Index

REVISION INDEX						
REV.	**PAR.**	**DESCRIPTION**	**DATA**	**R**	**V**	**A**
1.0		First release	06/02/2023	ag	mb	mb

R = Editing

V = Verify

A = Approval

1. SAFETY PRECAUTIONS

The present manual contains the information for the use of the AZ3 drive through the CANopen protocol. Use this manual together with the drive's user manual and the PC interface manual to understand the meaning of the parameters accessible via CANopen.

⚠ WARNING	Before trying to operate the drive using the CANopen protocol, the user must read the safety precautions reported in the drive's user manual.

2. ABOUT THIS MANUAL

2.1. CANopen and TEM PC Software Interface

The PC interface is used for the tuning and the parametrization of the device and is in fact a CANopen master application. The PC interface provide additional components and features that can help the development of customer application based on CANopen.

The software application provides masking for drive parameters, the user enters the numeric value associated to a certain variable and the application does all the numeric and protocol conversion to send the data to the device.

The TEM Interface can communicate with the drive through USB serial adapters (TEM **AZCANconvert**).

2.2. Numerical representation

In this manual, decimal numbers are represented using digits without suffix while hexadecimal numbers are represented with the letter “h” after the number.

3. CANOPEN INTRODUCTION

CANopen is a communication protocol defined in the CiA specifications.

Provides standardized communication objects: Service Data Objects (SDO) for configuring object directory entries, Process Data Objects (PDO) for real-time data transport, Network Management objects (NMT) for control and monitoring of the nodes as well as synchronization objects, timestamps and emergency telegrams.

The most important part of a device is the Object Dictionary. Object Dictionary is essentially a grouping of objects accessible via the network in an orderly and predefined way. Each object within the dictionary is addressed using a 16-bit index:

Index (hex)	Object
0000h	not used
1000h-1FFFh	Communication Profile Area
2000h-5FFFh	Manufacturer Specific Profile Area
6000h-9FFFh	Standardized Device Profile Area

Note that the data bytes are transmitted with the most significant bit first.

4. COMMUNICATION SETUP

The default values relating to communication with AZ3 series drives are: **BAUDRATE 125000** (bits per second):

- Baud rate: 125 kbit/s.
- Address: 1.

It's possible to change the baudrate using the TEM PC interface or writing in the following address the values of the table below:

INDEX 2068 SUB 00 UNS16

BAUD RATE	VALUE
20 kbit/s	**3**
50 kbit/s	**4**
125 kbit/s (default)	**5**
250 kbit/s	**6**
500 kbit/s	**7**
1 Mbit/s	**9**

It's possible to change the CANopen address using the TEM PC interface.

NOTE! Implementation suggestion of pc based master application: Usually in PC application the serial port is accessible through the virtual object handled by the operative system (COMx in windows/dos system, dev/ttySx in Unix system). Using virtual objects, so communication timings could suffer of delay due to the buffering of data. In that case, if the drive user has to implement the CANopen reception could be in the need of doing some "stretching" on the timings.

4.1. CANopen data types

The drives use primitive data types listed as follow:

DATA TYPE	DESCRIPTION
S8	Byte integer data with sign from -128 to 127
UNS8	Byte integer from 0 to 255
S16	Word data integer value with sign from -32768 to 32767
UNS16	Word data integer value from 0 to 65535
S32	Double word data integer from 0 to 4294967296
UNS32	Double word data integer with sign from -2147483648 to 2147483647
FLOATING POINT SINGLE PRECISION	32 bits standard representation IEEE 754

4.1.1. SUPPORTED CCS

The CCS (client command specifier) is a command value, contained in the head of the SDO message after the COB-ID.

COB-ID	LENGTH	CCS	MESSAGE
6XXh	8h	43h	XXXXh

CCS				n	e	s	
0	**0**	**1**	**0**	**1**	**0**	**1**	**1**

In the 1-byte command specifier of the SDO client, three bits are used to indicate the used protocol.

The values used are below:

Data type functions	Value
Write 8bit	**2Fh**
Read 8bit	**4Fh**
Write 16bit	**2Bh**
Read 16bit	**4Bh**
Write 32bit	**23h**
Read 32bit	**43h**
Invalid function (error)	
/	**80h**

4.1.2. CONVERSION HANDLING

The representation of value is as below:

0		1		2		3	
1	0	3	2	5	4	7	6

Example:

- Valore = 1000 HEX -> 0000 03EBh

0		1		2		3	
1	0	3	2	5	4	7	6
EBh		03h		00h		00h	

- Valore = 25000 HEX -> 0000 61A8h

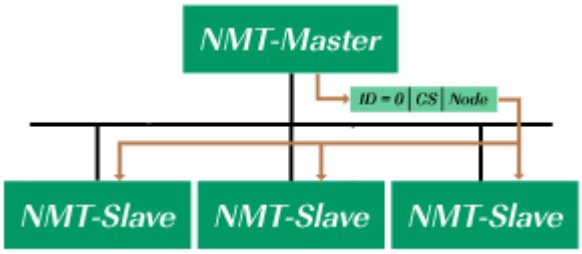
0		1		2		3	
1	0	3	2	5	4	7	6
A8h		61h		00h		00h	

- Valore = 1.1 (FLOAT) HEX -> 3F8C CCCDh

0		1		2		3	
1	0	3	2	5	4	7	6
CDh		CCh		8Ch		3Fh	

⚠ WARNING Exceeding the variable range may cause incorrect behavior!

