Smart encoders & actuators

User's guide

IF55 ROT CB

CANopen®

DS406 encoder profile

- SSI to CANopen converter
- Suitable for SSI rotary encoders
- Accepts MSB & LSB Aligned protocols up to 30 bits
- Cable and M12 connector outputs
- CANopen in compliance with DS 301 and DS 406 profiles

Suitable for the following models:

- IF55 ROT CB
- IF55 ROT CB-C

General Contents

General contents

Subject index

Typographic and iconographic conventions

In this guide, to make it easier to understand and read the text the following typographic and iconographic conventions are used:

- parameters and objects both of the device and the interface are coloured in GREEN;
- alarms are coloured in RED;
- states are coloured in FUCSIA.

When scrolling through the text some icons can be found on the side of the page: they are expressly designed to highlight the parts of the text which are of great interest and significance for the user. Sometimes they are used to warn against dangers or potential sources of danger arising from the use of the device. You are advised to follow strictly the instructions given in this guide in order to guarantee the safety of the user and ensure the performance of the device. In this guide the following symbols are used:

	This icon, followed by the word **WARNING**, is meant to highlight the parts of the text where information of great significance for the user can be found: user must pay the greatest attention to them! Instructions must be followed strictly in order to guarantee the safety of the user and a correct use of the device. Failure to heed a warning or comply with instructions could lead to personal injury and/or damage to the unit or other equipment.
	This icon, followed by the word **NOTE**, is meant to highlight the parts of the text where important notes needful for a correct and reliable use of the device can be found. User must pay attention to them! Failure to comply with instructions could cause the equipment to be set wrongly: hence a faulty and improper working of the device could be the consequence.
	This icon is meant to highlight the parts of the text where suggestions useful for making it easier to set the device and optimize performance and reliability can be found. Sometimes this symbol is followed by the word **EXAMPLE** when instructions for setting parameters are accompanied by examples to clarify the explanation.

Preliminary information

This guide is designed to describe the technical characteristics, installation and use of the SSI to CANopen gateways of the **IF55 series**.

IF55 series gateways allow the **integration of SSI encoders**, both rotary and linear, **into conventional fieldbuses or industrial Ethernet networks**.
The present manual is specifically designed to describe the SSI to CANopen IF55 model for rotary encoders (order code IF55 ROT CB). For information on the SSI to CANopen IF55 model for linear encoders (order code IF55 LIN CB) refer to the specific documentation.
For information on the gateways designed for the integration of other fieldbus/Ethernet encoders (for example, SSI to Profibus: order codes IF55 ROT PB and IF55 LIN PB; and SSI to EtherCAT: order codes IF55 ROT EC and IF55 LIN EC; etc.), refer to the specific documentation.

Please note that the present manual does not prescind from the user's guide of the SSI encoder it has to be connected to. Please read carefully the encoder's documentation before installing, connecting and operating the measuring system.
For detailed technical specifications please refer also to the product datasheet.

CANopen connection cap as follows:

CB	CANopen interface with PGs
CB-C	CANopen interface with M12 connectors

For any further information please refer to the product data sheet.

To make it easier to read the text, this guide can be divided into two main sections.
In the first section general information concerning the safety, the mechanical installation and the electrical connection as well as tips for setting up and running properly and efficiently the unit are provided.
In the second section, entitled **CANopen Interface (DS406)**, both general and specific information is given on the CANopen interface. In this section the interface features and the objects implemented in the unit are fully described.

Glossary of CANopen terms

CANopen, like many other networking systems, has a set of unique terminology. Table below contains a few of the technical terms used in this guide to describe the CANopen interface. They are listed in alphabetical order. The Glossary is owned and copyrighted by the CAN in Automation international users' and manufacturers' group.

Application layer	The application layer is the communication entity of the OSI (Open System Interface) reference model. It provides communication services to the application program.
Application objects	Application objects are signals and parameters of the application program visible at the application layer API (application programming interface).
Application profile	Application profiles define all communication objects and application objects in all devices that the network consists of.
Asynchronous PDO	An asynchronous PDO is transmitted whenever a defined internal event occurs. This event may also be the elapsing of the PDO's event timer. If an asynchronous PDO is received the protocol software immediately updates the mapped objects in the Object Dictionary.
Boot-up message	CANopen communication service transmitted whenever a node enters the **Pre-operational** state after initialization.
Bus	Topology of a communication network, where all nodes are reached by passive links, which allows transmission in both directions.
Bus analyser	Tool, which monitors the bus and displays the transmitted bits. There are bus analysers available on the physical layer, the data link layer, and different application layers (e.g. CANopen or DeviceNet).
Bus arbitration	If at the very same moment several nodes try to access the bus, an arbitration process is necessary. At the end of this process, only one node has bus access. The bus arbitration process used in CAN protocol is CMSA/CD (Carrier Sense Multiple Access/Collision Detection) with AMP (Arbitration on Message Priority). This allows bus arbitration without destruction of messages.
Bus length	The network cable length between the both termination resistors. The bus length of CANopen networks is limited by the used transmission rate. At 1 Mbps the maximum length is 25 m. When using lower transmission rates, longer bus lines may be used: at 50 kbps a length of 1 km is possible.
Bus off state	The CAN controllers switch to bus off state when the TEC (transmit error counter) has reached 255. During bus off state, the CAN controller transmits recessive bits. When a CANopen

	device recovers from bus off state, it has to transmit the boot-up message and it is recommended to send an Emergency message with the appropriate error code.
CAN	Controller Area Network (CAN) is a serial bus system originally developed by the Robert Bosch GmbH. It is internationally standardized by ISO 11898-1. CAN has been implemented by many semiconductor manufacturers.
CAN protocol controller	The CAN protocol controller is part of a CAN module performing data en-/de-capsulation, bit-timing, CRC, bit-stuffing, error handling, failure confinement, etc.
CAN transceiver	The CAN transceiver is connected to the CAN controller and to the bus lines. It provides the line transmitter and the receiver. There are high-speed, fault-tolerant, and single-wire transceivers available as well as transceivers for power-line or fiber optic transmissions.
CANopen	Family of profiles for embedded networking in industrial machinery, medical equipment, building automation (e.g. lift control systems, electronically controlled doors, integrated room control systems), railways, maritime electronics, truck-based superstructures, off-highway and off-road vehicles, etc.
CANopen application layer	The CANopen application layer and communication profile is standardized by EN 50325-4. It defines communication services and objects. In addition, it specifies the Object Dictionary and the network management (NMT).
CANopen Manager	The CANopen manager is responsible for the management of the network. The CANopen manager device shall include the NMT (network management) Master, the SDO (service data object) manager, and the Configuration manager.
CANopen Safety	Communication protocol allowing transmission of safety-relevant data. The protocol requires just one physical CAN network. Redundancy is achieved by sending each message twice with bit-wise inverted content using two identifiers differing at least in two bits.
Certification	Official compliance test of components or devices to a specific standard. CiA officially certifies CANopen devices.
CiA DR 303	Draft recommendation for CANopen cabling and connector pin assignments, coding of prefixes and SI unit as well as LED usage.
CiA DS 102	Draft standard for high-speed transmission according to ISO 11898-2 using 9-pin D-sub connectors.
CiA DS 301	The CANopen application layer and communication profile specification covers the functionality of CANopen NMT (network management) Slave devices.
CiA DS 401	The CANopen device profile for generic I/O modules covers the definition of digital and analogue input and output devices.
CiA DS 404	The CANopen device profile for measuring devices and closed-

	loop controllers supports also multi-channel devices.
CiA DS 406	The CANopen device profile for encoders defines the communication of rotating as well as linear sensors.
CiA DSP 302	The draft standard proposal for programmable CANopen devices includes CANopen manager functions, dynamic SDO connections, standardized boot-up procedure for NMT Slaves as well as program download.
CiA DSP 304	The CANopen safety protocol specification is approved by German authorities and is compliant to SIL class 3 applications.
CiA DSP 305	The Layer Setting Services (LSS) specify how to set node-ID and transmission rate via the CANopen network.
CiA DSP 306	This draft standard proposal defines format and content of Electronic Data Sheets (EDS) to be used in configuration tools.
CiA DSP 308	The CANopen framework for maritime applications defines redundancy of networks including swapping mechanism for SDOs and PDOs.
CiA DSP 309	Set of gateway specifications for CANopen to Ethernet-based networks (e.g. Modbus TCP(IP)).
CiA DSP 402	The CANopen device profile for drives and motion controllers defines the interface to frequency inverters, servo controllers as well as stepper motors.
CiA DSP 405	The CANopen device and interface profile for IEC 61131-3 compatible controllers is based on the CiA DSP 302 specification using network variables to be mapped into PDOs, and function blocks for SDO services, etc.
CiA DSP 407	The CANopen application profile for passenger information systems developed in cooperation with the German VDV specifies interfaces for a range of devices including displays, ticket printers, passenger counting units, main onboard computer, etc.
CiA DSP 408	The CANopen device profile for hydraulic controllers and proportional valves is compliant to the bus-independent VDMA device profile.
CiA DSP 410	The CANopen device profile for inclinometer supports 16-bit as well as 32-bit sensors.
CiA DSP 412	The CANopen device profiles for medical equipment specify the interfaces for x-ray collimators, x-ray generators, stands and tables.
CiA DSP 413	The CANopen interface profiles for in-vehicle truck gateways specify gateways to ISO 11992, J1939, and other in-vehicle networks. The CANopen network is mainly used for truck- or trailer-based superstructures, e.g. as in garbage trucks, truck-mounted cranes, and concrete mixers.
CiA DSP 414	The CANopen device profile for weaving machines specifies

	the interface for feeder sub-systems.
CiA DSP 415	The CANopen application profile for asphalt pavers specifies interfaces to different devices used in road construction machinery.
CiA DSP 416	The CANopen application profile for building doors specifies interfaces for locks, sensors, and other devices used in electronically controlled building doors.
CiA DSP 417	The CANopen application profile for lift control specifies the interfaces for car controller, door controller, call controller and other controllers as well as for car units, door units, input panels, and display units, etc.
CiA DSP 418	The CANopen device profile for battery modules specifies the interface to communicate with battery chargers.
CiA DSP 419	The CANopen device profile for battery charger specifies the interface to communicate with the battery module.
CiA DSP 420	The CANopen device profile family for extruder downstream devices defines interfaces for puller, corrugator and saw devices.
CiA DSP 421	The CANopen device profile for railways specifies interfaces to sub-systems such as diesel engines, brake controllers, door controllers, etc.
CiA DSP 422	The CANopen application profile for municipal vehicles defines the communication of sub-systems used in garbage trucks.
CiA TR 308	This technical report specifies some timings for CANopen performance testing tools.
Client / Server communication	In a Client/Server communication the Client initiates the communication with the Server. It is always a point-to-point communication.
Client SDO	The Client SDO initiates the SDO communication by means of reading or writing to the Object Dictionary of the Server device.
COB ID	The COB ID is the object specifying the CAN message identifier and additional parameters such as valid/invalid and remote frame support.
Communication object (COB)	A communication object is one or more CAN messages with a specific functionality, e.g. PDO, SDO, Emergency, Time, or Error Control.
Communication profile	A communication profile defines the content of communication objects such as Emergency, Time, Sync, Heartbeat, NMT, etc. in CANopen.
Configuration Manager	The Configuration Manager (CMT) provides mechanisms for configuration of CANopen devices during boot-up.
Confirmed communication	Confirmed communication services require a bi-directional communication, meaning that the receiving node sends a confirmation that the message has been received successfully.

Conformance test plan	Definitions of test cases that have to be passed successfully in order to achieve conformance to a communication standard. The conformance test plan for CAN is standardized by ISO 16845.
Conformance test tool	A conformance test tool is the implementation of a conformance test plan.
Consumer	In CAN networks a receiver of messages is called a consumer meaning the acceptance filter is opened.
D-sub connector	Standardized connectors. Most common in use is the 9-pin D-sub connector (DIN 41652); its pin-assignment for CAN networks is specified in CiA DS 102.
Data link layer	Second layer in the OSI reference model providing basic communication services. The CAN data link layer defines data, remote, error, and overload frames.
Data type	Object attribute in CANopen defining the format, e.g. UNSIGNED8, INTEGER16, BOOLEAN, etc.
Default value	Object attribute in CANopen defining the pre-setting of not user-configured objects after power-on or application reset.
Device profile	A device profile defines the device-specific communication services including the configuration services in all details.
Draft Recommendation (DR)	This kind of recommendation is not fixed, but it is published. CiA's draft recommendations are not changed within one year.
Draft Standard (DS)	This kind of standard is not fixed, but it is published. CiA's draft standards are not changed within one year.
Draft Standard Proposal (DSP)	This kind of standard is a proposal, but it is published. CiA's draft standard proposals may be changed anytime without notification.
EDS checker	Software tool that checks the conformity of electronic data sheets. The CANopen EDS checker is available on CiA's web-site to be downloaded.
EDS generator	Software tool that generates CANopen electronic data sheets.
Electronic Data Sheet (EDS)	Electronic data sheets describe the functionality of a device in a standardized manner.
Emergency message	Pre-defined communication service in CANopen mapped into a single 8-byte data frame containing a 2-byte standardized error code, the 1-byte error register, and 5-byte manufacturer-specific information. It is used to communicate device and application failures.
EN 50325-4	CENELEC standard defining the CANopen application layer (version 4.0).
Entry category	Object attribute in CANopen defining whether this object is mandatory or optional.
Error code	CANopen specifies standardized error codes transmitted in emergency messages.

