

WARNING



This is a general manual describing the CANopen Communication Profile of the INFRANOR **CD1-k**, **BD1/k** and **BD2/k** drive. For the installation and commissioning of the drive, please refer to the appropriate manuals.

Maintenance procedures should be attempted only by highly skilled technicians having good knowledge of electronics and servo systems with variable speed (EN 60204-1 standard) and using proper test equipment.

The conformity with the standards and the "CE" approval is only valid if the items are installed according to the recommendations of the amplifiers manuals. Connections are the user's responsibility if recommendations and drawings requirements are not met.

Any contact with electrical parts, even after power down, may involve physical damage.

Wait for at least 5 minutes after power down before handling the amplifiers (a residual voltage of several hundreds of volts may remain during a few minutes).

INFRANOR drives are conceived to be best protected against electrostatic discharges. However, some components are particularly sensitive and may be damaged. Before handling the drives and, particularly, before any contact with the connectors, the user himself must be earthed. Place or store the drives on conducting or electrostatically neutral areas but not on plastic areas, carpeting or insulation material that may be electrostatically loaded.

INFRANOR does not assume any responsibility for any physical or material damage due to improper handling or wrong descriptions of the ordered items.

Any intervention on the items, which is not specified in the manual, will immediately cancel the warranty.

Infranor reserves the right to change any information contained in this manual without notice.

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Chapter 1 – Overview

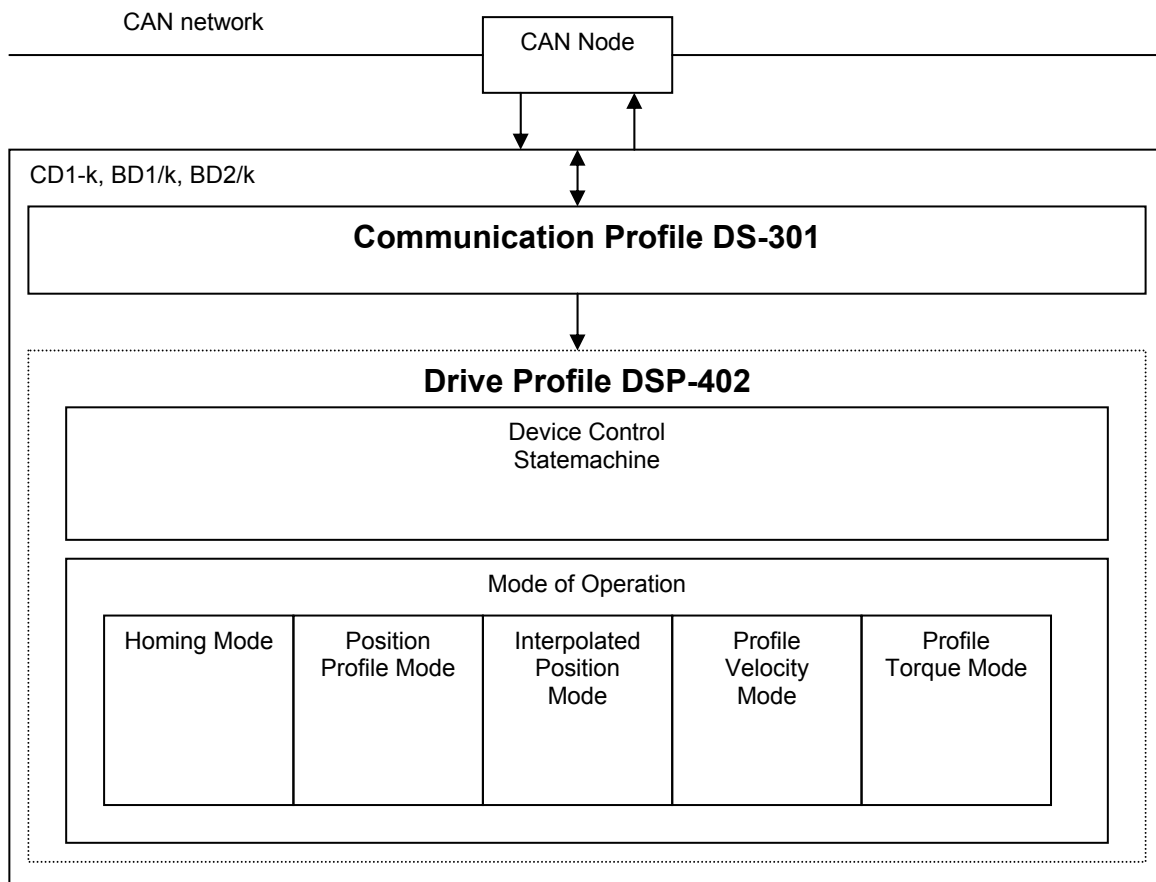
1.1 - REFERENCE

CiA DS-201..207	CAN Application Layer for Industrial Applications Version 1.1
CiA DS-301	Application Layer and Communication Profile Version 4.01
CiA DSP-402	Device Profile: Drive and Motion Control Version 1.1

1.2 - DEFINITIONS

CAN	Controller Area Network
CiA	CAN in Automation e. V. CAN-Bus international manufacturer and user organisation.
CAL	CAN Application Layer. The Application layer for CAN as specified by CiA.
COB	Communication Object is a CAN message. Data must be sent across a CAN network inside a COB.
COB-ID	COB-Identifier. Each CAN message has a single identifier. There are 2032 different identifiers in a CAN network.
NMT	Network Management. One of the services of the application layer. It performs initialisation, configuration and error handling in a CAN network.
PDO	Process Data Object.
SDO	Service Data Object.
pp	Profile Position Mode
pv	Profile Velocity Mode
hm	Homing Mode
ip	Interpolated Position Mode
tq	Profile Torque Mode
pc	Position Control Function
BD1/k	Infranor B range servo drive with resolver feedback
BD2/k	Infranor B range servo drive with encoder feedback
CD1-k	Infranor C range servo drive with resolver feedback

1.3 - ARCHITECTURE



Device Control: The drive starting and stopping are executed by the state machine.

The state machine - handled with a control word and a status word via CAN bus - gives the possibility to control the state of the drive: servo on/off, start/stop movement, fault reset...

Operation modes: The operation mode defines the behaviour of the drive :

Homing Mode: In this mode, various methods can be used to find a home position.

Profile Position Mode: In this mode, a trapezoidal trajectory generator gives the drive the possibility to execute a positioning with pre-set parameters such as target position, profile speed and acceleration.

Interpolated Position Mode: In this mode, the drive interpolates the continuous position reference from a coordinator controller. This mode provides the possibility for multiaxis synchronisation.

Profile Velocity Mode: This is the simple speed mode with speed reference from a host controller.

Profile Torque Mode: Only current loops are closed in this mode.

By default, the **CD1-k**, **BD1/k** and **BD2/k** drives are working in Interpolated Position Mode.

Chapter 2 – Communication Profile

2.1 - COMMUNICATION OBJECTS

2.1.1 - CAN TELEGRAM

SOM	COB-ID	RT R	CTRL	Data segment	CRC	ACK	EOM
-----	--------	---------	------	--------------	-----	-----	-----

SOM : Start Of Message
 COB-ID : COB-Identifier of 11 bits
 RTR : Remote Transmission Request
 CTRL: Control field
 Data : up to 8 bytes
 CRC : Cyclic Redundancy Check
 ACK : Acknowledge
 EOM : End Of Message

2.1.2 - DEFAULT COB-ID

The COB-ID is of 11 bits. Node-ID (bits 0 - 6) is the drive address from 1 to 127.

10	9	8	7	6	5	4	3	2	1	0
Function Code				NODE-ID						

Default COB-ID for the CD1-k, BD1/k and BD2/k drive:

Broadcast objects of the pre-defined connection set:

Object	Function Code	Resulting COB-ID	Communication Parameter at Index
NMT	0000	0	-
SYNC	0001	128 (80h)	1005h, 1006h, 1007h

Peer-to-peer objects of the pre-defined connection set:

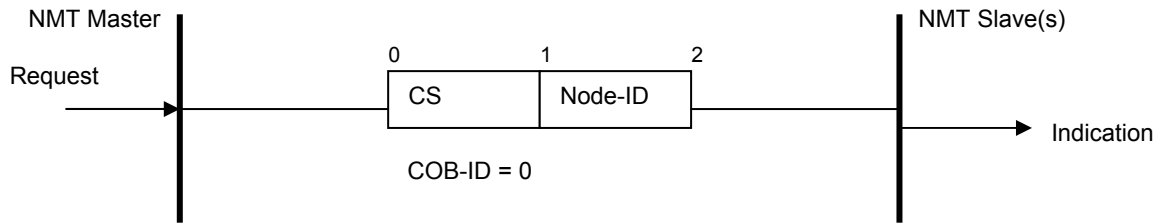
Object	Function Code	Resulting COB-ID	Communication Parameter at Index
EMERGENCY	0001	129 (81h) - 255 (FFh)	1014h
PDO1 (TX)	0011	385 (181h) - 511 (1FFh)	1800h
PDO1 (RX)	0100	513 (201h) - 639 (27Fh)	1400h
PDO3 (TX)	0111	897 (381h) - 1023 (3FFh)	1802h
PDO3 (RX)	1000	1025 (401h) - 1151 (47Fh)	1402h
SDO (TX)	1011	1409 (581h) - 1535 (5FFh)	1200h
SDO (RX)	1100	1537 (601h) - 1663 (67Fh)	1200h

TX = Transmit from drive to master

RX = Receive by drive from master

2.1.3 - NETWORK MANAGEMENT OBJECTS (NMT)

NMT Protocols



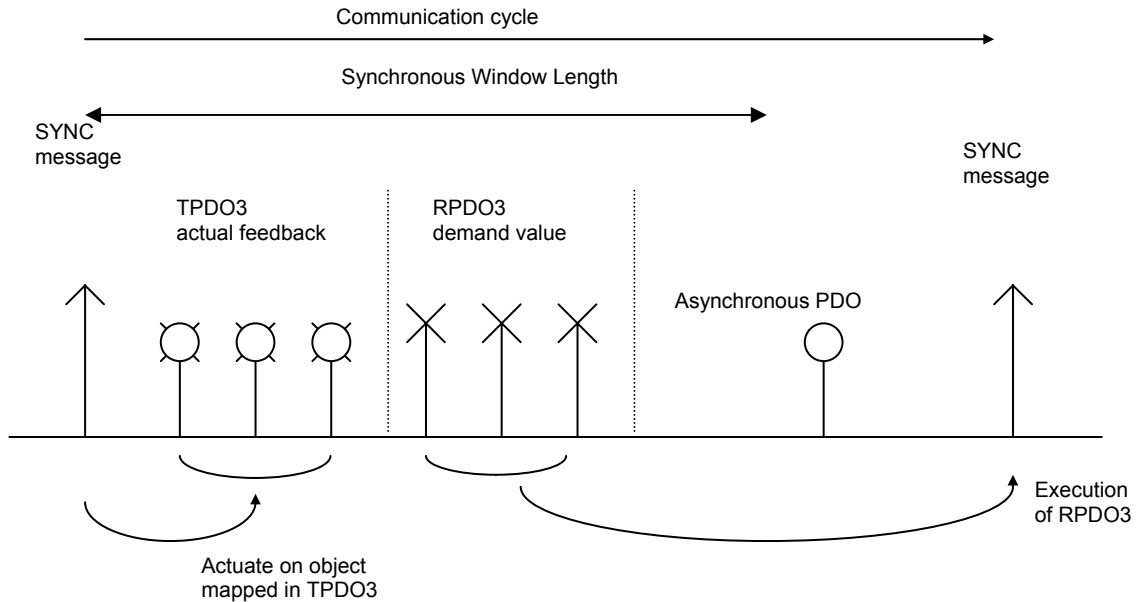
NMT Protocol	Command Specifier CS	Remarks
Start Remote Node	1	Change to NMT Operational state
Stop Remote Node	2	Change to NMT Stop state
Enter Pre-Operational	128	
Reset Node	129	
Reset Communication	130	

Node-ID: The Node-ID indicates the address of the **CD1-k, BD1/k or BD2/k** (defined by switches). If Node_ID = 0, the protocol addresses all NMT slaves.

2.1.4 - SYNCHRONISATION OBJECT (SYNC)

The SYNC object is a broadcast message sent by the master. This message provides a network clock. The period is specified by the communication cycle period (object 1006h). The Infranor servo-drives use this SYNC message to synchronize their clock.

At least 10 cycles are necessary for the servo-drive to start the synchronisation.



2.1.5 - PROCESS DATA OBJECT (PDO)

PDOs are unconfirmed messages used for real-time data exchange. PDOs sent by the master are RPDOs and PDOs sent by the drive are TPDOs. Data in each PDO are defined by a list of objects (PDO mapping).

Infranor servo drives have TPDO1, RPDO1, TPDO3 and RPDO3.

Each PDO is defined by:

- PDO communication parameters at object 1400h + RPDO_number-1 (for RPDO) or 1800h + TPDO_number-1 (for TPDO)
- PDO mapping at object 1600h + RPDO_number-1 (for RPDO) or 1A00h + TPDO_number-1 (for TPDO)

2.1.5.1 - Communication parameters

Communication parameters are:

- PDO COB-ID
- Transmission type

The distribution of COB-ID is defined by default (see section 2.1.2). The modification of COB-ID of PDO can be made in *NMT Pre-Operational State*; the new COB-ID will take effect when the NMT state machine changes to *Operation State*. The modification must not be taken in *NMT Operational State*, otherwise a *Reset_Communication* will be necessary before the new COB-ID takes effect.

Transmission type supported by Infranor Servo Drive:

Transmission type	PDO transmission				
	cyclic	acyclic	synchronous	asynchronous	RTR only
1	TPDO1 TPDO3				
2-240	TPDO3				
253				TPDO1 TPDO3	TPDO1 TPDO3
254			TPDO3		
255				TPDO1	

- Transmission types 1 - 240 are synchronous transmissions with regard to the SYNC messages. A value between 1 and 240 means that the PDO is synchronously and cyclically transferred. The transmission type indicates the number of SYNC which are necessary to trigger PDO transmissions.
- Transmission type 253 means that the PDO is only transmitted on remote transmission request.
- Transmission type 255 is event trigger. The **CD1-k** supports 2 events: change of status word and change of Capture input status.
- Transmission type 254 is specific to **CD1-k** (described in the specific manufacturer chapter).

PDO transmission modes of:

- *Synchronous*: the message is transmitted in synchronisation with the SYNC message. A synchronous message must be transmitted within a pre-defined time-window immediately after the SYNC message.
- *Asynchronous*: the message is sent independently of the SYNC message.

Triggering modes:

- *Event_Driven*:

Message transmission by reception of SYNC. In the Infranor Servo Drive, TPDO3 is used for this purpose.

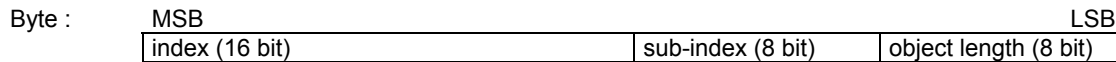
Message transmission by specific event. In the Infranor Servo Drive, TPDO1 is used for this purpose.

- *Remotely requested*: the transmission of an asynchronous PDO is initiated on reception of a remote request by any other device.

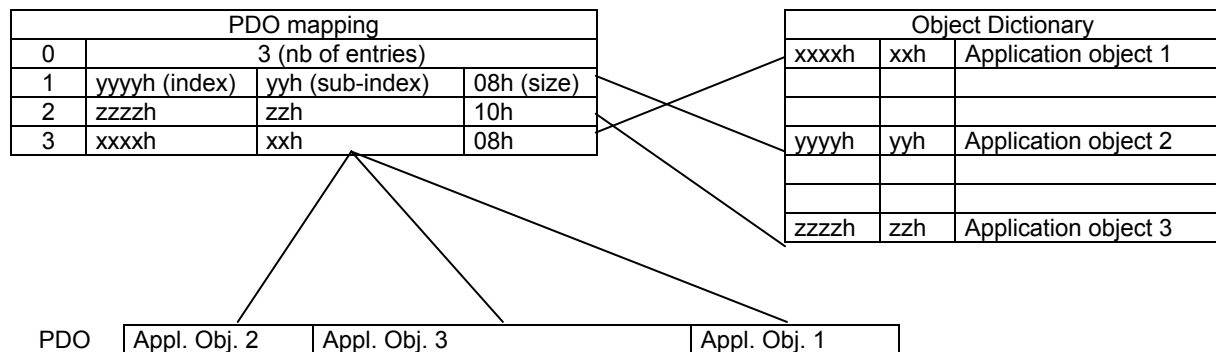
2.1.5.2 - PDO Mapping

The sub-index 0 of mapping parameter contains the number of valid entries within the mapping record. This number of entries is also the number of application variables which shall be transmitted/received with the corresponding PDO. The sub-index 1 to number of entries contains the information about the mapped application variables. These entries describe the PDO contents by their index, sub-index and length (in bits).

Structure of PDO Mapping Entry:



Principle of PDO mapping:



2.1.5.3 - Multiplexed data

The multiplexed data is used to multiplex more than one axis demand value into one message RPDO3. It is possible to send 4 axis demand values (16 bit absolute) with one RPDO3. Therefore, the controller must modify the COB-ID of RPDO3 of each axis to the same cob-ID. For example, for axis 1, object 60C1-1 is mapped into the first mapped object (object 1602-1), for axis 2, object 60C1-1 is mapped into the 2nd mapped object (object 1602-2) and so on... For each axis, the balance of the mapped objects must be mapped with a dummy object.

A dummy object mapped is realized with objects 0002h (integer8), 0003h (integer16), 0004h (integer32), 0005h (unsigned8), 0006h (unsigned16) or 0007h (unsigned32). These objects can be used to map a PDO as a dummy object but cannot be accessed via SDO (see DS-301, 9.5.3 Data type entry specification).

2.1.6 - SERVICE DATA OBJECT (SDO)

The SDO is a communication channel with 2 basic characteristics:

- Client/Server relationship,
- Object Dictionary.

Client/Server:

This is a relationship between a single client and a single server (Infranor Servo Drive). A client issues a request (upload/download) thus triggering the server to perform a certain task. After finishing the task, the server answers the request.

Object Dictionary:

All the objects (variables, constants, records...) of the server are defined as a list of objects where each element is appointed by an index and a sub-index. This list of objects is called object dictionary. This object dictionary allows the client the access to all objects of the server. The Infranor Servo Drive object dictionary consists of 2 parts: the communication profile (DS-301) for the objects related to the CAN communication and the device profile (DSP-402) for objects related to the drive functionality.

For more information about the SDO protocol, please report to the CiA DS-301 version 4.01 specification.