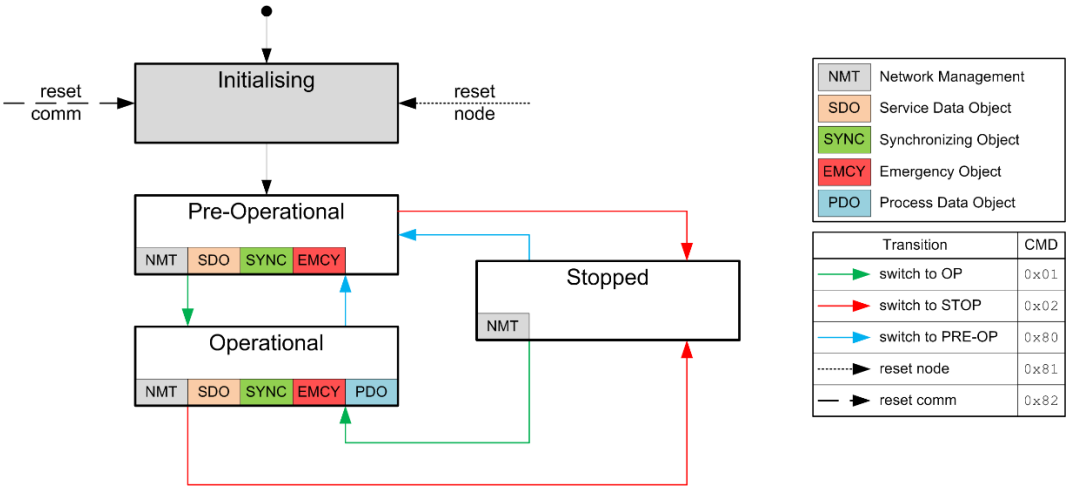
4.2. NMT



The NMT protocol is transmitted by the active NMT master in a CANopen network. The reception of the NMT protocol forces the CANopen device to transit to the commanded NMT state. The NMT protocol work with a single CAN frame with a data length of 2 byte. The first byte contains the command specifier and the second contains the Node-ID of the device that has to perform the command (if this value is equal to 0, all nodes have to perform the commanded state transition). The NMT protocol comes with the CAN-Identifier 0, the highest prior CAN-ID in a CAN-based system.

Link to web page:

https://www.can-cia.org/can-knowledge/canopen/network-management/



4.2.1. MESSAGE TO SEND FOR NMT

STATE	MESSAGE	BROADCAST
ENTER OPERATIONAL	00 02 01 ID*h	NO
	00 02 01 00h	YES
ENTER STOP	00 02 02 ID*h	NO
	00 02 02 00h	YES
ENTER PRE-OPERATIONAL	00 02 80 ID*h	NO
	00 02 80 00h	YES
RESET NODE	00 02 81 ID*h	NO
	00 02 81 00h	YES
RESET COMMUNICATION	00 02 82 ID*h	NO
	00 02 82 00h	YES

* ID refers to the address of the single slave.

4.3. SDO

An SDO allows to access device data through explicit requests.

The SDO protocol is based on a client/server model. For a download SDO, the client (typically the controller) sends a request indicating the object to read. The server (in this case, the bus coupler) returns the data contained in the object. For a load SDO, the client (typically the controller) sends a request indicating the object to write to and the desired value. After updating the object, the server (in this case, the bus coupler) returns a confirmation message.

4.3.1. SDO MESSAGE

The SDO or Service Data Objects provide access to the object dictionaries. It is particularly useful when configuring the device.

SDO protocol always confirms the read/write operation.

When performing a SDO Read or Write the index of the object dictionary entry and the sub index is always specified, the index is 2 bytes and the sub index 1 byte. if the data to be read/written is 32 bits or less then it can be done in an expedited packet thus only one transmit and one confirm receive is necessary.

COB-ID	NMT Function
600h+node id	SDO Receive
580h+node id	SDO Transmit

Below an example of reading the "**ControlWord**" parameter:

Request read:

Can Header	Data length	B0	B1	B2	B3	B4	B5	B6	B7
600h+node	(Default)	Command	Index		Sub Index	Data			
600h+Fh= 60Fh	8h	43h	4060h		00h	00h	00h	00h	00h

Answer read:

Can Header	Data length	B0	B1	B2	B3	B4	B5	B6	B7
580h+node	(Default)	Command	Index		Sub Index	Data			
580h+Fh= 58Fh	8h	43h	4060h		00h	06h	00h	00h	00h

Below an example of writing the decimal value "**15**" in the "**ControlWord**" parameter:

Request write:

Can Header	Data length	B0	B1	B2	B3	B4	B5	B6	B7
600h+node	(Default)	Command	Index		Sub Index	Data			
600h+Fh= 60Fh	8h	23h	4060h		00h	0Fh	00h	00h	00h

Answer write:

Can Header	Data length	B0	B1	B2	B3	B4	B5	B6	B7
580h+node	(Default)	Command	Index		Sub Index	Data			
580h+Fh= 58Fh	8h	60h	4060h		00h	00h	00h	00h	00h

If an SDO cannot be processed by the server (bus coupler), the server returns an error code (cancellation code). This situation is valid for download and upload SDOs. If the server does not respond within a pre-configured period of time (SDO Timeout), the client issues an SDO Timeout Override Code.

The network status of the device is indicated in the remaining seven bits:

Network status	Answer (hex)
STOPPED	04h or 84h
PRE-OPERATIONAL	7Fh or FFh
OPERATIONAL	05h or 85h

4.4. Heartbeat producer

In this protocol, the generator transmits a Heartbeat message periodically, based on the Producer Heartbeat Time parameter (in milliseconds).

Possible device response values depending on the current device status:

Network status	Value (hex)
BOOT-UP	00h
STOPPED	04h
OPERATIONAL	05h
PRE-OPERATIONAL	7Fh

4.5. PDO

Process data objects (PDOs) are used in CANopen for broadcasting high-priority control and status information. A PDO consists of a single CAN frame and communicates up to 8 byte of pure application data. Device designers have to evaluate the amount of process data that the device needs to receive and transmit. Based on the result of this evaluation process, they have to provide the related amount of receive and transmit PDOs within the device.

The PDO communication parameter objects and the PDO mapping parameter objects are described in this chapter. These objects are located in the communication segment of the object dictionary. For each PDO there is a PDO communication parameter object and a PDO mapping object. The PDO communication parameter object defines overall parameters of the PDO, like its COB-ID or if the PDO is synchronous or asynchronous.

The communication parameters for receive PDOs are arranged in the index range 1400h - 15FFh and for transmit PDOs in the range 1800h - 19FFh. The related mapping entries are managed in the index ranges 1600h -17FFh and 1A00h - 1BFFh.

RPDO (parameter)	
1	1400h
2	1401h
3	1402h
4	1403h

RPDO (mapping)	
1	1600h
2	1601h
3	1602h
4	1603h

TPDO (parameter)	
1	1800h
2	1801h
3	1802h
4	1803h

TPDO (mapping)	
1	1A00h
2	1A01h
3	1A02h
4	1A03h

4.5.1. PDO MAPPING

The PDO mapping parameter object defines which objects are mapped to this PDO.

