support only.				
2269	00	Resolver Cosine Gain	-	RW	$0..2^{16}$
	• Gain for resizing amplitude of the resolver cosine signal. For Service Support only.				
226A	00	Fault Resolver	-	RO	$0..2^{16}$
226B	00	Torque Denominator	V	RW	1..10
	• Scaling of the voltage signal applied to the analogue input +/- VREF. See also parameter Torque Numerator available in the *Analog IO* page of the Browser.				
2270	00	Motor Thermal Time Constant	s	RW	$0..2^{16}$
	• Thermal time constant of the servomotor. This is a manufacturing characteristic parameter of the servomotors.				
2275	00	Kp Speed Gain Level	As/rad	RW	0..32,767
	• Proportional gain of the speed control loop of DGV.				
2276	00	Tn Speed Integrative Time Constant	ms	RW	0..327,67
	• Integrative time constant gain of the speed control loop of DGV.				
227B	00	Kp Current Gain Level	V/A	RW	0..3276,7
	• Proportional gain of the current control loop of DGV.				

227C	00	Tn Current Integrative Time Constant	ms	RW	0..32,767
	• Integrative time constant gain of the current control loop of DGV.				
2281	00	Speed Command Filter	Hz	RW	5..4000
	• Frequency filter on the speed command of DGV.				
2285	00	Speed Command Filter Enable	-	RW	0 - Off / 1 - On
	• Enable filtering of DGV speed command.				
2286	00	Feedforward Speed Filter Enable	-	RW	0 - Off / 1 - On
2287	00	Feedforward Speed Filter	Hz	RW	5..4000
2288	00	Resolver Speed Filter	Hz	RW	100..1000
	• Frequency filter on the revolver speed feedback signal.				
2289	00	Encoder Speed Filter	Hz	RW	100..1000
	• Frequency filter on the encoder speed feedback signal.				
22AB	00	Current Filter 1 Frequency	Hz	RW	0..8000
22AC	00	Current Filter 1 Damping	0.0001	RW	1..10000
22AD	00	Current Filter 1 Depth	dB	RW	-100..100
22AE	00	Current Filter 1 Width	dec	RW	0,0001..3
22AF	00	Current Filter 1 Type	-	RW	0..2
	• Enabling Filter 1 on the current command of DGV. "0 - Off" disabled "1 - Low Pass" low pass filter enabled "2 - Band Reject" band reject filter enabled				
22BB	00	Current Filter 2 Frequency	Hz	RW	0..8000
22BC	00	Current Filter 2 Damping	0.0001	RW	1..10000
22BD	00	Current Filter 2 Depth	dB	RW	-100..100
22BE	00	Current Filter 2 Width	dec	RW	0,0001..3
22BF	00	Current Filter 2 Type	-	RW	0..2
	• Enabling Filter 2 on the current command of DGV. "0 - Off" disabled "1 - Low Pass" low pass filter enabled "2 - Band Reject" band reject filter enabled				
22CB	00	Current Filter 3 Frequency	Hz	RW	0..8000
22CC	00	Current Filter 3 Damping	0.0001	RW	1..10000
22CD	00	Current Filter 3 Depth	dB	RW	-100..100
22CE	00	Current Filter 3 Width	dec	RW	0,0001..3
22CF	00	Current Filter 3 Type	-	RW	0..2
	• Enabling Filter 2 on the current command of DGV. "0 - Off" disabled "1 - Low Pass" low pass filter enabled "2 - Band Reject" band reject filter enabled				

22E0	00	Input 1 Configuration	-	RW	0..17
	• Sub-index 0 of Index 22E0 is dedicated to configuration of digital inputs 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]			
22E0	01	Input 2 Configuration	-	RW	0..17
	• Sub-index 1 of Index 22E0 is dedicated to configuration of digital inputs D-IN 2 located on DGV front panel: same as Input 1 Configuration.				
22E0	02	Input 3 Configuration	-	RW	0..17
	• Sub-index 2 of Index 22E0 is dedicated to configuration of digital inputs D-IN 3 located on DGV front panel: same as Input 1 Configuration.				
22E0	03	Input 4 Configuration	-	RW	0..17
	• Sub-index 3 of Index 22E0 is dedicated to configuration of digital inputs D-IN 4 located on DGV front panel: same as Input 1 Configuration.				
22E0	04	Input 5 Configuration	-	RW	0..17
	• Sub-index 1 of Index 22E0 is dedicated to configuration of digital inputs D-IN 5 located on DGV front panel: same as Input 1 Configuration.				
22E0	05	Input 6 Configuration	-	RW	0..17
	• Sub-index 1 of Index 22E0 is dedicated to configuration of digital inputs D-IN 6 located on DGV front panel: same as Input 1 Configuration.				
22E0	06	Input 7 Configuration	-	RW	0..17
	• Sub-index 1 of Index 22E0 is dedicated to configuration of digital inputs D-IN 7 located on DGV front panel: same as Input 1 Configuration.				
22E0	07	Input 8 Configuration	-	RW	0..17
	• Sub-index 1 of Index 22E0 is dedicated to configuration of digital inputs D-IN 8 located on DGV front panel: same as Input 1 Configuration.				

22E1	00	Output 1 Configuration	-	RW	0..9
	• Sub-index 0 of Index 22E1 is dedicated to configuration of digital inputs D-OUT1 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				
22E1	01	Output 2 Configuration	-	RW	0..9
	• Sub-index 1 of Index 22E1 is dedicated to configuration of digital inputs D-OUT2 located on DGV front panel: same as Output 1 Configuration.				
22E1	02	Output 3 Configuration	-	RW	0..9
	• Sub-index 2 of Index 22E1 is dedicated to configuration of digital inputs D-OUT3 located on DGV front panel: same as Output 1 Configuration.				
22E4	00	Analog Output Configuration	-	RW	0..22
	• Shows the 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				

22E5	00	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				
22E6	00	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				
22E7	00	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				

Standardised Device Profile Area: Object Index 6000h - 9FFFh

Index (Hex)	Sub-index	Name	Units	Access	Range
603F	00	Error Code	-	RO	$0..2^{16}$
	•	Captures the code of the last error that occurred in the drive.			
6040	00	Control Word	-	RW	$0..2^{16}$
	•	Controls the state machine.			
6041	00	Status Word	-	RO	$0..2^{16}$
	•	Show the device status.			
6060	00	Modes Of Operation	-	RW	-4..7
	•	Switches the operating mode of the drive: - 4 Synchronization Mode - 3 Jogging Mode - 2 Analogue Torque Mode - 1 Analogue Velocity Mode 0 Reserved 1 Profile Position Mode 2 Reserved 3 Profile Velocity Mode 4 Profile Torque Mode 5 Reserved 6 Homing Mode 7 Interpolated Position Mode			
6061	00	Modes Of Operation Display	-	RO	$0..2^{16}$
	•	Shows the current mode of operation of the drive. Values allowed for this parameter are the same of Object Index 6060.			
6064	00	Position Actual Value	deg	RO	$-2^{31}..2^{31}-1$
	•	Actual position of the drive.			
6065	00	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 (Index 6064), measured by motor position transducer.			
6067	00	Position Window	Deg	RW	$-2^{31}..2^{31}-1$
	•	Bit 10 of Status Word set to 1 states that the target position was reached if the position actual value lies within “Position Window” before the “Position Monitoring Time” expires.			
6068	00	Position Monitoring Time	ms	RW	$-2^{31}..2^{31}-1$
	•	Bit 10 of Status Word set to 1 states that the target position was reached if the position actual value lies within “Position Window” before the “Position Monitoring Time” expires.			

606C	00	Velocity Actual Value	rpm	RO	$-2^{31}..2^{31}-1$
	• Velocity Actual Value (rpm)				
606D	00	Speed Window	deg	RW	$-2^{31}..2^{31}-1$
	• Bit 10 of Status Word set to 1 states that the target was reached if the speed actual value lies within the “Speed Window” before the “Speed Monitoring Time” expires.				
606E	00	Speed Monitoring Time	ms	RW	$-2^{31}..2^{31}-1$
	• Bit 10 of Status Word set to 1 states that the target was reached if the speed actual value lies within the “Speed Window” before the “Speed Monitoring Time” expires.				
606F	00	Min Speed	rpm	RW	$-2^{31}..2^{31}-1$
	• Minimum speed supervision limit. Bit 12 of Status Word set to 1 states when the axis exceeded the speed limit set with “Min Speed”.				
6071	00	Target Torque	%	RW	$-10^3...10^3$
	• Set torque (current) setpoint to be executed using motion tables. Note that the parameter unit is a percentage of the motor rated current. Range of parameter is: -1000,0 … 1000,0 % of the motor rated current (Object Index 2255)				
6077	00	Torque Actual Value	%	RO	$-10^3...10^3$
	• Current actual value when drive is torque-controlled. Note that the parameter unit is a percentage of the motor rated current. Range of parameter is: -1000,0 … 1000,0 % of the motor rated current (Object Index 2255)				
607A	00	Target Position	deg	RW	$-2^{31}..2^{31}-1$
	• Set position setpoint to be executed using motion tables.				
607C	00	Home Offset	deg	RW	$-2^{31}..2^{31}-1$
	• Programmable offset for axis referencing.				
607D	00	Software Position Limit	deg	RO	$0..2^{16}-1$
		• Number of entries = 2.			
	01	Min Software Position Limit	deg	RW	$-2^{31}..2^{31}-1$
		• Minimum absolute position for both Position Target and position actual value. This parameter defines position for operation of the software negative limit switch.			
	02	Max Software Position Limit	deg	RW	$-2^{31}..2^{31}-1$
		• Maximum absolute position for both Position Target and position actual value. This parameter defines position for operation of the software positive limit switch.			
607E	00	Polarity	-	RW	0..255
	• Invert sign of process variables. 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.				

607F	00	Max Profile Velocity	deg/s	RW	$-2^{31}..2^{31}-1$
	• Limitation of axis velocity. This parameter will saturate the velocity of the trapezoidal profile.				
6081	00	Profile Velocity	deg/s	RW	$-2^{31}..2^{31}-1$
	• Select velocity of trapezoidal motion profile. Parameterizing this value will affect the ramp function generator as well.				
6083	00	Profile Acceleration	deg/s^2	RW	$-2^{31}..2^{31}-1$
	• Acceleration of trapezoidal motion profile.				
6084	00	Profile Deceleration	deg/s^2	RW	$-2^{31}..2^{31}-1$
	• Deceleration of trapezoidal motion profile.				
6085	00	Quick Stop Deceleration	deg/s^2	RW	$-2^{31}..2^{31}-1$
	• Emergency stop ramp.				
6086	00	Motion Profile Type	-	RO	0
	• Selects the type of motion profile used to perform a profiled motion.				
6098	00	Homing Method	-	RW	0..255
	• Determines the method that will be used during homing (see also *Chapter 6*, *Homing Methods*) : 1 Homing on the negative HW limit switch and index pulse 2 Homing on the positive HW limit switch and index pulse 2 Homing on the falling edge of the positive home switch and index pulse 3 Homing on the rising edge of the positive home switch and index pulse 4 Homing on the falling edge of the negative home switch and index pulse 5 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				
6099	01	Homing Speed For Switch	deg/s	RW	$-2^{31}..2^{31}-1$
		• Homing speed during search for switch.			
	02	Homing Speed For Zero	deg/s	RW	$-2^{31}..2^{31}-1$
		• Homing speed during search for zero.			
609A	00	Homing Acceleration	deg/s^2	RW	$-2^{31}..2^{31}-1$
	• Parameterize acceleration and deceleration ramp for referencing procedure.				
60C0	00	Interpolation Mode	-	RO	0
	• Value 0 means linear interpolation.				

60C1	00	Number of Entries	-	RO	$-2^{31}..2^{31}-1$
		• Object name “Interpolation Data Record”. Number of Entries fixed to 2.			
	01	Position Setpoint	deg/s	RW	$-2^{31}..2^{31}-1$
		• Position targets for the linear interpolation mode (see *Interpolated Position Mode*).			
60C2	00	Number of Entries	-	RO	$-2^{31}..2^{31}-1$
		• Object name “Intepolation Time Period”. Number of Entries fixed to 3.			
	01	Intepolation Time Units	-	RW	$-2^{31}..2^{31}-1$
	02	Intepolation Time Index	-	RO	$-2^{31}..2^{31}-1$
		• Subindexes 60C2h-01 and 60C2h-02 define the interpolation time-cycle accordino to the formula: Tcycle = 60C2h-01 * 10^60C2h-02 • Sub-index 02 is fixed to -3, which means that the interpolation time-cycle is expressed in milliseconds and is set by Sub-index 01.			
60C5	00	Max Acceleration	deg/s^2	RW	$-2^{31}..2^{31}-1$
		• Limitation of axis acceleration.			
60C6	00	Max Deceleration	deg/s^2	RW	$-2^{31}..2^{31}-1$
		• Limitation of axis deceleration.			
60FF	00	Target Velocity	deg/s	RW	$-2^{31}..2^{31}-1$
		• Set speed setpoint to be executed using motion tables.			