2.1.7 - EMERGENCY OBJECT (EMCY)

The Emergency telegram consists of 8 bytes:

Byte	0	1	2	3	4	5	6	7
Content	Emergency Error Code		Error register (object 1001h)	Manufacturer Specific Error Field (object 3020h)				
				LSB			MSB	

2.1.7.1 - CD1-k Specific Error Field

Bit	Fault	treatment / Cycle	Stop	Remarks
0	Position Limits	Software / 500 µs	0, 1, 3	
1	I ² t	Software / 2 ms	0, 1, 3, warning	
2	RDC	Software / 500 µs	0	
3	Position Following	Software / 500 µs	0, 3	
4	EEPROM	Software		
5	Synchro_CAN	Software / cycle	0, 1, 3	
6	LowSpeed	Software / 500 µs	3, 0, 1	
7	Procedure	Software	0	
8	Current_Offset	Software		Not erasable
13	Motor Temperature	Software / 500 µs	0, 1, 3, warning	
14	Init_400V	Software		Not erasable
15	Overcurrent	Software / 62.5 µs	0, 1, 3	
16	power	Hardware	0	see below
17	power	Hardware	0	see below
18	power	Hardware	0	see below
19	IGBT	Hardware	0	s.c. ASIPM / PWM Error / Alim ASIPM / T° ASIPM / Over I
20	Power Supply Undervoltage	Hardware	0	not stored
21	Resolver Cable Interruption	Hardware	0	

The power faults are coded with bits 16, 17 and 18. The meaning is:

Bit			Meaning
18	17	16	
0	1	0	Overvoltage error
0	1	1	24 V error (18 V to 29 V)
1	0	0	Short-circuit motor phases/ground
1	0	1	System braking resistor error (short-circuit or overload)
1	1	0	Fan system error
1	1	1	Motor brake error

2.1.7.2 - BD1/k Specific Error Field

Bit	Fault	treatment / Cycle	Stop	Remarks
0	Position Limits	Software / 500 µs	0, 1, 3	
1	I ² t	Software / 2 ms	0, 1, 3, warning	
2	RDC	Software / 500 µs	0	
3	Position Following	Software / 500 µs	0, 3	
4	EEPROM	Software		
5	Synchro_CAN	Software / cycle	0, 1, 3	
7	Procedure	Software	0	
9	Power Stage	Hardware	0	
10	Resolver Cable Interruption	Hardware	0	
11	Power Supply Undervoltage	Hardware	0	not stored
12	Amplifier Temperature	Hardware	0	
13	Motor Temperature	Hardware	0	

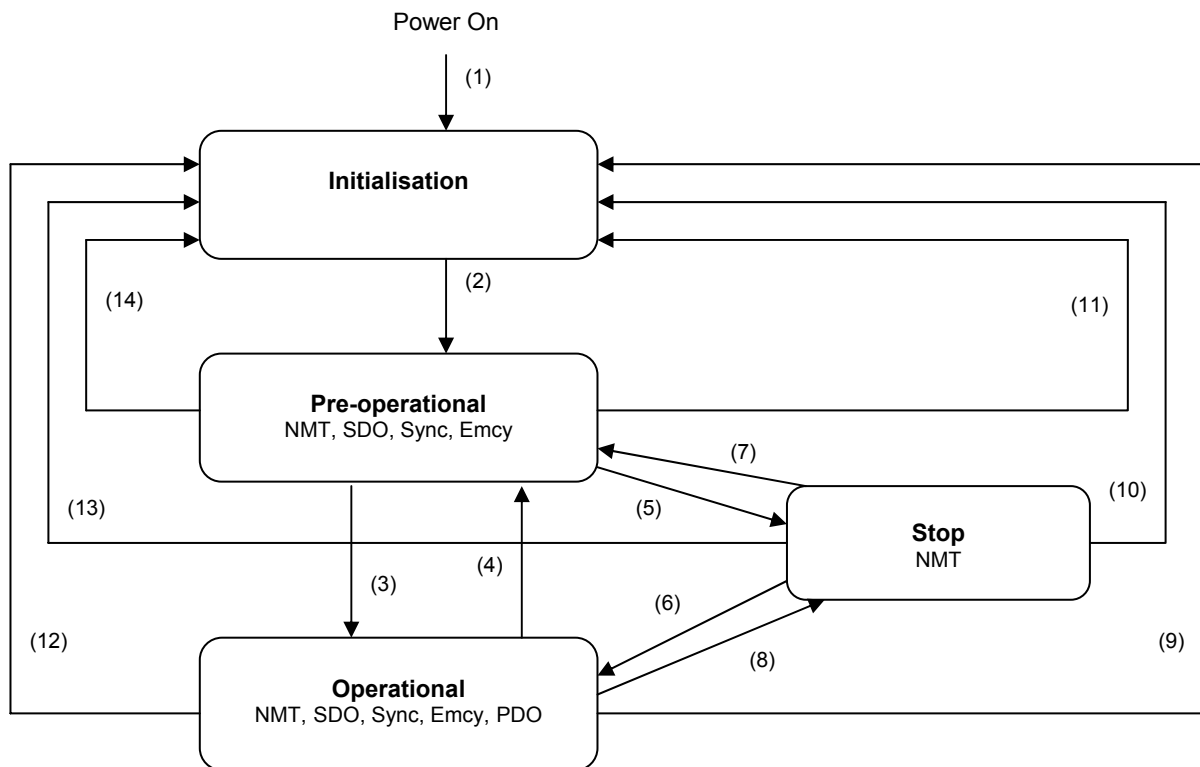
2.1.7.3 - BD2/k Specific Error Field

Bit	Fault	treatment / Cycle	Stop	Remarks
0	Position Limits	Software / 500 µs	0, 1, 3	
1	I ² t	Software / 2 ms	0, 1, 3, warning	
2	Encoder Counting	Software / 500 µs	0, 3	
3	Position Following / Speed Following	Software / 500 µs	0, 1, 3, warning	
4	EEPROM	Software		
5	Synchro_CAN	Software / cycle	0, 1, 3	
6	Hall Effect Sensors	Software	0	
7	Procedure	Software	0	
9	Amplifier Temperature	Hardware	0	
10	Motor Temperature	Hardware	0	
11	Power Stage Failure	Hardware	0	
12	Power Supply Undervoltage	Hardware	0	not stored
15	Encoder Cable Interruption	Hardware	0	

2.2 - NETWORK INITIALISATION AND SYSTEM BOOT-UP

2.2.1 - NMT STATE MACHINE

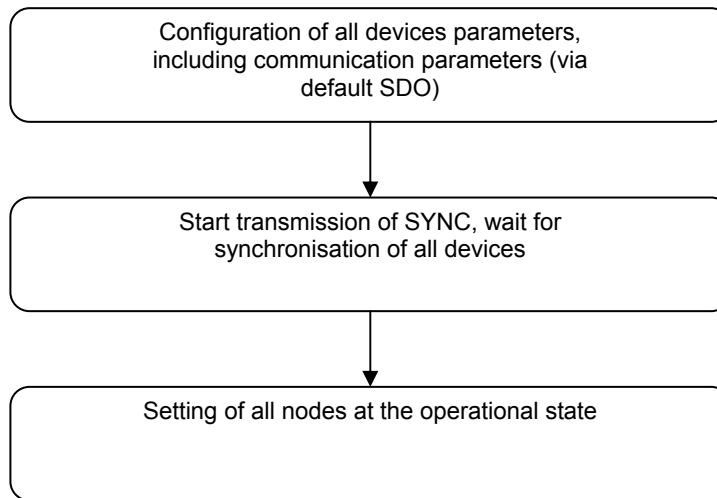
The NMT state machine defines the communication status.



(1)	At Power on, the initialisation state is automatically entered
(2)	Once the Initialisation over, Pre-Operational is automatically entered
(3), (6)	Start_Remote_Node indication
(4), (7)	Enter_Pre-Operational_State indication
(5), (8)	Stop_Remote_Node indication
(9), (10), (11)	Reset_Node indication
(12), (13), (14)	Reset_Communication indication

Minimum Boot-Up consists of one CAN telegram : a broadcast Start_Remote_Node message.

2.2.2 - INITIALISATION PROCEDURE



2.3 - OBJECT DICTIONARY

2.3.1 - GENERAL INFORMATION

2.3.1.1 - Object 1000h: Device Type

This object describes the type of a device.

Index	1000h
Name	Device Type
Object Code	VAR
Data Type	Unsigned32
Access	ro
PDO Mapping	No
Default Value	00020192h

Device Profile Number : 402
Additional Information : 02 Servo Drive

2.3.1.2 - Object 1001h: Error Register

Index	1001h
Name	Error Register
Object Code	VAR
Data Type	Unsigned8
Access	ro
PDO Mapping	No
Default Value	0

Bit Number	Description
0	Generic Error

2.3.1.3 - Object 1008h: Manufacturer Device Name

Index	1008h
Name	Manufacturer Device Name
Object Code	VAR
Data Type	Visible String
Access	ro
PDO Mapping	No
Default Value	'CD1-k' for CD1-k drive. 'BD1/k' for BD1/k drive. 'BD2/k' for BD2/k drive.

2.3.1.4 - Object 1009h: Manufacturer hardware version

Index	1009h
Name	Manufacturer Hardware Version
Object Code	VAR
Data Type	Visible String
Access	ro
PDO Mapping	No

2.3.1.5 - Object 100Ah: Manufacturer software version

Index	100Ah
Name	Manufacturer Software Version
Object Code	VAR
Data Type	Visible String
Access	ro
PDO Mapping	No

2.3.1.6 - Object 100Ch: Guard Time

The guard time (in ms) multiplied by the life time factor gives the life time for Life Guarding Protocol. It is 0 if not used.

Index	100Ch
Name	Guard time
Object Code	VAR
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Default Value	0

2.3.1.7 - Object 100Dh: Life Time factor

Index	100Dh
Name	Life Time Factor
Object Code	VAR
Data Type	Unsigned16
Access	rw
PDO Mapping	No
Default Value	0

2.3.1.8 - Object 1010h: Store Parameters

This object supports the saving of parameters in a non volatile memory. By read access, the device provides information about its saving capacities.

Sub-index 0: largest sub-index that is supported.

Sub-index 1: refers to all parameters that can be stored in the device.

In order to avoid storage of parameters by mistake, storage is only executed when a specific signature is written to the appropriate sub-index. The signature is 'save'.

Signature	MSB		LSB	
	ASCII	hex	ASCII	hex
	e	v	a	s
	65h	76h	61h	73h

On read access to the appropriate sub-index, the device provides information about its storage capabilities:

bit	value	meaning
31-2	0	reserved (=0)
1	0	Device does not save parameters autonomously
	1	Device saves parameters autonomously
0	0	Device does not save parameters on demand
	1	Device saves parameters on demand

For the Infranor Servo Drive, parameters are saved on demand.

2.3.1.9 - Object 1018h: Identity Object

Index	1018h
Name	Identity Object
Object Code	RECORD
Number of Elements	1

Value Description

Sub Index	1
Description	Vendor ID
Data Type	Unsigned32
Access	ro
PDO Mapping	No
Default Value	00000082h

The Vendor ID for Infranor is 082h.

2.3.2 - SYNC OBJECT

2.3.2.1 - Object 1005h: COB-ID Sync message

Index	1005h
Name	COB-ID Sync message
Object Code	VAR
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	00000080h

This object defines the COB-ID of the synchronisation object (SYNC).

The new COB-ID takes immediately effect if it is not changed in NMT Operation State. Otherwise, a *reset_communication* message is necessary.

2.3.2.2 - Object 1006h: Communication Cycle Period

Index	1006h
Name	Communication Cycle Period
Object Code	VAR
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Unit	µs
Value Range	2000..20000
Default Value	10000

This object defines the communication cycle. This period is also used for the synchronisation in interpolated position mode.

2.3.2.3 - Object 1007h: Synchronous Window Length

Index	1007h
Name	Synchronous Window Length
Object Code	VAR
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Unit	µs
Value Range	1500..20000
Default Value	

This object defines the synchronous window in which the drive can latch the value from synchronous PDO (RPDO3). Generally, it can be set at a value equal to (object 1006h) - 10000

2.3.3 - SDO OBJECTS

2.3.3.1 - Object 1200h: Server SDO Parameter

Index	1200h
Name	Server SDO parameter
Object Code	ARRAY
Number of Elements	2

Value Description

Sub Index	1
Description	COB-ID Client -> Server (rx)
Data Type	Unsigned32
Access	ro
PDO Mapping	No
Default Value	600h + Node-ID

Sub Index	2
Description	COB-ID Client -> Server (rx)
Data Type	Unsigned32
Access	ro
PDO Mapping	No
Default Value	580h + Node-ID

For the **CD1-k, BD1/k and BD2/k**, it is not possible to modify the COB-ID of the SDO objects.

2.3.4 - EMERGENCY OBJECT

2.3.4.1 - Object 1014h: COB-ID Emergency message

Index	1014h
Name	COB-ID Emergency message
Object Code	VAR
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	80h + Node-ID

2.3.5 - PDO OBJECTS

2.3.5.1 - Object 1400h: 1st Receive PDO Communication Parameter

Index	1400h
Name	1st Receive PDO Communication Parameter (RPDO1)
Object Code	ARRAY
Number of Elements	2

Value Description

Sub Index	1
Description	COB-ID
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	200h + Node-ID

Sub Index	2
Description	Transmission Type
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Default Value	253

2.3.5.2 - Object 1402h: 3rd Receive PDO Parameter

Index	1402h
Name	3rd Receive PDO Communication Parameter (RPDO3)
Object Code	ARRAY
Number of Elements	2

Value Description

Sub Index	1
Description	COB-ID
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	400h + Node-ID

Sub Index	2
Description	Transmission Type
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Default Value	1

2.3.5.3 - Object 1600h: 1st Receive PDO Mapping

Index	1600h
Name	1st Receive PDO Mapping
Object Code	ARRAY
Number of Elements	0..4

Value Description

Sub Index	0
Description	number of mapped objects
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Default Value	1

Sub Index	1
Description	1st mapped object
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	60400010h (control word)

2.3.5.4 - Object 1602h: 3rd Receive PDO Mapping

Index	1602h
Name	3rd Receive PDO Mapping
Object Code	ARRAY
Number of Elements	0..4

Value Description

Sub Index	0
Description	number of mapped objects
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Default Value	1

Sub Index	1
Description	3rd mapped object
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	60C10120h (Interpolated data record)

2.3.5.5 - Object 1800h: 1st Transmit PDO Parameter

Index	1800h
Name	1st Transmit PDO Communication Parameter (TPDO1)
Object Code	ARRAY
Number of Elements	2

Value Description

Sub Index	1
Description	COB-ID
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	180h + Node-ID

Sub Index	2
Description	Transmission Type
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Default Value	253

2.3.5.6 - Object 1802h: 3rd Transmit PDO Parameter

Index	1802h
Name	3rd Transmit PDO Communication Parameter (TPDO3)
Object Code	ARRAY
Number of Elements	2

Value Description

Sub Index	1
Description	COB-ID
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	380h + Node-ID

Sub Index	2
Description	Transmission Type
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Default Value	1

2.3.5.7 - Object 1A00h: 1st Transmit PDO Mapping

Index	1A00h
Name	1st Transmit PDO Mapping
Object Code	ARRAY
Number of Elements	0..4

Value Description

Sub Index	0
Description	number of mapped objects
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Default Value	1

Sub Index	1
Description	1st mapped object
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	60410010h (status word)

2.3.5.8 - Object 1A02h: 3rd Transmit PDO Mapping

Index	1A02h
Name	3rd Transmit PDO Mapping
Object Code	ARRAY
Number of Elements	0..4

Value Description

Sub Index	0
Description	number of mapped objects
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Default Value	1

Sub Index	1
Description	1st mapped object
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	60640020h (Actual position value)

Chapter 3 – Device Profile

3.1 - PDO MAPPING

By default the Infranor Servo Drive runs in interpolated position mode and the default PDO mapping is for this mode.

3.1.1 - RECEIVE PDO

PDO No.	Mapping Object Index	Mapping Object Name	Comment
1	6040h	Control Word	Controls the state machine
3	60C1h, 1	Interpolation Data Record	Controls the position

The RPDO1 is acyclic and RPDO3 is cyclic and synchronous.

In interpolated position mode, the position reference is given in Interpolated data record according to DSP-402.

3.1.2 - TRANSMIT PDO

PDO No.	Mapping Object Index	Mapping Object Name	Comment
1	6041h	Status Word	shows status
3	6064h	Actual Position	actual position

The TPDO1 is remotely request and the TPDO3 is cyclic and synchronous.

3.2 - COMMON ENTRIES IN THE OBJECT DICTIONARY

3.2.1 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
6402	VAR	Motor Type	Unsigned16	ro
6410	RECORD	Motor Data	-	rw
6502	VAR	Supported Drive Modes	Unsigned32	ro
6504	VAR	Drive Manufacturer	String	ro
6510	RECORD	Drive Data	-	rw
60FD	VAR	Digital Inputs	Unsigned32	ro
60FE	RECORD	Digital Outputs	-	rw

3.2.2 - OBJECT DESCRIPTION

3.2.2.1 - Object 6402h: Motor Type

The motor type is PM Synchronous motor.

Index	6402h
Name	Motor Type
Object Code	VAR
Data Type	Unsigned16
Access	ro
PDO Mapping	No
Default Value	0003

3.2.2.2 - Object 6410h: Motor Data

This object contains information about the connected motor.

The parameters "Number of Motor Pole Pairs", "Motor Phase" and "Sensor Offset" are necessary for the current commutation. These parameters can be calculated by the auto-phasing procedure.

CD1-k Motor Data:

Index	6410h
Name	Motor Data
Object Code	RECORD
Number of Elements	CD1-k: 4 BD1/k: 5 BD2/k: 6

Value Description

Sub Index	1
Description	Motor Id
Data Type	Unsigned16
Access	rw
PDO Mapping	No
Value Range	0..(2 ¹⁴ -1)
Default Value	eeprom
Drives supported	CD1-k, BD1/k, BD2/k
Write Condition	Drive disabled.

Sub Index	2
Description	Number of motor poles pairs This parameter defines the number of motor pole pairs per revolution of a rotating motor.
Data Type	Unsigned16
Access	rw
PDO Mapping	No
Unit	-
Value Range	0..12
Default Value	eeprom
Drives supported	CD1-k, BD1/k, BD2/k
Write Condition	Drive disabled.

Sub Index	3
Description	Phase order corresponds to the phases order (U, V, W) of the motor connection.
Data Type	Unsigned16
Access	rw
PDO Mapping	No
Value Range	0..1
Default Value	eeprom
Drives supported	CD1-k, BD1/k, BD2/k
Write Condition	Drive disabled.

Sub Index	4
Description	Sensor Offset phase shift between sensor and motor rotor.
Data Type	Unsigned16
Access	rw
PDO Mapping	No
Default Value	eeprom
Drives supported	CD1-k, BD1/k, BD2/k
Write Condition	Drive disabled.

CD1-k and BD1/k Sensor Offset (resolver):

Bit number	Description
0-15	Value of the offset 0 to FFFFh (0 to 360° mechanical degree).

The electrical degree of the offset will be:
electrical offset = mechanical value / Number of pole pairs

BD2/k Sensor Offset (encoder):

Bit number	Description
0-14	Absolute value of the offset 0 to 7FFFh (0 to 360° electrical degree).
15	Sign of the offset (encoder wiring direct or reverse)

This parameter is only valid for "Absolute single turn SIN/COS" encoder feedback configuration (see object 3080h).
This parameter value is depending on the SIN/COS encoder adjustment. There is only one value for a motor with a number of pole pairs > 1.

Sub Index	5
Description	Current Phase Lead Coefficient
Data Type	Unsigned16
Access	rw
PDO Mapping	No
Unit	Electrical degree / 1000rpm
Default Value	eeprom
Drives supported	BD1/k, BD2/k
Write Condition	Drive disabled.