The default RPDOs are mapped as follows:

- **RPDO 1** Mapping index 0x1600
  1. 60400010h Controlword – UNS16
  2. 60FF0020h Target_velocity – S32
- **RPDO 2** Mapping index 0x1601
  1. 60400010h Controlword – UNS16
  2. 607A0020h Target_position – S32
- **RPDO 3** Mapping index 0x1602
  1. 0x60400010 Controlword – UNS16
  2. 0x206A0120 vrefSetPoint – FLOAT
- **RPDO 4** Mapping index 0x1603
  1. 0x60400010 Controlword – UNS16
  2. 0x60710010 Target_torque – S16

The default TPDOs are mapped as follows:

- **TPDO 1** Mapping index 0x1A00
  1. 0x60410010 Statusword – UNS16
  2. 0x20050010 custom_velocity_actual_value - S16
  3. 0x20020010 Iqrmsx10 – S16 – 16 bit
  4. 0x20060010 custom_position_actual_value - S16
- **TPDO 2** Mapping index 0x1A01
  1. 0x60410010 Statusword – UNS16
  2. 0x60640020 Position_actual_value – S32
  3. 0x20690010 Error reg – UNS16
- **TPDO 3** Mapping index 0x1A02
  1. 0x60410010 Statusword – UNS16 – 16bit
  2. 0x606C0020 Velocity_actual_value – S32 – 32 bit
  3. 0x20690010 Error reg – UNS16
- **TPDO 4** Mapping index 0x1A03
  1. 0x60410010 Statusword – UNS16 – 16bit
  2. 0x60770010 Torque_actual_value– S16 – 16 bit
  3. 0x20690010 Error reg – UNS16

4.5.2. PDO COMMUNICATION PARAMETERS

These are the parameters for PDO communication:

- The first subparameter (Highest sub-index supported) indicates the highest index subparameter.
- The COB-ID subparameter contains the CAN-ID to be used and some additional protocol control bits.
- Transmission type subparameter determines activation (TPDO) or reception (RPDO) behavior.
- The Inhibit-time subparameter provides the time in ms on how long is the minimum time for the transmission of two TPDO messages. The Inhibit Time utility allows you to define a minimum delay before sending a new PDO. This avoids overloading the bus when a significant number of events occur in rapid succession. Inhibit Time is expressed in multiples of 100 µs. This feature is available for Type 255 transfer (Asynchronous).
- The Event timer subparameter specifies the period in ms from TPDO transmission to the (missing) time-out of an RPDO respectively.
- The SYNC start value subparameter indicates when the synchronous TPDO is transmitted first.

The value of this subparameter must match the value in the 1-byte SYNC message.

Sub-index	Name	Data type
00h	Highest sub-index supported	Unsigned8 (BYTE)
01h	COB-ID	Unsigned32 (DWORD)
02h	Transmission type	Unsigned8 (BYTE)
03h	Inhibit-time	Unsigned16 (WORD)
04h	Compatibility entry	Reserved
05h	Event timer	Unsigned16 (WORD)
06h	SYNC start value	Unsigned8 (BYTE)

The default RPDOs are configured as follows:

- **RPDO 1** Settings index 1400h
    1. 200h COBID used by PDO – UNS32
    2. 0h Transmission type – UNS8
    3. 0h Inhibit time – UNS16
    4. 0h Compatibility entry – UNS8
    5. 0h Event timer – UNS16
    6. 0h SYNC_start_value – UNS8
- **RPDO 2** Settings index 1401h
    1. 300h COBID used by PDO – UNS32
    2. 0h Transmission type – UNS8
    3. 0h Inhibit time – UNS16
    4. 0h Compatibility entry – UNS8
    5. 0h Event timer – UNS16
    6. 0h SYNC_start_value – UNS8
- **RPDO 3** Settings index 1402h
    1. 400h COBID used by PDO – UNS32
    2. 0h Transmission type – UNS8
    3. 0h Inhibit time – UNS16
    4. 0h Compatibility entry – UNS8
    5. 0h Event timer – UNS16
    6. 0h SYNC_start_value – UNS8
- **RPDO 4** Settings index 1403h
    1. 500h COBID used by PDO – UNS32
    2. 0h Transmission type – UNS8
    3. 0h Inhibit time – UNS16
    4. 0h Compatibility entry – UNS8
    5. 0h Event timer – UNS16
    6. 0h SYNC_start_value – UNS8

The default TPDOs are configured as follows:

- **TPDO 1** Settings index 1800h
    1. 180h COBID used by PDO – UNS32
    2. 1h Transmission type – UNS8
    3. 0h Inhibit time – UNS16
    4. 0h Compatibility entry – UNS8
    5. 0h Event timer – UNS16
    6. 0h SYNC_start_value – UNS8
- **TPDO 2** Settings index 1400h
    1. 280h COBID used by PDO – UNS32
    2. 1h Transmission type – UNS8
    3. 0h Inhibit time – UNS16
    4. 0h Compatibility entry – UNS8
    5. 0h Event timer – UNS16
    6. 0h SYNC_start_value – UNS8
- **TPDO 3** Settings index 1400h
    1. 380h COBID used by PDO – UNS32
    2. 1h Transmission type – UNS8
    3. 0h Inhibit time – UNS16
    4. 0h Compatibility entry – UNS8
    5. 0h Event timer – UNS16
    6. 0h SYNC_start_value – UNS8
- **TPDO 4** Settings index 1400h
    1. 480h COBID used by PDO – UNS32
    2. 1h Transmission type – UNS8
    3. 0h Inhibit time – UNS16
    4. 0h Compatibility entry – UNS8
    5. 0h Event timer – UNS16
    6. 0h SYNC_start_value – UNS8

5. PARAMETER LIST

A list of all the parameters in object dictionary is below:

5.1. Read/write registers

Variable	Type	Unit	Default	Range	Can open address		Added in FW version:
SPIDAC CHANNEL SEL1	UNS8	-	0	0÷255	INDEX SUB	2024h	1.50
SPIDAC CHANNEL SEL2	UNS8	-	0	0÷255	INDEX SUB	2025h	1.50
SPIDAC CHANNEL SEL3	UNS8	-	0	0÷255	INDEX SUB	2026h	1.50
SPIDAC CHANNEL SEL4	UNS8	-	0	0÷255	INDEX SUB	2027h	1.50
SPIDAC CHANNEL 1 SCALE	FLOAT	-	1	-1.0E21÷1.0E21	INDEX SUB	2028h	1.50
SPIDAC CHANNEL 2 SCALE	FLOAT	-	1	-1.0E21÷1.0E21	INDEX SUB	2029h	1.50
SPIDAC CHANNEL 3 SCALE	FLOAT	-	1	-1.0E21÷1.0E21	INDEX SUB	202Ah	1.50
SPIDAC CHANNEL 4 SCALE	FLOAT	-	1	-1.0E21÷1.0E21	INDEX SUB	202Bh	1.50
ID KP	FLOAT	-	0.2	-1.0E21÷1.0E21	INDEX SUB	202Ch	1.10
ID KI	FLOAT	-	200.0	-1.0E21÷1.0E21	INDEX SUB	202Dh	1.10
ID KD	FLOAT	-	0	-1.0E21÷1.0E21	INDEX SUB	202Eh	1.10
IQ KP	FLOAT	-	0.2	-1.0E21÷1.0E21	INDEX SUB	202Fh	1.10
IQ KI	FLOAT	-	200.0	-1.0E21÷1.0E21	INDEX SUB	2030h	1.10
IQ KD	FLOAT	-	0	-1.0E21÷1.0E21	INDEX SUB	2031h	1.10
SPEED KP	FLOAT	-	0.001	-1.0E21÷1.0E21	INDEX SUB	2032h	1.10

SPEED KI	FLOAT	-	0.02	-1.0E21÷1.0E21	INDEX SUB	2033h	1.10
SPEED KD	FLOAT	-	0	-1.0E21÷1.0E21	INDEX SUB	2034h	1.10
PROFILE DECELERATION	UNS32	Speed user units/s	1000	0÷4.2E10	INDEX SUB	6084h	1.10
V REF SETPOINT	FLOAT	V	0	-1.0E21÷1.0E21	INDEX SUB	206Ah 01h	1.50
V REF POSITIVE RAMP	FLOAT	V	4	-1.0E21÷1.0E21	INDEX SUB	206Ah 02h	1.50
V REF NEGATIVE RAMP	FLOAT	V	-4	-1.0E21÷1.0E21	INDEX SUB	206Ah 03h	1.50
HEATSINK TEMPERATURE	FLOAT	°C	0	-1.0E21÷1.0E21	INDEX SUB	2081h 00h	1.10
V BUS MAX	FLOAT	V	60	0÷100	INDEX SUB	203Dh	1.10
ENCODER TYPE	UNS16	-	0	0÷10	INDEX SUB	2039h	1.10
SET POINT SELECTOR	S16	-	0	0÷10	INDEX SUB	2038h	1.10
MOTOR POLES PAIR	UNS16	-	4	0÷16	INDEX SUB	203Ah	1.10
ALIGNMENT CURRENT	FLOAT	A	1	-	INDEX SUB	203Ch	1.50
NOMINAL CURRENT RMS	FLOAT	A	30	-100÷100	INDEX SUB	203Eh	1.10
PID TUNING TYPE SELECTOR	S16	-	0	0÷2	INDEX SUB	203Fh	1.50
SQUARE WAVE SPEED PERIOD	UNS16	$\frac{1}{10}$ ms	0	0÷65535	INDEX SUB	2040h 01h	1.50
HIGH VALUE SPEED REF	FLOAT	Speed user units/s	0	-	INDEX SUB	2040h 02h	1.50
LOW VALUE SPEED REF	FLOAT	Speed user units/s	0	-	INDEX SUB	2040h 03h	1.50
SQUARE WAVE CURRENT PERIOD	UNS16	$\frac{1}{10}$ ms	50	0÷65535	INDEX SUB	2041h 01h	1.50

HIGH VALUE CURRENT REF	FLOAT	A	4	-	INDEX SUB	2041h 02h	1.50
LOW VALUE CURRENT REF	FLOAT	A	-4	-	INDEX SUB	2041h 03h	1.50
MAX MOTOR SPEED	UNS32	User units	3000	0÷2.0E6	INDEX SUB	6080h	1.10
PROFILE ACCELERATION	UNS32	Speed user units/s	1000	0÷2.0E6	INDEX SUB	6083h	1.10
GEAR RATIO MOTOR REVOLUTION	UNS32	rounds	1	0÷400000	INDEX SUB	6091h 01h	1.10
GEAR RATIO SHAFT REVOLUTIONS	UNS32	rounds	1	0÷400000	INDEX SUB	6091h 02h	1.10
VELOCITY ENCODER RESOLUTION MOTOR REVOLUTIONS	UNS32	round/s	1	0÷400000	INDEX SUB	6090h 02h	1.10
VELOCITY ENCODER RESOLUTION INCREMENTS PER SECOND	UNS32	Incr/s	8192	0÷400000	INDEX SUB	6090h 01h	1.10
FEED CONSTANT FEED	UNS32	-	1	0÷400000	INDEX SUB	6092h 01h	1.10
FEED CONSTANT SHAFT REVOLUTIONS	UNS32	rounds	1	0÷400000	INDEX SUB	6092h 02h	1.10
POSITION ENCODER RESOLUTION MOTOR REVOLUTIONS	UNS32	rounds	1	0÷400000	INDEX SUB	608Fh 02h	1.10
POSITION ENCODER RESOLUTIONS ENCODER INCREMENTS	UNS32	-	8192	0÷400000	INDEX SUB	608Fh 01h	1.10
VELOCITY FACTOR NUMERATOR	S16	-	60	0÷32767	INDEX SUB	6094h 01h	1.10
VELOCITY FACTOR DENOMINATOR	S16	-	1	0÷32767	INDEX SUB	6094h 02h	1.10
POLARITY	UNS16	-	0	0÷65536	INDEX SUB	607Eh	1.10
CONTROL WORD	UNS16	-	0	0÷65535	INDEX SUB	6040h	1.10
MODES OF OPERATION	S8	-	3	-128÷127	INDEX SUB	6060h	1.10