Error control message	The CANopen error control messages are mapped to a single 1-byte CAN data frame assigned with a fixed identifier that is derived from the device's Node ID. It is transmitted as boot-up message before entering **Pre-operational** state after initialization, and it is transmitted if remotely requested by the NMT Master (node guarding) or periodically by the device (heart-beat).
Event driven	Event driven messages are transmitted when a defined event occurs in the node. This may be a change of input states, elapsing of a local timer, or any other local event.
Event timer	The event timer is assigned in CANopen to one PDO. It defines the frequency of transmission.
Expedited SDO	This is a confirmed communication service of CANopen (peer-to-peer). It is made up by one SDO initiate message of the Client node and the corresponding confirmation message of the Server node. Expedited SDOs are used if not more than 4 byte of data has to be transmitted.
Flying Master	In safety-critical applications, it may be required that a missing NMT Master is substituted automatically by another stand-by NMT Master. This concept of redundancy is called Flying Master.
Form error	A corruption of one of the pre-defined recessive bits (CRC delimiter, ACK delimiter and EOF) is regarded as a form error condition that will cause the transmission of an error frame in the very next bit-time.
Function code	First four bits of the CAN identifier in the CANopen pre-defined identifier set indicating the function of the communication object (e.g. TPDO_1 or Error Control message).
Galvanic isolation	Galvanic isolation in CAN networks is performed by optocouplers or transformers placed between CAN controller and CAN transceiver chip.
Gateway	Device with at least two network interfaces transforming all seven OSI (open system interconnection) protocol layers, e.g. CANopen-to-Ethernet gateway.
Heartbeat	CANopen uses heartbeat message to indicate that a node is still alive. This message is transmitted periodically.
Heartbeat consumer time	The heartbeat consumer time defines the time when a node is regarded as no longer alive due to a missing heartbeat message.
Heartbeat producer time	The heartbeat producer time defines the transmission frequency of a heartbeat message.
Identifier	In general, the term identifier refers to a CAN message identifier. The CAN message identifier identifies the content of a data frame. The identifier of a remote frame corresponds to the identifier of the requested data frame. The identifier includes implicitly the priority for the bus arbitration.

Index	16-bit address to access the CANopen dictionary; for array and records the address is extended by an 8-bit Subindex.
Inhibit timer	Object in CANopen for PDOs and Emergency messages that forbids for the specified time (inhibit time) a transmission of this communication object.
Initialization state	NMT Slave state in CANopen that is reached automatically after power-on and communication or application reset.
Interface profile	CANopen profile that describes just the interface and not the application behaviour of device, e.g. gateway and bridge devices.
ISO 11898-1	International standard defining the CAN data link layer including LLC, MAC and PLS sub-layers.
ISO 11898-2	International standard defining the CAN high-speed MAU.
Life guarding	Method in CANopen to detect that the NMT Master does not guard the NMT Slave any more. This not recommended for new systems designs.
Line topology	Networks, where all nodes are connected directly to one bus line. CAN networks use theoretically just line topologies without any stub cable. However in practice you find tree and star topologies as well.
Master	Communication or application entity that is allowed to control a specific function. In networks this is for example the initialization of a communication service.
Multiplexed PDO (MPDO)	The MPDO is made of 8 byte including one control byte, three multiplexer bytes (containing the 24-bit Index and Subindex), and four bytes of object data.
Network length	Bus length. The network cable length between both termination resistors. The bus length of CANopen networks is limited by the used transmission rate. At 1 Mbps the maximum length is 25 m. When using lower transmission rates, longer bus lines may be used: at 50 kbps a length of 1 km is possible.
Network management	Entity responsible for the network boot-up procedure and the optional configuration of nodes. It also may include node-supervising functions such as node guarding.
Network variables	Network variables are used in programmable CANopen devices to be mapped into PDOs after programming the device.
NMT	Network management in CANopen.
NMT Master	The NMT Master device performs the network management by means of transmitting the NMT message. With this message, it controls the state machines of all connected NMT Slave devices.
NMT Slave	The NMT Slaves receive the NMT message, which contains commands for the NMT state machine implemented in CANopen devices.

NMT state machine	The NMT state machines support different states and the highest prior CAN message transmitted controls the transition to the states by the NMT Master.
Node guarding	Mechanism used in CANopen and CAL to detect bus off or disconnected devices. The NMT Master sends a remote frame to the NMT Slave that is answered by the corresponding error control message.
Node ID	Unique identifier for a device required by different CAN-based higher-layer protocols in order to assign CAN identifiers to this device, e.g. in CANopen and DeviceNet. In the pre-defined connection set of CANopen some of the CAN message identifiers are derived from the assigned Node ID.
Object Dictionary	Heart of each CANopen device containing all communication and application objects.
Operational state	In the NMT **Operational** state all CANopen communication services are available.
PDO mapping	In PDOs, there may be mapped up to 64 objects. The PDO mapping is described in the PDO mapping parameters.
Pin assignment	Definition of the use of connector pins.
Pre-defined connection set	The pre-defined connection set is a default assignment of CAN message identifiers to CANopen communication objects. Some CANopen communication objects are distributed in broadcast (NMT message, Sync message, Time message) and others are transmitted between NMT Master device and dedicated NMT Slave devices (PDO, SDO, Emergency, and Error Control). This default assignment guarantees that the CAN message identifiers are uniquely assigned in the network, if the node-ID has been assigned uniquely.
Pre-operational state	In the NMT **Pre-operational** state no CANopen PDO communication is allowed.
Process Data Object (PDO)	Communication object defined by the PDO communication parameter and PDO mapping parameter objects. It is an unconfirmed communication service without protocol overhead.
Producer	In CAN networks a transmitter of messages is called a producer.
Protocol	Formal set of conventions and rules for the exchange of information between nodes, including the specification of frame administration, frame transfer and physical layer.
Receiver	A CAN node is called receiver or consumer, if it is not transmitter and the bus is not idle.
Redundant networks	In some safety-critical applications (e.g. maritime systems), redundant networks may be required that provide swapping capability in case of detected communication failures.
Remote frame	With a remote frame another node is requested to transmit

	the corresponding data frame identified by the very same identifier. The remote frame's DLC has the value of the corresponding data frame DLC. The data field of the remote frame has a length of 0 byte.
Remote transmission request (RTR)	Bit in the arbitration field indicating if the frame is a remote frame (recessive value) or a data frame (dominant value).
Repeater	Passive component that refreshes CAN bus signals. It is used to increase the maximum number of nodes, or to achieve longer networks (>1 km), or to implement tree or meshed topologies.
Reset application	This NMT command resets all objects in CANopen devices to the default values or the permanently stored configured values.
Reset communication	This NMT command resets only the communication objects in CANopen devices to the default values or the permanently stored configured values.
RPDO	The Receive Process Data Object (RPDO) is a communication object that is received by a CANopen device.
SDO block transfer	SDO block transfer is a CANopen communication service for increasing downloading. In SDO block transfer, the confirmation is sent after the reception of a number of SDO segments.
SDO Manager	The SDO Manager handles the dynamic establishment of SDO connections. It resides on the very same node as the NMT Master.
Segmented SDO	If objects longer than 4 bytes are transmitted by means of SDO services, a segmented transfer is used. The number of segments is theoretically not limited.
Server SDO	The Server SDO receives the SDO messages from the corresponding SDO Client and responds to each SDO message or to a block of SDO messages (SDO block transfer).
Service Data Object (SDO)	SDOs provide the access to entries in the CANopen Object Dictionary. An SDO is made up of at least two CAN messages with different identifiers. SDOs are always confirmed point-to-point communication services.
SI unit	International system of units for physical values as specified in ISO 1000:1983.
Stopped state	NMT state in which only NMT messages are performed and under some conditions error control messages are transmitted.
Sub-index	8-bit sub-address to access the sub-objects of arrays and records.
Suspend transmission	CAN controllers in error passive mode have to wait additional 8 bit-times before the next data or remote frame may be transmitted.
SYNC message	Dedicated CANopen message forcing the receiving nodes to

	sample the inputs mapped into synchronous TPDOs. Receiving this message causes the node to set the outputs to values received in the previous synchronous RPDO.
Termination resistor	In CAN high-speed networks with bus topology, both ends are terminated with resistors in order to suppress reflections.
TIME message	Standardized message in CANopen containing the time as a 6-byte value given as ms after midnight and days after 1st January 1984.
TPDO	The Transmit Process Data Object (TPDO) is a communication object that is transmitted by a CANopen device.
Transmission type	CANopen object defining the scheduling of a PDO.
Value definition	Detailed description of the value range in CANopen profiles.
Value range	Object attribute in CANopen defining the allowed values that this object supports.

1 - Safety summary

1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and stationary mechanical parts;
- device must be used only for the purpose appropriate to its design: use for purposes other than those for which it has been designed could result in serious personal and/or the environment damage;
- high current, voltage and moving mechanical parts can cause serious or fatal injury;
- warning! Do not use in explosive or flammable areas;
- failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment;
- Lika Electronic assumes no liability for the customer's failure to comply with these requirements.

1.2 Electrical safety

- Turn off power supply before connecting the device;
- connect according to explanation in the "4 - Electrical connections" section on page 25;
- in compliance with the 2014/30/EU norm on electromagnetic compatibility, following precautions must be taken:

  - before handling and installing, discharge electrical charge from your body and tools which may come in touch with the device;
  - power supply must be stabilized without noise, install EMC filters on device power supply if needed;
  - always use shielded cables (twisted pair cables whenever possible);
  - avoid cables runs longer than necessary;
  - avoid running the signal cable near high voltage power cables;
  - mount the device as far as possible from any capacitive or inductive noise source, shield the device from noise source if needed;
  - to guarantee a correct working of the device, avoid using strong magnets on or near by the unit;
  - minimize noise by connecting the shield and/or the connector housing and/or the frame to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user. Provide the ground connection as close as possible to the encoder. We suggest using the ground screw provided in the cap (use a TCEI M3 x 6 cylindrical head screw with 2 tooth lock washers).

1.3 Mechanical safety

- Install the device following strictly the information in the "3 - Mounting instructions" section on page 22;
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the encoder;
- do not tool the encoder or its shaft;
- delicate electronic equipment: handle with care; do not subject the device and the shaft to knocks or shocks;
- respect the environmental characteristics declared by manufacturer.

2 - Identification

The device can be identified through the **order code** and the **serial number** printed on the label applied to its enclosure. Information is listed in the delivery document too. Please always quote the order code and the serial number when reaching Lika Electronic for purchasing spare parts or needing assistance. For any information on the technical characteristics of the product refer to the technical catalogue.

Warning: devices having order code ending with "/Sxxx" may have mechanical and electrical characteristics different from standard and be supplied with additional documentation for special connections (Technical info).

3 - Mounting instructions

WARNING
Installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and mechanical parts compulsorily in stop.