This parameter defines the current phase lead according to the specific motor parameters (the effects of this parameter are particularly interesting on motors with low inductance and running at high speeds):

Phase Lead :

$$\tan\varphi = \frac{0,6 \cdot 10^{-7} \cdot K_t \cdot N_p \cdot (\text{MaxMotorSpeed})^2}{L \cdot I_{\text{rated}}}$$

- Kt : Motor torque constant (Nm/A_{eff})
- Np : Number of motor pole pairs
- MaxMotorSpeed: Maximum motor speed (rpm)
- I_{rated} : rated motor current (A_{eff})
- with : 0 ≤ φ ≤ 45°

Advance Phase Lead Coefficient (Electrical degree/1000 rpm) :

$$\text{Coef} = \varphi \frac{1000}{\text{MaxMotorSpeed}}$$

Sub Index	6
Description	Hall Effect Sensors Offset
Data Type	Unsigned16
Access	rw
PDO Mapping	No
Unit	-
Default Value	eeprom
Drives supported	BD2/K

Bit number	Description
0-14	Absolute value of the offset 0 to 7FFFh (0 to 360° electrical degree).
15	Sign of the offset (encoder wiring direct or reverse)

This parameter is only valid for "60° HES" or "120°HES" encoder feedback configuration (see object 3080h). This parameter value is depending on the Hall effect sensors adjustment. There is only one value for a motor with a number of pole pairs > 1.

3.2.2.3 - Object 6502h: Supported Drive Modes

Index	6502h
Name	Supported Drive Modes
Object Code	VAR
Data Type	Unsigned32
Access	ro
PDO Mapping	No
Value	0000006D

The Infranor Servo Drive can be used in following modes:

Bit Number	Description
0	Profile Position Mode
2	Profile Velocity Mode
3	Profile Torque Mode
5	Homing Mode
6	Interpolated Position Mode

3.2.2.4 - Object 6504h: Drive Manufacturer

Index	6504h
Name	Drive Manufacturer
Object Code	VAR
Data Type	Visible String
Access	ro
PDO Mapping	No
Value	'Infranor'

3.2.2.5 - Object 6510h: Drive Data

Index	6510h
Name	Drive Data
Object Code	RECORD
Number of Elements	7

Value Description

Sub Index	1
Description	Drive Family Code This parameter defines the family code for Infranor drives 00 -> BD1/k 01 -> BD2/k 02 -> CD1-k
Data Type	Unsigned16
Access	ro
PDO Mapping	No
Default Value	0002

Sub Index	2
Description	Drive Option Code
Data Type	Unsigned16
Access	ro
PDO Mapping	No
Default Value	0000

Sub Index	3
Description	Drive Voltage
Data Type	Unsigned16
Access	ro
PDO Mapping	No
Unit	V

Sub Index	4
Description	Drive Current Size
Data Type	Unsigned16
Access	ro
PDO Mapping	No
Unit	0.01 A

Sub Index	5
Description	Max Current
Data Type	Unsigned16
Access	rw
PDO Mapping	No
Unit	percent
Value Range	0000h..3FFFh
Default Value	3FFFh

Sub Index	6
Description	Rated Current
Data Type	Unsigned16
Access	rw
PDO Mapping	No
Unit	percent
Value Range	0000h..2000h
Default Value	2000h

Sub Index	7
Description	I ² t Mode
Data Type	Unsigned8
Access	rw
PDO Mapping	No
Unit	-
Value Range	0..1
Default Value	0

3.2.2.6 - Object 60FDh: Digital Inputs

Index	60FDh
Name	Digital Inputs
Object Code	VAR
Data Type	Unsigned32
Access	ro
PDO Mapping	Possible
Value	-

Bit Number	Description
0	Negative Limit Switch
1	Positive Limit Switch
2	Home Switch
3	Inhibit
16	Positive Limit Switch Input / Digital Input 0
17	Negative Limit Switch Input / Digital Input 1
18	INHIBIT
19	INDEX / Digital Input 3
20	CAPTURE / Digital Input 4
21	Low Speed / Digital Input 5

3.2.2.7 - Object 60FEh: Digital Outputs

Index	60FEh
Name	Digital Outputs
Object Code	RECORD
Number of Elements	2

Value Description

Sub Index	1
Description	Physical Outputs
Data Type	Unsigned32
Access	rw
PDO Mapping	Possible
Default Value	0000000h

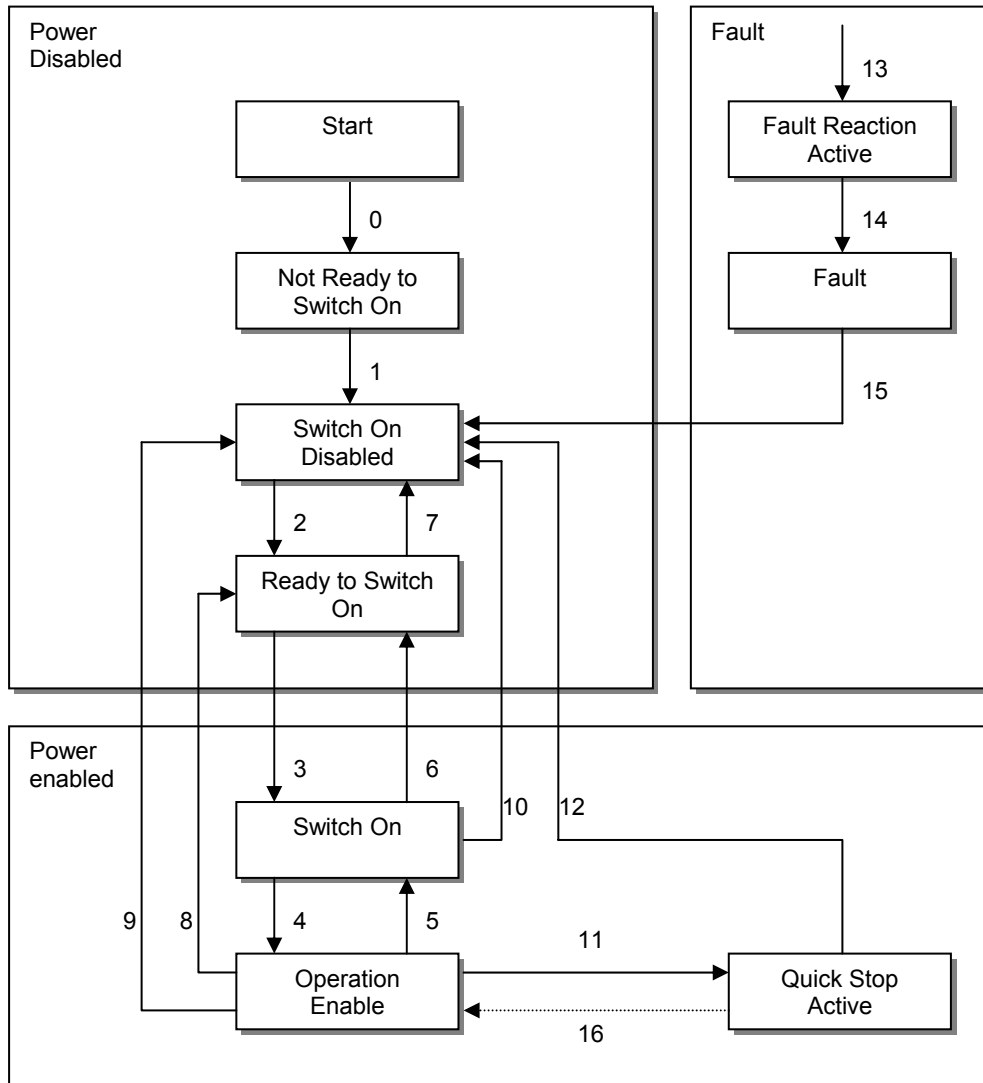
Bit Number	Description
0	Set brake
16	Digital Output 0
17	Digital Output 1
18	Digital Output 2
19	Digital Output 3

Sub Index	2
Description	Bitmask
Data Type	Unsigned32
Access	rw
PDO Mapping	No
Default Value	0000000h

3.3 - DEVICE CONTROL

3.3.1 - DRIVE STATE MACHINE

The state machine describes the status and the control sequence of the drive.



3.3.2 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
6040	VAR	Control Word	Unsigned16	rw
6041	VAR	Status Word	Unsigned16	ro
605A	VAR	Quick Stop Option Code	Integer16	rw
6060	VAR	Mode of Operation	Integer8	wo
6061	VAR	Mode of Operation Display	Integer8	ro

3.3.3 - OBJECT DESCRIPTION

3.3.3.1 - Object 6040h: Control Word

Index	6040h
Name	Control Word
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	Possible
Default Value	0000

Bit Number	Function
0	Switch On
1	Disable Voltage
2	Quick Stop
3	Enable Operation
4	Operation Mode Specific
5	Operation Mode Specific
6	Operation Mode Specific
7	Reset Fault (raising edge)
11	Out_Of_Limit (manufacturer specific)

Device control commands are triggered by the following bit patterns in the control word:

Command / Bit of the control_word	bit 7 Fault Reset	bit 3 Enable Operation	bit 2 Quick Stop	bit 1 Disable Voltage	bit 0 Switch On	Transition
Shutdown	X	X	1	1	0	2, 6, 8
Switch On	X	X	1	1	1	3
Disable Voltage	X	X	X	0	X	7, 9, 10, 12
Quick Stop	X	X	0	1	X	7, 10, 11
Disable Operation	X	0	1	1	1	5
Enable Operation	X	1	1	1	1	4, 16
Fault Reset	↑	X	X	X	X	15

Bit 4, 5, 6 are operation mode specific:

Bit	Profile Position Mode	Homing Mode	Interpolated Position Mode
4	new set point	Homing Operation Start	enable ip_mode
5	change_set_immediately	reserved	reserved
6	0: absolute 1: relative	reserved	reserved

Bit 11: Out_of_Limit. Manufacturer Specific.

When the motor is in limit position, this bit authorizes to move the motor.

3.3.3.2 - Object 6041h: Status Word

The status word indicates the current status of the drive. It is possible to define the TPDO1 to be transmitted at every change of status word (Device Event transmission type).

Index	6041h
Name	Status Word
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	ro
PDO Mapping	Possible
Default Value	-

Bit Number	Function
0	Ready to Switch On
1	Switch On
2	Operation Enabled
3	Fault
4	Voltage Disabled
5	Quick Stop
6	Switch On Disabled
7	Warning
9	Remote
10	Target Reached
12	Operation Mode Specific
13	Operation Mode Specific
14	Manufacturer Specific: Low Speed Mode
15	Manufacturer Specific: Drive Busy

Device Status Bit Meaning:

State	Bit 6 Switch On Disable	Bit 5 Quick Stop	Bit 3 Fault	Bit 2 Operation Enable	Bit 1 Switched On	Bit 0 Ready to Switch On
Not Ready to Switch On	0	X	0	0	0	0
Switch On Disabled	1	X	0	0	0	0
Ready to Switch On	0	1	0	0	0	1
Switched On	0	1	0	0	1	1
Operation Enable	0	1	0	1	1	1
Fault	0	X	1	1	1	1
Fault Reaction Active	0	X	1	1	1	1
Quick Stop Active	0	0	0	1	1	1

Bits 12, 13 are operation mode specific:

Bit	Profile Position Mode	Homing Mode	Interpolated Position Mode	Profile Velocity Mode
12	setpoint acknowledge	Homing attained	Ip-Mode active	Speed = 0
13	Following Error	Homing error	reserved	reserved

3.3.3.3 - Object 605Ah: Quick Stop Option Code

Index	605Ah
Name	Quick Stop Option Code
Object Code	VAR
Data Type	integer16
Object Class	all
Access	rw
PDO Mapping	No
Default Value	3

Quick stop option code	Action
0	Disable drive function
1	Slow down on slow down ramp
3	Slow down on current limit

The slow down ramp is defined in object 3300h.
The slow down current limit is defined in object 3301h.

3.3.3.4. Object 6060h: Mode of Operation

This parameter changes the operation mode of the drive.

Index	6060h
Name	Mode of Operation
Object Code	VAR
Data Type	integer8
Object Class	all
Access	wo
PDO Mapping	Possible

Mode of Operation	Action
1	Profile Position Mode
3	Profile Velocity Mode
4	Torque Profile Mode
6	Homing Mode
7	Interpolated Position Mode

The actual mode is reflected in the operation mode display (object 6061h).

3.3.3.5. Object 6061h: Mode of Operation Display

Index	6061h
Name	Mode of Operation Display
Object Code	VAR
Data Type	integer8
Object Class	all
Access	ro
PDO Mapping	No
Default Value	7

3.4 - FACTOR GROUP

3.4.1 - UNITS

The Units used in the CD1-k, BD1/k and BD2/k are the following:

Position: increment

Velocity: inc/s

Acceleration: inc/s²

Current: percent of current size (a value of 3FFFh means 100%).

3.4.2 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
607E	VAR	Polarity	Unsigned8	rw
608F	RECORD	Position Encoder Resolution		rw

Manufacturer specific object:

Index	Object	Name	Type	Attr.
3080	VAR	Encoder Feedback Type	Unsigned16	rw
308F	VAR	Encoder Feedback Resolution	Unsigned32	rw
3090	VAR	Encoder Pulse Interpolation	Unsigned16	rw
306A	VAR	Second Encoder Selection	Unsigned16	rw

3.4.3 - OBJECT DESCRIPTION

3.4.3.1 - Object 607Eh: Polarity

Index	607Eh
Name	Polarity
Object Code	VAR
Data Type	Unsigned8
Object Class	pc hm pp pv tq ip
Access	rw
PDO Mapping	No
Default Value	00

Bit Number	Description
7	Main Position polarity 0 => multiply by 1 (default) 1 => multiply by -1 CD1-k, BD1/k: resolver BD2/k: encoder
6	Main Velocity polarity 0 => multiply by 1 (default) 1 => multiply by -1 CD1-k, BD1/k: resolver BD2/k: encoder
5	2nd Position polarity 0 => multiply by 1 (default) 1 => multiply by -1 CD1-k, BD1/k, BD2/k: incremental encoder

For CD1-k, BD1/k and BD2/k position and velocity polarity bits are set or reset at the same time.

3.4.3.2 - Object 608Fh: Position Encoder Resolution

Index	608Fh
Name	Position Encoder Resolution
Object Code	ARRAY
Number of Elements	2

Value Description

Sub Index	1
Description	Encoder Increments
Data Type	Unsigned32
Object Class	all
Access	rw
PDO Mapping	No
Unit	inc
Value Range	100h .. 8000h for CD1-k and BD1/k 190h .. 3D0900h for BD2/k
Default Value	eeprom

This parameter defines the resolution for one motor revolution. For a resolver feedback, this parameter affects only the position feedback value, but neither the internal position resolution nor the position accuracy.

Sub Index	2
Description	Motor Revolutions
Data Type	Unsigned32
Access	ro
PDO Mapping	No
Default Value	1

3.4.3.3 - Object 3080h: Encoder Feedback Type (BD2/k)

This parameter value depends on the current settings of the encoder feedback jumpers COD and COM on the amplifier logic board (see [SMT-BD2 digital brushless servo amplifier manual](#)).

Index	3080h
Name	Encoder Feedback Type
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Default Value	eeprom

Value	Description
0	TTL incremental encoder configuration
1	TTL incremental encoder + 60° HES configuration
2	TTL incremental encoder + 120° HES configuration
10h	SIN/COS incremental encoder configuration
11h	SIN/COS incremental encoder + 60° HES configuration
12h	SIN/COS incremental encoder + 120° HES configuration
14h	Absolute single turn SIN/COS encoder

3.4.3.4 - Object 308Fh: Encoder Feedback Resolution (BD2/k)

Number of encoder pulses per motor revolution (rotating motor) or per motor pole pairs (linear motor).

Index	308Fh
Name	Encoder Feedback Resolution
Object Code	VAR
Data Type	Unsigned32
Object Class	all
Access	rw
PDO Mapping	No
Value Range	1F4h .. 0F4240h
Default Value	eeprom

3.4.3.5 - Object 3090h: Encoder Pulse Interpolation (BD2/k)

Index	3090h
Name	Encoder Pulse Interpolation
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Default Value	eeprom

Value	Description
0	No interpolation
1	SinCos interpolation (x1024)

3.4.3.6 - Object 306Ah: Second Encoder Selection (option)

The selection of the second encoder input allows to close the position loop with an extra encoder. Generally, this second encoder is on the load.

Index	306Ah
Name	Second Encoder Selection
Object Code	VAR
Data Type	Unsigned16
Object Class	pc hm pp ip
Access	rw
PDO Mapping	No
Default Value	0

Bit Number	Description
0	Position feedback for position loop 0 => main encoder feedback (resolver for CD1-k and BD1/k and encoder for BD2/k) 1 => second encoder feedback

3.5 - PROFILE POSITION MODE

In this mode, a trapezoidal trajectory generator gives the drive the possibility to execute a positioning with preset parameters as target position, profile speed and acceleration.

3.5.1 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
607A	VAR	Target Position	Integer32	rw
6080	VAR	Max Motor Speed	Unsigned16	rw
6081	VAR	Profile Velocity	Unsigned32	rw
6083	VAR	Profile Acceleration	Unsigned32	rw
6084	VAR	Profile Deceleration	Unsigned32	rw
6086	VAR	Motion Profile Type	Integer16	rw
607D	ARRAY	Software Position Limit	Integer32	rw
6067	VAR	Position Window	Integer32	rw

3.5.2 - OBJECT DESCRIPTION

3.5.2.1 - Object 607Ah: Target Position

Target position is the final position where the motor will move to in profile position mode. The start position is the current position. The positioning begins with the rising edge of bit 4 of the control word (new set point). Bit 6 of control word indicates if the target position is absolute (=0) or relative (=1) movement.

Index	607Ah
Name	Target Position
Object Code	VAR
Data Type	Integer32
Object Class	pc pp
Access	rw
PDO Mapping	Yes
Unit	inc
Value Range	$(-2^{31})..(2^{31}-1)$
Default Value	0

3.5.2.2 - Object 6080h: Max Motor Speed

The *max motor speed* defines the maximum speed the drive can reach. To avoid a saturation of the servo loop, the running speed must be less than *max. motor speed* (depends on the overflow accepted for the servo loop response).

Index	6080h
Name	Max Motor Speed
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Unit	rpm
Value Range	100..20000 rpm for CD1-k 100..14000 rpm for BD1/k and CD1-k2 100..25000 rpm for BD2/k
Default Value	eprom

3.5.2.3 - Object 6081h: Profile Velocity

The *profile velocity* is the running velocity for a positioning. If the positioning is too short, the profile velocity may not be reached.