Emergency Object (EMCY)

Emergency objects are triggered by the occurrence of a device internal error situation. An emergency object is transmitted only once per 'error event'. DGV Converters can provide the following emergency error codes.

Emergency Error Code	Error Type	Error Register	Error Register Bit
0x2300	Overcurrent of the IGBT module	0x03	Bit1
0x2310	Overvoltage	0x05	Bit2
0x3130	Mains	0x05	Bit2
0x3220	Undervoltage	0x05	Bit2
0x4210	Converter Thermal Protection	0x09	Bit3
0x4310	Motor Thermal Protection	0x09	Bit3
0x6110	Internal Error	0x21	Bit5
0x6111	Computation Overflow	0x21	Bit5
0x7114	Clamp Overload	0x21	Bit5
0x7115	Clamp Overtime	0x21	Bit5
0x7303	Resolver Fault	0x21	Bit5
0x7305	Sincos Encoder Fault	0x21	Bit5
0x7306	Sincos Encoder Interpolation Fault	0x21	Bit5
0x8410	Overspeed	0x21	Bit5
0x8611	Following Error	0x21	Bit5
0x8620	Hardware Negative Limit Switch	0x21	Bit5
0x8621	Hardware Positive Limit Switch	0x21	Bit5
0x8630	Max Travel for Switch	0x21	Bit5
0x8631	Max Travel for Zero	0x21	Bit5
0x8632	Invalid Table	0x21	Bit5
0xFF00	24V Brake Supply Fault (DGV300 only)	0x21	Bit5

The Emergency Telegram consists of 8 data bytes as shown below:

Header	Byte 0	Byte 1	Byte 2	Byte 3 … 7
0001xxxxxx01000	Emergency Error Code		Error Register (1001h)	Manufacturer Specific Error Field (Reserved)

Synchronisation Object (SYNC)

The SYNC producer broadcasts the Synchronisation Object periodically. This SYNC provides the basic network clock. The time period between the SYNCs is specified by the standard parameter Communication Cycle Period (Object Index 1006h), which may be configured.

The SYNC does not carry any data (L=0). The Identifier of the SYNC object is located at Object Index 1005h. The service is unconfirmed.

Chapter 6 - Description of Functions

Overview

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

Operating Modes

DGV Converters with CANOpen interface can operate different modes (Object Index 6060), 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.
- *Profile Position 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.
- *Profile Velocity Mode* performs speed control using digital speed targets.
- *Profile Torque Mode* performs torque control using digital torque targets.
- *Homing Mode* performs axis referencing using the several *Homing Methods* provided for this purpose
- *Jogging Mode* performs short steps when fine adjustment of axis position is necessary.
- *Synchronization Mode* can be used to perform speed or position synchronization of two mechanical systems (axes), the digital speed or position setpoints coming from a moving target. This mode generally requires two DGV drives, one acting as master device and one as slave device, or else an encoder providing the feedback of the moving target.
- *Interpolated Position Mode* performs time microinterpolation of position targets using the position and speed profiles generated by the drive itself.

Note. Control Mode (Object Index 2204) must be set to "2 - Field Bus" for activating field bus external control and afterwards selecting the operating mode (Object Index 6060).

Each mode, however, can be operated locally as well by setting Control Mode to "1 - Local", selecting the operating mode through parameter Local Operating Mode (Object Index 2202) and in case configuring the motion tables. In details,

- *Analogue Torque Mode* can be operated locally setting Index 2202 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 Index 2202 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*);
- *Profile Torque Mode* can be operated locally setting Index 2202 to "3 - Digital Torque" and setting the torque setpoint in a motion table (Object Index 6071);
- *Profile Velocity Mode* can be operated locally setting Index 2202 to "4 - Digital Speed" and setting the speed setpoint in a motion table (Object Index 6081);
- *Profile Position Mode* can be operated setting Index 2202 to "5 - Digital Position" and setting the position setpoint in a motion table (Object Index 607A). This mode includes the Homing, Jogging and Synchronization Modes. Interpolated Position Mode cannot be operated locally.

"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 *Profile Position*, *Profile Speed* and *Profile Torque*.

In order to switch between "direct" and "internal" commands, Bit 12 of the Control Word must be used:

- Bit 12 set to 1, the drive applies "direct" references from fieldbus;
- Bit 12 set to 0, the drive applies "internal" references taken from the motion tables.

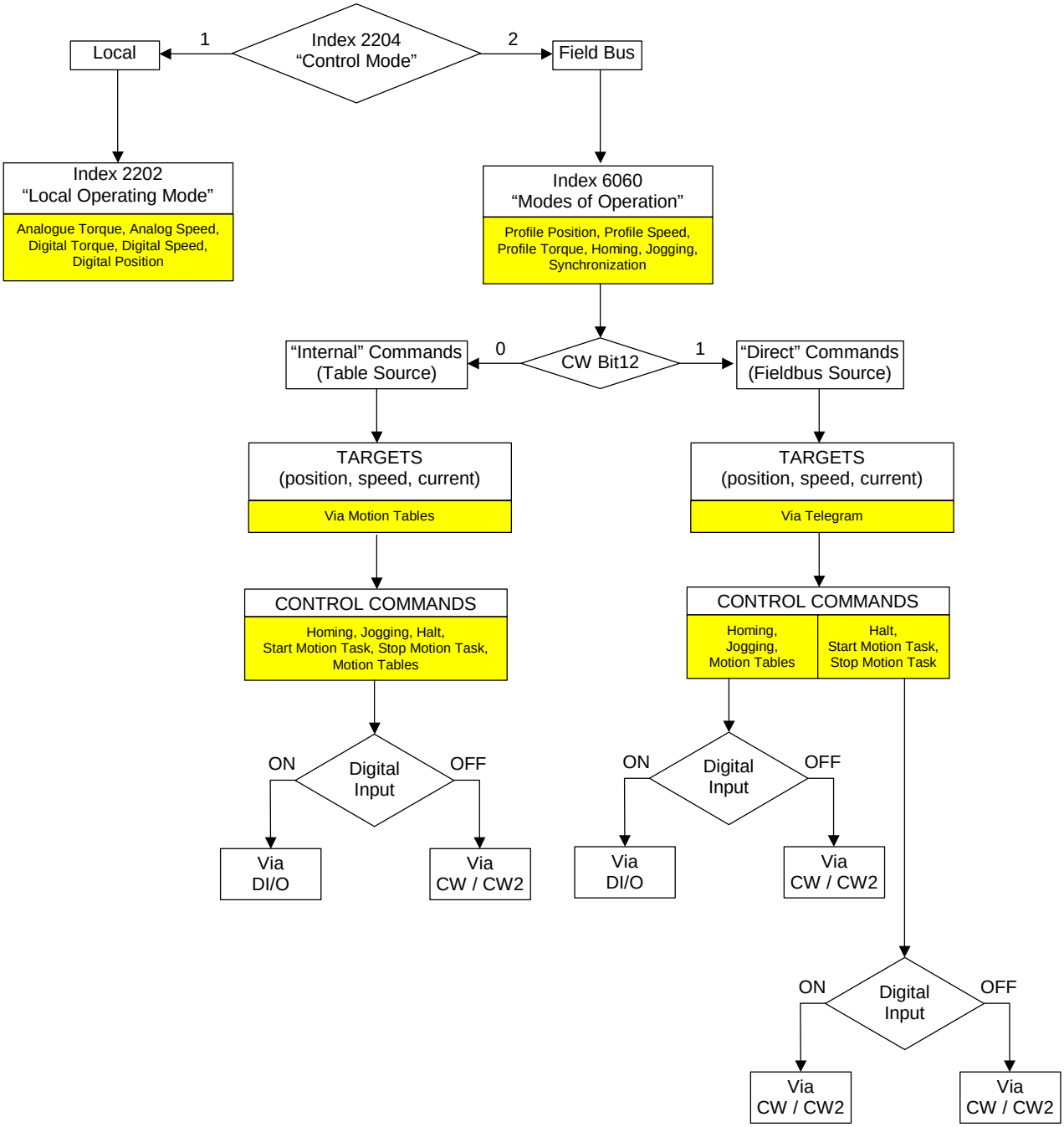
Different Objects are employed for "direct" and "internal" control.

Data	**Direct Commands** Bit 12 = 1	**Internal Commands (32 Tables)** Bit 12 = 0
Velocity Target (Profile Velocity Mode)	Index 2131h	Index 60FFh
Position Target (Profile Position Mode)	Index 2130h	Index 607Ah
Profile Velocity (Profile Position Mode)	Index 2133h	Index 6081h
Profile Acceleration (Profile Position & Velocity M.)	Index 2134h (% Index 60C5h)	Index 6083h
Profile Deceleration (Profile Position & Velocity M.)	Index 2135h (% Index 60C6h)	Index 6084h
Torque Target (Profile Torque Mode)	Index 2132h	Index 6071h

These operating modes can be operated:

- transmitting at least one PDO, which contains the Control Word and the Control Word 2 for switching the motion tables, when using "internal" control (Bit 12 = 0);
- transmitting at least one PDO, which contains the Control Word and one digital reference, relevant for the operating mode to be used (Bit 12 = 1).

Commands Flowchart



Example: Profile Position Mode

It is possible to carry out a positioning task using “direct” (Bit 12 = 1) or “internal” references (Bit 12 = 0).

Direct commands

In order to carry out a positioning task using direct commands, you can:

- Transmit a single PDO (minimal command)

	Byte							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Header	Control Word (6040h)		Direct Target Position (2130h)				Not used	

- Transmit two PDOs (full command)

	Byte							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Header	Control Word (6040h)		Control Word 2 (2020h)		Direct Target Position (2130h)			

	Byte							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Header	Direct Profile Velocity (2133h)				Direct Acceleration Override (2134h)		Direct Deceleration Override (2135h)	

Internal commands

In order to carry out a positioning task using internal commands, it is sufficient to send one PDO. It is possible to change axis speed on-the-fly (Velocity Override).

	Byte							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Header	Control Word (6040h)		Control Word 2 (2020h)		Velocity Override (2134h)		Not used	

Example: Profile Velocity Mode

It is possible to apply a speed command using “direct” or “internal” references.

Direct commands

In order to apply a speed command using direct commands, you can:

- Transmit a single PDO (minimal command)

	Byte							
	0	1	2	3	4	5	6	7
Header	Control Word (6040h)		Direct Target Velocity (2131h)				Not used	

- Transmit two PDOs (full command)

	Byte							
	0	1	2	3	4	5	6	7
Header	Control Word (6040h)		Control Word 2 (2020h)		Direct Target Velocity (2131h)			

	Byte							
	0	1	2	3	4	5	6	7
Header	Direct Acceleration Override (2134h)		Direct Deceleration Override (2135h)		Torque Reduction (2123h)		Not used	

Internal commands

In order to apply a speed command using internal commands, it is sufficient to send one PDO. It is possible to change the converter output current on-the-fly (Torque Reduction).

	Byte							
	0	1	2	3	4	5	6	7
Header	Control Word (6040h)		Control Word 2 (2020h)		Torque Reduction (2123h)		Not used	

Example: Profile Torque Mode

It is possible to apply a torque command using “direct” or “internal” references.

Direct commands

In order to apply a torque command using direct commands, it is sufficient to send one PDO.

	Byte							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Header	Control Word (6040h)		Control Word 2 (2020h)		Direct Target Torque (2132h)			

Internal commands

In order to apply a torque command using internal commands, it is sufficient to send one PDO.

	Byte							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Header	Control Word (6040h)		Control Word 2 (2020h)		Not used		Not used	

Analog Torque Mode

Selecting Analog Torque Mode (Index 6060 set to -2) activates torque control at the motor shaft.

The reference signal at Analog Input (+VREF, -VREF) is a current command, which produces torque. The Analog Input signal can be scaled adjusting the scaling factors Torque Numerator (Index 2253) and Torque Denominator (Index 226B). See also paragraph *Analog I/O* in *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**.

Note that in this operating mode bit 12 of the Status Word states whether drive is moving or stationary, based on the supervision limit of the minimum speed, set by Object “Min Speed”.

Basic Settings for Analog Torque Mode

After first configuration of the servodrives as illustrated in Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted for quick start-up.