3.1 Overall dimensions

(values are expressed in mm)

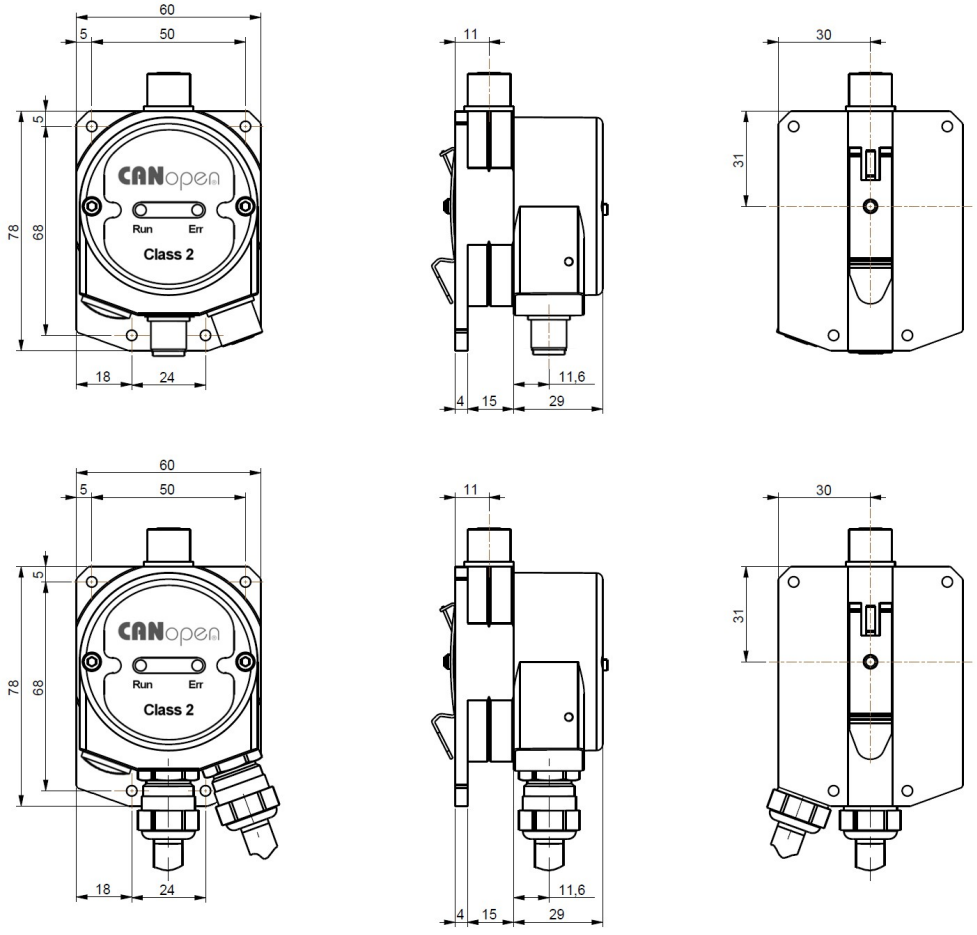


Figure 1

3.2 Installation on panel (Figure 2)

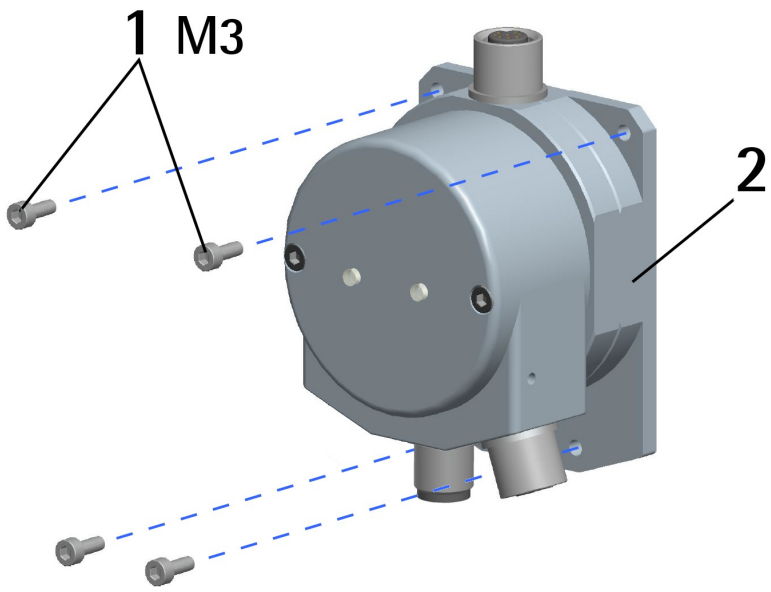


Figure 2

The unit is designed for installation on the even surface of a panel.
The back flange **2** is fitted with four holes for inserting the fixing screws **1**. Tighten the four fixing screws **1** until the unit is properly fastened to the support. Use **four M3 8 mm min. long cylinder head screws**. The recommended tightening torque is **1.1 Nm**.

3.3 Installation with DIN rail clip (Figure 3)

The unit can be installed on DIN profiles inside a rack. A clip **3** for direct fitting on DIN TS35 rails is supplied for free. It has to be fixed on the back of the flange **2** by means of the provided screw **4**.

WARNING
To mount the clip **3** you need to remove the cap **5** and drill a hole **A** in the back flange **2**. Delicate electronic circuits and wirings are located inside the cap **5**. Thus this operation has to be accomplished by skilled personnel only. Please pay careful attention and observe great precaution when carrying out this operation.

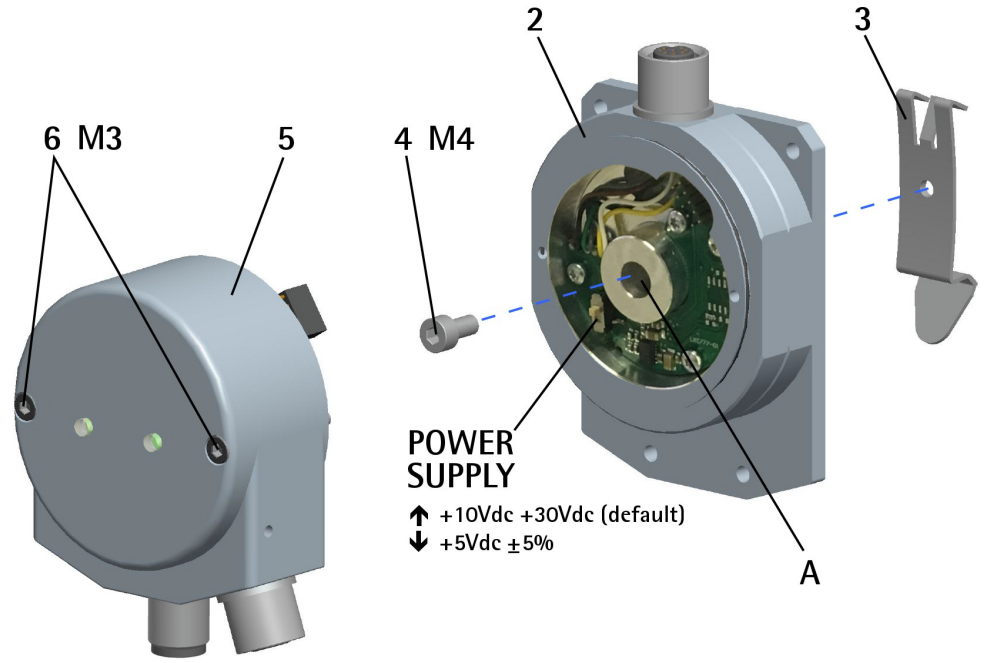


Figure 3

- Loosen the two screws **6** that fasten the cap **5** to the back flange **2**;
- open the cap **5** and separate it from the flange **2**; please pay attention to the internal wirings;
- drill a 4.5 mm diameter hole **A** in the flange **2**; use the notch in the inside of the flange **2** to guide the drill bit;

WARNING
Carefully remove the scrap material after drilling.

- mount the clip **3** on the back of the flange **2** and fix it by means of the provided M4 x 8 screw **4**; it has to be screwed on the inner side of the flange **2**;
- replace the cap **5** and fix it by means of the screws **6**.

4 - Electrical connections

WARNING
Power supply must be turned off before performing any electrical connection!

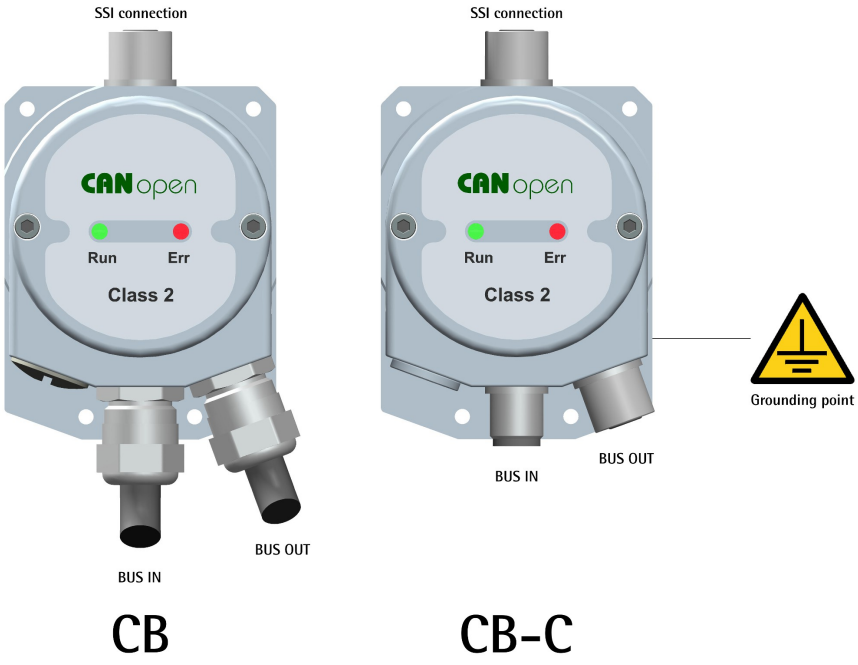


Figure 4

4.1 Converter's connection cap (Figure 5)

WARNING
Do not remove or mount the connection cap with power supply switched ON. Damage may be caused to internal components.

The terminal connectors for connecting the power supply and the BUS IN and BUS OUT cables (CB connection cap) as well as the DIP switches meant to set the encoder power supply, the node ID and the baud rate and activate the termination resistance (CB and CB-C connection caps) are located inside the converter connection cap. Thus you must remove the connection cap to access any of them.

NOTE
Be careful not to damage the internal components when you perform this operation.

To remove the connection cap loosen the two screws **1** (Figure 5). Please be careful with the internal connector.

Always replace the connection cap at the end of the operation. Take care in re-connecting the internal connector. Tighten the screws **1** using a tightening torque of approx. 2.5 Nm.

WARNING
You are required to check that the converter back flange and the connection cap are at the same potential before replacing the connection cap!

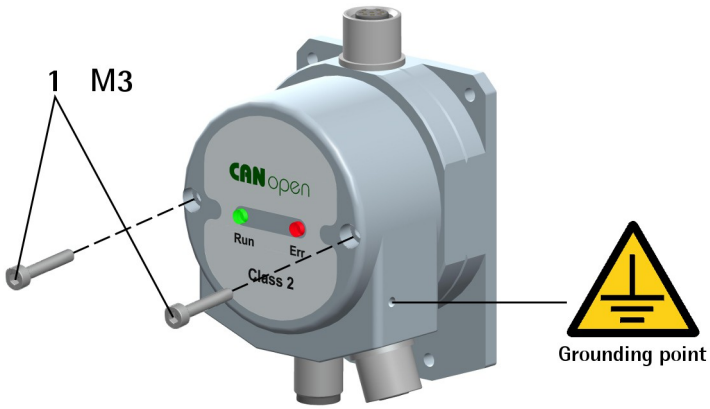
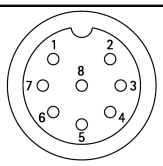


Figure 5

4.2 SSI connection (Figure 4)

The converter is fitted with one M12 8-pin female connector to network the IF55 gateway and the SSI encoder.

M12 8-pin	SSI connection
(frontal side)	 A coding female

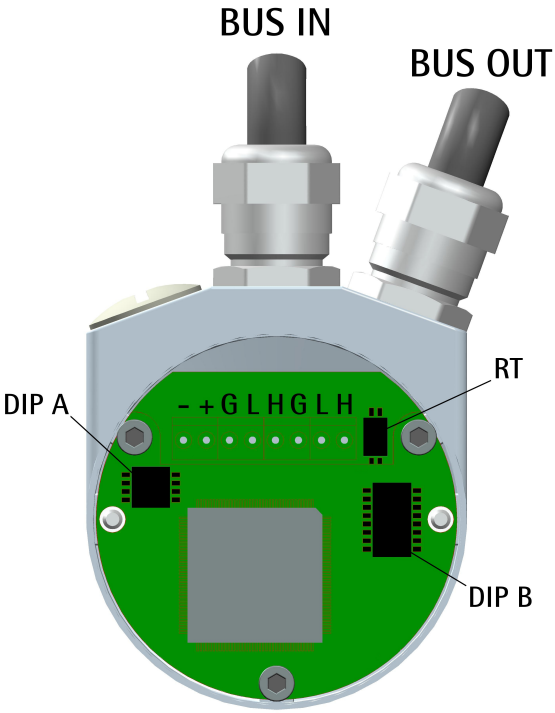
Pin	Description
1	0Vdc power supply voltage
2	+Vdc power supply voltage *
3	Clock IN +
4	Clock IN -
5	Data OUT +
6	Data OUT -
7 and 8	not connected

* The power supply voltage level must be set through the POWER SUPPLY DIP switch located inside the enclosure of the converter, see the "4.7 POWER SUPPLY DIP switch (Figure 8)" section on page 29.

WARNING
The max. length of the SSI cable must not exceed 30 m / 98.425 ft.

4.3 CANopen converter with PGs: CB version (Figure 4 and Figure 6)

Figure 6



The converter is N and BUS OUT connections. Th :o the terminal connectors in fr Nbus certificated cables to be used .06").

Terminal connector	Description
-	0Vdc power supply voltage
+	+10Vdc +30Vdc power supply voltage
G	CAN GND [1]
L	CAN Low
H	CAN High
PG	CAN Shield [2]

[1] CAN GND is the 0V reference of CAN signals, it is not connected to 0Vdc supply voltage.
[2] Connect the cable shield to the cable gland.