Index	6081h
Name	Profile Velocity
Object Code	VAR
Data Type	Unsigned32
Object Class	pp
Access	rw
PDO Mapping	No
Unit	inc/s
Value Range	-
Default Value	1000h

3.5.2.4 - Object 6083h: Profile Acceleration

Index	6083h
Name	Profile Acceleration
Object Code	VAR
Data Type	Unsigned32
Object Class	pp
Access	rw
PDO Mapping	No
Unit	inc/s ²
Value Range	-
Default Value	10000h

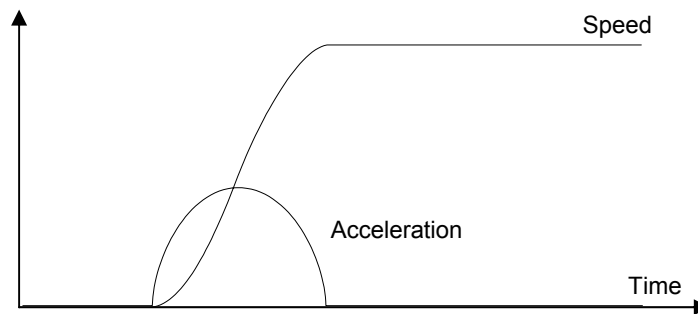
3.5.2.5 - Object 6084h : Profile Deceleration

Index	6084h
Name	Profile Deceleration
Object Code	VAR
Data Type	Unsigned32
Object Class	pp
Access	rw
PDO Mapping	No
Unit	inc/s ²
Value Range	-
Default Value	10000h

3.5.2.6 - Object 6086h: Motion Profile Type

Index	6086h
Name	Motion Profile Type
Object Code	VAR
Data Type	Integer16
Object Class	pp
Access	rw
PDO Mapping	No
Value Range	0 -> Trapezoidal profile -1 -> S-Curve
Default Value	0

The S-curve is defined by a polynomial. The acceleration profile is therefore parabolic.



3.5.2.7 - Object 607Dh: Software Position Limit

When the motor reaches the software position limit, an error will occur. To move out of the limit, the controller can:

- set the bit "out of limit" in control word which authorizes to move the motor.
- or change the "axis type" to rotative.

Index	607Dh
Name	Software Position Limit
Object Code	ARRAY
Number of Elements	2

Value Description

Sub Index	1
Description	Min Position Limit
Data Type	Integer32
Object Class	all
Access	rw
PDO Mapping	No
Unit	inc
Value Range	$(-2^{31})..(2^{31}-1)$
Default Value	-2^{31}

Sub Index	2
Description	Max Position Limit
Data Type	Integer32
Object Class	all
Access	rw
PDO Mapping	No
Unit	inc
Value Range	$(-2^{31})..(2^{31}-1)$
Default Value	$2^{31}-1$

3.5.2.8 - Object 6067h: Position Window

The "Position Window" defines a symmetrical range of accepted positions relatively to the target position. If the current position of the motor is within the position window, this target position is considered as reached (bit 10 of status word - Target Reached - is set). If the position window value is 0, the position window control is not active.

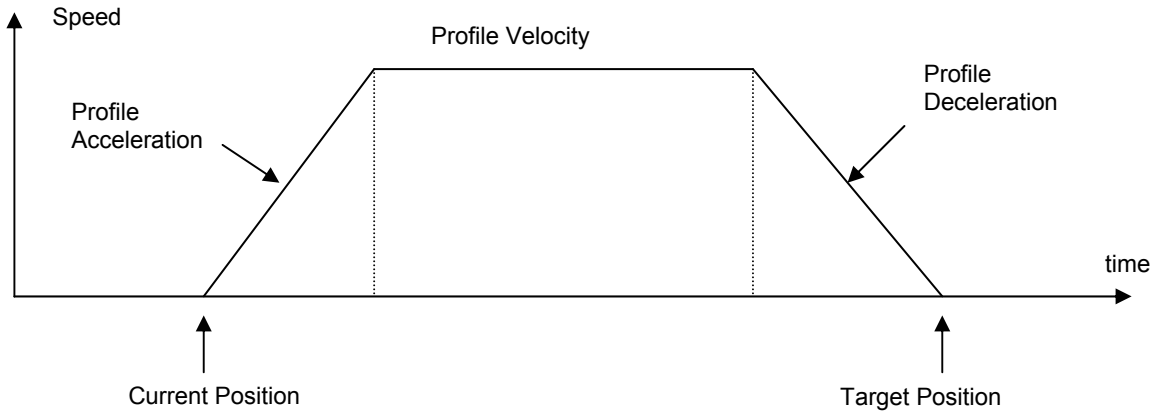
Index	6067h
Name	Position Window
Object Code	VAR
Data Type	Integer32
Object Class	pp
Access	rw
PDO Mapping	No
Unit	inc
Default Value	0

3.5.3 - FUNCTIONAL DESCRIPTION

In profile position mode, these bits in the control word are relative to the control of the trajectory :

Bit Number	Profile Position Mode
4	new set point
5	change set immediately
6	0: absolute 1: relative

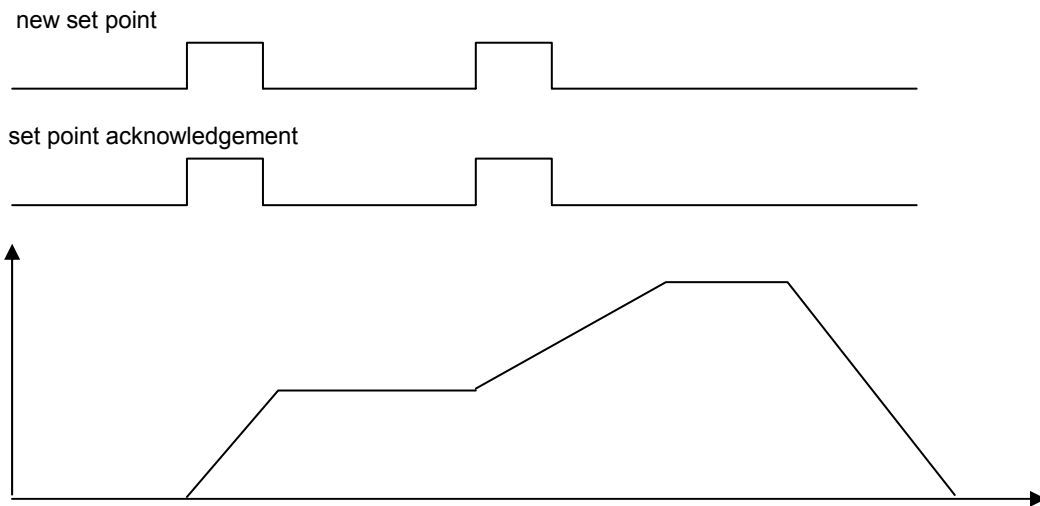
The movement will be triggered by a rising edge of bit 4 (new_set_point) of the control word. The acknowledgement of the new set point is confirmed by bit 12 (setpoint acknowledgement) of the status word. The target position will be taken as relative to the current position if bit 13 of control word = 1.



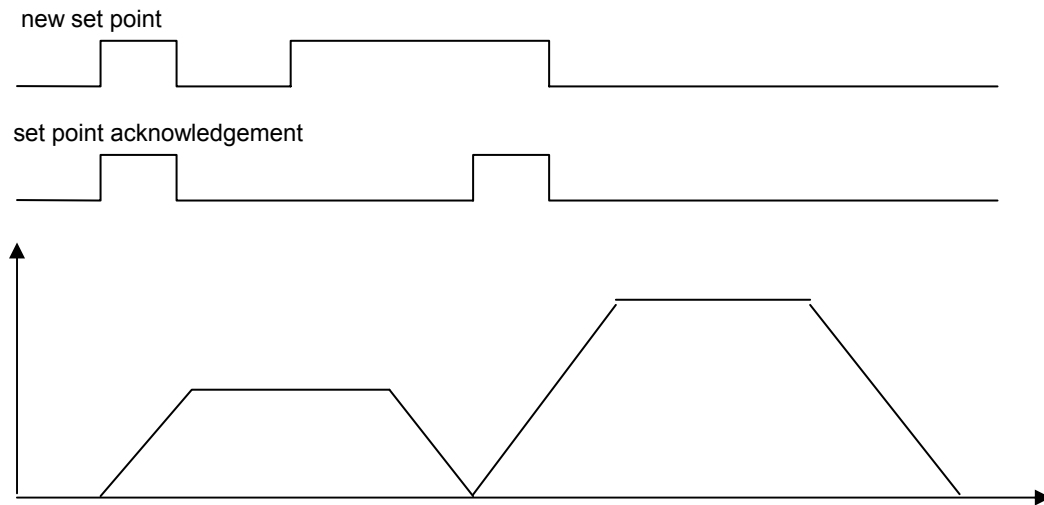
The speed profile is trapezoidal (motion profile type = 0) or S-curve (motion profile type = -1).

Change setpoint immediately

Bit change_set_immediately = 1 :



Bit change_set_immediately = 0 :



3.6 - HOMING MODE

3.6.1 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
607C	VAR	Home Offset	Integer32	rw
6098	VAR	Homing Method	Integer8	rw
6099	ARRAY	Homing Speeds	Unsigned32	rw
609A	VAR	Homing Acceleration	Unsigned32	rw

Manufacturer Specific Objects:

Index	Object	Name	Type	Attr.
309B	VAR	Zero Shift	Unsigned16	rw
309C	VAR	Homing Current Limit	Unsigned16	rw

3.6.2 - OBJECT DESCRIPTION

3.6.2.1 - Object 607Ch: Homing Offset

The *Home Offset* defines the position feedback value when the motor reaches the homing position.

Index	607Ch
Name	Home Offset
Object Code	VAR
Data Type	Integer32
Object Class	hm
Access	rw
PDO Mapping	No
Unit	inc
Value Range	$(-2^{31})..(2^{31}-1)$
Default Value	0

3.6.2.2 - Object 6098h: Homing Method

The *Homing Method* defines various ways of the drive to search the homing position.

Index	6098h
Name	Homing Method
Object Code	VAR
Data Type	Integer8
Object Class	hm
Access	rw
PDO Mapping	No
Default Value	23h

Value Description

Method supported: 1..14, 17..30, 33..35.

Methods specific: -1, -2, -3, -4.

Method	Search for Switch	Search for Index Pulse	Remarks
1	Negative Limit Switch	Exterior	
2	Positive Limit Switch	Exterior	
3	Positive Home Switch	Exterior	
4	Positive Home Switch	Interior	
5	Negative Home Switch	Exterior	
6	Negative Home Switch	Interior	
7	Home Switch, Negative Side	Exterior	Positive Initial Move. Reverse direction on Positive Limit Switch.
8	Home Switch, Negative Side	Interior	Positive Initial Move. Reverse direction on Positive Limit Switch.
9	Home Switch, Positive Side	Interior	Positive Initial Move. Reverse direction on Positive Limit Switch.
10	Home Switch, Positive Side	Exterior	Positive Initial Move. Reverse direction on Positive Limit Switch.
11	Home Switch, Positive Side	Exterior	Negative Initial Move. Reverse direction on Negative Limit Switch.
12	Home Switch, Positive Side	Interior	Negative Initial Move. Reverse direction on Negative Limit Switch.
13	Home Switch, Negative Side	Interior	Negative Initial Move. Reverse direction on Negative Limit Switch.
14	Home Switch, Negative Side	Exterior	Negative Initial Move. Reverse direction on Negative Limit Switch.
17	Negative Limit Switch	-	
18	Positive Limit Switch	-	
19	Positive Home Switch	-	
20	Positive Home Switch	-	
21	Negative Home Switch	-	
22	Negative Home Switch	-	
23	Home Switch, Negative Side	-	
24	Home Switch, Negative Side	-	
25	Home Switch, Positive Side	-	
26	Home Switch, Positive Side	-	
27	Home Switch, Positive Side	-	
28	Home Switch, Positive Side	-	
29	Home Switch, Negative Side	-	
30	Home Switch, Negative Side	-	
33		First Index Pulse	Negative Initial Move.
34		First Index Pulse	Positive Initial Move.
35		-	Homing On Current Position
-1	Mechanical Limit, Negative Move	First Index Pulse	
-2	Mechanical Limit, Positive Move	First Index	

		Pulse	
-3	Mechanical Limit, Negative Move	-	
-4	Mechanical Limit, Positive Move	-	

3.6.2.3 - Object 6099h: Homing Speeds

Homing Speeds defines the motor speed when searching the homing position.

Index	6099h
Name	Homing Speeds
Object Code	ARRAY
Number of Elements	2
Data Type	Unsigned32

Value Description

Sub Index	1
Description	Speed during search of switch
Object Class	hm
Access	rw
PDO Mapping	No
Unit	inc/s
Default Value	00000019h

Sub Index	2
Description	Speed during search of zero
Object Class	hm
Access	rw
PDO Mapping	No
Unit	inc/s
Default Value	0000000Ah

3.6.2.4 - Object 609Ah: Homing Acceleration

Index	609Ah
Name	Homing Acceleration
Object Code	VAR
Data Type	Unsigned32
Object Class	hm
Access	rw
PDO Mapping	No
Unit	inc/s ²
Default Value	00010000h

3.6.2.5 - Object 309Bh: Zero Shift

The "Zero Shift" parameter defines the shift of the zero pulse for the homing search.

Index	309Bh
Name	Zero Shift
Object Code	VAR
Data Type	Unsigned16
Object Class	hm
Access	rw
PDO Mapping	No
Conversion	8000h -> 180 degree
Value Range	0..FFFFh
Default Value	eeprom
Drive Supported	BD1/k

3.6.2.6 - Object 309Ch: Homing Current Limit

The "Homing current limit" defines the limit of current during homing on the mechanical limit. The value is defined as a percent of the drive maximum current (defined by object 6510h sub-index 5).

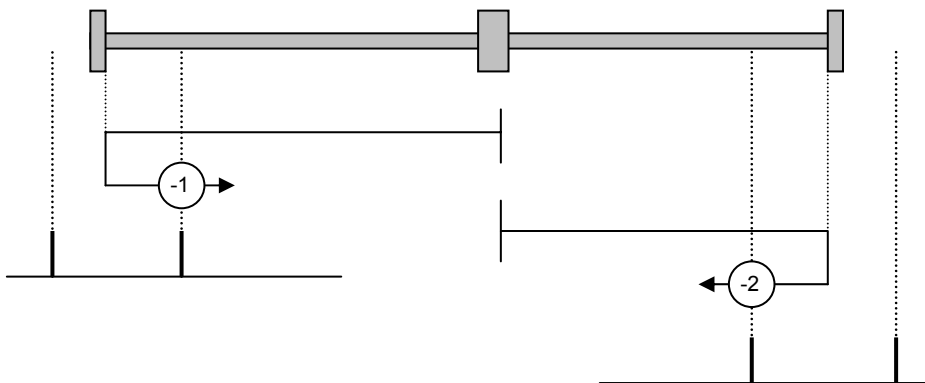
The "percent unit": a value of 4000h means 100 %.

Index	309Ch
Name	Homing Current Limit
Object Code	VAR
Data Type	Unsigned16
Object Class	hm
Access	rw
PDO Mapping	No
Unit	%
Value Range	0 - 4000h
Default Value	400h

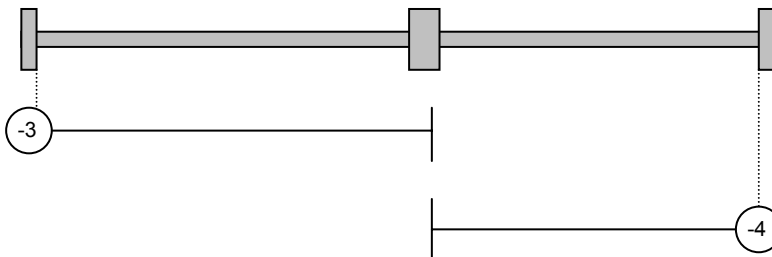
3.6.3 - FUNCTIONAL DESCRIPTION

The "Homing Current Limit" parameter defines the limit of current in the motor during the homing procedure. When the mechanical limit is reached, the current in the motor increases up to this limit and the motor speed is 0. This position will be taken as the homing position. An offset value (object 607Ch) can be used to preset the homing position value).

Method -1 and -2 define homing on mechanical limit with index pulse.



Method -3 and -4 define homing on mechanical limit.



3.7 - POSITION CONTROL FUNCTION

3.7.1 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
6063	VAR	Position Actual Value	Integer32	ro
6064	VAR	Position Actual Value	Integer32	ro
6065	VAR	Following Error Window	Integer32	rw
60FB	RECORD	Position Control Parameter Set		rw

3.7.2 - OBJECT DESCRIPTION

3.7.2.1 - Object 6063h: Position Actual Value*

Index	6063h
Name	Position Actual Value*
Object Code	VAR
Data Type	Integer32
Object Class	all
Access	ro
PDO Mapping	No
Unit	inc
Value Range	$(-2^{31})..(2^{31}-1)$
Drives Supported	CD1-k, BD1/k, BD2/k

3.7.2.2 - Object 6064h: Position Actual Value

Index	6064h
Name	Position Actual Value
Object Code	VAR
Data Type	Integer32
Object Class	all
Access	ro
PDO Mapping	Possible
Unit	inc
Value Range	$(-2^{31})..(2^{31}-1)$
Drives Supported	CD1-k, BD1/k, BD2/k

The **CD1-k, BD1/k and BD2/k** do not support different types of position unit, but only increments. Object 6064h *Position Actual Value* has thus the same unit as 6063h.