TARGET VELOCITY	S32	User units	0	-2.0E6÷2.0E6	INDEX SUB	60FFh	1.10
TORQUE LIMIT	FLOAT	Nm	-	-	INDEX SUB	2009h	1.50
TORQUE LIMIT FACTOR	S32	Nm	-	-2.0E6÷2.0E6	INDEX SUB	206Bh	1.50
TDI CW MODE	UNS8	-	0	0÷255	INDEX SUB	204Eh 01h	1.10
CUSTOM POSITION ACTUAL VALUE	S16	-	-	-32768÷32767	INDEX SUB	2006h	1.50
DIGITAL OUTPUT BYTES	UNS16	-	32	0÷65535	INDEX SUB	60FDh	1.50
MOTOR TYPE	UNS16	-	10	0÷65535	INDEX SUB	6402h	1.10
MOTOR PHASE DISPLACEMENT	FLOAT	-	0	-	INDEX SUB	2052h 01h	1.50
ZERO MARK DISPLACEMENT FROM U ZERO	FLOAT	-	0	-	INDEX SUB	2052h 02h	1.50
T ALIGN	UNS16	A	20000	0÷65535	INDEX SUB	203Bh	1.50
DELTA PHASING ANGLE ERROR	FLOAT	[rad]	0.18	-	INDEX SUB	2052h 04h	1.50
ENCODER PHASE DISPLACEMENT	FLOAT	[rad]	3.14	-6.28÷6.28	INDEX SUB	2052h 03h	1.10
OUTPUT 1 SELECTOR	UNS8	-	0	0÷255	INDEX SUB	204Eh 02h	1.10
OUTPUT 2 SELECTOR	UNS8	-	0	0÷255	INDEX SUB	204Eh 03h	1.10
ENCODER FEEDBACK MODE	UNS8	-	0	0÷255	INDEX SUB	204Eh 04h	1.10
ABSOLUTE ENCODER NUMBER OF BITS	UNS16	-	25	0÷65535	INDEX SUB	2074h	1.50
ABSOLUTE ENCODER MULTI TURN STARTING BIT	UNS16	-	14	0÷65535	INDEX SUB	2075h	1.50
ABSOLUTE ENCODER MULTI TURN NUMBER OF BITS	UNS16	-	12	0÷65535	INDEX SUB	2076h	1.50

ABSOLUTE ENCODER SINGLE TURN STARTING BIT	UNS16	-	1	0÷65535	INDEX SUB	2077h	1.50
ABSOLUTE ENCODER SINGLE TURN NUMBER OF BITS	UNS16	-	13	0÷65535	INDEX SUB	2078h	1.50
ABSOLUTE ENCODER ENCODING	UNS16	-	1	0÷65535	INDEX SUB	2079h	1.50
ABSOLUTE ENCODER ANGLE PHASING OFFSET	FLOAT	-	0	-	INDEX SUB	207Ah	1.50
MODBUS ADDRESS	UNS16	-	1	0÷65535	INDEX SUB	207Ch	1.68
MODBUS BAUD RATE	UNS32	-	19200	0÷4.2E10	INDEX SUB	207Dh	1.68
PARITY	UNS16	-	-	0÷65535	INDEX SUB	207Eh	1.68
ADDRESS 1	UNS16	-	0	0÷65535	INDEX SUB	207Fh	1.68
ADDRESS 2	UNS16	-	0	0÷65535	INDEX SUB	2080h	1.68
ADDRESS 3	UNS16	-	0	0÷65535	INDEX SUB	208Ah	1.70
ADDRESS 4	UNS16	-	0	0÷65535	INDEX SUB	208Bh	1.70
MAX FOLLOWING ERROR	UNS32	-	0	0÷4.2E10	INDEX SUB	6065h	1.68
FOLLOWING ERROR TIMEOUT	UNS16	-	-	0÷4.2E10	INDEX SUB	6066h	1.68
FILTERED SAMPLES 1	S16	-	-	-32768÷32767	INDEX SUB	2082h	1.84
FILTERED SAMPLES 2	S16	-	-	-32768÷32767	INDEX SUB	2083h	1.84
CAN BIT RATE	UNS8	-	-	0÷65535	INDEX SUB	2068h	1.68
USER RANGE 1	FLOAT	-	1000	-1.0E9÷1.0E9	INDEX SUB	2045h 02h	1.10

OFFSET 1	FLOAT	-	0	-1.0E9÷1.0E9	INDEX SUB	2045h 03h	1.10
ZERO THRESHOLD 1	UNS16	-	5	0÷65535	INDEX SUB	2045h 04h	1.10
USER RANGE 2	FLOAT	-	1000	-1.0E9÷1.0E9	INDEX SUB	2046h 02h	1.10
OFFSET 2	FLOAT	-	-500	-1.0E9÷1.0E9	INDEX SUB	2046h 03h	1.10
ZERO THRESHOLD 2	UNS16	-	1	0÷65535	INDEX SUB	2046h 04h	1.10
SELECTOR 1	UNS8	-	2	0÷255	INDEX SUB	2045h 01h	1.10
SELECTOR 2	UNS8	-	4	0÷255	INDEX SUB	2046h 01h	1.10
AUX PWM OUT 1 SEL	UNS8	-	0	0÷5	INDEX SUB	204Eh 05h	1.10
AUX PWM OUT 2 SEL	UNS8	-	0	0÷5	INDEX SUB	204Eh 06h	1.10
BRAKE 1 MODE SEL	UNS8	-	1	0÷100	INDEX SUB	204Eh 07h	1.10
BRAKE 1 POW VALUE	UNS8	%	100	0÷5	INDEX SUB	204Fh 01h	1.10
BRAKE 2 MODE SEL	UNS8	-	1	0÷100	INDEX SUB	204Eh 08h	1.50
BRAKE 2 POW VALUE	UNS8	%	100	0÷5	INDEX SUB	204Fh 02h	1.50
TARGET TORQUE	S16	‰of rated torque	0	-10000÷10000	INDEX SUB	6071h	1.10
MAX TORQUE	UNS16	-	10000	0÷10000	INDEX SUB	6072h	1.10
MAX CURRENT	UNS16	-	10000	0÷10000	INDEX SUB	6073h	1.10
MOTOR RATED TORQUE	UNS32	mNm	2300	0÷1.0E9	INDEX SUB	6076h	1.10
MOTOR RATED CURRENT	UNS32	mA	16000	0÷1.0E9	INDEX SUB	6075h	1.10