4.4 CANopen converter with M12 connectors: CB-C version (Figure 4 and Figure 7)

The converter is fitted with two M12 5-pin connectors with pin-out in compliance with the CANopen® standard. Therefore you can use standard CANopen cables commercially available.

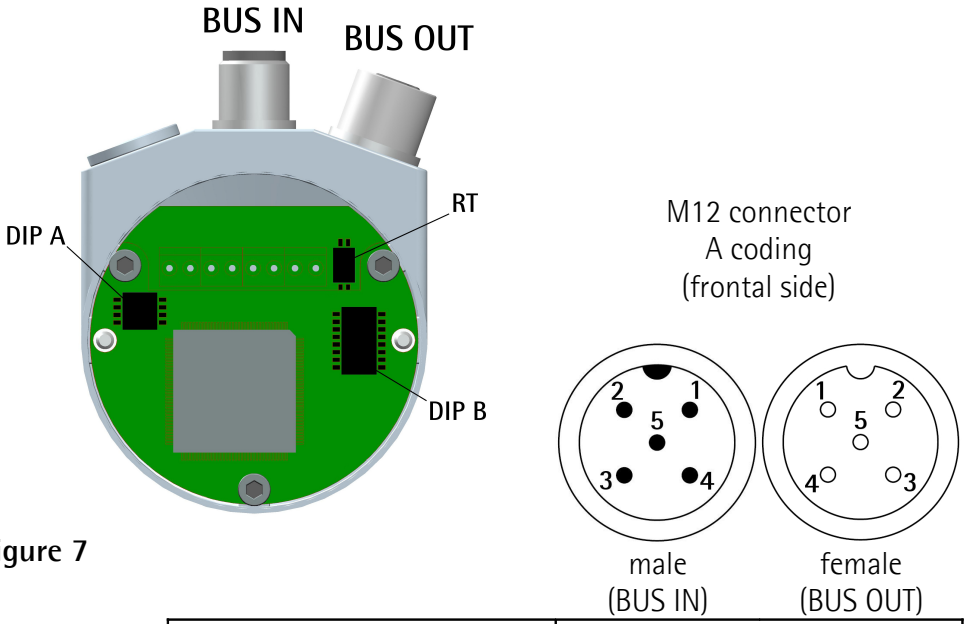


Figure 7

M12	Description
Case	CAN Shield
1 [1]	
2	+10Vdc +30Vdc power supply voltage
3	0Vdc power supply voltage
4	CAN High
5	CAN Low

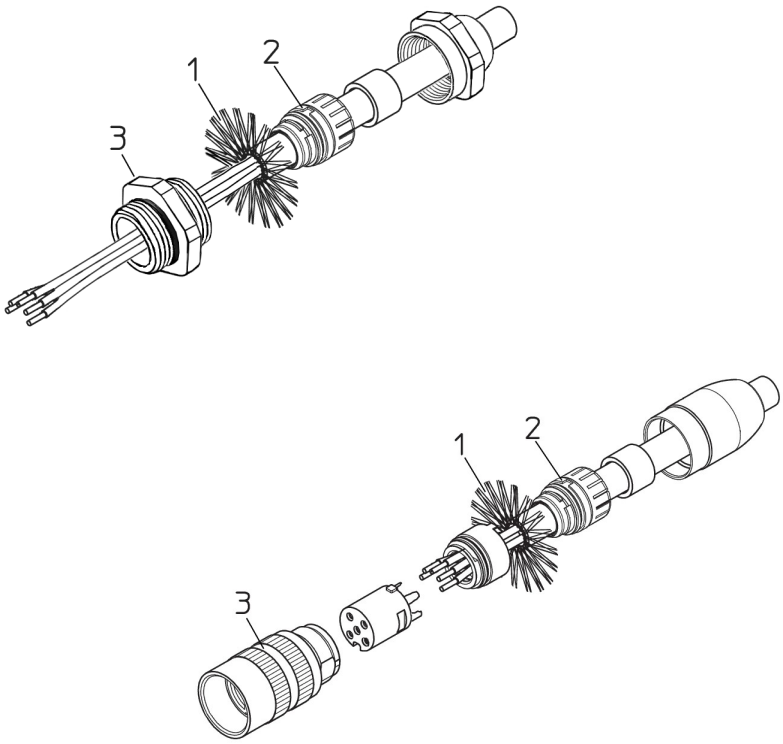
[1] CAN Shield is also connected to pin 1 to allow the connection of the shield even if the plug connector has a plastic case.

4.5 Ground connection (Figure 4)

Minimize noise by connecting the shield and/or the connector housing and/or the enclosure to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user. You are advised to provide the ground connection as close as possible to the unit. We suggest using the ground point provided in the connection cap (see the Figure 4, use one TCEI M3 x 6 cylindrical head screw with two tooth lock washers).

4.6 Shield connection

Disentangle and shorten the shielding **1** and then bend it over the part **2**; finally place the ring nut **3** of the connector. Be sure that the shielding **1** is in tight contact with the ring nut **3**.



4.7 POWER SUPPLY DIP switch (Figure 8)

WARNING
Power supply must be turned off before performing this operation!

The power supply voltage level to be provided to the connected encoder must be set through the POWER SUPPLY DIP switch located inside the enclosure of the converter. It must be according to the power supply voltage level required by the connected SSI encoder. To access the POWER SUPPLY DIP switch refer to the "4.1 Converter's connection cap (Figure 5)" section on page 25.

Set the POWER SUPPLY DIP switch to UP position to provide +10Vdc +30Vdc power supply voltage level to the encoder (default setting); set the POWER SUPPLY DIP switch to DOWN position to provide +5Vdc ±5% power supply voltage level to the encoder.

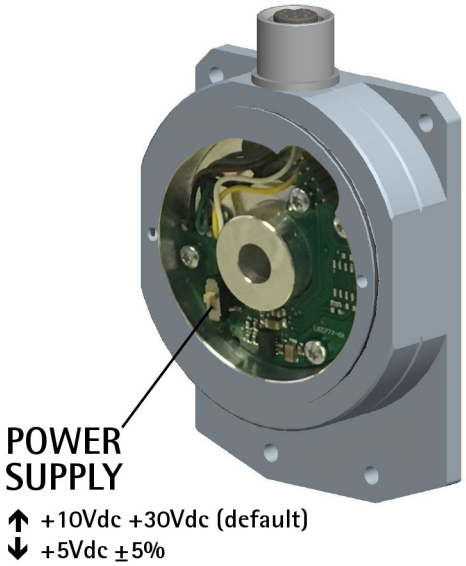


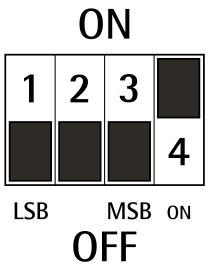
Figure 8

4.8 Baud rate: DIP A (Figure 6 and Figure 7)

WARNING
Power supply must be turned off before performing this operation!

The transmission rate must be set **via hardware** by using the DIP A DIP switch. The bit 4 of **DIP A** must be always set to "ON".

DIP A:



Switch off the device and set the binary value of the transmission rate considering that: ON = 1, OFF = 0.

bit	**1** LSB	**2**	**3** MSB	**4**
	2^0	2^1	2^2	ON

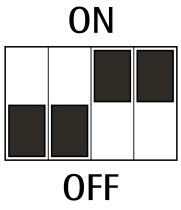
Available baud rate values:

Decimal value	Binary value	Baud rate
0	000	20 Kbit/s
1	001	50 Kbit/s
2	010	100 Kbit/s
3	011	125 Kbit/s
4	100	250 Kbit/s
5	**101**	**500 Kbit/s (default)**
6	110	800 Kbit/s
7	111	1000 Kbit/s

EXAMPLE

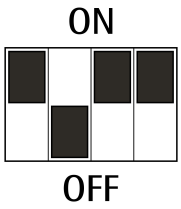
Set the baud rate to 250Kbit/s:
$4_{10} = 100_2$ (binary value, see the table above)

bit	1	2	3	4
	2^0	2^1	2^2	2^3
	OFF	OFF	ON	ON



Set the baud rate to 500Kbit/s:
$5_{10} = 101_2$ (binary value, see the table above)

bit	1	2	3	4
	2^0	2^1	2^2	2^3
	ON	OFF	ON	ON

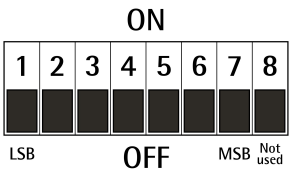


4.9 Node number: DIP B (Figure 6 and Figure 7)

WARNING
Power supply must be turned off before performing this operation!

The node number must be set via hardware by using the DIP B dip switch.
Allowed node addresses range between 1 and 127. **The default value is 1.**

DIP B:



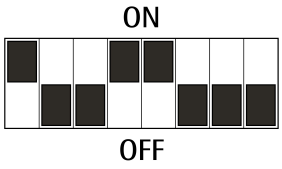
Switch off the device and set the binary value of the node number considering that: ON = 1, OFF = 0

bit	1 LSB	2	3	4	5	6	7 MSB	8 not used
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	

EXAMPLE

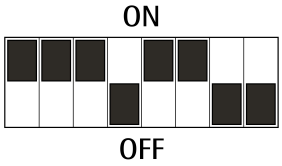
Set the node number = 25:
25_{10} = 0001 1001_2 (binary value)

bit	1	2	3	4	5	6	7	8
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	
	ON	OFF	OFF	ON	ON	OFF	OFF	OFF



Set the node number = 55:
55_{10} = 0011 0111_2 (binary value)

bit	1	2	3	4	5	6	7	8
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	
	ON	ON	ON	OFF	ON	ON	OFF	OFF

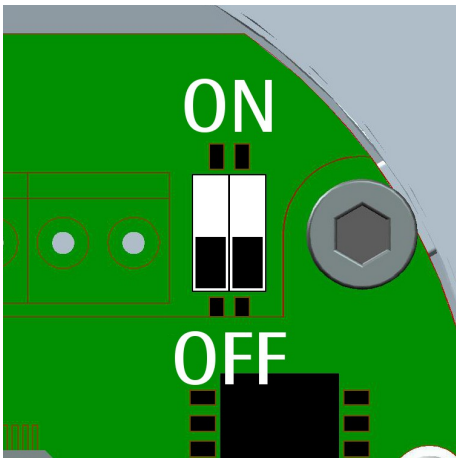


4.10 RT Bus termination (Figure 6 and Figure 7)

WARNING
Power supply must be turned off before performing this operation!

A bus termination resistance is provided inside the connection cap and must be activated as line termination if the device is at the ends of the transmission line (i.e. it is either the first or the last device in the transmission line).
Use RT Switch to activate or deactivate the bus termination.

RT	Description
1 = 2 = ON	Activated: if the device is either the first or the last device in the transmission line
1 = 2 = OFF	Deactivated: if the device is neither the first nor the last device in the transmission line



4.11 Diagnostic LEDs (Figure 4)

Two LEDs located in the rear side of the converter are designed to show the operating or fault status of the CANopen® interface.

GREEN LED	Description
ON	The encoder is in Operational state
Single flash	The encoder is in Stopped state
Blinking	The encoder is in Pre-Operational state

RED LED	Description
ON	Bus off, the CAN controller is switched off
Double flash	Node guarding error, see on page 77 ff
Single flash	Max. number of warning errors reached
Blinking	Generic error or Flash memory error, see on page 77 ff
OFF	No error

During initialization, the device carries out a hardware test to check LEDs operation. Both LEDs light up.

5 - Getting started

The following instructions allow the operator to quickly and safely set up the converter in a standard operational mode and to execute its main functions. For complete and detailed information please read the mentioned pages thoroughly.

- Mechanically install the device, see on page 22 ff;
- execute the electrical and network connections, see on page 25 ff;
- if required, set the power supply voltage level of the connected encoder, see on page 29;
- set the node address, see on page 31;
- set the transmission rate, see on page 30;
- set the line termination if required, see on page 32;
- switch on the +10Vdc +30Vdc power supply;
- in the software tool install the EDS file, see on page 40;
- set the characteristics of the connected SSI encoder:
  - set the output code used to arrange the output information next to the **2200-01 Code Type (BIN/GRAY)** object;
  - set the protocol used to arrange the absolute information next to the **2200-02 SSI Protocol** object;
  - set the number of SSI clocks next to the **2200-03 Number of SSI clocks** object;
  - set the physical singleturn resolution of the SSI encoder next to the **2200-04 Physical Singleturn Resolution [bits]** object; the **6501-00 Singleturn resolution** object is automatically set accordingly;
  - set the physical multiturn resolution of the SSI encoder next to the **2200-05 Physical Multiturn Resolution [bits]** object; the **6502-00 Number of distinguishable revolutions** object is automatically set accordingly;
- if you want to use the physical resolution (see the **6501-00 Singleturn resolution** object and the **6502-00 Number of distinguishable revolutions** object), please check that the **Scaling function control** parameter is disabled (the bit 2 in the **6000-00 Operating parameters** object = 0; see on page 62);
- otherwise, if you need a custom resolution, enable the **Scaling function control** parameter (the bit 2 in the **6000-00 Operating parameters** object = 1; see on page 62) and then set the resolution you need for your application next to the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects (see on page 63);

- now, if you need you can enter the Preset value next to the **6003-00 Preset value** object and then set it in the desired position; see on page 67;
- save the new setting values (**1010-01 Store parameters** object; see on page 49).