3.7.2.3 - Object 6065h: Following Error Window

Index	6065h
Name	Following Error Window
Object Code	VAR
Data Type	Integer32
Object Class	pp ip hm
Access	rw
PDO Mapping	No
Unit	inc
Value Range	0..7FFFh for CD1-k and BD1/k 0..7FFFFFFFh for BD2/k
Default Value	eeeprom
Drives Supported	CD1-k, BD1/k, BD2/k

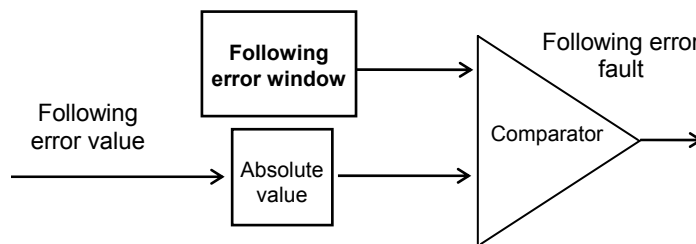
3.7.2.4 - Object 3031h: Position Following Error Dynamic Gain

Index	3031h
Name	Position Following Error Dynamic Gain
Object Code	VAR
Data Type	Unsigned16
Object Class	pp ip hm
Access	rw
PDO Mapping	No
Value Range	0..7FFFh
Default Value	
Drives Supported	BD2/k

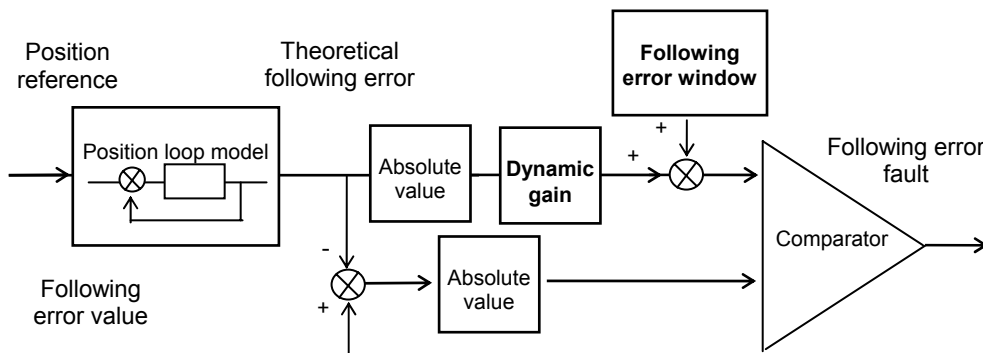
3.7.2.5 - Object 3033h: Position Following Error Detection Mode

Index	3033h
Name	Position Following Error Detection Mode 0 --> Relative to the dynamic model 1 --> Absolute
Object Code	VAR
Data Type	Unsigned16
Object Class	pp ip hm
Access	rw
PDO Mapping	No
Value Range	0..1
Default Value	
Drives Supported	BD2/k

If the following error detection mode is set at 0, the position following error fault is generated as described below:



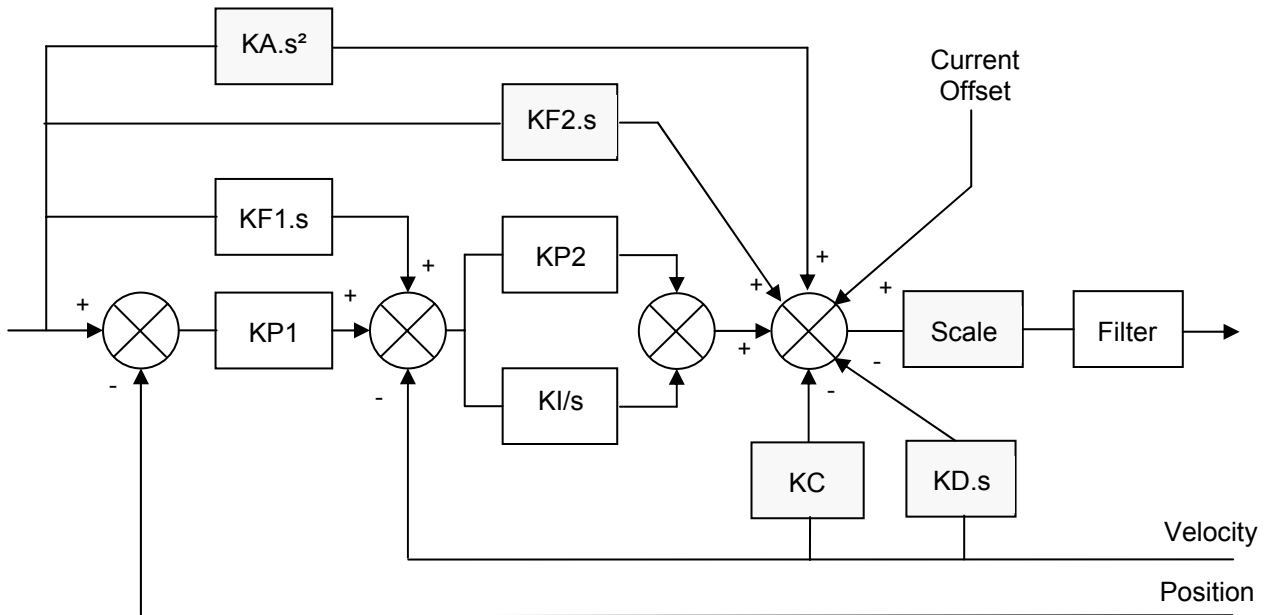
If the following error detection mode is set at 1, the position following error fault is generated as described below:



3.7.2.6 - Object 3214h: Position Error

Index	3033h
Name	Position Error Position Error is the difference between position reference and position feedback.
Object Code	VAR
Data Type	Integer32
Object Class	pp ip hm
Access	ro
PDO Mapping	No

3.7.2.7 - Object 60FBh: Position Control Parameter Set



- KA Feedforward Acceleration (CD1-k and BD2/k only)
- KF1 Feedforward Speed 1
- KF2 Feedforward Speed 2 (CD1-k and BD2/k only)
- KP1 Proportional Position Gain
- KP2 Proportional Speed Gain
- KI Integral Speed Gain
- KC Damping Gain (CD1-k and BD2/k only)
- KD Derivative Gain (BD2/k only)
- Scale Regulator Gains Scaling (BD2/k only)

Index	60FBh
Name	Position Control Parameter Set
Object Code	RECORD
Number of Elements	4

Value Description

Sub Index	1
Description	Proportional Position Gain Defines the proportional gain that acts upon the position error (KP1).
Data Type	Unsigned16
Object Class	pp ip hm
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eprom

Sub Index	2
Description	Feedforward Speed 1 Gain Defines the feedforward term amplitude (KF1) corresponding to the speed input command (derivation of the position input command). This feedforward term allows to reduce the following error during the motor acceleration and deceleration phases.
Data Type	Unsigned16
Object Class	pp ip hm
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eprom

Sub Index	3
Description	Feedforward Acceleration Gain Defines the feedforward acceleration corresponding to the acceleration input command (second derivation of the position input command). This feedforward term allows to reduce the following error during the motor acceleration and deceleration phases. This gain is not supported by the BD1/k and must be set at 0.
Data Type	Unsigned16
Object Class	pp ip hm
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eprom 0 for BD1/k

Sub Index	4
Description	Feedforward Speed 2 Gain This gain value is equal to the damping speed gain value +Feedforward friction gain value. The feedforward friction gain allows to cancel the load viscous friction effect (load viscous friction torque is proportional to axis speed). This feedforward term allows to reduce the following error during the motor acceleration and deceleration phases. This gain is not supported by the BD1/k and must be set at 0.
Data Type	Unsigned16
Object Class	pp ip hm
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eprom 0 for BD1/k

3.8 - INTERPOLATED POSITION MODE

The interpolated position mode is used to control several axes in coordination. The trajectory must be generated by the host controller and the elementary set point is sent at a fixed cycle time (same as communication cycle time) to all axes.

The cycle time synchronisation of all axes is assumed by SYNC message. The flow of set point data must be sent in real-time.

The elementary set point could be only position if linear interpolation is chosen. The cubic interpolation mode requires position and velocity for each set point.

3.8.1 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
60C0	VAR	Interpolation Submode Select	Integer16	rw
60C1	RECORD	Interpolation Data Record		rw
60C4	RECORD	Interpolation Data Configuration		rw

3.8.2 - OBJECT DESCRIPTION

3.8.2.1 - Object 60C0h: Interpolation Submode Select

Index	60C0h
Name	Interpolation Submode Select
Object Code	VAR
Data Type	Integer16
Object Class	ip
Access	rw
PDO Mapping	No
Default Value	0

Interpolation Submode Select	Description
------------------------------	-------------

0	Linear interpolation
-1	Cubic interpolation

3.8.2.2 - Object 60C1h: Interpolation Data Record

Index	60C1h
Name	Interpolation data record
Object Code	RECORD
Number of Elements	2

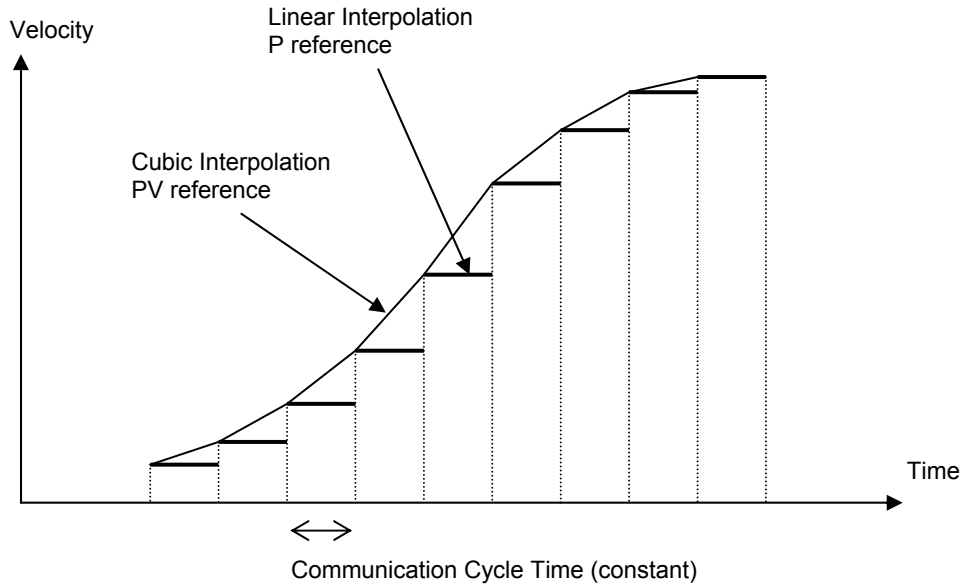
Value Description

Sub Index	1
Description	First parameter of ip function
Data Type	Integer32
Object Class	ip
Access	rw
PDO Mapping	Possible

Sub Index	2
Description	Second parameter of ip function
Data Type	Integer32
Object Class	ip
Access	rw
PDO Mapping	Possible

When in linear interpolation mode, only the first parameter of interpolation data record is used. The data must be the position reference.

When in cubic interpolation mode, the first parameter of interpolation data record must contain position reference and the second parameter of interpolation data record contains velocity reference.



Note: The velocity reference for each set-point must be the instantaneous velocity at this point (not the average velocity).

3.8.2.3 - Object 60C4h: Interpolation Data Configuration

Index	60C4h
Name	Interpolation Data Configuration
Object Code	RECORD
Number of Elements	6

Value Description

Sub Index	1
Description	Max Buffer Size
Data Type	Unsigned32
Object Class	ip
Access	ro
PDO Mapping	No
Default Value	2 for CD1-k 1 for BD1/k

Sub Index	2
Description	Actual Size
Data Type	Unsigned32
Object Class	ip
Access	ro
PDO Mapping	No
Default Value	2 for CD1-k 1 for BD1/k

Sub Index	3
Description	Buffer Organisation
Data Type	Unsigned8
Object Class	ip
Access	ro
PDO Mapping	No
Default Value	0

Sub Index	4
Description	Buffer Position
Data Type	Unsigned16
Object Class	ip
Access	rw for CD1-k ro for BD1/k
PDO Mapping	No
Default Value	0

Sub Index	5
Description	Size of Data record
Data Type	Unsigned8
Object Class	ip
Access	wo
PDO Mapping	No

Sub Index	6
Description	Buffer Clear
Data Type	Unsigned8
Object Class	ip
Access	wo
PDO Mapping	No

3.9 - PROFILE VELOCITY MODE

The profile velocity mode authorizes the drive to operate with a velocity reference. Only speed loop and current loop are closed in this mode.

3.9.1 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
6069	VAR	Velocity Sensor Actual Value	Integer32	ro
606A	VAR	Sensor Selection Code	Integer16	ro
606B	VAR	Velocity Demand Value	Integer32	ro
606C	VAR	Velocity Actual Value	Integer32	ro
60FF	VAR	Target Velocity	Integer32	rw
604F	VAR	Ramp Function	Unsigned32	rw
60F9	RECORD	Velocity Control Parameter Set		rw
30FB	VAR	Regulator Gain Scaling	Unsigned16	rw
3422	VAR	Time interval for speed measurement	Unsigned16	rw

3.9.2 - OBJECT DESCRIPTION

3.9.2.1 - Object 6069h: Velocity Sensor Actual Value

Index	6069h
Name	Velocity Sensor Actual Value
Object Code	VAR
Data Type	Integer32
Object Class	all
Access	ro
PDO Mapping	No
Unit	inc/sec

3.9.2.2 - Object 606Ah: Sensor Selection Code

Index	606Ah
Name	Sensor Selection Code
Object Code	VAR
Data Type	Integer16
Object Class	all
Access	ro
PDO Mapping	No
Default Value	0

Sensor Selection Code	Description
-----------------------	-------------

0	Velocity actual value from position sensor
---	--

3.9.2.3 - Object 606Bh: Velocity Demand Value

Index	606Bh
Name	Velocity Demand Value
Object Code	VAR
Data Type	Integer32
Object Class	pv
Access	ro
PDO Mapping	No
Unit	inc/sec

3.9.2.4 - Object 606Ch: Velocity Actual Value

Index	606Ch
Name	Velocity Actual Value
Object Code	VAR
Data Type	Integer32
Object Class	all
Access	ro
PDO Mapping	Possible
Unit	inc/sec

3.9.2.5 - Object 60FFh: Target Velocity

Index	60FFh
Name	Target Velocity
Object Code	VAR
Data Type	Integer32
Object Class	pv
Access	rw
PDO Mapping	Possible
Unit	inc/sec

3.9.2.6 - Object 604Fh: Ramp Function

Index	604Fh
Name	Ramp Function When different from 0, the ramp function is effective and this parameter defines the time for speed between 0 and max. motor speed (6080h).
Object Code	VAR
Data Type	Unsigned32
Object Class	pv
Access	rw
PDO Mapping	No
Unit	ms
Value Range	0..16383
Default Value	eeprom

3.9.2.7 - Object 60F9h: Velocity Control Parameter Set

Index	60F9h
Name	Velocity Control Parameter Set
Object Code	RECORD
Number of Elements	6 for CD1-k and BD1/k 7 for BD2/k

See 3.7.2.7 for the controller diagram.

Value Description

Sub Index	1
Description	Proportional Speed Gain Defines the proportional regulator gain (KP2) that acts upon the speed error.
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eeprom

Sub Index	2
Description	Integral Speed Gain Defines the integral regulator gain (KI) that acts upon the speed error.
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eeprom

Sub Index	3
Description	Integral 2 Speed Gain This gain is used only in PI ² speed regulator. It is the same as the proportional position gain.
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eeprom

Sub Index	4
Description	Damping Gain This gain is used for getting the maximum servo loop stiffness. This gain is not supported by BD1/k and must be 0.
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eeprom

Sub Index	5
Description	Speed Loop Low-pass filter Defines the cut-off frequency at -3 dB (Fev) of the first order filter that acts upon the current control. The value of this parameter is depending on the selected bandwidth.
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Conversion	Cut-off frequency (Hz) = $1000/\pi * \ln(65536/[60F9-5])$
Value Range	0B10h (1000 Hz) et F069h (20 Hz)
Default Value	eeprom

Sub Index	6
Description	Anti-resonance Filter Selection Enables or inhibits the anti-resonance filter.
Data Type	Unsigned8
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	0..1
Default Value	eeprom

Anti-resonance filter Selection	Function
0	standard filter
1	anti-resonance filter

Sub Index	7
Description	Derivative Gain
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	00..FFFFh
Default Value	eeprom

3.9.2.8 - Object 30FBh: Regulator Gains Scaling (BD2/k)

Index	30FBh
Name	This term is acting like a multiplying factor for the regulator gains (KP2, KC, KI, KD, KA, KB) in order to avoid the gain values saturation when the load/motor inertia ratio is very high.
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Value Range	1..1000
Default Value	1

3.9.2.9 - Object 3422h: Time Interval for speed measurement

Index	3422h
Name	Time Interval for Speed Measurement 0 -> Time interval for speed measurement = 0.5 ms 1 -> Time interval for speed measurement = 1 ms 2 -> Time interval for speed measurement = 2 ms The higher the time interval value, the better the speed measurement resolution but the speed loop gain values must be reduced to maintain the servo loop stability because of the larger speed measurement delay. For the BD2/k drive : The speed measurement resolution value can be calculated according to the following formula : Speed resolution (rpm) = 15000 / Encoder feedback resolution (object 308Fh) / Time interval (ms)
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Default Value	eeprom
Drive Supported	CD1-k (not CD1-k2) and BD2/k

3.9.2.10 - Object 30F5h: Speed Following Error Limit (BD2/k)

Index	30F5h
Name	Speed Following Error Limit
Object Code	VAR
Data Type	Integer32
Object Class	pv
Access	rw
PDO Mapping	No
Unit	inc/sec
Default Value	eeprom
Drive Supported	BD2/k

3.10 - PROFILE TORQUE MODE

In this mode, the drive operates only with current loops and there is no speed or position control.

3.10.1 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
6071	VAR	Target Torque	Integer16	rw
6087	VAR	Torque Slope	Unsigned32	rw
6088	VAR	Torque Profile Type	Integer16	ro
60F6	RECORD	Torque Control Parameter Set		rw

3.10.2 - OBJECT DESCRIPTION

3.10.2.1 - Object 6071h: Target Torque

Index	6071h
Name	Target Torque
Object Code	VAR
Data Type	Integer16
Object Class	tq
Access	rw
PDO Mapping	Possible
Unit	per thousand of the drive max. current

3.10.2.2. Object 6087h: Torque Slope

Index	6087h
Name	Torque Slope
Object Code	VAR
Data Type	Unsigned32
Object Class	tq
Access	rw
PDO Mapping	No
Default Value	0

3.10.2.3 - Object 6088h: Torque profile type

This parameter is not used by Infranor Servo Drives, but only for compatibility.

Index	6088h
Name	Torque profile type
Object Code	VAR
Data Type	Integer16
Object Class	tq
Access	ro
PDO Mapping	No
Default Value	0

3.10.2.4 - Object 60F6h: Torque Control Parameter Set (CD1-k)

This object defines the parameters of the current loops.

This object is only available on the CD1-k drive.

Index	60F6h
Name	Torque Control Parameter Set
Object Code	RECORD
Number of Elements	4

Value Description

Sub Index	1
Description	q-Loop Proportional Gain
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eprom

Sub Index	2
Description	q-Loop Integral Gain
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eprom

Sub Index	3
Description	d-Loop Proportional Gain
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eprom

Sub Index	4
Description	d-Loop Integral Gain
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Value Range	0..FFFFh
Default Value	eprom

3.11 - MANUFACTURER DEVICE SPECIFIC

3.11.1 - OBJECT DICTIONARY ENTRIES

Index	Object	Name	Type	Attr.
<i>Error and Stop Function</i>				
3020	VAR	Drive Error Code	Unsigned32	ro
3021	VAR	Warning Code	Unsigned16	ro
3330	VAR	Fault Reaction Mask 1	Unsigned16	rw
3331	VAR	Fault Reaction Mask 3	Unsigned16	rw
3300	ARRAY	Stop 1 Parameter	Unsigned32	rw
3301	VAR	Stop 3 Parameter	Unsigned16	rw
3302	VAR	Inhibit Parameter	Unsigned16	rw
3310	VAR	Low-Speed Threshold	Unsigned32	rw
3320	RECORD	Motor Temperature Sensor Threshold		rw
3321	VAR	Motor Temperature Monitor	Unsigned16	ro
<i>Current Function</i>				
30D0	VAR	Current Offset	Integer16	rw
30D1	VAR	Current Limitation	Integer16	rw
30D4	VAR	Current Monitor	Integer16	ro
30E0	VAR	Voltage Monitor	Integer16	ro
<i>Inputs/Outputs</i>				
30FD	VAR	Digital Input Bitmask	Unsigned16	rw
<i>Position Control Function</i>				
3210	VAR	Raw Position	Integer32	ro
3211	VAR	Internal Position Offset	Integer32	rw
3212	VAR	Main Position	Integer32	ro
3213	VAR	Secondary Position	Integer32	rw
3360	VAR	Axis Type (Rotative/Linear)	Unsigned8	rw
3350	VAR	Absolute 16 bit mode	Unsigned8	rw
<i>Servo On/Off Timing Function</i>				
3304	VAR	Amplifier Reaction Delay	Unsigned16	rw
3305	VAR	Brake Reaction Delay	Unsigned16	rw
<i>Capture Inputs (CD1-k)</i>				
3380	VAR	Capture Inputs Configuration	Unsigned16	rw
3381	VAR	Capture Inputs Status	Unsigned16	ro
3382	VAR	Capture Input Filter	Unsigned32	rw
3383	VAR	Capture Input 1 Position	Integer32	ro
3384	VAR	Capture Input 2 Position	Integer32	ro
<i>TPDO3 Control</i>				
33A0	VAR	TPDO3 Count	Unsigned8	rw
33A1	VAR	TPDO3 Control	Unsigned8	rw
<i>Auto-Phasing</i>				
3410	VAR	Auto-phasing	Unsigned32	wo
3414	VAR	Motor phasing	Unsigned32	wo
<i>Auto-Tuning</i>				
3421	VAR	Auto-tuning Time Interval Select	Unsigned16	rw
3430	VAR	Auto-tuning Application Requirements	Unsigned16	rw
3420	RECORD	Auto-tuning		rw
<i>Encoder Output</i>				
3480	VAR	Encoder Division Ratio (BD2/k)	Unsigned16	rw
3486	RECORD	Encoder Emulation Output (BD1/k)		rw

3.11.2 - ERROR AND STOP FUNCTION

3.11.2.1 - Object 3020h: Drive Error Code

Index	3020h
Name	Drive Error Code
Object Code	VAR
Data Type	Unsigned32
Object Class	all
Access	ro

See [section 2.1.7](#) for the meaning of this object.