Basic Settings for Analog Torque Mode

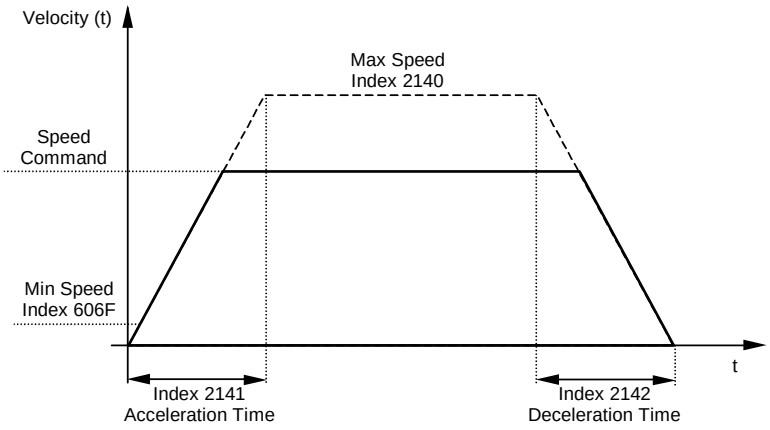
Object	Name	Value	Remarks
6060	Modes of Operation	-2	Analog Torque Mode
606F	Min Speed	Custom	Threshold for bit 12 of SW
2253	Torque Numerator	Custom	Scaling of Analog Input +VREF
226B	Torque Denominator	Custom	-VREF
2257	Brake Current	Custom	Current for dynamic braking
227B	Kp Current Gain Level	Default	Parameters of the current
227C	Tn Current	Default	internal control loop

Analog Speed Mode

Selecting Analog Speed Mode (Index 6060 set to -1) activates control of the motor speed.

The reference signal at Analog Input (+VREF, -VREF) is a speed command. The Analog Input signal can be scaled adjusting the scaling factors Speed Numerator (Index 2250) and Speed Denominator (Index 2252). See also paragraph *Analog I/O* in *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 (Index 2140).
- Acceleration Time (Index 2141) and Deceleration Time (Index 2142) fix ramps for accelerating and decelerating regardless amplitude of the speed command.
- Min Speed (Index 606F) fixes the minimum speed for bit 12 of the Status Word.

In this operating mode bit 12 of the Status Word states whether drive is moving or stationary, based on the supervision limit of the minimum speed, set by Object “Min Speed”.

Basic Settings for Analog Speed Mode

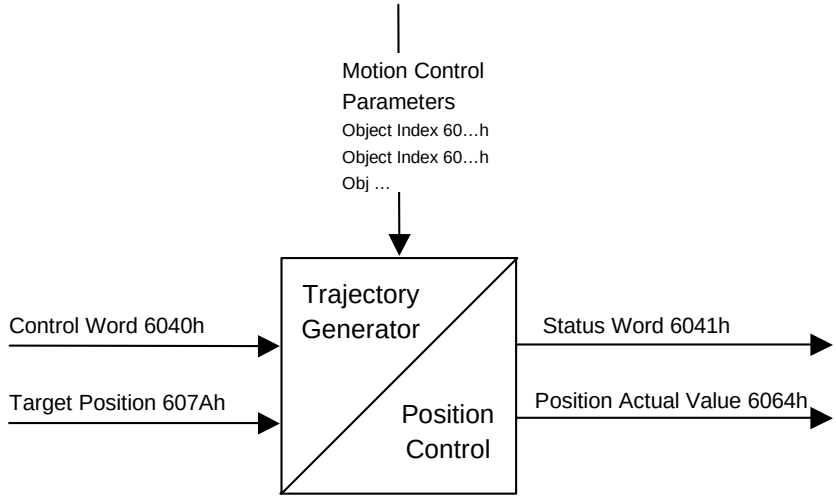
After first configuration of the servodrives as illustrated in Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted for quick start-up of this mode.

Basic Settings for Analog Speed Mode			
Object	**Name**	**Value**	**Remarks**
6060	Modes of Operation	-1	Analog Speed Mode
607F	Min Speed	Custom	Threshold for bit 12 of SW
2140	Max Speed	Custom	Limitation of speed command
2141	Acceleration Time	Custom	Ramp for accelerating
2142	Deceleration Time	Custom	Ramp for decelerating
2143	Quick Stop Time	Custom	Emergency stop ramp
2144	Ramp Function Generator Enable	1 - On	Enable internal ramp generator
2251	Maximum Speed	Custom	Motor maximum speed
2250	Speed Numerator	Custom	Scaling of Analog Input +VREF
2252	Speed Denominator	Custom	-VREF
2257	Brake Current	Custom	Current for dynamic braking
2265	Overspeed Threshold Level	Custom	Overspeed Threshold
2275	Kp Speed Gain Level	Custom	Parameters of the PI internal
2276	Tn Speed	Custom	speed control loop

Profile Position Mode

Profile Position Mode (Index 6060 set to 1) performs single-axis position control.

The target position is generally a field bus reference. When a target position 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. However, motion tables previously configured with fixed targets (Index 607Ah “Target Position”) can be operated. For this purpose either Control Word 2 (Object Index 2020) or Digital Inputs should be used.



This operating mode of DGV supports various positioning functions for different purposes and applications. A detailed description of these functions is given in the following paragraphs.

Note that a number of bits of the Control Word and Status Word are mode specific here. For the Control Word:

- on the positive edge of the **Bit 4** (0 → 1), the drive starts moving to the new setpoint;
- **Bit 5:** set to 0 select the *Single Setpoint* function, set to 1 select the *Change Set Immediately* function;
- **Bit 6:** set to 0 select *Absolute Positioning*, set to 1 select *Relative Positioning*;
- **Bit 8** set to 1 halts the motion;
- **Bit 12** set to 0 activates “internal” control, set to 1 activates “direct” control.

In the Status Word:

- **Bit 10** is set when the drive has reached the position target;
- **Bit 12** shows that setpoint was acknowledged on the positive edge of the signal (0 → 1);
- **Bit 13** is set when a following error has occurred.

Basic Settings for Profile Position Mode

After first configuration of the servodrives as illustrated in Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted for quick start-up.

Note that axis referencing is necessary before executing any positioning task (see *Homing Mode*).

Basic Settings for Profile Position Mode

Object	Name	Value	Remarks
6060	Modes of Operation	1	Profile Position Mode
607A	Target Position	Custom	-
2020	Control Word 2	Custom	Selection of motion tables
2100	Position Conversion Numerator	65536	Conversion of axis position
2101	Position Conversion Denominator	Custom	into internal units
2102	Axis Type	1 / 2	“1” Rotary, “2” Linear Axis
210A	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
2113	Position Modulo	Custom	For ex. 1000.000 [deg]
2115	Modulo Conversion Activation	0 / 1	“1” Activate Position Modulo
2116	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
2117	Enable Table	On / Off	For “internal” Control
211A	Jerk-limiting Time Constant	Custom	Smooth profile generator
211D	Next Running Table	Custom	For “internal” Control
211E	Delay before Running Next Table	Custom	Delay time
6065	Following error window	Custom	See *Monitoring Functions*
6067	Position Window	Custom	See *Monitoring Functions*
6068	Position Monitoring Time	Custom	See *Monitoring Functions*
606F	Min Speed	Custom	Threshold for bit 12 of SW
607D	Min-Max Software Position Limit	Custom	Set the positive and negative software limit switch
607E	Polarity	Custom	Sign of the position target
607F	Max Profile Velocity	Custom	Profile parameter
6081	Profile Velocity	Custom	Profile parameter
6083	Profile Acceleration	Custom	Profile parameter
6084	Profile Deceleration	Custom	Profile parameter
6085	Quick Stop Deceleration	Custom	Emergency stop deceleration
6086	Motion Profile Type	0	Trapezoidal Profile
60C5	Max Acceleration	Custom	Axis max acceleration
60C6	Max Deceleration	Custom	Axis max deceleration

Positioning Functions

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

- Absolute positioning
- Relative positioning
- Position Modulo
- Single Setpoint, Change Set Immediately.

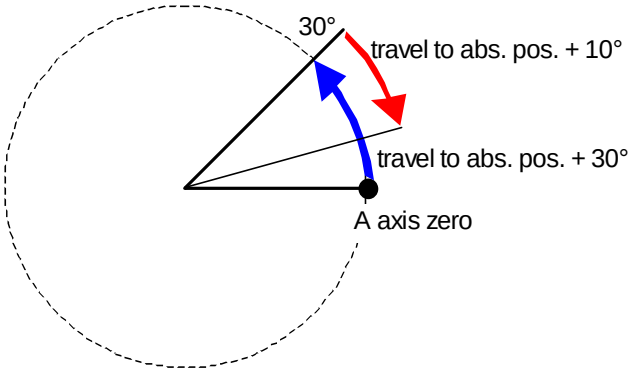
In addition, monitoring functions can be programmed, such as hardware and software limit switches, following error monitoring, positioning and speed monitoring, standstill monitoring.

Absolute Positioning

When Profile Position Mode is selected, Bit 6 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).

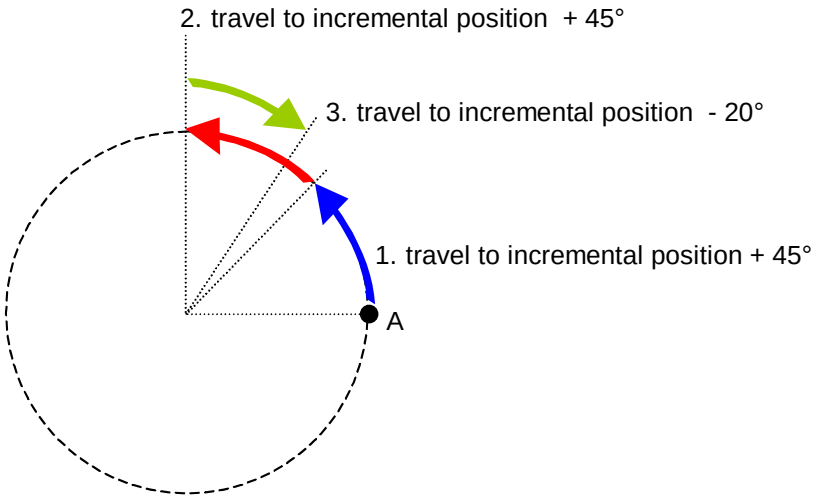


Relative Positioning

When Profile Position 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.



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.

Position Modulo

The Profile Position Mode provides also the Position Modulo function for rotary axis. The drive approaches the new position target moving within the position modulo range. The direction of approach to target depends on the sign of position setpoint.

For positioning with Position Modulo set the following parameters:

- Object Index 2115, Modulo Conversion Activation, set to 1 activates the Position Modulo function. Setting to 0, instead, restores standard positioning.
- Object Index 2113, Position Modulo, parameterize the position modulo range.
- Object Index 2116, Positioning Mode, sets positioning functions.

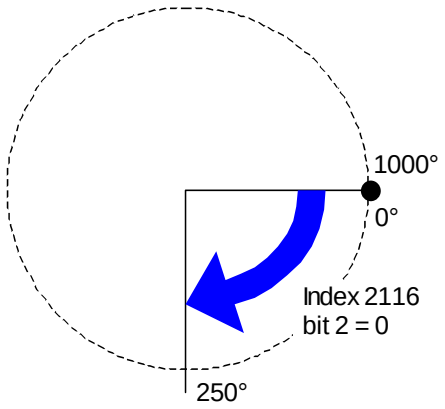
Note that when Position Modulo is activated both absolute and relative positioning functions can be operated. Moreover, the drive can be programmed to select the shortest trip to target.

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

...when positive direction

When positive direction is selected (Index 2116, bit 2 = 0), any position target within the position modulo range (Index 2113) is approached moving forward clockwise.

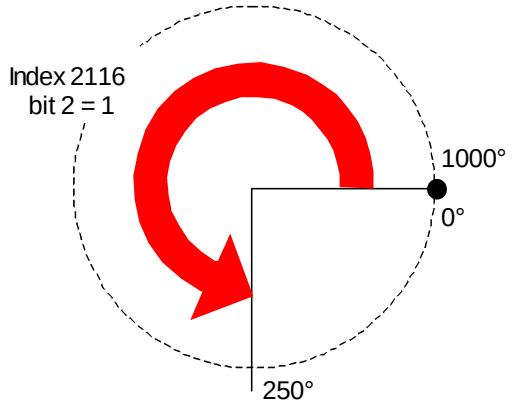
For example, assuming that modulo range is equal to 1000 degrees (Index 2113 = 1000) and position target is 250 degrees, the axis will approach the target moving clockwise.



Note that only position targets less or equal to the position modulo are allowed.

...when negative direction

When negative direction is selected (Index 2116, bit 2 = 1), any position target within the position modulo range (Index 2113) is approached moving forward counterclockwise.



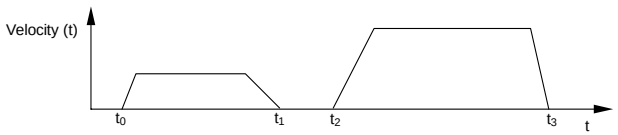
…running shortest trip to target

When bit 3 of Index 2116 is set to 1, the drive approaches the position target running the shortest trip within the position modulo range (Index 2113), regardless the direction of motion.