NOTE

Please consider that if the **2200-06 Bypass** object (see on page 60) is set to "0" = disabled, the position value read by the encoder can be processed according to needs, so the user can scale the value, set a preset, and change the counting direction. On the contrary, if the **2200-06 Bypass** object (see on page 60) is set to "1" = enabled, the information from the encoder is transmitted "as it is" and not processed in any way. The preset, scaling and counting direction functions -even if set and enabled- are ignored; also the output code setting is ignored. If, for example, the user sets a preset while the bypass mode is enabled, the value is accepted, but not activated. As soon as the bypass mode is disabled, the preset, scaling and counting direction functions -if set and enabled- become active and the **6004-00 Position value** will be accordingly.

EXAMPLE 1

We need to connect the **MM36 12/8192 BB** rotary encoder.

The main features of the rotary encoder are:
Singleturn Resolution: **12 bits = 4,096 cpr** ("12", see the order code in the product datasheet).
Multiturn Resolution: **13 bits = 8,192 rev.** ("8192", see the order code in the product datasheet).
Total resolution = **25 bits** = 4,096 x 8,192 = 33 554 432
Output code: **Binary code** ("BB", see the order code in the product datasheet).
SSI protocol: **25-bit "LSB Right Aligned" protocol** (see the User's manual).

2200-01 Code Type (BIN/GRAY) = 00h (= Binary code)
2200-02 SSI Protocol = 00h (= 25-bit "LSB Right Aligned" protocol)
2200-03 Number of SSI clocks = 19h (= 25 dec)
2200-04 Physical Singleturn Resolution [bits] = 0Ch (= 12 bits = 4,096 cpr)
2200-05 Physical Multiturn Resolution [bits] = 0Dh (= 13 bits = 8,192 rev.)

6501-00 Singleturn resolution and **6502-00 Number of distinguishable revolutions** objects are automatically set accordingly and used to arrange the position information
Total Physical Resolution = **6501-00 Singleturn resolution** * **6502-00 Number of distinguishable revolutions**

If you want to use the physical resolution:
Bit 2 **Scaling function control** in the 6000-00 Operating parameters object = 0

If you need a custom resolution:
Bit 2 **Scaling function control** in the 6000-00 Operating parameters object = 1
Now set the resolution you need for your application next to the 6001-00 Programmable pulse per revolution and 6002-00 Programmable total measuring range objects

EXAMPLE 2
We need to connect the **AS58 13/BB** rotary encoder.

The main features of the rotary encoder are:
Singleturn Resolution: **13 bits = 8192 cpr** ("13", see the order code in the product datasheet).
Multiturn Resolution: **0 bits = 1 rev.** (see the order code in the product datasheet).
Output code: **Binary code** ("BB", see the order code in the product datasheet).
SSI protocol: **13-bit "LSB Right Aligned" protocol** ("BB", se the order code in the product datasheet, see the User's manual).

2200-01 Code Type (BIN/GRAY) = 00h (= Binary code)
2200-02 SSI Protocol = 00h (= 13-bit "LSB Right Aligned" protocol)
2200-03 Number of SSI clocks = 0Dh (= 13 dec)
2200-04 Physical Singleturn Resolution [bits] = 0Dh (= 13 bits = 8,192 cpr)
2200-05 Physical Multiturn Resolution [bits] = 0h (= 2^0 bits = 1 rev.)

6501-00 Singleturn resolution and 6502-00 Number of distinguishable revolutions objects are automatically set accordingly and used to arrange the position information
Total Physical Resolution = 6501-00 Singleturn resolution * 6502-00 Number of distinguishable revolutions

If you want to use the physical resolution:
Bit 2 **Scaling function control** in the 6000-00 Operating parameters object = 0

If you need a custom resolution:
Bit 2 **Scaling function control** in the 6000-00 Operating parameters object = 1
Now set the resolution you need for your application next to the 6001-00 Programmable pulse per revolution and 6002-00 Programmable total measuring range objects

EXAMPLE 3
We need to connect the **AM58 13/4096 GA** rotary encoder.

The main features of the rotary encoder are:
Singleturn Resolution: **13 bits = 8,192 cpr** ("13", see the order code in the product datasheet).
Multiturn Resolution: **12 bits = 4,096 rev.** ("4096", see the order code in the product datasheet).
Output code: **Gray code** ("G", see the order code in the product datasheet).
SSI protocol: **25-bit "LSB Right Aligned" protocol** (see the User's manual).

2200-01 Code Type (BIN/GRAY) = 01h (= Gray code)
2200-02 SSI Protocol = 00h (= 25-bit "LSB Right Aligned" protocol)
2200-03 Number of SSI clocks = 19h (= 25 dec)
2200-04 Physical Singleturn Resolution [bits] = 0Dh (= 13 bits = 8,192 cpr)
2200-05 Physical Multiturn Resolution [bits] = 0Ch (= 12 bits = 4,096 rev.)

6501-00 Singleturn resolution and **6502-00 Number of distinguishable revolutions** objects are automatically set accordingly and used to arrange the position information
Total Physical Resolution = **6501-00 Singleturn resolution** * **6502-00 Number of distinguishable revolutions**

If you want to use the physical resolution:
Bit 2 **Scaling function control** in the **6000-00 Operating parameters** object = 0

If you need a custom resolution:
Bit 2 **Scaling function control** in the **6000-00 Operating parameters** object = 1
Now set the resolution you need for your application next to the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects

EXAMPLE 4
We need to connect the **HM58 16/16384 GA** rotary encoder.

The main features of the rotary encoder are:
Singleturn Resolution: **16 bits = 65,536 cpr** ("16", see the order code in the product datasheet).
Multiturn Resolution: **14 bits = 16,384 rev.** ("16384", see the order code in the product datasheet).
Output code: **Gray code** ("GA", see the order code in the product datasheet).
SSI protocol: **32-bit "LSB Right Aligned" protocol** (see the User's manual).

2200-01 Code Type (BIN/GRAY) = 01h (= Gray code)
2200-02 SSI Protocol = 00h (= 32-bit "LSB Right Aligned" protocol)
2200-03 Number of SSI clocks = 20h (= 32 dec)
2200-04 Physical Singleturn Resolution [bits] = 10h (= 16 bits = 65,536 cpr)
2200-05 Physical Multiturn Resolution [bits] = 0Eh (= 14 bits = 16,384 rev.)

6501-00 Singleturn resolution and 6502-00 Number of distinguishable revolutions objects are automatically set accordingly and used to arrange the position information
Total Physical Resolution = 6501-00 Singleturn resolution * 6502-00 Number of distinguishable revolutions

If you want to use the physical resolution:
Bit 2 **Scaling function control** in the 6000-00 Operating parameters object = 0

If you need a custom resolution:
Bit 2 **Scaling function control** in the 6000-00 Operating parameters object = 1
Now set the resolution you need for your application next to the 6001-00 Programmable pulse per revolution and 6002-00 Programmable total measuring range objects

5.1 Quick reference

After setting the SSI encoder parameters and then using the default settings provided by the manufacturer, you can read immediately the position value.

Follow the instructions below to:

- read the physical resolution of the device: physical singleturn resolution 6501-00 Singleturn resolution; number of physical revolutions 6502-00 Number of distinguishable revolutions;
- set the desired cycle time: 6200-00 Cyclic timer ≠ 0
- set the Operational mode;
- read the current position (in a cyclic mode and/or in a synchronous mode).

The default Baud rate and Node-ID are:
Baud rate = 500 Kbit/s
Node-ID = 1

Read the value of the physical resolution per revolution 6501-00 Singleturn resolution (physical singleturn resolution)

Master → Encoder

COB-ID	Cmd	Index		Sub	Process data			
601	40	01	65	00	-	-	-	-

Encoder → Master

COB-ID	Cmd	Index		Sub	Process data			
581	43	01	65	01	A0	A1	A2	A3

steps/rev. = ((A3<<24) | (A2<<16) | (A1<<8) | A0)

Read the number of physical revolutions 6502-00 Number of distinguishable revolutions

Master → Encoder

COB-ID	Cmd	Index		Sub	Process data			
601	40	02	65	00	-	-	-	-

Encoder → Master

COB-ID	Cmd	Index		Sub	Process data			
581	43	02	65	01	B0	B1	B2	B3

N. rev. =((B3<<24) | (B2<<16) | (B1<<8) | B0)

Set the cyclic time 6200-00 Cyclic timer (100 ms = 64h)

Master → Encoder

COB-ID	Cmd	Index		Sub	Process data			
600+ID	2B	00	62	00	64	00	-	-

Encoder → Master

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	00	62	00	00	00	-	-

Set the Operational mode

Master → Encoder

COB-ID	Cmd	Node
000	01	01

Read the position every 100 ms

Encoder → Master

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3
181	Low	...	...	High

NOTE

For further examples please refer to the "7 - Setting-up" section on page 81.

6 - CANopen® interface (DS 406)

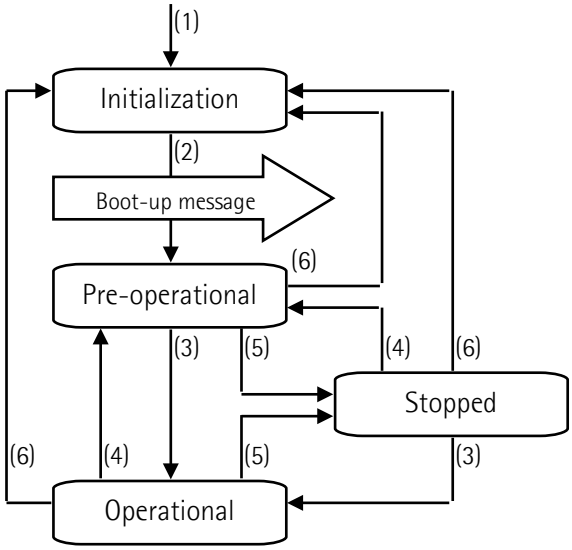
CANopen® converters for SSI encoders are always Slave devices and comply with the "Device profile for encoders", Class 2.
For any omitted information concerning the CANopen protocol, refer to the "CiA Draft Standard Proposal 301. Application Layer and Communication Profile" and to the "CiA Draft Standard Proposal 406. Device profile for encoders" documents available at the address **www.can-cia.org**.

6.1 EDS file

CANopen® converters are supplied with their own EDS file **Lika_IF55_ROT_DS406_Vx.eds**, see at **www.lika.biz > DISPLAYS & INTERFACES > SIGNAL CONVERTERS & INTERFACES (POSICONTROL)**.
EDS file is available in both English (**Lika_IF55_ROT_DS406_Vx_en.eds**) and Italian (**Lika_IF55_ROT_DS406_Vx_it.eds**) versions.
Vx is intended to indicate the file version.
EDS file has to be installed in the CANopen® Master device.
Please note that the rotary encoder converters and the linear encoder converters have different EDS files. Files for rotary encoders are marked with -ROT- in the file name; while files for linear encoders are marked with -LIN- in the file name.

6.2 State machine

CANopen® devices are designed to operate using different states. Transition from one state to another is made by sending specific NMT messages (see the Figure below).



(1)	Power on
(2)	Initialization carried out, boot-up message is sent automatically
(3)	NMT message: **Start remote node**
(4)	NMT message: **Enter pre-operational**

(5)	NMT message: **Stop remote node**
(6)	NMT message: **Reset node** or **Reset communication** command

6.2.1 Initialization state

This is the first state the CANopen® device enters after the power is turned on or after a hardware reset (**Reset node** command). As soon as the basic CANopen® device initialization is carried out, the device reads and loads the parameters saved on EPROM, sends a boot-up message and then switches automatically to **Pre-operational** state.

6.2.2 Pre-operational state

In this state the communication between the Master and the Slave is possible using SDO messages. They allow working parameters to be set. The Slave cannot send PDO messages. The state is signalled through the green LED (see on page 33).
To switch the Slave device to **Operational** state the Master must send a **Start remote node** command using an NMT message (see on page 81).

6.2.3 Operational state

In this state the Slave device is active and all communication objects are available. The Slave device can use the parameters available in the "Object dictionary" (see on page 46) and is allowed to send process data using PDO messages. The "Object dictionary" can be accessed by using SDO messages. To switch the Slave device back to the **Pre-operational** state the Master must send an **Enter pre-operational** command using an NMT message (see on page 81).

6.2.4 Stopped state

In this state the Slave device is forced to cut off the communication with the Master (except the node guarding, if active).
The communication using PDO and SDO messages is not allowed.
To switch the Slave device to either the **Pre-operational** or the **Operational** state the Master must send the specific commands **Enter pre-operational** or **Start remote node** using an NMT message (see on page 81).