3.11.2.2 - Object 3021h: Warning Code

Index	3021h
Name	Warning Code
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	ro

Bit	Meaning	CD1-k	BD1/k	BD2/k
1	I ² t warning	x	x	x
3	Position Following (BD2/k)			x
9	Limit Switch -	x		x
10	Limit Switch +	x		x
11	Drive over-temperature warning (CD1-k)	x		
13	Motor over-temperature warning (CD1-k)	x		

3.11.2.3 - Object 3330h: Fault Reaction Mask 1

This object defines which errors (when the pertaining bit is set) will trigger a stop 1.

Index	3330h
Name	Fault Reaction Mask 1
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
Default Value	0000h

Bit	Fault
0	Position Limits
1	I ² t
2	RDC
3	Following Error
4	EEPROM
5	Synchro_CAN
6	LowSpeed (CD1-k)
7	Procedure
8	Current_Offset (CD1-k)
13	Temp. Motor (CD1-k)
14	Init_400V (CD1-k)
15	Over Current (CD1-k)

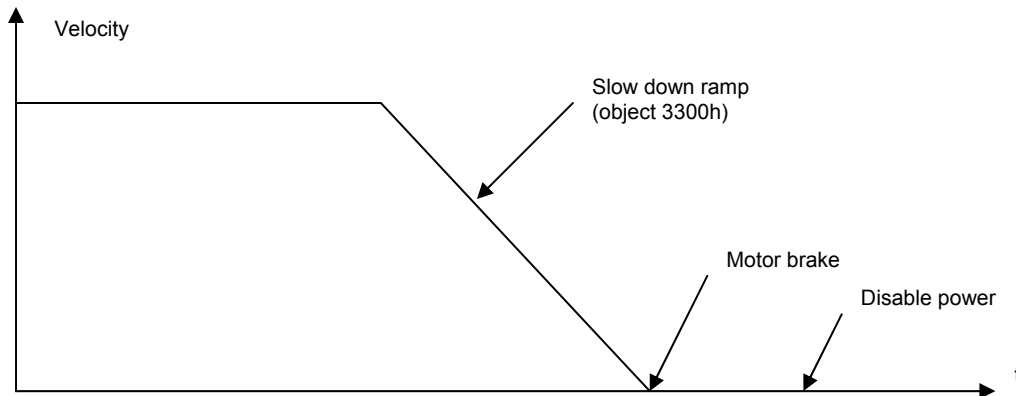
3.11.2.4 - Object 3331h: Fault Reaction Mask 3

This object defines which errors (when the pertaining bit is set) will trigger a stop 3.

Index	3331h
Name	Fault Reaction Mask 3
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
Default Value	0041h for CD1-k 0001h for BD1/k and BD2/k

3.11.2.5 - Object 3300h: Stop 1 Parameter

With stop 1, the motor is slowed down in position mode with a slow down ramp. There are 2 values for the stop 1 ramp: one value when the motor is moving in the positive direction and one value when the motor is moving in the negative direction. This gives the possibility to optimise the stopping time for a vertical axis. For a horizontal axis, these ramps should be the same.



Index	3300h
Name	Stop 1 Parameter
Object Code	ARRAY
Number of Elements	2

Value Description

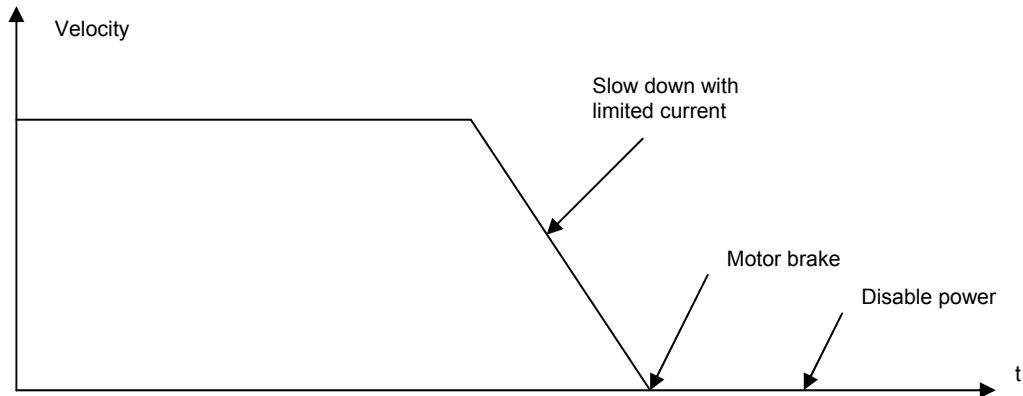
Sub Index	1
Description	Stop 1 Ramp (positive direction)
Data Type	Unsigned32
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Unit	inc/s ²
Default Value	0003D090h

Sub Index	2
Description	Stop 1 Ramp (negative direction)
Data Type	Unsigned32
Object Class	pp ip hm pv
Access	rw
PDO Mapping	No
Unit	inc/s ²
Default Value	0003D090h

3.11.2.6 - Object 3301h: Stop 3 Parameter

Index	3301h
Name	Stop 3 Parameter
Object Code	VAR
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
Unit	Percent of current rating
Default Value	03FFFh

With stop 3, the motor is slowed down in velocity loop with a current limitation.



3.11.2.7 - Object 3302h: Inhibit Parameter (CD1-k)

Index	3302h
Name	Inhibit Parameter
Object Code	VAR
Data Type	Unsigned16
Object Class	pp ip hm pv
Access	rw
Unit	Percent of current rating
Default Value	3FFFh

When the INHIBIT input is activated, the motor is slowed down in velocity loop with a current limitation (as stop 3).

3.11.2.8 - Object 3310h: Low Speed Threshold (CD1-k)

The Low Speed Threshold defines the maximum speed authorized in low speed mode (Low Speed Input is activated). If the motor speed is higher, a low speed error will occur and the motor will be slowed down with the defined stop.

Index	3310h
Name	Low Speed Threshold
Object Code	VAR
Data Type	Unsigned32
Object Class	all
Access	rw
PDO Mapping	No
Unit	inc/sec

3.11.2.9 - Object 3320h: Motor Temperature Sensor (CD1-k)

This object defines the parameters for temperature error detection by a motor temperature sensor.
This object is supported only by CD1-k.

Index	3320h
Name	Motor Temperature Sensor
Object Code	ARRAY
Number of Elements	3

Value Description

Sub Index	1
Description	Sensor Type (CTN/CTP)
Data Type	Unsigned8
Object Class	all
Access	rw
PDO Mapping	No

This parameter defines the sensor type for error detection: 0 means CTN and 1 means CTP.

Sub Index	2
Description	Motor Temperature Sensor Error Threshold
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No

This parameter defines the threshold of the equivalent resistor corresponding to the temperature at which an error will be triggered.

The threshold value is defined below:

$$\text{Threshold} = 40958.5 \times R_{st} / (1.2 + R_{st})$$

R_{st} is the equivalent resistance, in $k\Omega$, of this temperature value.

Sub Index	3
Description	Motor Temperature Sensor Warning Threshold
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No

This parameter defines the threshold of the equivalent resistor corresponding to the temperature at which a warning will be notified.

The threshold value is defined below:

$$\text{Threshold} = 40958.5 \times R_{st} / (1.2 + R_{st})$$

R_{st} is the equivalent resistance, in $k\Omega$, of this temperature value.

3.11.2.10 - Object 3321h: Motor Temperature Sensor Monitor (CD1-k)

Index	3321h
Name	Motor Temperature Sensor Monitor
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	ro
PDO Mapping	No

The returned value gives an image of the equivalent resistance with

$$R = 1.2 \times [3321h] / (40958.5 - [3321h])$$

The temperature corresponding to this resistance depends on the temperature sensor specifications.

3.11.3 - CURRENT FUNCTIONS

3.11.3.1 - Object 30D0h: Current Offset

This parameter defines an offset for the current output. This is useful for a vertical axis.

Index	30D0h
Name	Current Offset
Object Code	VAR
Data Type	Integer16
Object Class	all
Access	rw
PDO Mapping	No
Unit	Percent of drive current
Value Range	0-2000h
Default Value	0

3.11.3.2 - Object 30D1h: Current Limitation

This parameter defines the dynamic limitation of the current output.

Index	30D1h
Name	Current Limitation
Object Code	VAR
Data Type	Integer16
Object Class	all
Access	rw
PDO Mapping	Possible
Unit	Percent of drive current
Default Value	4000h

3.11.3.3 - Object 30D4h: Current Monitor

This object is the motor current monitor. This monitor is calculated with vector transformation. This means that the current monitor is true only if the motor position is correct (no resolver error...).

Index	30D4h
Name	Current Monitor
Object Code	VAR
Data Type	Integer16
Object Class	all
Access	ro
PDO Mapping	Possible
Unit	Percent of Amplifier Size

3.11.3.4 - Object 30E0h: Voltage Monitor (CD1-k)

This object is the motor voltage monitor.

Data conversion: 1000h -> 100V

This object is supported only by the CD1-k drive.

Index	30E0h
Name	Voltage Monitor
Object Code	VAR
Data Type	Integer16
Object Class	all
Access	ro
PDO Mapping	Possible

3.11.4 - INPUTS/OUTPUTS

3.11.4.1 - Object 30FDh: Digital Inputs Bitmask

Index	30FDh
Name	Digital Input Bitmask
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Default Value	003Fh

By default, the digital inputs of the drive are dedicated inputs with special function. Except for the INHIBIT or ENABLE inputs, all other inputs can be dissociated from their function in order to be used as a simple digital input. The status of these inputs can be read by object 60FDh.

Bit	Meaning
0	INPUT0 / Limit Switch +
1	INPUT1 / Limit Switch -
2	INHIBIT or ENABLE
3	INPUT3 / INDEX
4	INPUT4 / CAPTURE
5	INPUT5 / LOWSPEED

3.11.5 - POSITION CONTROL FUNCTION

The motor position (object 6064h) is calculated as shown below:

$$\text{Pos} = \text{RawPos} - \text{Offset}$$

Offset (object 3211h) is a value calculated by the homing procedure.

RawPos (object 3210h) is the position given by the internal counter of the drive. The lowest bits of RawPos allow to calculate the position over one motor revolution (resolver); this value is absolute over one revolution.

$$\text{Resolver} = \text{RawPos} \text{ modulo } [\text{Encoder_increments}]$$

Example: Encoder_increments = 4096, the resolver position will be the lowest 12 bits.

When the homing is done, the backup of the motor position before the logic supply (24 V for the CD1-k and auxiliary supply for the BD1/k and BD2/k) shuts down, allows, under certain conditions, to get back the motor position without homing.

Example: Pos1 (object 6064h) is the motor position and Offset1 (object 3211h) is the offset value before the logic supply shut-down. Pos1 value is absolute when the homing is done. Pos1 and Offset1 are saved.

When the logic supply is on again, Pos2 (object 6064h) is the motor position. When the homing is not done, Offset2 is equal to 0.

So, the following calculation can be made:

$$\begin{aligned} \text{Res1} &= (\text{Pos1} - \text{Offset1}) \text{ modulo } [\text{Encoder_increments}] \\ \text{Res2} &= \text{Pos2} \text{ modulo } [\text{Encoder_increments}] \end{aligned}$$

The motor shifts when the drive is out of logic supply:

$$\text{Motor_Shift} = (\text{Res2} - \text{Res1}) \text{ modulo } [\text{Encoder_increments}]$$

In the example above, where the Encoder_increments = 4096, this subtraction must be done only with 12 bits and a sign extension in order to get the result on 32 bits. The result can be positive or negative.

The motor shift calculation when the drive is out of logic supply is possible as the *Res1* and *Res2* are physically absolute values. But *Res1* and *Res2* are only absolute over one revolution and the true motor shift must not exceed 1/2 rev. or this calculation is not correct.

It is important to define a threshold for an error if the motor shift is large. But there is no way to know if the motor has moved an exact number of revolutions when the drive is out of logic supply.

The motor position we can find is:

$$Pos = Pos1 + Motor_Shift$$

To get this value from object 6064, it is necessary to define the position offset as follows:

$$Offset2 = Pos2 - (Pos1 + Motor_Shift)$$

Remarks:

- Object 3210h is only for information, it is not necessary to calculate the offset.
- To make the above calculation, it is necessary to back-up the internal offset (object 3211h) after the homing procedure and the motor position (object 6064h) before the logic supply shuts down.

3.11.5.1 - Object 3210h: Internal Raw Position

This object returns :

- the position value of the main feedback (resolver for CD1-k and BD1/k or encoder for BD2/k) if the main feedback is selected for position loop,
- the position value of the secondary encoder feedback if the secondary encoder is selected for position loop.

Index	3210h
Name	Internal Raw Position
Object Code	VAR
Data Type	Integer32
Object Class	All
Access	ro
PDO Mapping	No
Unit	Inc

3.11.5.2 - Object 3211h: Internal Position Offset

Index	3211h
Name	Internal Position Offset
Object Code	VAR
Data Type	Integer32
Object Class	All
Access	rw
PDO Mapping	No
Unit	inc

3.11.5.3 - Object 3212h: Main Position

Index	3212h
Name	Main Position This value is the position of the main sensor on the motor (resolver for CD1-k and BD1/k and encoder for BD2/k).
Object Code	VAR
Data Type	Integer32
Object Class	All
Access	ro
PDO Mapping	No
Unit	inc

3.11.5.4 - Object 3213h: Secondary Position

Index	3213h
Name	Secondary Position This value is the position of the secondary sensor (encoder) on the load (option).
Object Code	VAR
Data Type	Integer32
Object Class	All
Access	ro
PDO Mapping	No
Unit	inc

3.11.5.5 - Object 3360h: Axis Type

This parameter define the axis type: linear or rotative.
A linear axis has the software position limit active.

Index	3360h
Name	Axis Type
Object Code	VAR
Data Type	Unsigned8
Object Class	ip pp hm
Access	rw
PDO Mapping	No
Default Value	0

3.11.5.6 - Object 3350h: Absolute 16-bit Mode

Index	3350h
Name	Absolute 16-bit mode
Object Code	VAR
Data Type	Unsigned8
Object Class	ip
Access	rw
PDO Mapping	No
Value Range	0..1
Default Value	0

The position reference in interpolated position mode can be defined as 16-bits only. This is to reduce the bus traffic.

When in 16-bit mode (object 3350h = 1), the position reference in object 60C1-1 via PDO is set at 16 bits and the drive calculates the upper word. At the beginning, it is necessary to set the upper word with object 60C1-1 via SDO (Integer32). The mapping of RPDO3 must be changed to object 60C1 sub-index 1 with 16-bit length.

3.11.6 - SERVO ON/OFF TIMING FUNCTION

The drive can be enabled or disabled by the control word (Switch On/Off). The timing sequence and the timing of the brake can be defined by objects 3304h and 3305h.

3.11.6.1 - Object 3304h: Amplifier Reaction Delay

Index	3304h
Name	Amplifier Reaction Delay
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Unit	ms
Default Value	0

This parameter defines the delay between the servo control by the control word and the effective servo loop output (PWM output). The **CD1-k** drive hardware requires about 45 ms to be active.

3.11.6.2 - Object 3305h: Motor Brake Reaction Delay

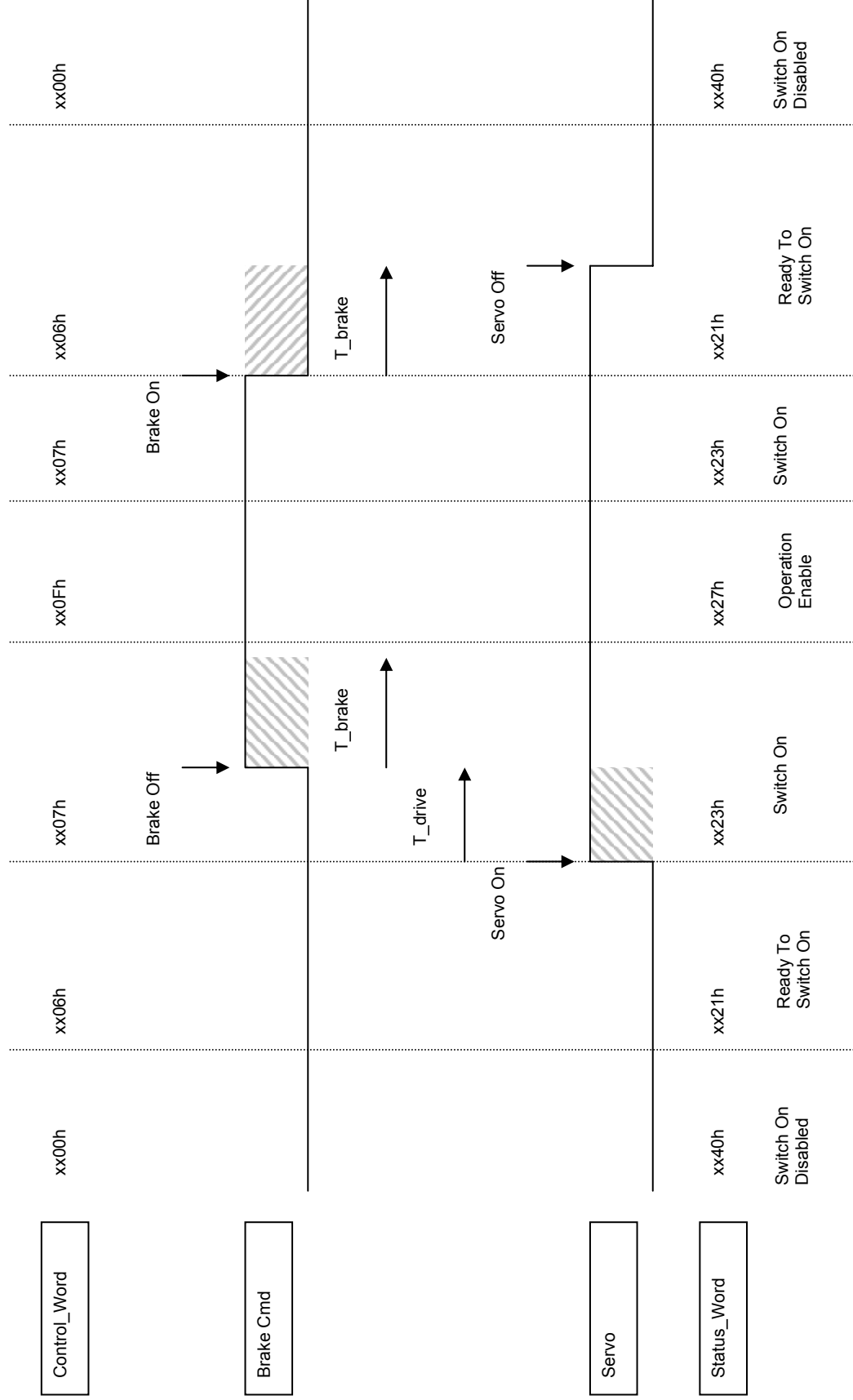
Index	3305h
Name	Motor Brake Reaction Delay
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Unit	ms
Default Value	0

This parameter defines the delay between the brake control and the effective motor brake opening or closing.