Single Setpoint

This function is controlled by Object Index 2116, Positioning Mode (bit 1 = 0) when control mode is Local, or by bit 5 of the Control Word when control mode is Field Bus.

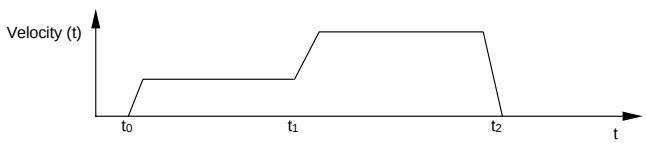
The drive unit is controlled by single setpoints processed one at a time. After reaching target position the drive unit signals the setpoint acknowledge (bit 10 of the Status Word) and then waits for the next position setpoint. Hence drive speed is reduced to zero before accepting a new setpoint.



Change Set Immediately

This function is controlled by Object Index 2116, Positioning Mode (bit 1 = 1) when control mode is Local, or by bit 5 of the Control Word when control mode is 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

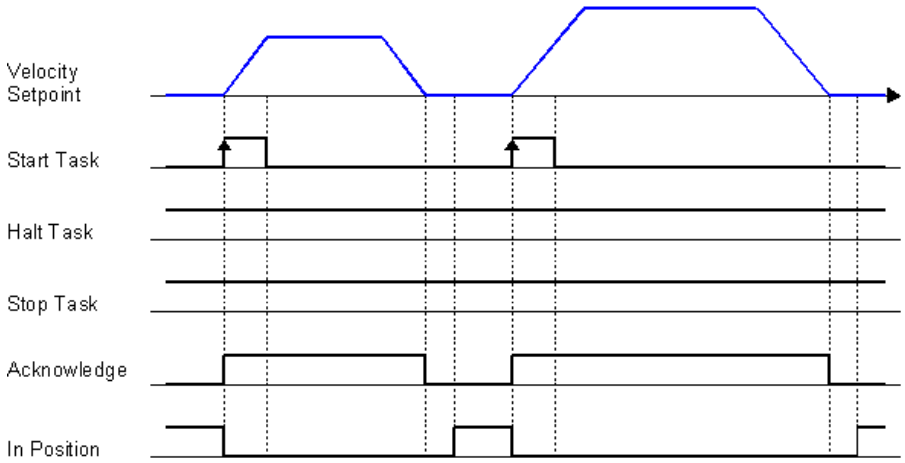
In the following, diagrams of control and status signals during positioning are presented. These diagrams are valid both in local and field bus control.

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

Single Positioning Tasks

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



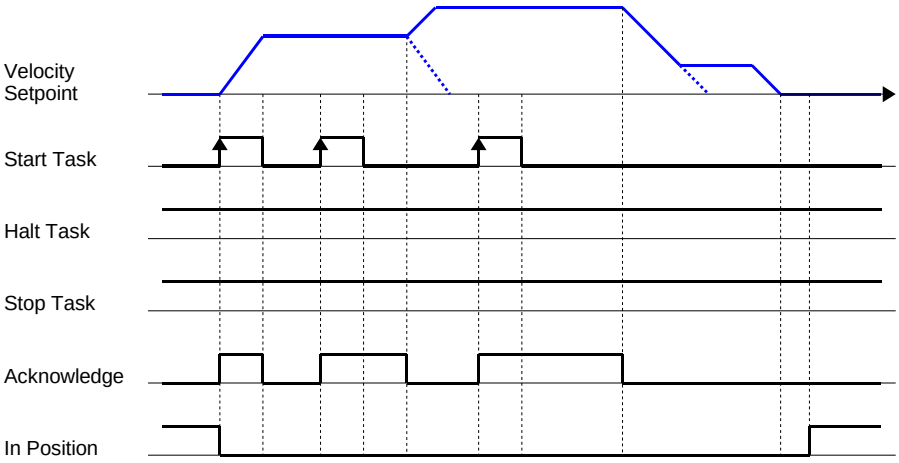
A positive edge of command signal ”Start Task” activates a new positioning task; a positive edge of status signal “Acknowledge” indicates that the positioning started.

After Acknowledge, the command ”Start Task” can be disabled.

After positioning is over, status signal “Acknowledge” changes to low and the unit may accept a new positioning task.

Multiple Positioning Tasks

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



A positive edge of command signal ”Start Task” activates a first positioning task; a positive edge of status signal “Acknowledge” indicates that the positioning is being executed.

After ”Acknowledge”, the command ”Start Task” can be disabled.

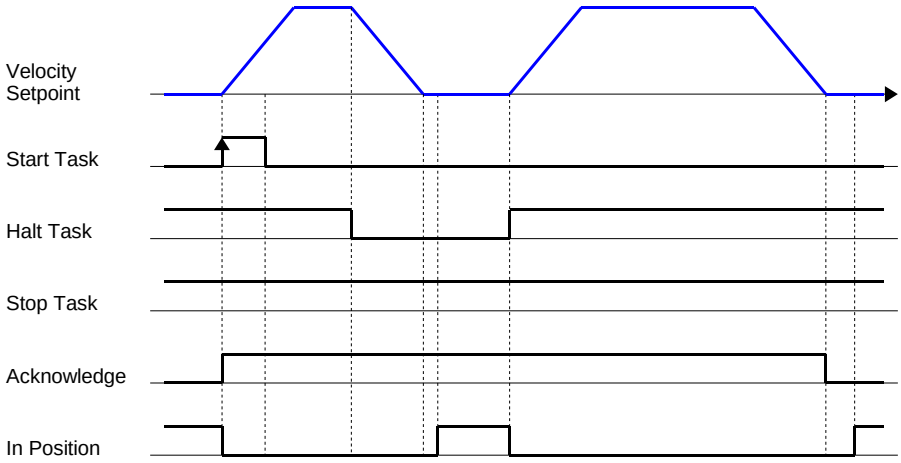
Status signal ”Acknowledge” changes to low immediately, in order to let the unit accept a new position target.

The new positioning task is activated by a positive edge of command “Start Task”. Signal “Acknowledge” indicates that the new positioning task is being accepted.

As the unit starts executing the new positioning, signal “Acknowledge” changes to low, in order to let the unit accept a new position target. And so on.

Intermediate Stop

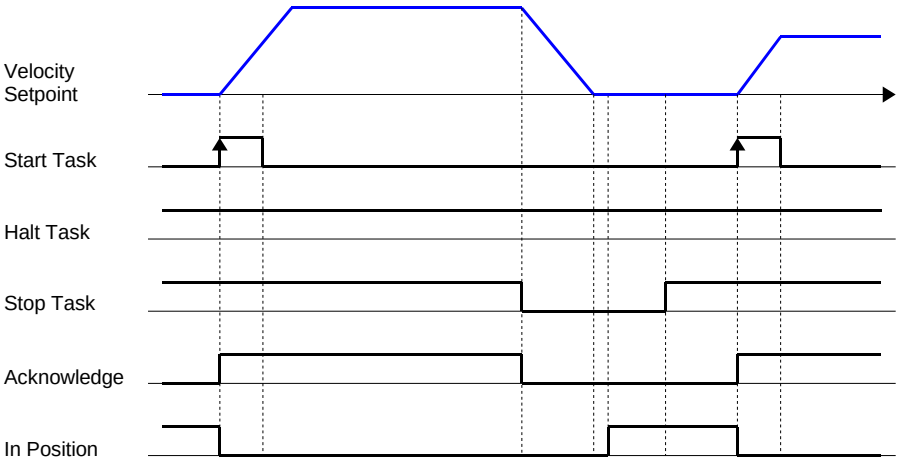
Diagram of signals for intermediate stop during a positioning task (Intermediate Stop).



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.



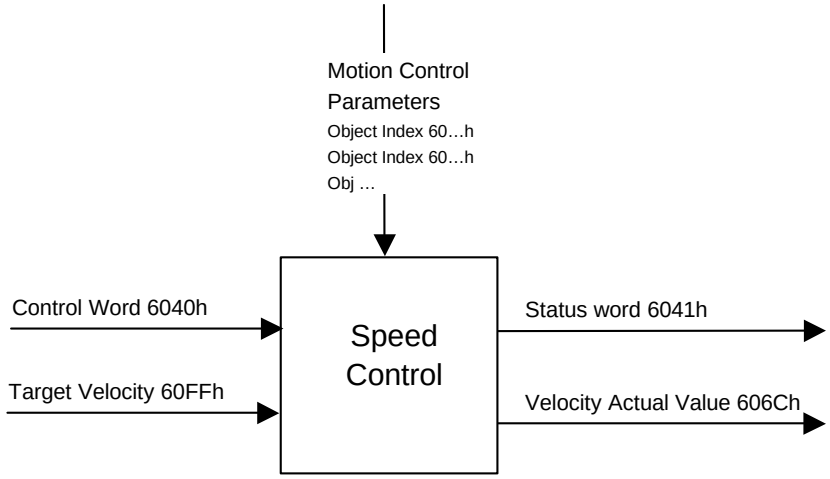
As a command Stop Task is activated, the positioning task is aborted. The unit stops and sets the signal “In Position”. As Stop command is released, the unit may be restarted with a new ”Start Task” command.

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.

Profile Velocity Mode

Profile Velocity Mode (Index 6060 set to 3) performs remote control of the motor speed.

The speed setpoint is generally a field bus reference. Profile Acceleration and Deceleration (Index 6083-6084) are used to generate a speed motion profile. However, motion tables externally controlled and previously configured with fixed targets (Index 60FFh, Target Velocity) can be operated. For this purpose either Control Word 2 (Object Index 2020) or Digital Inputs should be used.



Note that a number of bits of the Control Word and Status Word are mode specific here.

For the Control Word:

- **Bit 8** set to 1 halts the motion;
- **Bit 12** set to 0 activates “internal” control, set to 1 activates “direct” control.

For the Status Word:

- **Bit 10** is set when the drive has reached the setpoint;
- **Bit 12** states when the drive is moving or stationary, based on Min Speed.

Basic Settings for Profile Velocity Mode

After first configuration of the servodrives as illustrated in Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted for quick start-up.

Basic Settings for Profile Velocity Mode			
Object	**Name**	**Value**	**Remarks**
6060	Modes of Operation	3	Profile Velocity Mode
606D	Speed Window	Custom	See *Speed Monitoring*
606E	Speed Monitoring Time	Custom	See *Speed Monitoring*
606F	Min Speed	Custom	Threshold for bit 12 of SW
607E	Polarity	Custom	Sign of the speed target
607F	Max Profile Velocity	Custom	Limitation of Target Velocity
6083	Profile Acceleration	Custom	Profile parameter
6084	Profile Deceleration	Custom	Profile parameter
6085	Quick Stop Deceleration	Custom	Emergency stop deceleration
60C5	Max Acceleration	Custom	Axis max acceleration
60C6	Max Deceleration	Custom	Axis max deceleration
60FF	Target Velocity	Custom	Target speed from motion table
210A	Limit Switch Enable	0001b	Enable HW negative limit switch
		0010b	Enable HW positive limit switch

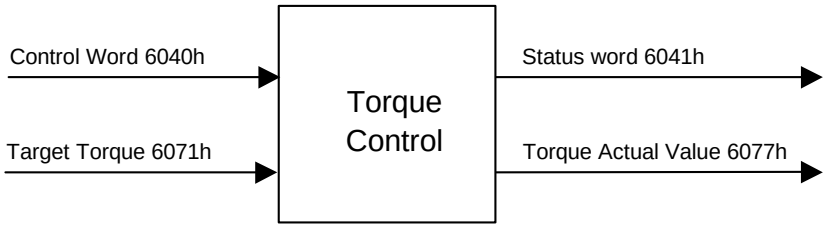
Profile Torque Mode

Profile Torque Mode (Index 6060 set to 4) performs remote torque control at the motor shaft.

The torque setpoint is normally a field bus reference. However, motion tables externally controlled and previously configured with fixed targets (Index 6071h, Target Torque) can be operated. For this purpose either Control Word 2 (Object Index 2020) or Digital Inputs are to be used.

Note that measuring unit of Index 6071h is Arms, hence Target Torque is indeed a current setpoint. This setpoint is a percentage of the Continuous Current (Index 2255). Range 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**.



Note that a number of bits of the Control Word and Status Word are mode specific here.

For the Control Word:

- **Bit 8** set to 1 halts the motion;
- **Bit 12** set to 0 activates “internal” control, set to 1 activates “direct” control.

Bit 10 of the Status Word is set when the drive has reached the setpoint.