TORQUE SLOPE	UNS32	‰ of rated torque/s	1000	0÷1.0E9	INDEX SUB	6087h	1.10
TARGET POSITION	S32	-	0	-1.0E18÷1.0E18	INDEX SUB	607Ah	1.10
MIN POSITION RANGE LIMIT	S32	-	-100000	-1.0E18÷1.0E18	INDEX SUB	607Bh 01h	1.10
MAX POSITION RANGE LIMIT	S32	-	100000	-1.0E18÷1.0E18	INDEX SUB	607Bh 02h	1.10
SOFT MIN POSITION LIMIT	S32	-	0	-1.0E18÷1.0E18	INDEX SUB	607Dh 01h	1.10
SOFT MAX POSITION LIMIT	S32	-	0	-1.0E18÷1.0E18	INDEX SUB	607Dh 02h	1.10
MAX PROFILE VELOCITY	UNS32	-	3000	0÷2.0E6	INDEX SUB	607Fh	1.10
PROFILE VELOCITY	UNS32	-	1000	0÷2.0E6	INDEX SUB	6081h	1.10
POSITION KP	FLOAT	-	1.0	-1.0E21÷1.0E21	INDEX SUB	2035h	1.10
POSITION KI	FLOAT	-	0	-1.0E21÷1.0E21	INDEX SUB	2036h	1.10
POSITION KD	FLOAT	-	0	-1.0E21÷1.0E21	INDEX SUB	2037h	1.10
POSITION WINDOW	UNS32	-	-	0÷4.2E10	INDEX SUB	6067h	1.50
POSITION WINDOW TIME	UNS16	-	-	0÷65535	INDEX SUB	6068h	1.50
BRAKE DISENGAGE TIME	UNS16	ms	0	0÷65535	INDEX SUB	2051h 01h	1.10
BRAKE ENGAGE TIME	UNS16	ms	0	0÷65535	INDEX SUB	2051h 02h	1.10
SHUTDOWN OPTION CODE	S16	-	1	-32768÷32767	INDEX SUB	605Bh	1.10
DISABLE OPERATION OPTION CODE	S16	-	1	-32768÷32767	INDEX SUB	605Ch	1.10
BRAKING RESISTOR VALUE	FLOAT	Ω	0	0÷1.0E9	INDEX SUB	2053h 01h	1.10

BRAKING RESISTOR MAX POWER	FLOAT	W	0	0÷1.0E9	INDEX SUB	2053h 03h	1.10
ALIMENTATION POWER	FLOAT	W	3.36	0÷1.0E6	INDEX SUB	2053h 02h	1.10
DI1 RISE SELECTOR	UNS8	-	0	0÷255	INDEX SUB	2047h 01h	1.10
DI1 FALL SELECTOR	UNS8	-	0	0÷255	INDEX SUB	2047h 02h	1.10
DI2 RISE SELECTOR	UNS8	-	0	0÷255	INDEX SUB	2047h 03h	1.10
DI2 FALL SELECTOR	UNS8	-	0	0÷255	INDEX SUB	2047h 04h	1.10
DI3 RISE SELECTOR	UNS8	-	0	0÷255	INDEX SUB	2047h 05h	1.10
DI3 FALL SELECTOR	UNS8	-	0	0÷255	INDEX SUB	2047h 06h	1.10
DI4 RISE SELECTOR	UNS8	-	0	0÷255	INDEX SUB	2047h 07h	1.10
DI4 FALL SELECTOR	UNS8	-	0	0÷255	INDEX SUB	2047h 08h	1.10
SPEED VALUE 1	S32	-	0	-1.0E9÷1.0E9	INDEX SUB	2048h	1.10
SPEED VALUE 2	S32	-	0	-1.0E9÷1.0E9	INDEX SUB	2049h	1.10
SPEED VALUE 3	S32	-	0	-1.0E12÷1.0E12	INDEX SUB	2084h	1.70
SPEED VALUE 4	S32	-	0	-1.0E12÷1.0E12	INDEX SUB	2085h	1.70
POSITION VALUE 1	S32	-	0	-1.0E12÷1.0E12	INDEX SUB	204Ah	1.10
POSITION VALUE 2	S32	-	0	-1.0E12÷1.0E12	INDEX SUB	204Bh	1.10
POSITION VALUE 3	S32	-	0	-1.0E12÷1.0E12	INDEX SUB	2086h	1.70
POSITION VALUE 4	S32	-	0	-1.0E12÷1.0E12	INDEX SUB	2087h	1.70

TORQUE VALUE 1	S16	-	0	-10000÷10000	INDEX SUB	204Ch	1.10
TORQUE VALUE 2	S16	-	0	-10000÷10000	INDEX SUB	204Dh	1.10
TORQUE VALUE 3	S16	-	0	-10000÷10000	INDEX SUB	2088h	1.70
TORQUE VALUE 4	S16	-	0	-10000÷10000	INDEX SUB	2089h	1.70
RETENTION VOLTAGE 1	FLOAT	%of rated voltage	15	0÷100	INDEX SUB	2067h 01h	1.50
RETENTION VOLTAGE 2	FLOAT	%of rated voltage	15	0÷100	INDEX SUB	2067h 02h	1.50
HEART BEAT TIME	UNS16	ms	1000	0÷65535	INDEX SUB	1017h	1.50
CONSUMER HEART BEAT 1	UNS32	-	134072	0÷4.2E10	INDEX SUB	1016h 01h	1.50
CONSUMER HEART BEAT 2	UNS32	-	68536	0÷4.2E10	INDEX SUB	1016h 02h	1.50
MOTOR WINDINGS RESISTANCE	FLOAT	Ω	0,07	-	INDEX SUB	206Eh	1.50
MOTOR WINDINGS INDUCTANCE	FLOAT	H	1.9E-4	-	INDEX SUB	206Fh	1.50
MOTOR MAGNETS FLUX	FLOAT	Wb	1.93E-4	-	INDEX SUB	2070h	1.50
SENSORLESS SPEED MULTIPLIER FACTOR	FLOAT	-	9.3E-3	-	INDEX SUB	2071h	1.50
SENSORLESS SPEED CORRECTION ACCUMULATOR	FLOAT	-	2.5E-4	-	INDEX SUB	2072h	1.50
FLUX WEAKENING PARAMETER	FLOAT	-	0.03	-	INDEX SUB	2073h	1.50
STORE ALL PARAMETERS	UNS16	-	0	0÷1.0E9	INDEX SUB	1010h 01h	1.10
BOOT TIMEOUT	UNS16	ms	1000	0÷65535	INDEX SUB	200Ah	1.68
BOOT CAN RX BOX	UNS16	-	520	0÷65535	INDEX SUB	200Bh	1.68