The control of the motor brake is automatic with Switch On/Off by the control_word. To disable the motor brake control, it is necessary to set bit 0 of object 60FE sub-index 2 (digital output bitmask). The motor brake is then manually controlled by bit 0 of object 60FE sub-index 1.

If there is no brake on the motor, it is necessary to disable the automatic control to avoid an error.

Servo On/Off Timing Diagram



3.11.7 - POSITION CAPTURE FUNCTION (CD1-K)

The drive can capture the position with 2 inputs:

- CAPTURE input as capture 1
 - INDEX input as capture 2
- at a rate of 125 μ s.

3.11.7.1 - Object 3380h: Capture Inputs Configuration

Index	3380h
Name	Capture Inputs Configuration
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Default Value	0

Bit	Meaning
0	Capture 1 at rising edge
1	Capture 1 at falling edge
2	Capture 2 at rising edge
3	Capture 2 at falling edge

3.11.7.2 - Object 3381h: Capture Inputs Status

Index	3381h
Name	Capture Inputs Status
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	ro
PDO Mapping	Possible (16 bit length or 8 bit length)
Default Value	0

Bit	Meaning
0	Capture at rising edge of input 1 has occurred
1	Capture at falling edge of input 1 has occurred
2	Capture at rising edge of input 2 has occurred
3	Capture at falling edge of input 2 has occurred
4	Capture 1 signal
5	Capture 2 signal
8	Limit Switch +
9	Limit Switch -
10	INHIBIT
11	INDEX
12	CAPTURE
13	LOWSPEED

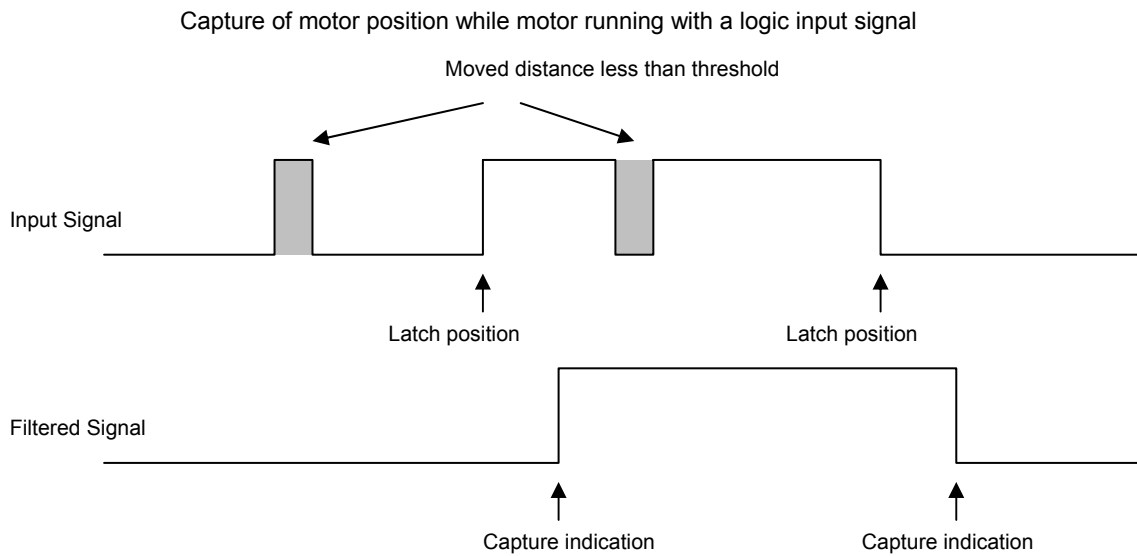
If object 3383h is mapped in a PDO3 (triggered by SYNC event) or PDO1 (triggered by changed value), then bits 0 and 1 are cleared as soon as the captured position value is transmitted by the PDO. Reading object 3383h by SDO does not clear bits 0 and 1.

If object 3384h is mapped in a PDO3 (triggered by SYNC event) or PDO1 (triggered by changed value), then bits 2 and 3 are cleared as soon as the captured position value is transmitted by the PDO. Reading object 3384h by SDO does not clear bits 2 and 3.

Bits 4 and 5 are status of the capture input signal after filtering (see object 3382h below). These status before filtering are monitored in bits 11 and 12.

3.11.7.3 - Object 3382h: Capture Input Filter

This parameter defines the value in distance threshold of the capture input filter. If the difference of position between rising and falling edges is less than the threshold, then the signal is the following:



Index	3382h
Name	Capture Input Filter
Object Code	VAR
Data Type	Unsigned32
Object Class	all
Access	rw
PDO Mapping	No
Unit	inc
Value Range	0..00007FFFh
Default Value	0

3.11.7.4 - Object 3383h: Capture Input 1 Position

This object returns the position latched by input 1 at rising or/and falling edge, as defined in the capture inputs configuration (object 3380h).

Index	3383h
Name	Capture 1 Position
Object Code	VAR
Data Type	Integer32
Object Class	all
Access	ro
PDO Mapping	Possible (16-bit - LSW)
Unit	inc

3.11.7.5 - Object 3384h: Capture Input 2 Position

This object returns the position latched by input 2 at rising or/and falling edge as defined in the capture inputs configuration (object 3380h).

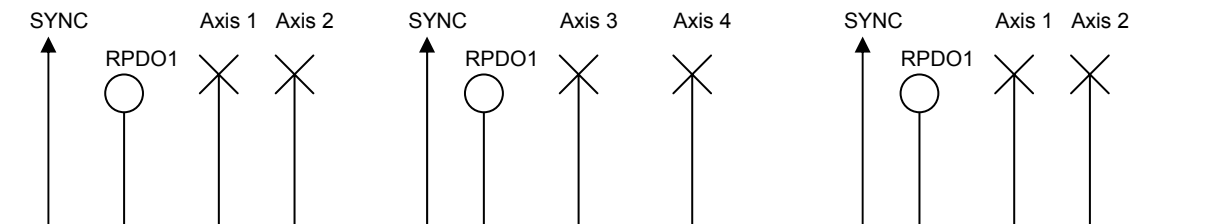
Index	3384h
Name	Capture 2 Position
Object Code	VAR
Data Type	Integer32
Object Class	all
Access	ro
PDO Mapping	Possible (16-bit LSW)
Unit	inc

3.11.8 - TPDO3 CONTROL (CD1-K)

The **CD1-k** has a special transmission mode for the TPDO3 defined by a TPDO3_Control (object 33A1h) and a TPDO3_Count (object 33A0h). The purpose of this mode is to control the number of cyclic TPDO3 for each axis.

TPDO3_Control is predefined for each axis. TPDO3_Count is counter value of the host. For each axis, when TPDO3_Count is equal to TPDO3_Control, it will transmit the TPDO3 in synchronisation with the SYNC message. The transmission type for the TPDO3 must be 254.

To be sure that all axes have got the same value of TPDO3_Count at the same synchronisation, the RPDO1 COB-ID must be redefined to be the same for all axes and mapped with TPDO3_Count object.



3.11.8.1 - Object 33A0h: TPDO3 Count

Index	33A0h
Name	TPDO3 Count
Object Code	VAR
Data Type	Unsigned8
Object Class	all
Access	rw
PDO Mapping	Possible

3.11.8.2 - Object 33A1h: TPDO3 Control

Index	33A1h
Name	TPDO3 Control
Object Code	VAR
Data Type	Unsigned8
Object Class	all
Access	rw
PDO Mapping	No

3.11.9 - PHASING FUNCTION

3.11.9.1 - Object 3410h: Auto-phasing procedure

Writing to this object will execute the auto-phasing procedure. For more information about the auto-phasing procedure, please refer to the User Guide of the corresponding servo drive.

Index	3410h
Name	Auto-phasing procedure
Object Code	VAR
Data Type	Unsigned32
Object Class	-
Access	wo
PDO Mapping	No

In order to avoid running the auto-phasing procedure by mistake, the auto-phasing is only executed when a specific signature is written to the this object. This signature is 'apha'.

Signature	MSB		LSB	
ASCII	a	h	p	a
hex	61h	68h	70h	61h

3.11.9.2 - Object 3414h: Motor phasing procedure (BD2/k)

Writing to this object will execute the motor phasing procedure. This command starts the motor phasing procedure after the amplifier power up when incremental encoder types without Hall Effect Sensors are used ([see BD2/k manual](#)). Enable input must be active.

Index	3414h
Name	Motor phasing procedure
Object Code	VAR
Data Type	Unsigned32
Object Class	-
Access	wo
PDO Mapping	No

In order to avoid running the motor phasing procedure by mistake, the motor phasing is only executed when a specific signature is written to the this object. This signature is 'mcal'.

Signature	MSB		LSB	
ASCII	l	a	c	m
hex	6Ch	61h	63h	6Dh

3.11.10 - AUTO-TUNING FUNCTION

3.11.10.1 - Object 3421h: Auto-tuning Time Interval Selection Mode

Index	3421h
Name	Auto-tuning Time Interval Selection Mode
Object Code	VAR
Data Type	Unsigned16
Object Class	ip pp hm pv
Access	rw
PDO Mapping	No
Value Range	0..1 0 -> manual setting of "Time Interval Speed Measurement " parameter 1 -> automatic setting of "Time Interval Speed Measurement " parameter by auto-tuning. This parameter must be set before starting the auto-tuning. This parameter is not valid for BD1/k or CD1-k2.
Default Value	eeprom

3.11.10.2 - Object 3430h: Auto-tuning Application Requirements (BD2/k)

Index	3430h
Name	Auto-tuning Application Requirements
Object Code	VAR
Data Type	Unsigned16
Object Class	ip pp hm
Access	rw
PDO Mapping	No
Value Range	0..1 0 -> Minimum tracking error 1 -> Minimum overshoot This parameter must be set before starting the auto-tuning.
Default Value	eeprom

3.11.10.3 - Object 3420h: Auto-tuning procedure

Index	3420h
Name	Auto-tuning procedure
Object Code	RECORD
Number of Elements	3

Value Description

Sub Index	1
Description	Bandwidth
Data Type	Unsigned8
Object Class	-
Access	rw
PDO Mapping	No
Value Range	0..8 for CD1-k and BD2/k 0..5 for BD1/k

This parameter defines the auto-tuning bandwidth:

Value	Filter	Bandwidth	CD1-k	BD1/k	BD2/k
0	Standard filter	Low Bandwidth	x	x	x
1	Standard filter	Medium Bandwidth	x	x	x
2	Standard filter	High Bandwidth	x	x	x
3	Anti-resonance filter	Low Bandwidth	x	x	x
4	Anti-resonance filter	Medium Bandwidth	x	x	x
5	Anti-resonance filter	High Bandwidth	x	x	x
6	High stiffness filter	Low Bandwidth	x		x
7	High stiffness filter	Medium Bandwidth	x		x
8	High stiffness filter	High Bandwidth	x		x

Sub Index	2
Description	Start auto-tuning procedure
Data Type	Unsigned32
Object Class	all
Access	wo
PDO Mapping	No

In order to avoid running the auto-tuning procedure by mistake, the auto-tuning is only executed when a specific signature is written to the this sub-index. The signature is 'atun'.

Signature	MSB			LSB
ASCII	n	u	t	a
hex	6Eh	75h	74h	61h

3.11.11 – ENCODER OUTPUT

3.11.11.1 - Object 3480h: Encoder Output Division Ratio (BD2/k)

Index	3480h
Name	Encoder Output Division Ratio Encoder Division Ratio = $1 / 2^{[3480h]}$ Encoder Output Resolution = Encoder Feedback Resolution x Encoder Division Ratio = $[308Fh] / 2^{[3480h]}$
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Value Range	0..3
Default Value	eeprom
Write Condition	Drive disabled.

3.11.11.2 - Object 3486h: Encoder Emulation Output (BD1/k)

Index	3486h
Name	Encoder Emulation Output
Object Code	RECORD
Number of Elements	5

Value Description

Sub Index	1
Description	Encoder Resolution
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Value Range	
Default Value	eeprom

The **Encoder resolution** parameter defines the encoder resolution on channels A and B of the encoder position output for one revolution of the motor shaft. Binary and decimal values are both accepted. The maximum encoder resolution per revolution is limited by the motor speed as shown in the table below:

MAXIMUM POSSIBLE SPEED (rpm)	900	3600	14000
MAXIMUM ENCODER RESOLUTION	8192	4096	1024

Sub Index	2
Description	Number of Zero Pulse
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Value Range	1..16
Default Value	eeprom

The **Number of zero pulse** parameter defines the number of zero pulses on channel Z for one revolution of the motor shaft.

Sub Index	3
Description	Zero Pulse Width
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Value Range	0..32768
Default Value	eeprom

The **Zero pulse width** parameter defines the width (as a resolution) of the zero pulses on channel Z. The adjustment range is between 8 and 32768. 32768 corresponds to one revolution of the motor shaft.

Sub Index	4
Description	Zero Pulse Origin Shift
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Value Range	0..32768
Default Value	eeprom

The **Zero pulse origin shift** parameter defines the shift between the first zero pulse on channel Z and the resolver marker pulse. The adjustment range is between 0 and 32768 points. 32768 points correspond to one revolution of the motor shaft.

Sub Index	5
Description	Encoder Emulation Output Programming Procedure
Data Type	Unsigned32
Object Class	all
Access	wo
PDO Mapping	No

The Programming procedure modifies the encoder emulation output according to the parameters defined by object 3086 subindex 1, 2, 3, 4.

In order to avoid running the encoder emulation output programming procedure by mistake, it is only executed when a specific signature is written to the this sub-index. The signature is 'enco'.

Signature	MSB			LSB
ASCII	o	c	n	e
hex	6Fh	63h	6Eh	65h

Appendix 1 - Object Dictionary

C1 indicates objects supported by the CD1-k.
 B1 indicates objects supported by the BD1/k.
 B2 indicates objects supported by the BD2/k.
 Grayed: Objects not supported by all 3 drives.

COMMUNICATION

Index	Sub-index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
1000	0	Device type	Unsigned32	ro	00020192h	No	x	x	x
1001	0	Error register	Unsigned8	ro	00h	No	x	x	x
1005	0	COB-ID SYNC	Unsigned32	rw	00000080h	No	x	x	x
1006	0	Communication cycle period	Unsigned32	rw	eeeprom	No	x	x	x
1007	0	Synchronous Window Length	Unsigned32	rw		No	x	x	x
1008	0	Manufacturer device name	String	ro	CD1-k BD1/k BD2/k	No	x	x	x
1009	0	Manufacturer hardware version	String	ro		No	x	x	x
100A	0	Manufacturer software version	String	ro		No	x	x	x
100C	0	Guard Time	Unsigned8	rw	00h	No	x	x	x
100D	0	Life Time Factor	Unsigned16	rw	0000h	No	x	x	x
1010		Store Parameters	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	01h	No	x	x	x
	1	Save All Parameters	Unsigned32	rw	Signature = 65766173h	No	x	x	x
1014	0	COB-ID EMCY	Unsigned32	rw	00000080h +Node_Id	No	x	x	x
1018		Identity Object	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	01h	No	x	x	x
	1	Vendor-ID	Unsigned32	ro	00000082h	No	x	x	x
1200		1st Server SDO Parameter	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h	No	x	x	x
	1	COB-ID client => server	Unsigned32	ro	00000600h +Node_Id	No	x	x	x
	2	COB-ID server => client	Unsigned32	ro	00000580h +Node_Id	No	x	x	x
1400		1st Receive PDO Parameter	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h	No	x	x	x
	1	COD-ID	Unsigned32	rw	00000200h +Node_Id	No	x	x	x
	2	transmission type	Unsigned8	rw	FDh	No	x	x	x
1402		3rd Receive PDO Parameter	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h	No	x	x	x
	1	COD-ID	Unsigned32	rw	00000400h +Node_Id	No	x	x	x
	2	transmission type	Unsigned8	rw	01h	No	x	x	x
1600		1st Receive PDO Mapping	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	rw	01h	No	x	x	x
	1	1st object to be mapped	Unsigned32	rw	60400010h	No	x	x	x
	2	2nd object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
	3	3rd object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
	4	4th object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
1602		3rd Receive PDO Mapping	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	rw	01h	No	x	x	x
	1	1st object to be mapped	Unsigned32	rw	60C10120h	No	x	x	x
	2	2nd object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
	3	3rd object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
	4	4th object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
1800		1st Transmit PDO Parameter	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h	No	x	x	x
	1	COD-ID	Unsigned32	rw	00000180h +Node_Id	No	x	x	x
	2	transmission type	Unsigned8	rw	FDh	No	x	x	x

1802		3rd Transmit PDO Parameter	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h	No	x	x	x
	1	COD-ID	Unsigned32	rw	00000380h +Node_Id	No	x	x	x
	2	transmission type	Unsigned8	rw	01h	No	x	x	x
1A00		1st Transmit PDO Mapping	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	rw	01h	No	x	x	x
	1	1st object to be mapped	Unsigned32	rw	60410010h	No	x	x	x
	2	2nd object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
	3	3rd object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
	4	4th object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
1A02		3rd Transmit PDO Mapping	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	rw	01h	No	x	x	x
	1	1st object to be mapped	Unsigned32	rw	60640020h	No	x	x	x
	2	2nd object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
	3	3rd object to be mapped	Unsigned32	rw	00000000h	No	x	x	x
	4	4th object to be mapped	Unsigned32	rw	00000000h	No	x	x	x

COMMON ENTRIES IN THE OBJECT DICTIONARY

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
6402	0	Motor Type	Unsigned16	ro	0003h	No	x	x	x
6410		Motor Data	RECORD						
	0	Number of supported entries	Unsigned8	ro		No	04	05	06
	1	Motor Id	Unsigned16	rw	eprom	No	x	x	x
	2	Number Pair Poles	Unsigned16	rw	eprom	No	x	x	x
	3	Motor Phase	Unsigned16	rw	eprom	No	x	x	x
	4	Sensor Offset	Unsigned16	rw	eprom	No	x	x	x
	5	Current Phase Lead	Unsigned16	rw	eprom	No		x	x
6	Hall Effect Sensors Offset	Unsigned16	rw	eprom	No			x	
6502	0	Supported Drive Modes	Unsigned32	ro	0000006Dh	No	x	x	x
6504	0	Drive Manufacturer	String	ro	Infranor	No	x	x	x
6510		Drive Data	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	07h	No	x	x	x
	1	Drive Family Code	Unsigned16	ro		No	02	00	01
	2	Drive Option Code	Unsigned16	ro	0000h	No	x	x	x
	3	Voltage	Unsigned16	ro		No	x	0	0
	4	Current Size	Unsigned16	ro		No	x	0	0
	5	Max Current	Unsigned16	rw	eprom	No	x	x	x
	6	Rated Current	Unsigned16	rw	eprom	No	x	x	x
7	I ² t Mode	Unsigned8	rw	eprom	No	x	x	x	
60FD	0	Digital Inputs	Unsigned32	ro		Possible	x	x	x
60FE		Digital Outputs	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h	No	x	x	x
	1	Physical Outputs	Unsigned32	rw	00000000h	Possible	x	x	x
	2	Bitmask	Unsigned32	rw	00000000h	No	x	x	x