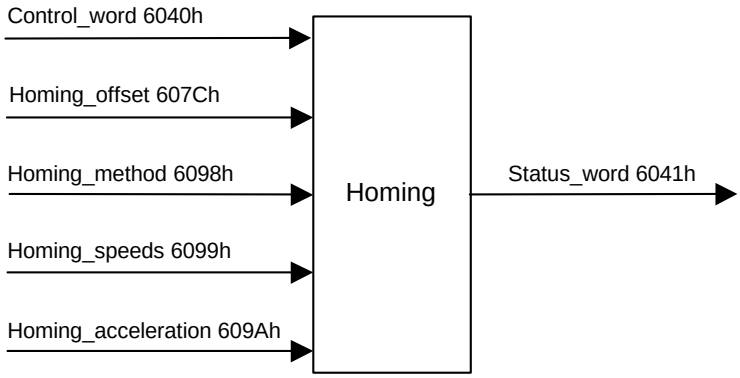
Basic Settings for Profile Torque Mode

After first configuration of the servodrives as illustrated in Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted for quick start-up.

Basic Settings for Profile Torque Mode			
Object	**Name**	**Value**	**Remarks**
6060	Modes of Operation	4	Profile Torque Mode
606F	Min Speed	Custom	-
6071	Target Torque	Custom	-1000 to 1000 % of Index 2255
607E	Polarity	Custom	Sign of the speed target
2255	Continuous Current	Default	Drive continuous current
2256	Peak Current	Default	Drive peak current
2257	Brake Current	Custom	Current for emergency stop

Homing Mode

Homing Mode (Index 6060 set to 6) is used for axis referencing. The drive seeks the homing position (also called the datum, reference point or zero point) according to the specifics of the homing method selected. The function block of the homing mode is given below:



Note that a number of bits of the Control Word and Status Word are mode specific here. For the Control Word:

- on the positive edge of the **Bit 4** (0 → 1), the drive starts performing the homing procedure (also called referencing),
- **Bit 8** set to 1 halts the motion.

For the Status Word:

- **Bit 10** is set when the drive has reached the setpoint,
- **Bit 12** is set when the homing procedure was successfully completed,
- **Bit 13** is set when an error occurred during the homing procedure.

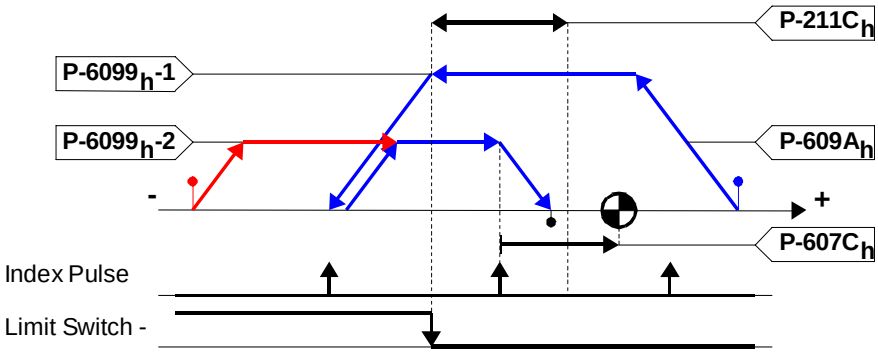
Homing Mode can be performed locally too (Control Mode, Index 2204, set to "1 - Local"). In that case the Local Operating Mode "5 - Digital Position" must be previously selected and the digital input "13 - Start Homing" must be necessarily configured.

Homing Methods

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

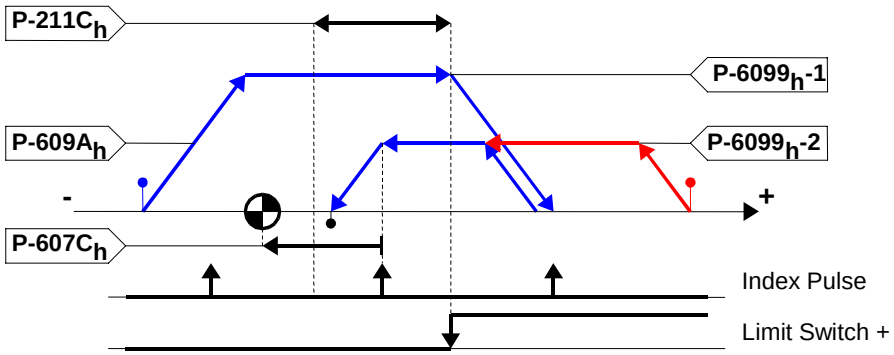
Method 1: Homing on the negative limit switch and index pulse

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.



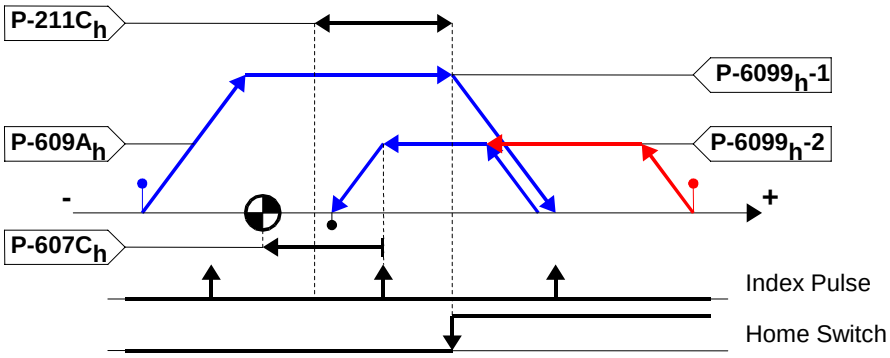
Method 2: Homing on the positive limit switch and index pulse

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.



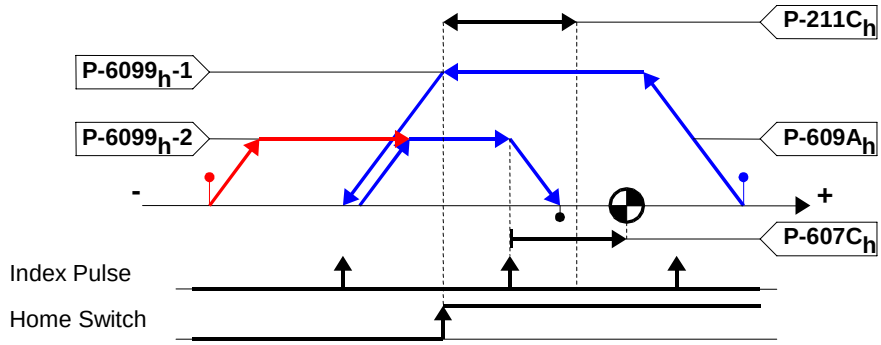
Method 3: Homing on the falling edge of the positive home switch and index pulse

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.



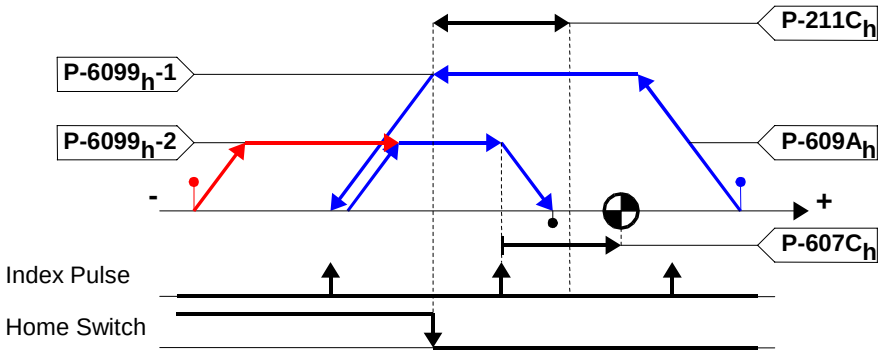
Method 4: Homing on the rising edge of the positive home switch and index pulse

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.



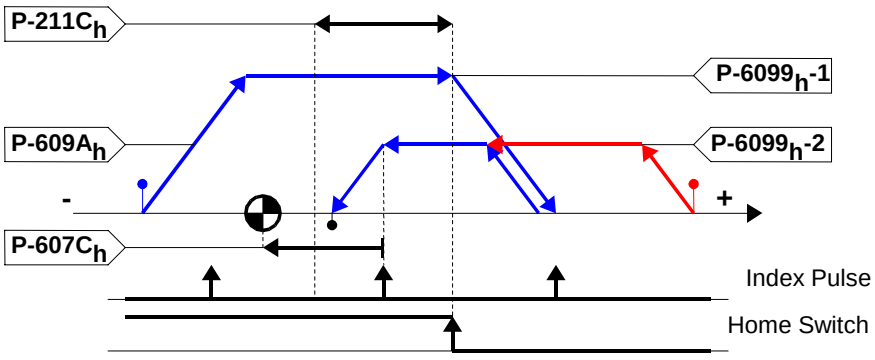
Method 5: Homing on the falling edge of the negative home switch and index pulse

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.



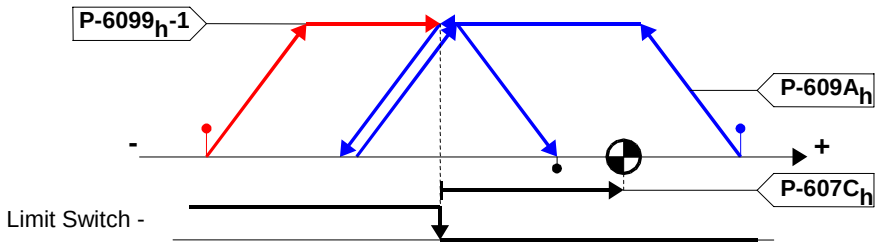
Method 6: Homing on the rising edge of the negative home switch and index pulse

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.



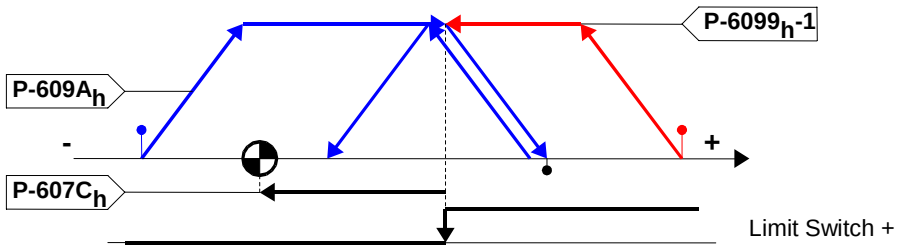
Method 17: Homing on the negative limit switch

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.



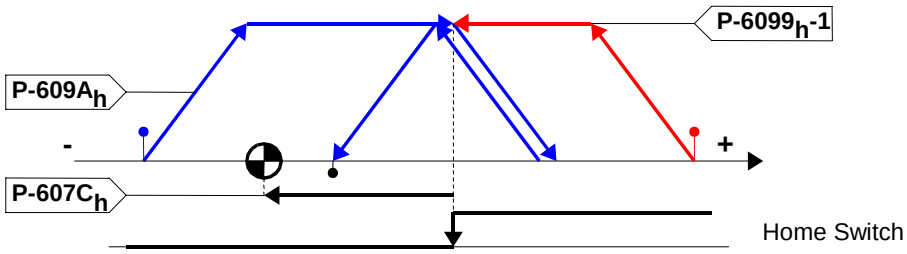
Method 18: Homing on the positive limit switch

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.



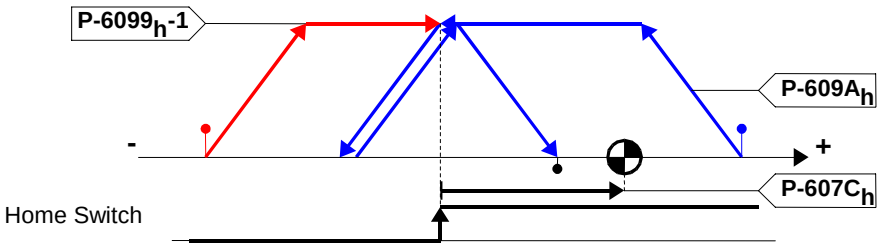
Method 19: Homing on the falling edge of the positive home switch

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.



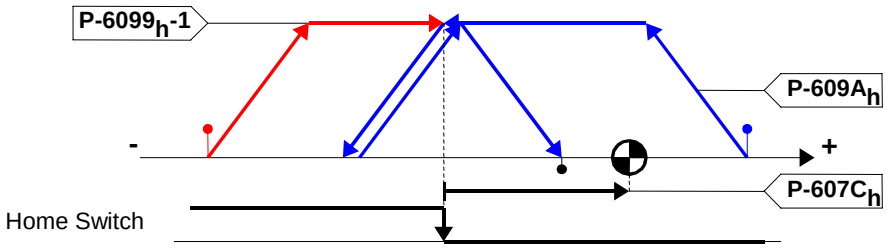
Method 20: Homing on the rising edge of the positive home switch

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.