NOTE
Please refer to the "7 - Setting-up" section on page 81 for an example of how the states are to be set.

6.3 Communication objects

Four different kinds of communication messages are used in a CANopen® network:

- Network management NMT protocol: NMT protocols are used by the Master to manage the nodes and the network, issue the state machine change commands (i.e. to start and stop the devices), detect the remote device boot-ups and the error conditions.
- Process Data Objects PDO protocol: used to process real time data (transmission of process data in real time).
- Service Data Objects SDO protocol: used to set and read values from the "Object dictionary" of a remote device.
- Special function Objects:
  - SYNC: synchronization message used by the Master to enable the Slave devices to transmit process data (encoder position information).
  - Emergency: error messages are triggered by each error event.
  - Node Guarding: used to request the state of the Slave; the NMT Master checks the NMT Slaves at regular intervals.

Relation between the device states and the communication objects:

	Initial.	Pre-oper.	Operat.	Stopped
NMT		X	X	X
PDO			X	
SDO		X	X	
SYNC			X	
EMCY		X	X	
Boot-up	X			
Node guarding		X	X	X

6.3.1 Pre-defined connection set

Master → Slave broadcast		
Type of COB (Object)	Function code (binary)	COB-ID (hex)
NMT	0000	000
SYNC	0001	080

peer-to-peer transmission		
EMERGENCY	0001	081 - 0FF
PDO 1 (tx)	0011	181 - 1FF
PDO 2 (tx)	0101	281 - 2FF

PDO 3 (tx)	0111	381 - 3FF
PDO4 (tx)	1001	481 - 4FF
SDO (tx)	1011	581 - 5FF
SDO (rx)	1100	601 - 67F
Nodeguard	1110	701 - 77F
Boot-up	1110	701 - 77F

The type of COB (transmitted / tx or received / rx) is viewed from the Slave device.

6.4 NMT objects

Structure of NMT objects:

COB-ID (11 bits)		2 CAN Data Bytes	
Func.code	Node ID	Command	Slave ID
0000	0	NMT Func.	Slave ID

If the Slave ID = 00h, the NMT message is sent to all the nodes in the network.

NMT Function:

Command	NMT Function	State of the node
01 hex	**Start remote node**	Operational
02 hex	**Stop remote node**	Stopped
80 hex	**Enter pre-operational**	Pre-operational
81 hex	**Reset node**	Pre-operational
82 hex	**Reset communication**	Pre-operational

6.5 Boot-up objects

Structure of the Boot-up message:

COB-ID(hex)	1 CAN Data Byte
700+Node ID	00

6.6 PDO objects

PDO (tx) messages are always made up of 4 CAN Data Bytes and are used by the unit to transmit the position value.

Structure of PDO objects:

IDENTIFIER	
COB-ID(hex)	
F.C.	Node-ID

4 CAN Data Bytes			
Byte 0	Byte 1	Byte 2	Byte 3
Low	...	...	High
position value (with PDO1, PDO2, PDO3)			

Three types of PDO messages are defined, they are:

PDO1 Cyclic mode: cyclic transmission of the position

The device uses the PDO1 message to transmit the position value **cyclically**, i.e. periodically and independently from the Master.
The interval between two issues is set in the **6200-00 Cyclic timer** object.
To activate (or deactivate) the cyclic mode it is necessary to set to 0 (or 1) the most significant bit of COB-ID used by PDO1 (**1800 PDO1 parameters**, sub 1 object).

PDO2 and PDO3 SYNC mode: synchronous transmission of the position

The transmission of the position value is managed by the Master **by sending a SYNC message**.
SYNC message is a high-priority COB transmitted by the Master to request the position value of the Slave through a PDO.
If several nodes (Slave devices) are connected to the network, the Master receives the position values from the Slaves according to the order of the Node addresses.

The unit can be programmed to send a reply after a set number of SYNC messages by setting a counter.
The PDO message will be transmitted after having received the set number of SYNC messages.
For PDO2 the value of the counter must be set in the **1801 PDO2 parameters**, sub 2 object.
For PDO3 refer to the **1802 PDO3 parameters**, sub 2 object.

The SYNC transmission mode can be enabled (or disabled) by setting to 0 (or 1) the most significant bit (MSB) of COB-IB used by PDO (**1801 PDO2 parameters** / **1802 PDO3 parameters**, sub1 objects).

NOTE
More than one transmission mode can be active at the same time.

6.7 SDO objects

SDO messages are used to set and read values from the Object dictionary of the Slave device. These parameters are described in the "Object dictionary" section (see on page 46).
4 bytes at the most are used for CAN data, other 4 bytes are used for Command, Index and Sub-index fields. SDO messages are always followed by confirmation. Thus when the Master sends an SDO message to the Slave, then the Slave always sends a reply (and a warning, should an error occur).

Structure of SDO message:

IDENTIFIER		from 4 to 8 CAN data bytes							
COB-ID(hex)		0	1	2	3	4	5	6	7
F.C.	Node-ID	Com	Index		Sub	Data			
		1byte	LSB	MSB	1byte	LSB	...	...	MSB

Com command
Index parameter index
Sub parameter sub-index
Data parameter value

6.7.1 Command

The command byte contains the type of telegram transmitted to the CAN network.
Three types of telegram are available:

- Set: it is used to send the configuration parameters to a device;
- Req: it is used by the Master to read data from a Slave device;
- Warnings: they are used by the Slave to send error messages to the Master (e.g. following a wrong SDO message: **Object does not exist in the object dictionary**, ...).

Command	COB	COB type	Data length
22h	Set	M → S request	not spec.
23h	Set	M → S request	4 bytes
2Bh	Set	M → S request	2 bytes
2Fh	Set	M → S request	1 byte
60h	Set	S → M confirmation	0 byte
40h	Req	M → S request	0 byte
42h	Req	S → M reply	not spec.
43h	Req	S → M reply	4 bytes
4Bh	Req	S → M reply	2 bytes
4Fh	Req	S → M reply	1 byte
41h	Req	S → M reply segmented SDO	
80h	Warning	S → M reply	4 bytes

6.8 Object dictionary

The most important part of a device profile is the Object Dictionary. The Object Dictionary is essentially a grouping of objects accessible via the network in an ordered, pre-defined fashion.
The user-related objects are grouped in three main areas: the Communication Profile Area, the Manufacturer Specific Profile Area and the Standardised Device Profile Area. The objects are all described in the EDS file.

The **Communication Profile Area** at indexes from 1000h to 1FFFh contains the communication specific parameters for the CANopen network. These entries are common to all devices. NMT services, PDO objects and SDO objects are described in this section. The Communication Profile Area objects comply with the "CiA Draft Standard Proposal 301 CANopen Application layer and communication profile". Refer to the "6.8.1 Communication Profile Area objects (DS 301)" section on page 47.

The **Manufacturer Specific Profile Area** at indexes from 2000h to 5FFFh is free to add manufacturer-specific functionality. Refer to the "6.8.2 Manufacturer Specific Profile Area objects" section on page 56.

The **Standardised Device Profile Area** at indexes from 6000h to 9FFFh contains all data objects common to a class of devices that can be read or written via the network. The device profiles may use entries from 6000h to 9FFFh to describe the device parameters and the device functionality. The Standardised Device Profile Area objects comply with the "CiA Draft Standard 406 CANopen Device profile for encoders". Refer to the "6.8.3 Device Profile Area objects (DS 406)" section on page 61.

In the following pages the objects implemented are listed and described as follows:

Index-subindex Object name
[data types, attribute]

- Index and subindex are expressed in hexadecimal notation.
- Attribute:
  ro = read only access
  rw = read and write access

Unsigned/Signed8 data type:

Process data bytes							
byte 4							
7	6	5	4	3	2	1	0
MSbit			...			LSbit	

Unsigned/Signed16 data type:

Process data bytes	
byte 4	byte 5
LSByte	MSByte

Unsigned/Signed32 data type:

Process data bytes			
byte 4	byte 5	byte 6	byte 7
LSByte	...	...	MSByte

Unsigned/Signed64 data type:

Process data bytes							
byte 4	byte 5	byte 6	byte 7	byte 8	byte 9	byte 10	byte 11
LSByte	...	...	...	...	...	...	MSByte

6.8.1 Communication Profile Area objects (DS 301)

1000-00 Device type

[Unsigned32, ro]
It contains information about the device type. The object describes the type of device and its functionality.
Default = 0002 0196h = absolute rotary encoder, DS 406

1001-00 Error register

[Unsigned8, ro]
Should an error occur, the bit 0 of this object will be set to "1".
Default = 00h

1003 Pre-defined error field

This object is intended to show the last four errors which caused an emergency message to be triggered. For any information refer to the "6.10 Emergency (EMCY) objects" section on page 77.

- **00 Number of occurred errors** [Unsigned8, rw]
  (write 00h to delete the error list)
- **01 Last error occurred** [Unsigned32, ro]
- **02-05 Previous errors occurred** [Unsigned32, ro]

1005-00 COB_ID SYNC message

[Unsigned32, rw]
This object indicates the configured COB-ID of the synchronisation object (SYNC). Further, it defines whether the CANopen device generates the SYNC.
Default = 0000 0080h (CANopen device generates SYNC message)

1008-00 Manufacturer device name

[String, ro]
It shows the name of the device (manufacturer).
Default = "IF55ROT_CB"

1009-00 Manufacturer hardware version

[String, ro]
It shows the hardware version of the device.
Default = device dependent

100A-00 Manufacturer software version

[String, ro]
It shows the software version of the device.
Default = device dependent

100C-00 Guard time

[Unsigned16, rw]
It allows to set the Guard time expressed in milliseconds (msec).
The **100C-00 Guard time** object is used in the "Node guarding protocol" controlled by the Master. For more details see the "6.11 Node guarding protocol" section on page 78.
Default = 0000h

100D-00 Life time factor

[Unsigned8, rw]
The **100D-00 Life time factor** object is used in the "Node guarding protocol" controlled by the Master. For more details see the "6.11 Node guarding protocol" section on page 78.
Default = 00h

1010-01 Store parameters

[Unsigned32, rw]
This object is used to save all parameters on non-volatile memory.
Write "**save**" (ASCII code in hexadecimal format) in the data bytes:

Master → Slave

COB-ID	Cmd	Index		Sub	Data bytes			
600+ID	23	10	10	01	73	61	76	65
					s	a	v	e

Slave → Master (confirmation)

COB-ID	Cmd	Index		Sub	Data bytes			
580+ID	60	10	10	01	00	00	00	00

1011-01 Restore default parameters

[Unsigned32, rw]
This object allows the operator to restore all parameters to default values (default values are set at the factory by Lika Electronic engineers to allow the operator to run the device for standard operation in a safe mode).
Write "**load**" (ASCII code in hexadecimal format) in the data bytes and then issue a **Reset node** command:

Master → Slave

COB-ID	Cmd	Index		Sub	Data bytes			
600+ID	23	11	10	01	6C	6F	61	64
					l	o	a	d

Slave → Master (confirmation)

COB-ID	Cmd	Index		Sub	Data bytes			
580+ID	60	11	10	01	00	00	00	00

Master → Slave (**Reset node**)

COB-ID	Cmd	Slave ID
000	81	ID

Slave → Master (Boot-up)

COB-ID	Cmd
700+ID	00

NOTE
Save the default values after upload using the store parameters function (see the 1010-01 Store parameters object).

1014-00 COB-ID EMCY

[Unsigned32, rw]
This object defines the COB-ID used to send emergency messages (EMCY).
At power on, this object is forced to the default value.
Default = 0000 0080h+Node-ID

1015-00 Inhibit time EMCY

[Unsigned16, rw]
Inhibit time of the emergency messages (EMCY) expressed in multiples of 100 µs. When set to 0, this function is disabled.
Default = 0000h

1018 Identity object

- **01 Vendor-ID** provided by CIA organization [Unsigned32, ro]
  Default = 0000 012Eh
- **02 Product code** [Unsigned32, ro]
  Default = 0000 000Bh
- **03 Revision number** [Unsigned32, ro]
  Default = 0001 0001h

1800 PDO1 parameters

PDO1 message is used by default for cyclic transmission of the position value.
For more information refer to the "6.6 PDO objects" section on page 44.
See the **6200-00 Cyclic timer** object to set the cyclic timer.

- **01 COB-ID of PDO1** [Unsigned32, rw]

Bit number	Value	Meaning
31 (MSB)	0	PDO exists / is valid
	1	PDO does not exist / is not valid
30	0	RTR allowed on this PDO **(not implemented)**
	1	no RTR allowed on this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28 ... 11	0	if bit 29 = 0
	X	if bit 29 = 1: bits 28-11 of 29-bit-COB-ID
10 ... 0 (LSB)	X	bits 10-0 of COB-ID

Default = 4000 0180h+Node-ID (no RTR, COB-ID)

WARNING
It is mandatory to set the bit 30 of COB-ID to 1 (value 0 is not allowed). This means that "No RTR is allowed on the PDO".
At power on, this object is forced to the default value.