DEVICE CONTROL

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
6040	0	Control Word	Unsigned16	rw	0000h	No	x	x	x
6041	0	Status Word	Unsigned16	ro	0240h	Possible	x	x	x
6060	0	Mode of Operation	Integer8	wo	07h	Possible	x	x	x
6061	0	Mode of Operation Display	Integer8	ro	07h	Possible	x	x	x
605A	0	Quick Stop Option Code	Integer16	rw	0003h	No	x	x	x

FACTOR GROUP

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
607E	0	Polarity	Unsigned8	rw	00h	No	x	x	x
608F		Position Encoder Resolution	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h	No	x	x	x
	1	Encoder Increments	Unsigned32	rw	eeeprom	No	x	x	x
	2	Motor Revolutions	Unsigned32	ro	00000001h	No	x	x	x
3080	0	Encoder Feedback type	Unsigned16	rw	eeeprom	No			x
308F	0	Encoder Feedback resolution	Unsigned32	rw	eeeprom	No			x
3090	0	Encoder Pulse Interpolation	Unsigned16	rw	eeeprom	No			x
306A	0	Second Encoder Selection	Unsigned16	rw	0000h	No		x	x

PROFILE POSITION MODE

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
607A	0	Target Position	Integer32	rw	00000000h	Possible	x	x	x
6080	0	Max Motor Speed	Unsigned16	rw	eeeprom	No	x	x	x
6081	0	Profile Velocity	Unsigned32	rw	00001000h	No	x	x	x
6083	0	Profile Acceleration	Unsigned32	rw	00010000h	No	x	x	x
6084	0	Profile Deceleration	Unsigned32	rw	00010000h	No	x	x	x
6086	0	Motion Profile Type	Integer16	rw	0000h	No	x	x	x
607D		Software Position Limit	ARRAY				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h	No	x	x	x
	1	Min Position Limit	Integer32	rw	80000000h	No	x	x	x
	2	Max Position Limit	Integer32	rw	7FFFFFFFh	No	x	x	x
6067	0	Position Window	Integer32	rw	00000000h	No	x	x	x

HOMING MODE

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
607C	0	Home Offset	Integer32	rw	00000000h	No	x	x	x
6098	0	Homing Method	Integer8	rw	23h	No	x	x	x
6099		Homing Speeds	ARRAY				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h	No	x	x	x
	1	Speed during search for switch	Unsigned32	rw	00000019h	No	x	x	x
	2	Speed during search for zero	Unsigned32	rw	0000000Ah	No	x	x	x
609A	0	Homing Acceleration	Unsigned32	rw	00010000h	No	x	x	x
309B	0	Zero Shift	Unsigned16	rw	CD1-k: 0000h BD1/k: eeeprom BD2/k: eeeprom	No	x	x	x
309C	0	Homing Current Limit	Unsigned16	rw	0400h	No	x	x	x

POSITION CONTROL FUNCTION

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
6063	0	position actual value*	Integer32	ro		No	x	x	x
6064	0	position actual value	Integer32	ro		Possible Integer32 Integer16	x	x	x
6065	0	following error window	Integer32	rw	eeeprom	No	x	x	x
3031		Position Following Error Dynamic Gain	Unsigned16	rw	eeeprom	No			x
3033		Position Following Error Detection Mode	Unsigned16	rw	eeeprom	No			x
3214	0	Position Error	Integer32	ro		No	x	x	x
60FB		Position Control Parameter Set	RECORD				x	x	x
	0		Unsigned8	ro		No	04	02	04
	1	Proportional Gain	Unsigned16	rw	eeeprom	No	x	x	x
	2	Feed Forward Speed 1 Gain	Unsigned16	rw	eeeprom	No	x	x	x
	3	Feed Forward Acceleration	Unsigned16	rw	eeeprom	No	x		x
	4	Feed Forward Speed 2 Gain	Unsigned16	rw	eeeprom	No	x		x

INTERPOLATED POSITION MODE

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
60C0	0	interpolation submode select	Integer16	rw	0000h	No	x	x	x
60C1		Interpolation data record	RECORD				x	x	x
	0	Number of supported entries	unsigned8	ro	02h		x	x	x
	1	First parameter of ip function	integer32	rw		Possible integer32 integer16	x	x	x
	2	Second parameter of ip function	integer32	rw		Possible	x	x	x
60C4		Interpolation Data Configuration	RECORD				x	x	x
	0	Number of supported entries	unsigned8	ro	06h		x	x	x
	1	Max Buffer Size	unsigned32	ro	2 for CD1-k 1 for BD1/k	No	x	x	x
	2	Actual Size	unsigned32	ro	2 for CD1-k 1 for BD1/k	No	x	x	x
	3	Buffer Organization	unsigned8	ro	00h	No	x	x	x
	4	Buffer Position	unsigned16		00h	No	rw	ro	ro
	5	Size of Data Record	unsigned8	wo		No	x	x	x
	6	Buffer Clear	unsigned8	wo		No	x	x	x

PROFILE VELOCITY MODE

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
6069	0	Velocity Sensor Actual Value	integer32	ro		No	x	x	x
606A	0	Sensor Selection Code	Integer16	ro	0000h	No	x	x	x
606B	0	Velocity Demand Value	Integer32	ro		No	x	x	x
606C	0	Velocity Actual Value	Integer32	ro		Possible	x	x	x
60FF	0	Target Velocity	Integer32	rw	00000000h	Possible	x	x	x
604F	0	Ramp Function	Unsigned32	rw	eeeprom	No	x	x	x
60F9		Velocity Control Parameter Set	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro		No	06	06	07
	1	Proportional Gain	Unsigned16	rw	eeeprom	No	x	x	x
	2	Integral 1 Gain	Unsigned16	rw	eeeprom	No	x	x	x
	3	Integral 2 Gain	Unsigned16	rw	eeeprom	No	x	x	x
	4	Damping Gain	Unsigned16	rw	eeeprom	No	x	0	x
	5	Speed Error Low-pass Filter	Unsigned16	rw	eeeprom	No	x	x	x
	6	Anti-resonance filter	Unsigned8	rw	eeeprom	No	x	x	x
7	Derivative Gain	Unsigned16	rw	eeeprom	No			x	
30FB	0	Regulator Gains Scaling	Unsigned16	rw	eeeprom	No			x
3422	0	Time Interval for Speed Measurement	Unsigned16	rw	eeeprom	No	x		x
30F5	0	Speed Following Error Limit	Integer16	rw	eeeprom	No			x

PROFILE TORQUE MODE

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
6071	0	Target Torque	Integer16	rw		Possible	x	x	x
6087	0	Torque Slope	Unsigned32	rw		No	x	x	x
6088	0	Torque Profile Type	Integer16	ro		No	x	x	x
60F6		Torque Control Parameter Set	RECORD				x		
	0	Number of supported entries	Unsigned8	ro	04h	No	x		
	1	q-Loop Proportional Gain	Unsigned16	rw	eeeprom	No	x		
	2	q-Loop Integral Gain	Unsigned16	rw	eeeprom	No	x		
	3	d-Loop Proportional Gain	Unsigned16	rw	eeeprom	No	x		
4	d-Loop Integral Gain	Unsigned16	rw	eeeprom	No	x			

MANUFACTURER SPECIFIC

Index	Sub-Index	Name	Type	Attr.	Default Value	PDO	C1	B1	B2
3020	0	Drive Error Code	Unsigned32	ro	00000000h		x	x	x
3021	0	Warning Code	Unsigned16	ro	0000h		x	x	x
306A	0	2nd Encoder Selection	Unsigned16	rw	0000h			x	x
30D0	0	Current Offset	Integer16	rw	0000h		x		x
30D1	0	Current Limitation	Integer16	rw	3FFFh	Possible	x	x	x
30D4	0	Current Monitor	Integer16	ro		Possible	x	x	
30E0	0	Voltage Monitor	Integer16	ro		Possible	x		
30FD	0	Digital Inputs Configuration	Unsigned16	rw	003Fh		x	x	x
3210	0	Raw Position	Integer32	ro			x	x	x
3211	0	Internal Position Offset	Integer32	rw	00000000h		x	x	x
3212	0	Main Position	Integer32	ro			x	x	x
3213	0	Secondary Position	Integer32	rw				x	x
3300		Stop 1 Ramp	RECORD				x	x	x
	0	Number of supported entries	Unsigned8	ro	02h		x	x	x
	1	Stop 1 Ramp Pos	Unsigned32	rw	0003D090h		x	x	x
	2	Stop 1 Ramp Neg	Unsigned32	rw	0003D090h		x	x	x
3301	0	Stop 2 Current Limit	Unsigned16	rw	3FFFh		x	x	x
3302	0	Inhibit Current Limit	Unsigned16	rw	3FFFh		x		
3304	0	Amplifier Reaction Delay	Unsigned16	rw	00h		x	x	x
3305	0	Brake Reaction Delay	Unsigned16	rw	00h		x	x	x
3310	0	Low speed threshold	Unsigned32	rw			x		
3320		Motor Temperature Sensor	RECORD				x		
	0	Number of supported entries	Unsigned8	ro	03h		x		
	1	CTP/CTN	Unsigned8	rw	eeeprom		x		
	2	Motor Temperature Sensor Error Threshold	Unsigned16	rw	eeeprom		x		
	3	Motor Temperature Sensor Warning Threshold	Unsigned16	rw	eeeprom		x		
3321	0	Motor temperature sensor monitor	Unsigned16	rw	0000h		x		
3330	0	Fault Reaction Mask 1	Unsigned16	rw	0000h		x	x	x
3331	0	Fault Reaction Mask 2	Unsigned16	rw	CD1-k: 0041h BD1/k: 0001h BD2/k: 0001h		x	x	x
3350	0	Absolute 16 bit mode	Unsigned8	rw	00h		x	x	x
3360	0	Axis Type (rotative/linear)	Unsigned8	rw	00h		x	x	x
3380	0	Fast Inputs Configuration	Unsigned16	rw			x		
3381	0	Fast Inputs Status	Unsigned16	ro		Possible Unsigned8 Unsigned16	x		
3382	0	Fast Input Position Filter	Unsigned32	rw	00000000h		x		
3383	0	Fast Input 1 Capture	Integer32	ro		Possible Integer16	x		
3384	0	Fast Input 2 Capture	Integer32	ro		Possible Integer16	x		
33A0	0	TPDO3 Count	Unsigned8	rw	00h		x		
33A1	0	TPDO3 Control	Unsigned8	rw	00h		x		
3410	0	Auto-phasing	Unsigned32	wo	Signature = 61687061h	No	x	x	x
3414	0	Motor Phasing	Unsigned32	wo	Signature = 6C61636Dh	No			x
3420		Auto-tuning	RECORD			No	x	x	x
	0	Number of supported entries	Unsigned8	ro	02h		x	x	x
	1	Bandwidth	Unsigned8	rw	eprom		x	x	x
	2	Start	Unsigned32	wo	Signature = 6E757461h		x	x	x
3421	0	Auto-tuning Time Interval Selection Mode	Unsigned16	rw	eeeprom		x		x
3430	0	Auto-tuning Application Requirements	Unsigned16	rw	eeeprom				x
3480	0	Encoder Output Division Ratio	Unsigned16	rw	eeeprom				x

3486		Encoder Emulation Output	Unsigned16	rw	eeeprom			x	
	0	Number of supported entries	Unsigned8	ro	05h	No		x	
	1	Encoder Resolution	Unsigned16	rw	eeeprom	No		x	
	2	Number of Zero Pulse	Unsigned16	rw	eeeprom	No		x	
	3	Zero Pulse Width	Unsigned16	rw	eeeprom	No		x	
	4	Zero Pulse Origin Shift	Unsigned16	rw	eeeprom	No		x	
	5	Programming Procedure	Unsigned32	wo	Signature = 6F636E65h	No		x	

Appendix 2 - Quick Start

A2.1 - OVERVIEW

The purpose of this paper is to give the user a quick overview of how to use Infranor Servo Drives.

Main steps :

1. Installation

- Wiring the drive
- Switching on power
- Commissioning

2. Operation

- Starting communication (NMT)
- Setting communication parameters (SDO)
- Starting Synchronisation (SYNC)
- Data Exchange (PDO)
- Servo on / Servo off
- Move on

A2.2 - INSTALLATION

A2.2.1 - WIRING

Please refer to the "Installation Guide" for the drive connections.
The INHIBIT input and the LOW_SPEED input must be connected to 24 V.

A2.2.2 - POWERING

For the CD1-k: Always switch on the 24 Volt supply (5 s) before the power supply, otherwise an error will be displayed which cannot be cleared. It is important to wait at least 30 s between switching off and on again the drive.

A2.2.3 - COMMISSIONING

The **CD1-k**, **BD1/k** and **BD2/k** drives commissioning is made by means of the PC software "VDSetup".

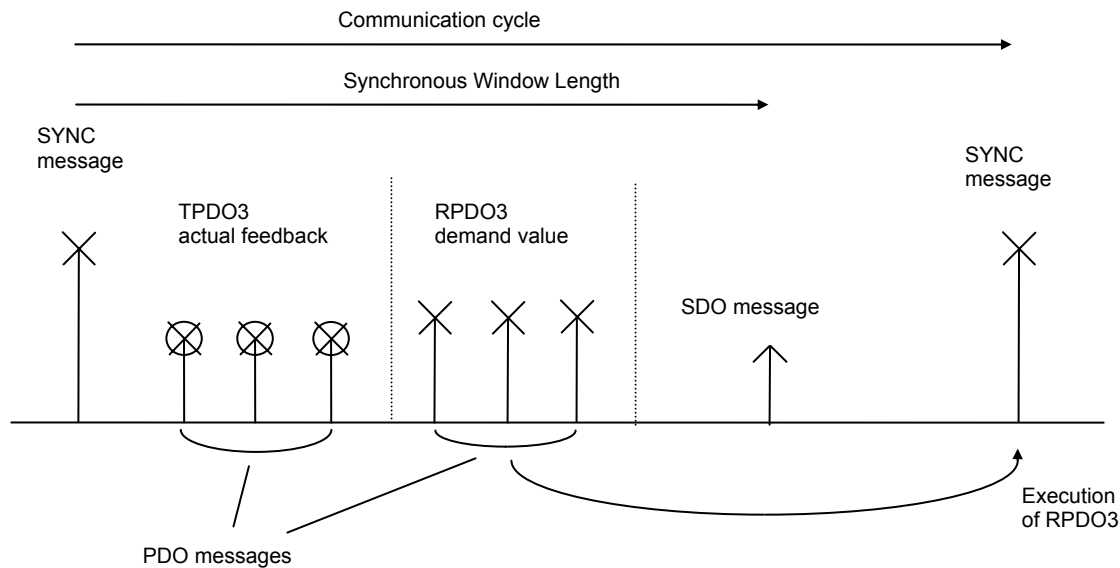
After launching VDSetup, the user must "disable CAN bus" in the "Set-up" menu. Otherwise, the drive cannot be enabled for auto-tuning or auto-phasing. Do not forget to "enable CAN bus" again before running with CAN bus.

After the commissioning, do not forget to store the parameters into the EEPROM.

Note: When executing the auto-tuning, the drive must be set into position mode in order to have the position gains calculated.

A2.3 - OPERATION

The Infranor Servo Drives mainly runs in "Interpolated position mode" (see section 3.8). In this mode, the controller sends elementary position references to the drive at a regular cycle time.



A2.3.1 - START COMMUNICATION (NMT)

Infranor Servo Drives are able of minimum boot-up. This means that after a reset at power-on, they will automatically switch to "Pre-Operational" state. In this state, it is possible to change parameters via the SDO communication.

To be able to exchange data via PDO, it is necessary to switch to "Operational" state by a "Start Remote Node" (see section 2.1.3: *NMT Protocols*).

A2.3.2 - SETTING COMMUNICATION PARAMETERS (SDO)

Except for the drive parameters which can be adjusted and stored in the drive, the communication parameters must be sent to the drive at every power on.

The main parameters to be set are:

- Communication cycle period (object 1006 sub-index 0): this object defines the duty cycle of the controller. This value is entered in μs and must be a multiple of 500. For example, 4000 for a cycle period of 4 ms.
- Synchronous window length (object 1007 sub-index 0): this object defines the synchronous window (μs) in which the drive can take the demand value via RPDO3. Generally, it can be set at a communication cycle value minus 1000.

Other communication parameters can be adjusted as COB-ID, PDO mapping...

For the interpolated position mode, the resolution position parameter also needs to be adjusted (object 608F sub-index 1).

A2.3.3 - START SYNCHRONISATION (SYNC)

After having started the communication by NMT, the controller must send a SYNC message and a RPDO3 message to the drive at every cycle defined in section 3.2. The drive is in "Operational" state.

A2.3.4 - EXCHANGE DATA (PDOS)

The exchange data in Interpolated position mode are mainly the position demand value sent by the controller (via RPDO3) and the current position value sent by the drive (via TPDO3).

It is possible to modify the mapping of these PDOS to exchange other data, but in interpolated position mode, the drive position demand is required for executing this function (object 60C1 sub-index 1: Interpolated data record).

A2.3.5. SERVO ON / SERVO OFF

Once the communication OK, the drive can be controlled via a control word (object 6040 sub-index 0) and a status word (object 6041 sub-index 0). The control and status words are written/read via SDO or RPDO1/TPDO1.

The state diagram is given in [section 3.3.1](#).

Simplified sequence to enable the drive (servo on):

Control word sent by the controller	Status word replied by the drive	Drive state	Remarks
xx00h	x240h	Switch On Disabled	drive is disabled
xx06h	x221h	Ready To Switch On	drive is disabled
xx0Fh	x227h	Operation Enable	drive is enabled

The "Ready To Switch On" state is mandatory, as the drive cannot change from "Switch On Disabled" directly to "Operation Enable".

If there is an error, the drive will switch to "Fault Reaction Active" and then to "Fault" state. To exit the "Fault" state, the controller must send a rising edge of bit 7 in the control word. Once the fault reset, the drive will switch to "Switch On Disabled" state.

A2.3.6 - MOVE ON

Once in "operation enable", the controller must set bit 4 of the control word to enable the IP-Mode ([see section 3.3.3.1: Control_word](#)). The drive replies by setting bit 12 of the status word ([see 3.3.3.2. Status_word](#)). From this moment on, the drive will follow the position demand value via RPDO3.

Note: If the position demand is not set at the same value as the current position value when bit 4 of control word is set, a following error will occur.

A2.3.7 - OTHER CONSIDERATIONS

When an error occurs, an emergency message is sent to the controller ([see section 2.1.7](#)).

The "Fault" state can also be detected in the status word (xxxFh). The error meaning is in object 3020h (manufacturer specific).