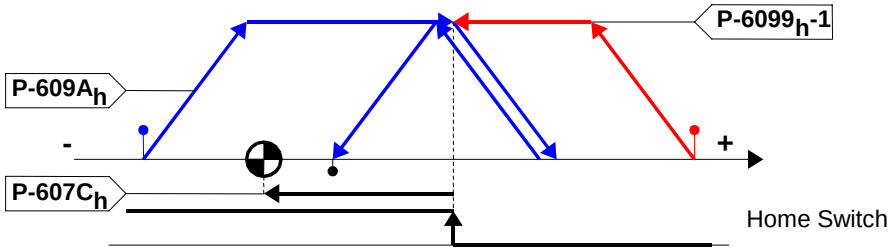
Method 21: Homing on the falling edge of the negative home switch

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.



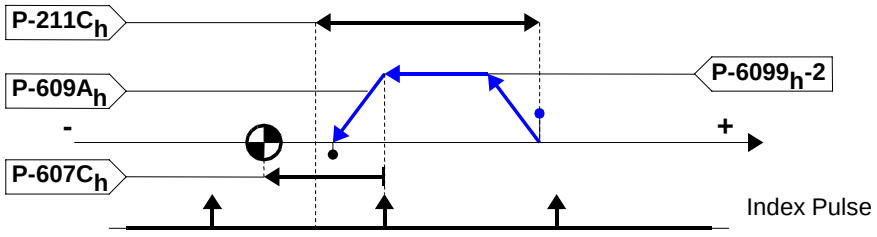
Method 22: Homing on the rising edge of the negative home switch

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.



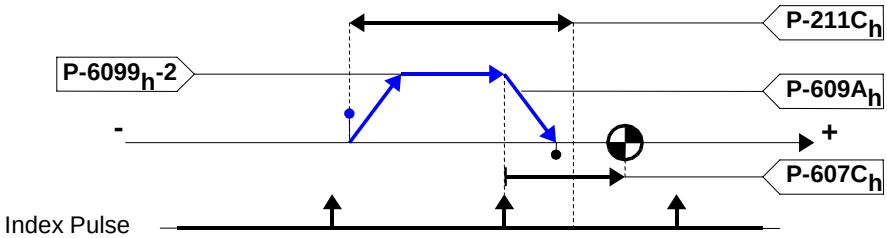
Method 33: Homing on the index pulse in the negative direction

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



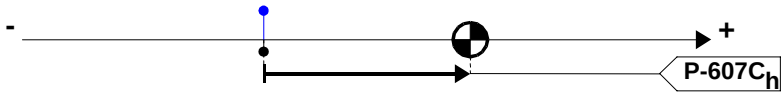
Method 34: Homing on the index pulse in the positive direction

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 Axis Referencing

After first configuration of the servodrives as illustrated Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted for axis referencing.

Basic Settings for Referencing				
Object	**Name**	**Value**		**Remarks**
6060	Modes of Operation	6		Homing Mode
211B	Max Travel for Switch	-		Reserved
211C	Max Travel for Zero	Custom		
607C	Homing offset	Optional		
6098	Homing method	Custom	“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
6099-01	Homing speed for Switch	Custom		
6099-02	Homing speed for Zero	Custom		
609A	Homing acceleration	Custom		

Note. When Homing Mode is selected and fieldbus control is set (Index 2204 = "2 - Field Bus"), the homing procedure can be started using bit 4 of the Control Word or configuring a digital input with "Start Homing".

Digital Inputs configured for selecting the motion tables and motion tasks have priority on both Control Word and Control Word 2.

Jogging Mode

Jogging, also called inching, is used for short motion, such as moving out of hardware and software limit switches, adjusting axis position, etc.

When jogging is used, DGV is still speed-controlled. In this case, however, Jogging Mode must be selected (Index 6060 set to -3) and parameters Jogging Speed and Jogging Acceleration have to be adjusted.

Note that two jogging procedure can be programmed (one for large move, for instance, and one for very short move). When Jogging Mode is selected,

- as long as Control Word **Bit 4** is set, DGV performs Jogging 1 using Jogging Speed 1 (Index 2110) and Jogging Acceleration (Index 2112);
- as long as Control Word **Bit 5** is set, DGV performs Jogging 2 using Jogging Speed 2 (Index 2111) and Jogging Acceleration (Index 2112);
- **Bit 8** set to 1 halts the motion.

Bit 10 of the Status Word is set when target has been reached.

Synchronization Mode

This mode (Index 6060h set to -4) is used to electronically synchronise two mechanical axes. DGV provide *Velocity Synchronization* and *Position Synchronization*. One or several slave drives may receive the setpoints from a master drive or a master encoder (moving target). Therefore the encoder interface of DGV can be configured as either input or output.

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

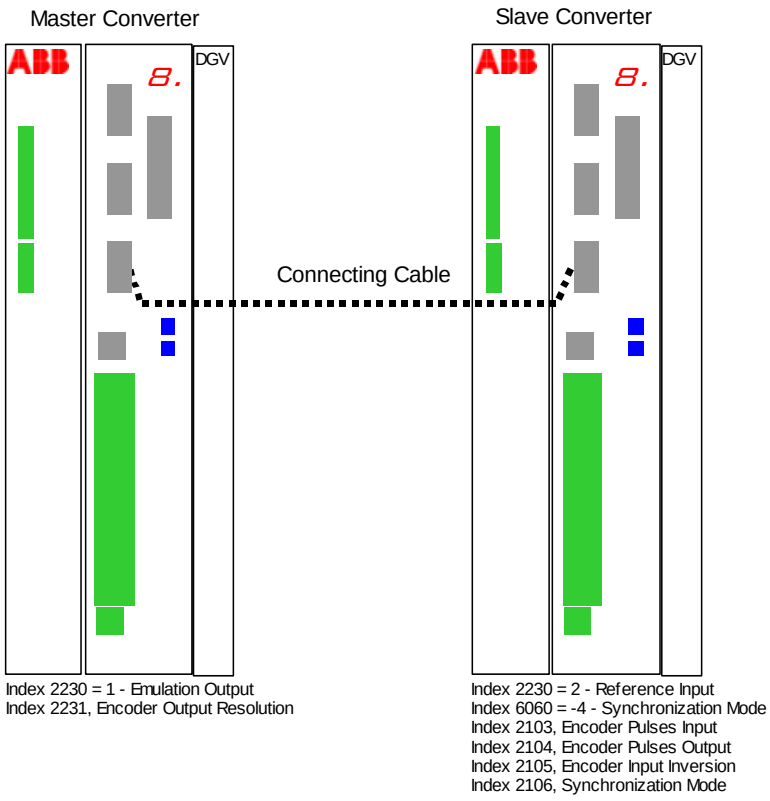
Note that a number of bits of the Control Word and Status Word of the slave device are mode specific here.

For the Control Word, on the positive edge of the **Bit 4** (0 → 1) the slave device starts performing synchronisation to the moving target.

For the Status Word:

- **Bit 12** is set when the synchronization has been reached;
- **Bit 13** is set when a following error has occurred.

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 Interface* of the *Installation Manual*.



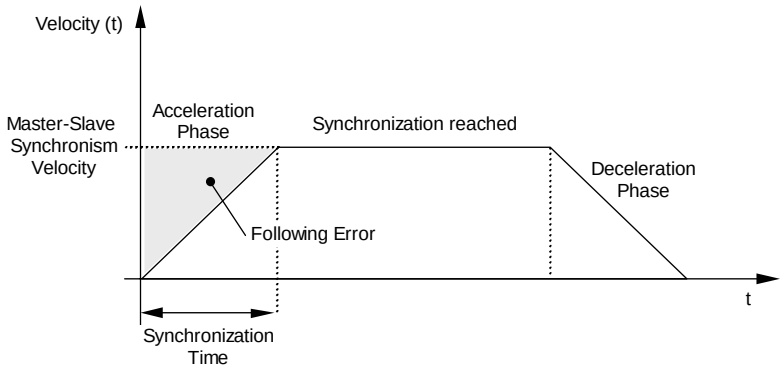
The master converter (Object Index 2230 = 1 - Emulation Output) provides an encoder-emulated output signal. Resolution of this signal can be parameterised using Object Index 2231, Encoder Output Resolution.

The DGV slave converter (Object Index 2230 = 2 - Reference Input) is supplied with the encoder-emulated input signal from the master converter. Set Object Index 2106 to "1 - Speed Sync" to perform*Velocity Synchronization*, to "2 - Position Sync" to perform *Position Synchronization*.

The synchronization command may come from bit 4 of the Control Word or the digital input D-IN "Start Sync". If configured, the digital output D-OUT “Sync Reached” is set when the synchronism has been reached.

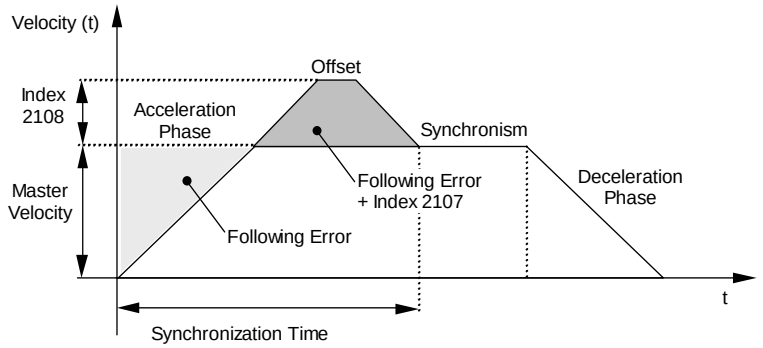
Velocity Synchronization

When Index 2106 is set to "1 - Speed Sync", Velocity Synchronization is performed. Therefore as a synchronization command is given, the drive accelerates with Profile Acceleration (Index 6083) 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.



Position Synchronization

When Index 2106 is set to 2, Position Synchronization is performed. Therefore when a synchronization input command is given, the drive accelerates with Profile Acceleration (Index 6083) 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 Velocity (Index 2108) and Offset Position (Index 2107).



Basic Settings for Synchronization

After first configuration of the servodrives as illustrated Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted for quick start-up of axis synchronization.

Basic Settings for Synchronization			
Object	**Name**	**Master DGV**	**Slave DGV**
2230	Encoder Interface Configuration	1 - Emulation Output	2 - Reference Input
6060	Modes of Operation	1 - Profile Position	-4 - Synchronization
6065	Following error window	Custom	Custom
6083	Profile Acceleration	Custom	Custom
6084	Profile Deceleration	Custom	Custom
60C5	Max Acceleration	Custom	Custom
60C6	Max Deceleration	Custom	Custom
607D-01	Min Software Position Limit	Custom	Custom
607D-02	Max Software Position Limit	Custom	Custom
607E	Polarity	Custom	-
2100	Position Conversion Numerator	65536	65356
2101	Position Conversion Denominator	Custom	Custom
2102	Axis Type	1-Rotary / 2-Linear	1-Rotary / 2-Linear
2103	Encoder Pulses Input	Not used	65536
2104	Encoder Pulses Output	Not used	Custom
2105	Encoder Input Inversion	Not used	Optional
2106	Synchronization Type	Not used	1-Speed / 2-Position
2107	Synchronization Offset Position	Not used	Custom
2108	Synchronization Offset Velocity	Not used	Custom
210A	Limit Switch Enable	Custom	Custom
210B	Synchronization Window	Not used	Custom
210C	Synchronization Monitoring Time	Not used	Custom
2117	Enable Table	Custom	Custom

Interpolated Position Mode

The Interpolated Position Mode (Index 6060 set to 7) perform a time interpolation of the position setpoints by the SYNC-Object.

Object Index 60C0, Interpolation Mode, defines the type of interpolation, linear.

Object Index 60C1, subindex 1 “Position Setpoint”, contains the position setpoints to be interpolated. This Object must be sent using synchronous PDO-Rx.

Object Index 60C2 fixes through subindex 1 “Interpolation Time Units” and 2 “Interpolation Time Index” the interpolation cycle, according to the formula:

$$T_{cycle} = 60C2h\text{-}1 * 10\text{^}60C2h\text{-}2 \text{ seconds}$$

Sub-index 2 (60C2h-2) is set to -3, therefore the time cycle is given in milliseconds and it is defined through Sub-index 1 (60C2h-1).

For linear interpolation the same basic entries of the Profile Position Mode must be properly set.

Note that a number of bits of the Control Word and Status Word are mode specific here.

Bit 4 of the Control Word set to 1 enables drive internal interpolation.

In the Status Word:

- **Bit 12** is set as the interpolation is enabled,
- **Bit 13** is set if a following error occurs.

Basic Settings for Interpolation Mode

After first configuration of the servodrive as illustrated in Chapter 5 of the *Firmware Manual*, the following parameters must be adjusted for quick start-up.