- **02 Transmission type** [Unsigned8, rw]

Transmission type	PDO transmission	
00h (0)	Acyclic, synchronous	**not implemented**
01h ... F0h (1 ... 240)	Cyclic, synchronous	**implemented**
F1h ... FBh (241 ... 251)	**not implemented - reserved**	
FCh (252)	Synchronous, RTR only	**not implemented**
FDh (253)	Asynchronous, RTR only	**not implemented**
FEh (254)	Asynchronous, manufacturer specific	**implemented**
FFh (255)	Asynchronous, device profile specific	**not implemented**

Default = FEh (cyclic transmission, see hereafter and the **6200-00 Cyclic timer** object)

WARNING
Following an attempt to set the **Transmission Type** to 0, the value is accepted but the PDO message is not sent; following an attempt to change the **Transmission Type** to any other value that is not supported by the device, an abort message (abort code = 0609 0030h: **Invalid value for parameter**) is generated.
If the value next to the **6200-00 Cyclic timer** object ≠ 0, the PDO message is sent cyclically and the interval between two messages is the time set next to the **6200-00 Cyclic timer** object; otherwise, if the value next to the **6200-00 Cyclic timer** object = 0, the PDO message is not sent.

NOTE
Refer to the "7 - Setting-up" section on page 81 for an example of how the **1800 PDO1 parameters** object is to be set.

1801 PDO2 parameters

PDO2 message is used by default for synchronous transmission of the position value. For more information refer to the "6.6 PDO objects" section on page 44.

- **01 COB-ID of the PDO2** [Unsigned32, rw]

Bit number	Value	Meaning
31 (MSB)	0	PDO exists / is valid
	1	PDO does not exist / is not valid
30	0	RTR allowed on this PDO **(not implemented)**
	1	no RTR allowed on this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28 ... 11	0	if bit 29 = 0
	X	if bit 29 = 1: bits 28-11 of 29-bit-COB-ID
10 ... 0 (LSB)	X	bits 10-0 of COB-ID

Default = 4000 0280h+Node-ID (no RTR, COB-ID)

WARNING
It is mandatory to set the bit 30 of COB-ID to 1 (value 0 is not allowed).
This means that "No RTR is allowed on the PDO".
At power on, this object is forced to the default value.

- **02 Transmission type** [Unsigned8, rw]

Transmission type	PDO transmission	
00h (0)	Acyclic, synchronous	**not implemented**
01h ... F0h (1 ... 240)	Cyclic, synchronous	**implemented**
F1h ... FBh (241 ... 251)	**not implemented - reserved**	
FCh (252)	Synchronous, RTR only	**not implemented**
FDh (253)	Asynchronous, RTR only	**not implemented**
FEh (254)	Asynchronous, manufacturer specific	**implemented**
FFh (255)	Asynchronous, device profile specific	**not implemented**

Default = 01h (synchronous transmission at each SYNC command)
The position value is transmitted after the set number of SYNC commands.

The interval between the SYNC commands must be set next to this **1801 PDO2 parameters**, sub 2 object.

WARNING
Following an attempt to set the **Transmission Type** to 0, the value is accepted but the PDO message is not sent; following an attempt to change the **Transmission Type** to any other value that is not supported by the device, an abort message (abort code = 0609 0030h: **Invalid value for parameter**) is generated.
If the value next to the **6200-00 Cyclic timer** object ≠ 0, the PDO message is sent cyclically and the interval between two messages is the time set next to the **6200-00 Cyclic timer** object; otherwise, if the value next to the **6200-00 Cyclic timer** object = 0, the PDO message is not sent.

NOTE
Refer to the "7 - Setting-up" section on page 81 for an example of how the **1801 PDO2 parameters** object is to be set.

1802 PDO3 parameters

PDO3 message is used by default for synchronous transmission of the position value. For more information refer to the "6.6 PDO objects" section on page 44.

- **01 COB-ID of the PDO3** [Unsigned32, rw]

Bit number	Value	Meaning
31 (MSB)	0	PDO exists / is valid
	1	PDO does not exist / is not valid
30	0	RTR allowed on this PDO **(not implemented)**
	1	no RTR allowed on this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28 ... 11	0	if bit 29 = 0
	X	if bit 29 = 1: bits 28-11 of 29-bit-COB-ID
10 ... 0 (LSB)	X	bits 10-0 of COB-ID

Default = C000 0380h+Node-ID (disable, no RTR)

WARNING
It is mandatory to set the bit 30 of COB-ID to 1 (value 0 is not allowed). This means that "No RTR is allowed on the PDO".
At power on, this object is forced to the default value.

- **02 Transmission type** [Unsigned8, rw]

Transmission type	PDO transmission	
00h (0)	Acyclic, synchronous	**not implemented**
01h ... F0h (1 ... 240)	Cyclic, synchronous	**implemented**
F1h ... FBh (241 ... 251)	**not implemented - reserved**	
FCh (252)	Synchronous, RTR only	**not implemented**
FDh (253)	Asynchronous, RTR only	**not implemented**
FEh (254)	Asynchronous, manufacturer specific	**implemented**
FFh (255)	Asynchronous, device profile specific	**not implemented**

Default = 01h (synchronous transmission at each SYNC command)
The position value is transmitted after the set number of SYNC commands.
The interval between the SYNC commands must be set next to this **1802 PDO3 parameters**, sub 2 object.

WARNING
Following an attempt to set the **Transmission Type** to 0, the value is accepted but the PDO message is not sent; following an attempt to change the **Transmission Type** to any other value that is not supported by the device, an abort message (abort code = 0609 0030h: **Invalid value for parameter**) is generated.
If the value next to the **6200-00 Cyclic timer** object ≠ 0, the PDO message is sent cyclically and the interval between two messages is the time set next to the **6200-00 Cyclic timer** object; otherwise, if the value next to the **6200-00 Cyclic timer** object = 0, the PDO message is not sent.

NOTE
Refer to the "7 - Setting-up" section on page 81 for an example of how the **1802 PDO3 parameters** object is to be set.

NOTE
- The transmission of PDO1, PDO2 and PDO3 messages can be enabled (or disabled) by setting to "0" (or "1") the most significant bit (MSB) used by PDO (**180xh**, sub1 object).
- The cyclic transmission or synchronous transmission can be modified by setting the **180xh** sub 2 object. If you need the position value to be transmitted every "n" SYNC commands, you must set the "n" value next to the **180xh** sub 2 object:

01h: synchronous transmission at each SYNC command;
02h: synchronous transmission every two SYNC commands;
...
FEh: cyclic transmission:
if **6200-00 Cyclic timer** ≠ 0 → "cyclic transmission": the cycle time is set next to the **6200-00 Cyclic timer** object;
if **6200-00 Cyclic timer** = 0 → the PDO message is not sent.

1A00-01 TPDO1 mapping parameter

[Unsigned32, rw]
This object contains the mapping of the PDO the encoder uses to transmit the position value, according to the DS 406 device profile specifications.
This object describes the content of the PDO by its index, sub-index and length.
The length contains the length of the application object expressed in bits.

31 24	23 16	15 8	7 0
Index		Sub-Index	Length
MSB			LSB

Default = 6004 0020h = **6004-00 Position value** object, the length is 32 bits.

1A01-01 TPDO2 mapping parameter

[Unsigned32, rw]
See the **1A00-01 TPDO1 mapping parameter** object.
Default = 6004 0020h = **6004-00 Position value** object, the length is 32 bits.

1A02-01 TPDO3 mapping parameter

[Unsigned32, rw]
See the **1A00-01 TPDO1 mapping parameter** object.
Default = 6008 0040h = **6008-00 High precision position value** object, the length is 64 bits.

6.8.2 Manufacturer Specific Profile Area objects

2104-00 Limit switch min.

[Unsigned32, rw]
This object is used to set the lowest software limit switch (-) in the travel.
If the encoder position is greater than the value set in this object, then the bit 12 of the **6500-00 Operating status** object will be set to "0".
If the encoder position is less than the value set in this object, then the bit 12 of the **6500-00 Operating status** object will be set to "1".
To enable this function set the bit 12 **Limit switch min.** of the **6000-00 Operating parameters** object to "1".
Default = 0000 0010h

2105-00 Limit switch max.

[Unsigned32, rw]
This object is used to set the highest software limit switch (+) in the travel.
If the encoder position is less than the value set in this object, then the bit 13 of the **6500-00 Operating status** object is set to "0".
If the encoder position is greater than the value set in this object, then the bit 13 of the **6500-00 Operating status** object is set to "1".
To enable this function set the bit 13 **Limit switch max.** of the **6000-00 Operating parameters** object to "1".
Default = 001F FFF0h

2200-01 Code Type (BIN/GRAY)

[Unsigned8, rw]
It sets the output code used by the SSI encoder to output the absolute position information. The output code can be Binary (00h) or Gray (01h). For any information on the output code please refer to the "User's manual" of the connected encoder.
Default = 00h

EXAMPLE
We need to connect the following rotary encoder: **MM36 12/8192 BB**.
MM36 ... BB encoder uses the Binary code to output the absolute position information. Thus you have to set the value 00h here. For further information refer to the "User's manual" of the connected encoder.

EXAMPLE
We need to connect the following rotary encoder: **AM58 13/4096 GA**.
"GA" in the order code means that "LSB Right Aligned" protocol and Gray code are used to arrange the absolute position information. Thus you have to set the value 01h here. For further information refer to the "User's manual" of the connected encoder.

2200-02 SSI Protocol

[Unsigned8, rw]
It sets the SSI protocol used by the SSI encoder to arrange the absolute position information. The SSI protocol can be the "LSB Right Aligned" protocol (00h) or the "MSB Left Aligned" protocol (01h). For any information on the SSI protocol please refer to the "User's manual" of the connected encoder.
Default = 00h

EXAMPLE
We need to connect the following rotary encoder: **MM36 12/8192 BB**.
MM36 encoder uses the 25-bit "LSB Right Aligned" protocol to arrange the absolute position information. Thus you have to set the value 00h here. For further information refer to the "User's manual".

2200-03 Number of SSI clocks

[Unsigned8, rw]
It sets the number of SSI clocks required by the SSI encoder to send the complete data word. The number of clocks depends on the encoder resolution and the type of SSI protocol. The value has to be comprised between 1 and 32. If you enter an out-of-range value, the number of clocks is forced to the default value. For any information on the SSI clocks required please refer to the "User's manual" of the connected encoder.
Default = 20h

NOTE
If the **2200-02 SSI Protocol** object is set to 01h = "MSB Left Aligned" protocol, the **2200-03 Number of SSI clocks** must be equal to the number of bits of the **total physical resolution**.

EXAMPLE
We need to connect the following rotary encoder: **AS58 13/BB**.
AS58 uses the 13-bit "LSB Right Aligned" protocol to arrange the absolute position information as its overall resolution is ≤ 13 bits (13 bits). It always requires 13 clocks (the length of the word is always 13 bits, regardless of the max. number of information to provide). Thus you have to set 13 here. For further information refer to the "User's manual" of the connected encoder.

EXAMPLE
We need to connect the following rotary encoder: **AM36 19/4096 BG**.
AM36 encoder implements the "MSB Left Aligned" protocol and requires 31 clocks (the length of the word is 31 bits). Thus you have to set 31 in this entry. For further information refer to the encoder's "User's manual" of the connected encoder.

EXAMPLE
We need to connect the following rotary encoder: **MM36 12/8192 BB**.
MM36 uses the 25-bit "LSB Right Aligned" protocol to arrange the absolute position information as its overall resolution is ≤ 25 bits (12 + 13 bits). It always requires 25 clocks (the length of the word is always 25 bits, regardless of the max. number of information to provide). Thus you have to set 25 here. For further information refer to the "User's manual" of the connected encoder.

EXAMPLE
We need to connect the following rotary encoder: **HM58 16/16384 BA**.
HM58 uses the 32-bit "LSB Right Aligned" protocol to arrange the absolute position information as its overall resolution is ≤ 32 bits (16 + 14 bits). It always requires 32 clocks (the length of the word is always 32 bits, regardless of the max. number of information to provide). Thus you have to set 32 here. For further information refer to the "User's manual" of the connected encoder.

2200-04 Physical Singleturn Resolution [bits]

[Unsigned8, rw]

WARNING
This parameter is active only if the bit 2 **Scaling function control** in the **6000-00 Operating parameters** object is set to "=0"; otherwise it is ignored and the system uses the custom values (**6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range**) to calculate the position information.
Furthermore, if the **2200-06 Bypass** parameter (see on page 60) is set to "1" = enabled, the scaling function -even if enabled- is ignored and the position information is outputted as it is.