BOOT CAN TX BOX	UNS16	-	776	0÷65535	INDEX SUB	200Ch	1.68
BOOT OPTIONS	UNS8	-	1	0÷255	INDEX SUB	200Fh	1.68
BOOT DIRECT BOOT	UNS8	-	0	0÷255	INDEX SUB	2010h	1.68
RESERVED 1	UNS8	-	0	0÷255	INDEX SUB	2013h	1.68
RESERVED 2	UNS8	-	0	0÷255	INDEX SUB	2014h	1.68
DIGITAL OUTPUT 1 DIRECT COMMAND	UNS8	-	0	0÷255	INDEX SUB	6220h 01h	1.68
DIGITAL OUTPUT 2 DIRECT COMMAND	UNS8	-	0	0÷255	INDEX SUB	6220h 02h	1.68

5.2. Only read parameters

Variable	Type	Unit	Default	Range	Can open address		Firmware version
PHASE DATA INCREMENTAL CAPTURES 12	S16	-	-	-32768÷32767	INDEX SUB	2063h 01h	1.50
PHASE DATA INCREMENTAL CAPTURES 0	S16	-	-	-32768÷32767	INDEX SUB	2063h 02h	1.50
PHASE DATA INCREMENTAL CAPTURES 1	S16	-	-	-32768÷32767	INDEX SUB	2063h 03h	1.50
PHASE DATA INCREMENTAL CAPTURES 2	S16	-	-	-32768÷32767	INDEX SUB	2063h 04h	1.50
PHASE DATA INCREMENTAL CAPTURES 3	S16	-	-	-32768÷32767	INDEX SUB	2063h 05h	1.50
PHASE DATA INCREMENTAL CAPTURES 4	S16	-	-	-32768÷32767	INDEX SUB	2063h 06h	1.50
PHASE DATA INCREMENTAL CAPTURES 5	S16	-	-	-32768÷32767	INDEX SUB	2063h 07h	1.50
PHASE DATA INCREMENTAL CAPTURES 6	S16	-	-	-32768÷32767	INDEX SUB	2063h 08h	1.50
PHASE DATA INCREMENTAL SECTOR CAPTURES 0	UNS8	-	-	0÷255	INDEX SUB	2064h 01h	1.50
PHASE DATA INCREMENTAL SECTOR CAPTURES 1	UNS8	-	-	0÷255	INDEX SUB	2064h 02h	1.50
PHASE DATA INCREMENTAL SECTOR CAPTURES 2	UNS8	-	-	0÷255	INDEX SUB	2064h 03h	1.50
PHASE DATA INCREMENTAL SECTOR CAPTURES 3	UNS8	-	-	0÷255	INDEX SUB	2064h 04h	1.50
PHASE DATA INCREMENTAL SECTOR CAPTURES 4	UNS8	-	-	0÷255	INDEX SUB	2064h 05h	1.50
PHASE DATA INCREMENTAL SECTOR CAPTURES 5	UNS8	-	-	0÷255	INDEX SUB	2064h 06h	1.50
CAN BITRATE INDEX	UNS16	-	-	0÷65535	INDEX SUB	2068h	1.50
ERROR REGISTER	UNS16	-	-	0÷65535	INDEX SUB	2069h	1.50
STATUS WORD	UNS16	-	0	0÷65535	INDEX SUB	6041h	1.10
BOOT CAN NODE	UNS8	-	5	0÷255	INDEX SUB	200Dh	1.68
BOOT MODBUS NODE	UNS8	-	-	0÷255	INDEX SUB	200Eh	-

BOOT BIT RATE	UNS8	-	-	0÷255	INDEX SUB	2011h	1.68
RES	UNS8	-	-	0÷255	INDEX SUB	2012h	1.68
RAM ERRORS COUNTER	UNS8	-	0	0÷255	INDEX SUB	2057h 06h	1.50
RAM INDEX	UNS8	-	0	0÷255	INDEX SUB	2057h 07h	1.50
ERROR CODE 1	UNS16	-	0	0÷65535	INDEX SUB	205Ah 01h	1.10
ERROR CODE 2	UNS16	-	0	0÷65535	INDEX SUB	205Bh 01h	1.10
ERROR CODE 3	UNS16	-	0	0÷65535	INDEX SUB	205Ch 01h	1.10
ERROR CODE 4	UNS16	-	0	0÷65535	INDEX SUB	205Dh 01h	1.10
ERROR CODE 5	UNS16	-	0	0÷65535	INDEX SUB	205Eh 01h	1.10
ERROR CODE 6	UNS16	-	0	0÷65535	INDEX SUB	205Fh 01h	1.10
ERROR CODE 7	UNS16	-	0	0÷65535	INDEX SUB	2060h 01h	1.10
ERROR CODE 8	UNS16	-	0	0÷65535	INDEX SUB	2061h 01h	1.10
TORQUE ACTUAL VALUE	S16	-	0	-10000÷10000	INDEX SUB	6077h	1.10
CURRENT ACTUAL VALUE	S16	-	0	-10000÷10000	INDEX SUB	6078h	1.50
TORQUE DEMAND	S16	-	0	-32768÷32767	INDEX SUB	6074h	1.50
DC LINK CIRCUIT VOLTAGE	UNS32	mV	-	0÷4.2E10	INDEX SUB	6079h	1.50
POSITION ACTUAL VALUE	S32	-	0	-2.0E6÷2.0E6	INDEX SUB	6064h	1.10
VL VELOCITY ACTUAL VALUE	S16	-	-	-32768÷32767	INDEX SUB	6044h	1.50
VELOCITY ACTUAL VALUE	S32	-	0	-2 E9÷2.0E9	INDEX SUB	606Ch	1.10
RMS CURRENT	FLOAT	A	-	-1.0E21÷1.0E21	INDEX SUB	2054h	1.50
HALL TRANSITION 0	FLOAT	-	-	-1.0E21÷1.0E21	INDEX SUB	2065h 01h	1.50
HALL TRANSITION 1	FLOAT	-	-	-1.0E21÷1.0E21	INDEX SUB	2065h 02h	1.50
HALL TRANSITION 2	FLOAT	-	-	-1.0E21÷1.0E21	INDEX SUB	2065h 03h	1.50
HALL TRANSITION 3	FLOAT	-	-	-1.0E21÷1.0E21	INDEX SUB	2065h 04h	1.50
HALL TRANSITION 4	FLOAT	-	-	-1.0E21÷1.0E21	INDEX SUB	2065h 05h	1.50
HALL TRANSITION 5	FLOAT	-	-	-1.0E21÷1.0E21	INDEX SUB	2065h 06h	1.50
HALL TRANSITION SECTOR 0	UNS8	-	-	-1.0E21÷1.0E21	INDEX SUB	2066h 01h	1.50
HALL TRANSITION SECTOR 1	UNS8	-	-	-1.0E21÷1.0E21	INDEX SUB	2066h 02h	1.50