Basic Settings for Interpolated Position Mode			
Object	**Name**	**Value**	**Remarks**
6060	Modes of Operation	7	Interpolated Position Mode
2100	Position Conversion Numerator	65536	Conversion of axis position
2101	Position Conversion Denominator	Custom	into DGV internal units
210A	Limit Switch Enable	Custom	-
2116	Positioning Mode	000**0**b	Absolute Positioning
		000**1**b	Relative Positioning
2117	Enable Table	Custom	-
2119	Motion Type Selection	0 / 1	0-Table (Internal) / 1-Field Bus
6065	Following error window	Custom	-
6067	Position Window	Custom	-
6068	Position Monitoring Time	Custom	-
607D-01	Min Software Position Limit	Custom	-
607D-02	Max Software Position Limit	Custom	-
607E	Polarity	Custom	-
607F	Max Profile Velocity	Custom	-
6081	Profile Velocity	Custom	-
6083	Profile Acceleration	Custom	-
6084	Profile Deceleration	Custom	-
6085	Quick Stop Deceleration	Custom	Emergency stop deceleration
6086	Motion Profile Type	0	Trapezoidal Profile
60C1-01	Position Setpoint	Custom	-
60C2-01	Interpolation Time Units	Custom	Interpolation formula
60C5	Max Acceleration	Custom	-
60C6	Max Deceleration	Custom	-

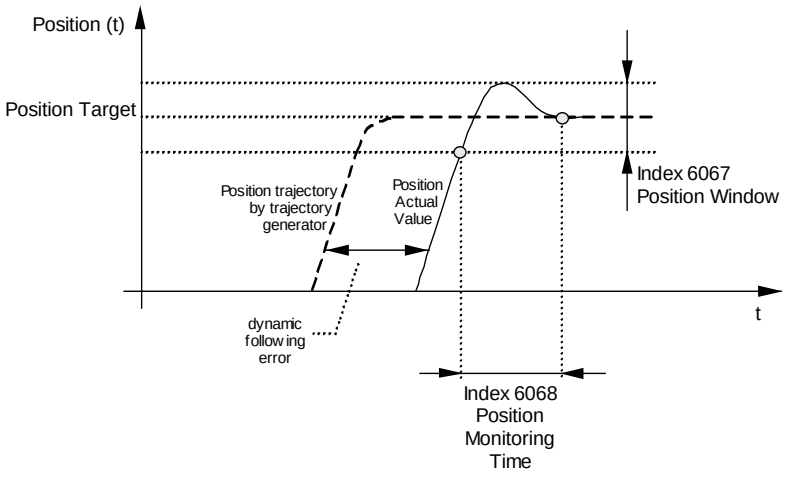
Monitoring Functions

Monitoring functions of speed and position 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 (Index 6067) before the Position Monitoring Time expires (Index 6068).

Position Window defines the maximum error allowed between the position actual value and the position target. As the trajectory generator reaches the position target, the Position Monitoring Time function starts counting.



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 (Index 6065) fixes the maximum dynamic following error, that is maximum position fluctuation or delay allowed during positioning dynamics. The following error is given by the difference between the position reference value, provided by the trajectory 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.

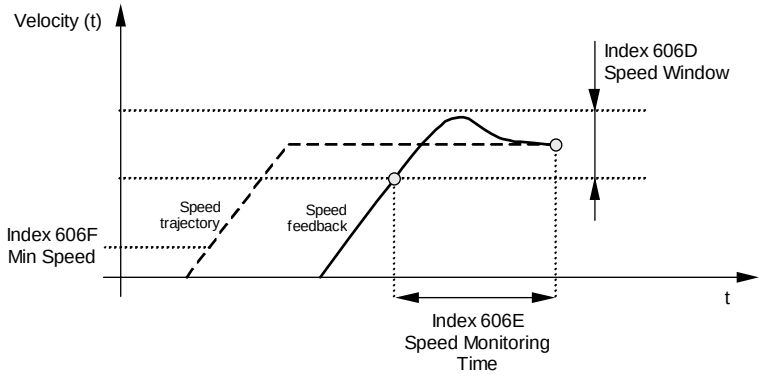
- Bit 10 of the Status Word notifies when axis comes outside the setpoint position.
- Whenever the motor position exceeds the Following Error Window, a fault condition occurs.

Note. Besides mechanical characteristics of the whole system, following error depends on the stability of the position control loop, i.e. 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 trajectory speed target. As the trajectory 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

Monitoring of synchronization is performed as for previous modes, through parameterization of Synchronization Window and Synchronization Monitoring Time. These parameters match with synchronization mode, speed or position.

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

Axis-Coupling

Object Index 2230h “Encoder Interface Configuration” allows to configure the encoder emulated interface of the converter, in order to perform master-slave axis coupling (terminal X8 of the frontal panel, see *Installation Manual*).

Index 2230h 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 Index 2231h “Encoder Output Resolution”.

- Index 2231h set to 1, resolution 128 pulses/turn
- Index 2231h set to 2, resolution 256 pulses/turn
- Index 2231h set to 3, resolution 512 pulses/turn
- Index 2231h 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 Index 2103h “Encoder Pulses Input” and 2104h “Encoder Pulses Output”.

Standard Coupling

Standard coupling means that the position feedback of the master-axis (Index 2230h set to “1 - Emulation Output”) is the position reference of the slave-axis (Index 2230h 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 (Index 2230h set to “4 - Reference Output”) supplies one or more slave-axes (Index 2230h set to “2 - Reference Input”).

Note. Since the position reference is withdrawn downstream the jerk limiting filter block (Index 211Ah), 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:

- Object Index 2125h “Cam 1 Switch-on Position”
- Object Index 2126h “Cam 1 Switch-off Position”
- Object Index 2127h “Cam 2 Switch-on Position”
- Object Index 2128h “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 Object Index 2129h “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

Objects Indexes 22E6h " Digital Input Inversion" and 22E7h "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, Index 22E6h

- 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, Index 22E7h

- 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 - EDS File

A sample of the CANOpen EDS file *DGV.eds* for DGV is hereby presented. This file is available together with ABB Sace product documentation.

```
[FileInfo]
CreatedBy=ABB Sace S.p.a.
ModifiedBy=ABB Sace S.p.a.
Description=EDS for DGV - DGV CANOpen
FileVersion=1
FileRevision=1
CreationTime=00:00AM
CreationDate=30-06-03
ModificationTime=00:00AM
ModificationDate=31-07-03
FileName=DGV.eds

[DeviceInfo]
VendorNumber=0000011C
ProductNumber=500
ProductVersion=1
ProductRevision=1
OrderCode=DVC500
BaudRate_50=1
BaudRate_100=1
BaudRate_125=1
BaudRate_250=1
BaudRate_500=1
BaudRate_1000=1
SimpleBootUpMaster=0
ExtendedBootUpMaster=0
SimpleBootUpSlave=1
ExtendedBootupSlave=1
Granularity=0x0
DynamicChannelsSupported=0x0
VendorName=ABB Sace S.p.a.
ProductName= DGV700 CANOpen

[StandardDataTypes]
0x0001=1
0x0002=0
0x0003=0
0x0004=0
0x0005=1
0x0006=1
0x0007=1
0x0008=0
0x0009=1
0x000A=0
0x000B=0
0x000C=0
0x000D=0
0x000E=0
0x000F=0

[DummyUsage]
Dummy0001=0
Dummy0002=0
Dummy0003=0
Dummy0004=0
Dummy0005=0
Dummy0006=0
Dummy0007=0
```

```
[Comments]
Lines=0

[MandatoryObjects]
1=0x1000
2=0x1001
3=0x1018
SupportedObjects=3

[1000]
ParameterName=DeviceType
ObjectType=0x7
DataType=0x7
AccessType=ro
PDOMapping=0
DefaultValue=0x20192

[1001]
ParameterName=ErrorRegister
ObjectType=0x7
DataType=0x5
AccessType=ro
PDOMapping=0
DefaultValue=0x0

[1018]
ParameterName=IdentityObject
ObjectType=0x9
DataType=0x23
AccessType=ro
PDOMapping=0
DefaultValue=0x0000011C
[OptionalObjects]
SupportedObjects=51
1=0x1008
2=0x1009
3=0x100a
4=0x100b
5=0x100c
6=0x100d
7=0x1012
8=0x1014
9=0x1400
10=0x1401
11=0x1402
12=0x1403
13=0x1600
14=0x1601
15=0x1602
16=0x1603
17=0x1604
18=0x1605
19=0x1606
20=0x1607
21=0x1800
22=0x1801
23=0x1802
24=0x1803
25=0x1a00
26=0x1a01
27=0x1a02
28=0x1a03
29=0x1a04
30=0x1a05
31=0x1a06
32=0x605a
33=0x6065
34=0x6067
35=0x6068
36=0x606d
37=0x606e
38=0x606f
39=0x607a
40=0x607c
41=0x607d

...

...
42=0x607e
43=0x6081
44=0x6083
45=0x6084
46=0x6085
47=0x6086
48=0x6098
49=0x6099
50=0x609a
51=0x60ff

[ManufacturerObjects]
SupportedObjects=0

[Tools]
Items=0

[1005]
ParameterName=Sync COB-ID
ObjectType=0x7
DataType=0x7
AccessType=rw
DefaultValue=0x80
PDOMapping=0

[1006]
ParameterName=Sync COB-ID
ObjectType=0x7
DataType=0x7
AccessType=rw
PDOMapping=0

[1008]
ParameterName=DeviceName
ObjectType=0x7
DataType=0x9
AccessType=ro
PDOMapping=0
DefaultValue= DGV700

[1009]
ParameterName=HardwareVersion
ObjectType=0x7
DataType=0x9
AccessType=ro
PDOMapping=0
DefaultValue=01/01

[100a]
ParameterName=SoftwareVersion
ObjectType=0x7
DataType=0x9
AccessType=ro
PDOMapping=0
DefaultValue=1.0

[100b]
ParameterName=NodeID
ObjectType=0x7
DataType=0x7
LowLimit=1
HighLimit=127
AccessType=ro
PDOMapping=0

[100c]
ParameterName=GuardTime
ObjectType=0x7
DataType=0x6
AccessType=rw
DefaultValue=0x0
PDOMapping=0

...
```

```
...

[100d]
ParameterName=LifeTimeFactor
ObjectType=0x7
DataType=0x5
AccessType=rw
DefaultValue=0x0
PDOMapping=0

[1012]
ParameterName=COB-ID
TimeStampObject
ObjectType=0x7
DataType=0x5
AccessType=ro
PDOMapping=0

[1014]
ParameterName=COB-ID
EmergencyMessage
ObjectType=0x7
DataType=0x5
AccessType=RO
PDOMapping=0

[1400]
ParameterName=ReceivePDO1
Parameter
ObjectType=0x9
DataType=0x20
AccessType=rw
PDOMapping=0
SubNumber=0x3

[1400sub0]
ParameterName=NumberOfEntries
ObjectType=0x7
DataType=0x5
AccessType=RO
DefaultValue=2
PDOMapping=0

[1400sub1]
ParameterName=COB-ID
ObjectType=0x7
DataType=0x7
AccessType=RW
DefaultValue=512+NodeID
PDOMapping=0

[1400sub2]
ParameterName=TransmissionType
ObjectType=0x7
DataType=0x5
AccessType=RW
DefaultValue=255
PDOMapping=0


...


[1600]
ParameterName=ReceivePDO1 Mapping
ObjectType=0x9
DataType=0x21
AccessType=rw
PDOMapping=0
SubNumber=0x2

[1600sub0]
ParameterName=NumberOfMappedObjec
ts
ObjectType=0x7
DataType=0x5
LowLimit=1
HighLimit=64
AccessType=RO
DefaultValue=1
PDOMapping=0

[1600sub1]
ParameterName=1.MappedObject
ObjectType=0x7
DataType=0x7
AccessType=RO
DefaultValue=0x60400010
PDOMapping=0


...


[1800]
ParameterName=TransmitPDO1
Parameter
ObjectType=0x9
DataType=0x20
AccessType=rw
PDOMapping=0
SubNumber=0x3

[1800sub0]
ParameterName=NumberOfEntries
ObjectType=0x7
DataType=0x5
LowLimit=1
HighLimit=64
AccessType=RO
DefaultValue=2
PDOMapping=0

[1800sub1]
ParameterName=COB-ID
ObjectType=0x7
DataType=0x7
AccessType=RO
DefaultValue=384+NodeID
PDOMapping=0

[1800sub2]
ParameterName=TransmissionType
ObjectType=0x7
DataType=0x5
AccessType=RO
DefaultValue=255
PDOMapping=0


...


[1a00]
ParameterName=TransmitPDO1
Mapping
ObjectType=0x9
DataType=0x21
AccessType=rw
PDOMapping=0
SubNumber=0x2
```

```
...

[1a00sub0]
ParameterName=NumberOfMappedObjec
ts
ObjectType=0x7
DataType=0x5
LowLimit=1
HighLimit=64
AccessType=RO
DefaultValue=1
PDOMapping=0

[1a00sub1]
ParameterName=1.MappedObject
ObjectType=0x7
DataType=0x7
AccessType=RO
DefaultValue=0x60410010
PDOMapping=0


...


[6065]
ParameterName=FollowingErrorWindo
w
ObjectType=0x07
DataType=0x07
AccessType=rw
PDOMapping=0

[6067]
ParameterName=PositionWindow
ObjectType=0x07
DataType=0x07
AccessType=rw
PDOMapping=0

[6068]
ParameterName=PositionMonitoringT
ime
ObjectType=0x07
DataType=0x07
AccessType=rw
PDOMapping=0

[607a]
ParameterName=TargetPosition
ObjectType=0x07
DataType=0x07
AccessType=rw
PDOMapping=0

...
```

Appendix B - CANOpen Error Codes

The following table shows *Emergency Object (EMCY)*, i.e. the CANOpen error register bit number, and the corresponding error codes displayed on DGV front panel.