HALL TRANSITION SECTOR 2	UNS8	-	-	-1.0E21÷1.0E21	INDEX SUB	2066h 03h	1.50
HALL TRANSITION SECTOR 3	UNS8	-	-	-1.0E21÷1.0E21	INDEX SUB	2066h 04h	1.50
HALL TRANSITION SECTOR 4	UNS8	-	-	-1.0E21÷1.0E21	INDEX SUB	2066h 05h	1.50
HALL TRANSITION SECTOR 5	UNS8	-	-	-1.0E21÷1.0E21	INDEX SUB	2066h 06h	1.50

5.3. Coils

Variable	Type	Unit	Default	Range	Can open address		
PHASING IN PROGRESS	COIL	-	0	-	INDEX SUB	2018h (bit 0)	1.10
START PHASING	COIL	-	0	-	INDEX SUB	2018h (bit 1)	1.10
ALIGNMENT REQUEST	COIL	-	0	-	INDEX SUB	2018h (bit 2)	1.50
REVERT ENCODER DIRECTION	COIL	-	0	-	INDEX SUB	2018h (bit 3	1.50
INVERT POSITION FEEDBACK	COIL	-	0	-	INDEX SUB	2018h (bit 4)	1.10
AUTO-PHASED MOTOR	COIL	-	0	-	INDEX SUB	2018h (bit 5)	1.10
INVERT SPEED FEEDBACK	COIL	-	0	-	INDEX SUB	2018h (bit 6)	1.10
SENSORLESS ACTIVATION	COIL	-	0	-	INDEX SUB	2018h (bit7)	1.50
SENSORLESS DEFLUX ACTIVATION	COIL	-	0	-	INDEX SUB	2018h (bit 8)	1.50
ABSOLUTE ENCODER PHASING START	COIL	-	0	-	INDEX SUB	2018h (bit 9)	1.50
RESET POSITION	COIL	-	0	-	INDEX SUB	2018h (bit 11)	1.50
CUT OFF POWER ON 0 VEL	COIL	-	0	-	INDEX SUB	2018h (bit 12	1.50
RESET ERROR	COIL	-	0	-	INDEX SUB	2018h (bit 13)	1.50
TORQUE LIMIT ON	COIL	-	0	-	INDEX SUB	2018h (bit 14)	1.50
SOFTWARE RESET	COIL	-	0	-	INDEX SUB	2018h (bit 15)	1.50
STO CONTROLWORD	COIL	-	0	-	INDEX SUB	2019h (bit 0)	1.10
READY TO SWITCH ON AT STARTUP	COIL	-	0	-	INDEX SUB	2019h (bit 1)	1.10
OPERATION ENABLE AT STARTUP	COIL	-	0	-	INDEX SUB	2019h (bit 2)	1.10
EMCY-CODE	COIL	-	0	-	INDEX SUB	2019h (bit 3)	1.50
BRAKE HOLDING FUNCTION ACTIVATION	COIL	-	0	-	INDEX SUB	2019h (bit 4)	1.50
ENCODER CHECK	COIL	-	0	-	INDEX SUB	2019h (bit 5)	1.50
THERMISTOR CHECK ACTIVATION	COIL	-	0	-	INDEX SUB	2019h (bit 6)	1.50
BRAKE ACTIVATION	COIL	-	0	-	INDEX SUB	2019h (bit 7)	1.10
BRAKE VALUE	COIL	-	0	-	INDEX SUB	2019h (bit 8	1.10
EEPROM DIAGNOSTIC LOG CLEANING	COIL	-	0	-	INDEX SUB	2019h (bit 9)	1.50

EEPROM AUTOPHASING DATA CLEANING	COIL	-	0	-	INDEX SUB	2019h (bit 10)	1.10
EEPROM PARAMETERS CLEANING	COIL	-	0	-	INDEX SUB	2019h (bit 11)	1.10
EEPROM TOTAL CLEANING	COIL	-	0	-	INDEX SUB	2019h (bit 12)	1.10
DIRECTION CHANGE LOCK	COIL	-	0	-	INDEX SUB	2019h (bit 14)	1.70
DIGITAL INPUT HANDLING STO ENABLED	COIL	-	0	-	INDEX SUB	2019h (bit 15)	1.50
START	COIL	-	0	-	INDEX SUB	201Bh (bit 0)	1.10
NOT READY TO SWITCH ON	COIL	-	0	-	INDEX SUB	201Bh (bit 1)	1.10
SWITCH ON DISABLED	COIL	-	0	-	INDEX SUB	201Bh (bit 2)	1.10
READY TO SWITCH ON	COIL	-	0	-	INDEX SUB	201Bh (bit 3)	1.10
SWITCHED ON	COIL	-	0	-	INDEX SUB	201Bh (bit 4)	1.10
OPERATION ENABLED	COIL	-	1	-	INDEX SUB	201Bh (bit 5)	1.10
QUICK STOP ACTIVE	COIL	-	0	-	INDEX SUB	201Bh (bit 6)	1.10
FAULT	COIL	-	0	-	INDEX SUB	201Bh (bit 7)	1.10
FAULT REACTION ACTIVE	COIL	-	0	-	INDEX SUB	201Bh (bit 8)	1.10
POWER OFF RESET	COIL	-	0	-	INDEX SUB	201Bh (bit 9)	1.50