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

Please note that some fault messages shown on the drive front panel are not available as binary error code, and vice versa.

Error Code	LED Code	Description	Error Register	Error Register Bit	Emergency Error Code
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	-	-	-
F01	GGRGG	Overcurrent of the IGBT module	0x03	Bit1	0x2300
F02	GGGGR	Overvoltage	0x05	Bit2	0x2310
F03	GRRGG	Mains	0x05	Bit2	0x3130
F04	GGGRG	Undervoltage	0x05	Bit2	0x3220
F05	-	-	-	-	-
F06	-	-	-	-	-
F07	GRGGG	Converter Thermal Protection	0x09	Bit3	0x4210
F08	GGRRR	Motor Thermal Protection	0x09	Bit3	0x4310
F09	-	-			
F10	GGRGR	Resolver Fault	0x21	Bit5	0x7303
F11	GRRGR	Sincos Encoder Fault	0x21	Bit5	0x7305
F12	GRRRG	Sincos Encoder Interpolation Fault	0x21	Bit5	0x7306
F13	-	-	-	-	-
F14	-	-	-	-	-
F15	GGRRG	Overspeed	0x21	Bit5	0x8410
F16	-	-	-	-	-
F17	-	-	-	-	-
F18	-	-	-	-	-
F19	GRGRG	Following Error	0x21	Bit5	0x8611
F20	GRRRR	Hardware Negative Limit Switch	0x21	Bit5	0x8620
F21	RGGGG	Hardware Positive Limit Switch	0x21	Bit5	0x8621
F22	-	-	-	-	-
F23	-	-	-	-	-
F24	RGGGR	Clamp Overload	0x21	Bit5	0x7114
F25	GGGRR	Field bus Fault	-	-	-
F26	RGGRR	Max Travel for Switch	0x21	Bit5	0x8630
F27	RGRGG	Max Travel for Zero	0x21	Bit5	0x8631
F28	GRGGR	Internal Error	0x21	Bit5	0x6110
F29	RGGRG	Clamp Ovetime	0x21	Bit5	0x7115
F30	GRGRR	Computation Overflow	0x21	Bit5	0x6111
F31	RRRRG	24 V Bake Supply Fault	0x21	Bit5	0xFF00
F32	RRGGG	Invalid table	0x21	Bit5	0x8632

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Appendix C - Technical Data

CAN Network

Protocol

CANOpen

Standards

CAN in Automation: DS-301 v. 4.02 *Application Layer and Communication Profile*, and DSP-402 v. 2.0 *Device Profile Drives and Motion Control*,

ISO 11898 *Controller Area Network for High-Speed Communication*

Compatible Masters

Any CAN master device that supports the CANOpen communication protocol

Network Size

Up to 127 stations using repeaters

Medium

Twisted pair cable terminated with 120 ohm resistors. For CANOpen networks with less than 64 nodes, the bus cable should fulfill the following DC parameters:

Bus Length [m]	Resistance/ Length [mΩ/m]	Cross Section [mm^2]	Termination Resistance [Ω]	Baudrate [kbit/s]
< 40	70	0,25 ... 0,34	120	1000 up to 40 m
40 ... 300	< 60	0,34 ... 0,6	150 ... 300	> 500 up to 100 m
300 ... 600	< 40	0,5 ... 0,6	150 ... 300	> 100 up to 500 m
600 ... 1000	< 26	0,75 ... 0,8	150 ... 300	> 50 up to 1000 m

Transmission Rate

50 to 1000 kBaud
Default: 125 kBaud

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.

Basic Data Types

Unsigned*n* is a non-negative integer value in the range: 0 … 2^n-1.

Integer*n* is an integer value in the range: -2^{n-1} … 2^{n-1}-1.

- Example. The value range of Unsigned32 is : 0 … 2^{32}-1.
- Example. The value range of Integer16 is : -2^{15} … 2^{15}-1.

Units

Note that process variables are Axis Type dependent.

Therefore axis units are for rotary axis:

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

And axis units for linear axis:

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

DGV Internal Units

Process variables in their units can be transformed into DGV internal units using conversion factors Object Index 2100, Position Conversion Numerator, and Object Index 2101, Position Conversion Denominator.

A resolver transducer with 65536 counts/turn is used, then conversion factors must be selected:

- 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

  Object Index 2100 = nr. of rotor-turns * 65536

  and Position Conversion Denominator is

  Object Index 2101= nr. of axis-turns * 360000

  For example:

  Assuming gear ratio is 3:10, then

  Object Index 2100= 10 * 65536

  Object Index 2101= 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

  Object Index 2100 = nr. of rotor-turns * 65536

  and Position Conversion Denominator is

  Object Index 2101 = nr. of axis-turns * 20000

Example.

Extract Object Index 6081, Profile Velocity, from Chapter 5.

Object Index	Name	Units	Access	Value Range
6081	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. Profile Velocity has to be set to " 10000 dec " .

If Profile Velocity 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.

CAN Vocabulary

Vocabulary currently used in CAN technology.

broadcast transmission	A communication service performing a simultaneous transmission from one to all nodes.
boot-up message	CANOpen communication service transmitted whenever a node enters the pre-operational state after initialisation
bus	Topology of a communication network, where all nodes are reached by passive links, which allows transmission in both directions.
bus access	When the bus is idle, any node may start to transmit a frame. In CAN networks the nodes access the bus by transmitting the dominant SOF (start of frame) bit.
bus arbitration	If at the very same moment several nodes try to access the bus, an arbitration process is necessary. At the end of this process, only one node has bus access. The bus arbitration process used CAN protocol is CMSA/CD (Carrier Sense Multiple Access/Collision Detection) with AMP (Arbitration on Message Priority). This allows bus arbitration without destruction of messages.
bus driver	Component that converts information or data signals into physical signals so that these signals can be transferred across the communication medium.
bus idle	During bus idle state no CAN frame is transmitted and all connected nodes transmit recessive bits.
bus length	The network cable length between the both termination resistors. The bus length of CAN networks is limited by the used transmission rate. At 1 Mbit/s the maximum length is theoretically 40 m. When using lower transmission rates, longer bus lines may be used: at 50 kbit/s a length of 1 km is possible.
bus load	The busload is the ratio of transmitted bits to bus idle bits within a defined time unit.
bus state	Either of the two complementary logical states: dominant or recessive.
CAN	Controller Area Network (CAN) is a serial bus system originally developed by the Robert Bosch GmbH. It is internationally standardized by ISO 11898-1. CAN has been implemented by many semiconductor manufacturers.
CAN device	Hardware module providing a CAN interface.
CAN-H	The CAN-H line of ISO 11898-2 compliant transceiver is in recessive state on 2.5 V and in dominant state on 3.5 V.
CAN in Automation (CiA)	The international users' and manufacturers' *Automation (CiA)* group founded in 1992 promotes CAN and supports some higher-layer protocols.
CAN-L	The CAN-L line of ISO 11898-2 compliant transceiver is in recessive state on 2.5 V and in dominant state on 1.5 V.
CAN node	Synonym for CAN device.
CANOpen	Family of profiles for embedded networking in industrial machinery, medical equipment, building automation (e.g. lift control systems, electronically controlled doors, integrated room control systems), railways, maritime electronics, truck-based superstructures, off-highway and off-road vehicles, etc.
CANOpen application layer	The CANOpen application layer and communication profile is standardized by EN 50325-4. It defines communication services and objects. In addition, it specifies the object dictionary and the network management (NMT).

CANOpen Manager	The CANOpen manager is responsible for the management of the network. In the CANOpen manager device, there resides the NMT (network management) master, the SDO (service data object) manager, and the Configuration manager.
CiA DS 301	The CANOpen application layer and communication profile specification covers the functionality of CANOpen NMT (network management) slave devices.
CiA DSP 402	The CANOpen device profile for drives and motion controllers defines the interface to frequency inverters, servo controllers as well as stepper motors.
COB-ID	The COB-ID is the object specifying the identifier and additional parameters such as valid/invalid and remote frame support.
communication object (COB)	A communication object is one or more CAN messages with a specific functionality, e.g. PDO, SDO, Emergency, Time, or Error Control
data field	The data field of the CAN data frame contains 0 to 8 byte of user information.
data frame	The CAN data frame carries data from a producer to one or more consumers. It consists of the start of frame bit, the arbitration field, the control field, the CRC field, the data field, the acknowledge field, the end of frame field.
data type	Object attribute in CANOpen defining the data format, e.g. Unsigned8, Integer16, Boolean, etc.
dominant bit	Bit on the CAN bus lines representing dominant state. It has the logical value 0.
dominant state	A dominant state overwrites by definition a recessive state.
Emergency message	Pre-defined communication service in CANOpen mapped into a single 8-byte data frame containing a 2-byte standardized error code, the 1-byte error register, and 5-byte manufacturer-specific information. It is used to communicate device and application failures.
end of frame (EOF)	Seven recessive bits make the EOF field of CAN data and remote frames.
event-driven	Event-driven messages are transmitted when a defined event occurs in the node. This may be a change of input states, elapsing of a local timer, or any other local event.
Index	16-bit address to access the CANOpen dictionary; for array and records the address is extended by an 8-bit sub-index.
Initialization state	NMT slave state in CANOpen that is reached automatically after power on and communication or application reset.
Life guarding	Method in CANOpen to detect that the NMT master does not guard the NMT slave anymore.
master	Communication or application entity that is allowed to control a specific function. In networks this is for example the initialisation of a communication service.
master/slave communication	In master/slave communication system the master initiates and controls the communication. The slave is not allowed to initiate any communication at all.
message	A message in CAN may be a data frame or remote frame.
NMT	Network management in CANOpen.
NMT Master	The NMT Master device performs the network management by means of transmitting the NMT message. With this message, it controls the state machines of all connected NMT Slave devices.

NMT Slave	The NMT Slaves receive the NMT message, which contains commands for the NMT state machine implemented in CANOpen devices.
NMT state machine	The NMT state machines defined for CANOpen. They support different states and the highest prior CAN message transmitted controls the transition to the states by the NMT master .
node	Assembly, linked to the CAN network, capable of communicating across the networking according to the CANOpen protocols.
node guarding	Mechanism used in CANOpen and CAL to detect bus-off or disconnected devices. The NMT master sends a remote frame to the NMT slave that is answered by the corresponding error control message.
node-ID	Unique identifier for a device required by different CAN-based higher-layer protocols in order to assign a CANOpen identifier to this device.
Nominal bit-rate	The nominal bit-rate is the number of bits per second transmitted in the absence of resynchronization by an ideal transmitter.
PDO mapping	In PDOs, there may be mapped up to 64 objects. The PDO mapping is described in the PDO mapping parameters.
Physical layer	Lowest layer in the OSI reference model defining the connectors, bus cables, and electrical or optical signals representing a bit value.
Pre-operational state	In the NMT pre-operational state no CANOpen PDO communication is allowed.
priority	Attribute to a frame controlling its ranking during arbitration. In CAN data and remote frames, the identifier (ID) gives the priority. The lower the ID, the higher is the priority.
recessive bit	Bit on the CAN bus lines representing recessive state. It has the logical value 1.
start of frame	The very first bit of any data and remote frames. *(SOF)* The SOF's state is always dominant.
Stopped state	NMT state in which only NMT messages are performed and under some conditions error control messages are transmitted.
sub-index	8-bit sub-address to access the sub-objects of arrays and records.
SYNC message	Dedicated CANOpen message forcing the receiving nodes to sample the inputs mapped into synchronous Transmit PDOs. Receiving this message causes the node to set the outputs to values received in the previous synchronous Received PDO.
termination resistor	In CAN high-speed networks with bus topology, both ends are terminated with resistors in order to suppress reflections.

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