It sets the physical singleturn resolution (the number of physical distinguishable steps per each revolution) of the SSI encoder expressed in bits.
The value has to be comprised between 1 and 18. If you enter an out-of-range value, the physical singleturn resolution value is forced to the default value.
As soon as you confirm the value, the system automatically sets the value in the **6501-00 Singleturn resolution** object accordingly. For any information on the singleturn resolution please refer to the "User's manual" of the connected encoder.
Default = 10h

EXAMPLE
We need to connect the following rotary encoder: **MM36 12/8192**.
As you can see in the product datasheet, "12" in the order code means a physical singleturn resolution of 12 bits (4,096 cpr). Thus you have to set the

value 12 here. For further information refer also to the "User's manual" of the connected encoder.

EXAMPLE
We need to connect the following rotary encoder: **HM58 16/16384**.
As you can see in the product datasheet, "16" in the order code means a physical singleturn resolution of 16 bits (65,536 cpr). Thus you have to set the value 16 here. For further information refer also to the "User's manual" of the connected encoder.

2200-05 Physical Multiturn Resolution [bits]

[Unsigned32, rw]

WARNING
This parameter is active only if the bit 2 **Scaling function control** in the **6000-00 Operating parameters** object is set to "=0"; otherwise it is ignored and the system uses the custom values (**6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range**) to calculate the position information.
Furthermore, if the **2200-06 Bypass** parameter (see on page 60) is set to "1" = enabled, the scaling function -even if enabled- is ignored and the position information is outputted as it is.

It sets the physical multiturn resolution (the number of physical revolutions) of the SSI encoder expressed in bits.
The value has to be comprised between 1 and 14. If you enter an out-of-range value, the physical multiturn resolution value is forced to the default value.
As soon as you confirm the value, the system automatically sets the value in the **6502-00 Number of distinguishable revolutions** object accordingly. For any information on the multiturn resolution please refer to the "User's manual" of the connected encoder.
Default = 0Eh

EXAMPLE
We need to connect the following rotary encoder: **AS58 13**.
AS58 is a singleturn encoder, thus its physical number of revolutions is 1. To translate the number of revolutions into bits, you must calculate the power of 2 of the value: $1 = 2^0$. Thus the value to be set here is 0. For further information refer also to the "User's manual" of the connected encoder.

EXAMPLE
We need to connect the following rotary encoder: **MM36 12/8192**.
In the order code, the hardware multiturn resolution is usually expressed in number of revolutions. To translate the number of revolutions into bits, you

must calculate the power of 2 of the value: 8,192 = 2^{13}. Thus the value to be set here is 13. For further information refer also to the "User's manual" of the connected encoder.

EXAMPLE
We need to connect the following rotary encoder: **HM58 16/16384**.
In the order code, the hardware multiturn resolution is usually expressed in number of revolutions. To translate the number of revolutions into bits, you must calculate the power of 2 of the value: 16,384 = 2^{14}. Thus the value to be set here is 14. For further information refer also to the "User's manual" of the connected encoder.

2200-06 Bypass

[Unsigned8, rw]
If **2200-06 Bypass** = 0 = disabled, the "Bypass mode" is disabled, that is: the position value (refer to the **6004-00 Position value** parameter on page 69) read by the encoder can be processed according to needs, so the user can scale the value, set a preset and change the counting direction.
If **2200-06 Bypass** = 1 = enabled, the "Bypass mode" is enabled, that is: the information from the encoder is transmitted "as it is" and not processed in any way. The preset, scaling and counting direction functions -even if set and enabled- are ignored. If, for example, the user sets a preset while the "Bypass mode" is enabled, the value is accepted, but not activated. As soon as the "Bypass mode" is disabled, the preset, scaling and counting direction functions -if set and enabled- become active and the **6004-00 Position value** will be accordingly.
Default = 00h

3000-00 Baud rate

[Unsigned8, rw]
This object is not active and any attempt to write will fail.
The bit rate has to be set via hardware using the DIP A DIP switch. For any information refer to the "4.8 Baud rate: DIP A (Figure 6 and Figure 7)" section on page 30.
Default = 05h

3001-00 Node-ID

[Unsigned8, rw]
This object is not active and any attempt to write will fail.
The node number has to be set via hardware using the DIP B DIP switch. For any information refer to the "4.9 Node number: DIP B (Figure 6 and Figure 7)" section on page 31.
Default = 01h

6.8.3 Device Profile Area objects (DS 406)

6000-00 Operating parameters

[Unsigned16, rw]

Bit	Function	bit = 0	bit = 1
0	**Code sequence**	**CW (clockwise)**	CCW (counter clockwise)
1	not used		
2	**Scaling function control**	**disabled**	enabled
3 ... 11	not used		
12	**Limit switch min.**	**disabled**	enabled
13	**Limit switch max.**	**disabled**	enabled
14 - 15	not used		

Default values are highlighted in bold
Default = 0000h

NOTE
Refer to the "7 - Setting-up" section on page 81 for an example of how the 6000-00 Operating parameters object is to be set.

Code sequence
It defines whether the position value outputted by the transducer increases (count up information) when the encoder shaft rotates clockwise (CW) or counter-clockwise (CCW). When **Code sequence** = 0, the position value increases when the encoder shaft rotates clockwise; on the contrary, when **Code sequence** = 1, the position value increases when the encoder shaft rotates counter-clockwise. CW and CCW rotations are viewed from shaft end.

To know whether the **Code sequence** is currently enabled, you can read the bit 0 **Code sequence** of the 6500-00 Operating status object, see on page 71.

WARNING
Every time you change the **Code sequence**, then you are required to set a new preset value (see the 6003-00 Preset value object) and finally save the new parameters (see the 1010-01 Store parameters object).

NOTE
Please consider that if the 2200-06 Bypass object (see on page 60) is set to "1" = enabled, the counting direction function -if set differently from default- is ignored.

Scaling function control
If this option is disabled (bit 2 = 0), the device uses the physical singleturn resolution and the physical multiturn resolution to arrange the absolute position information (see the **2200-04 Physical Singleturn Resolution [bits]** and **2200-05 Physical Multiturn Resolution [bits]** objects; the **6501-00 Singleturn resolution** and **6502-00 Number of distinguishable revolutions** objects are automatically set accordingly). The values set in the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects are ignored.
On the contrary, if it is enabled (bit 2 = 1), the system will use the values set in the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects to calculate the position information.
The relation between the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects is as follows:

$$\text{Transmitted position} = \frac{\text{6001-00 Programmable pulse per revolution}}{\text{6501-00 Singleturn resolution}} * \text{real position} \leq \text{6002-00 Programmable total measuring range}$$

To know whether the **Scaling function control** is currently enabled, you can read the bit 2 **Scaling** of the **6500-00 Operating status** object, see on page 71.

WARNING
When you enable the scaling function (bit 2 **Scaling function control** = 1), please enter scaled values next to the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects that are consistent with the physical values.

WARNING
Every time you enable the scaling function and/or change the scaling values (see the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects), then you are required to set a new preset value (see the **6003-00 Preset value** object) and finally save the new parameters (see the **1010-01 Store parameters** object).

NOTE
Please consider that if the **2200-06 Bypass** object (see on page 60) is set to "1" = enabled, the scaling function -if set differently from default- is ignored.

Limit switch min.
Limit switch max.
They allow to enable (1) / disable (0) the function of the **2104-00 Limit switch min.** and **2105-00 Limit switch max.** objects respectively. For further information see on page 56.
To know whether the **Limit switch min.** / **Limit switch max.** is currently enabled, you can read the bit 12 **Limit switch min.** and the bit 13 **Limit switch max.** of the **6500-00 Operating status** object, see on page 71.

6001-00 Programmable pulse per revolution

[Unsigned32, rw]

WARNING
This object is active only if the bit 2 **Scaling function control** in the **6000-00 Operating parameters** object is set to "=1"; otherwise it is ignored and the system uses the physical values (**6501-00 Singleturn resolution** and **6502-00 Number of distinguishable revolutions**) to calculate the position information. Furthermore, if the **2200-06 Bypass** object (see on page 60) is set to "1" = enabled, the scaling function -even if enabled- is ignored and the position information is outputted as it is.

This object sets a custom number of distinguishable steps per revolution (custom singleturn resolution). The value has to be comprised between 1 and **6501-00 Singleturn resolution**. If you enter an out-of-range value, the number of steps per revolution is forced to the physical singleturn resolution.

To avoid counting errors, please check that

$$\frac{\text{6501-00 Singleturn resolution}}{\text{6001-00 Programmable pulse per revolution}} = \text{integer value.}$$

Default = 0001 0000h

Setting the resolution per revolution 6001-00 Programmable pulse per revolution (2^{16}=0001 0000h)

Master → Encoder (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	23	01	60	00	00	00	01	00

Encoder → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	01	60	00	00	00	00	00

WARNING
When you set a new value next to the **6001-00 Programmable pulse per revolution** object, please always check also the **6002-00 Programmable total measuring range** object value and be sure that the resulting number of revolutions complies with the physical number of revolutions of the device (see the **6502-00 Number of distinguishable revolutions** object, it can be 1 or 16,384, see the order code).

Let's suppose that the HM58 16/16384 encoder is programmed as follows:
6001-00 Programmable pulse per revolution = 8,192
6002-00 Programmable total measuring range = 33,554,432 = 8,192 cpr * 4,096 revolutions
Let's set a new singleturn resolution, for instance: **6001-00 Programmable pulse per revolution** = 360 cpr

If we do not change the **6002-00 Programmable total measuring range** value at the same time, we will get the following result:

Number of revolutions =	33,554,432 (**6002-00 Programmable total measuring range**) 360 (**6001-00 Programmable pulse per revolution**)	= 93,206.755...

As you can see, the encoder is required to carry out more than 93,000 revolutions, this cannot be as the hardware number of revolutions is, as stated, 16,384 (see the **6502-00 Number of distinguishable revolutions** object). When this happens, the encoder falls into an error.

WARNING
Every time you enable the scaling function (bit 2 **Scaling function control** in the **6000-00 Operating parameters** object) and/or change the value in the scaled values (**6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects), then you are required to set a new preset value (see the **6003-00 Preset value** object) and finally save the new parameters (see the **1010-01 Store parameters** object).

WARNING
Every time you change the value in this object then you are required to set a new preset value (see the **6003-00 Preset value** object) and finally save the new parameters (see the **1010-01 Store parameters** object).

NOTE
Please refer to the "7 - Setting-up" section on page 81 for an example of how the **6001-00 Programmable pulse per revolution** is to be set.

6002-00 Programmable total measuring range

[Unsigned32, rw]

WARNING

This object is active only if the bit 2 **Scaling function control** in the **6000-00 Operating parameters** object is set to "=1"; otherwise it is ignored and the system uses the physical values (**6501-00 Singleturn resolution** and **6502-00 Number of distinguishable revolutions**) to calculate the position information. Furthermore, if the **2200-06 Bypass** object (see on page 60) is set to "1" = enabled, the scaling function -even if enabled- is ignored and the position information is outputted as it is.

This object sets a custom number of distinguishable steps over the total measuring range. The total resolution of the encoder results from the product of **6001-00 Programmable pulse per revolution** by the required **Number of revolutions**. Allowed values are less than or equal to **6001-00 Programmable pulse per revolution** * **6502-00 Number of distinguishable revolutions**.
Default = 4000 0000h

Setting the total resolution 6002-00 Programmable total measuring range (2^{30} = 4000 0000h)

Master → Encoder (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	23	02	60	00	00	00	00	40

Encoder → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	02	60	00	00	00	00	00

WARNING

When you set a new value next to the **6002-00 Programmable total measuring range** object, please always check also the **6001-00 Programmable pulse per revolution** object value and be sure that the resulting number of revolutions complies with the **Hardware number of revolutions** (**2200-05 Physical Multiturn Resolution [bits]**) of the device.
Let's suppose that our HM58 16/16384 encoder is programmed as follows:
6001-00 Programmable pulse per revolution: 8,192
6002-00 Programmable total measuring range = $33{,}554{,}432_{10}$ = 8,192 (cpr) * 4,096 (rev.)
Let's set a new total resolution, for instance: **6002-00 Programmable total measuring range** = 360.
As the **6002-00 Programmable total measuring range** must be greater than or equal to the **6001-00 Programmable pulse per revolution**, the above

setting is not allowed. When this happens, the encoder falls into an error signalling the faulty condition through the diagnostic LEDs (see on page 33).

WARNING
When you enable the scaling function (**Scaling function control** = 1), please enter scaled values next to the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects that are consistent with the physical values. In the case of inconsistent values, the system does not go online and visually warns about the wrong parametrization and fault condition by means of the diagnostic LEDS.

WARNING
Every time you change the value in this object then you are required to set a new preset value (see the **6003-00 Preset value** object) and finally save the new parameters (see the **1010-01 Store parameters** object).

EXAMPLE
We connect the HM58 **16/16384** rotary encoder.

The physical resolution is as follows:

- Hardware counts per revolution: **2200-04 Physical Singleturn Resolution [bits]** = 16 bits, thus **6501-00 Singleturn resolution** = 65,536 (2^{16})
- Hardware number of turns: **2200-05 Physical Multiturn Resolution [bits]** = 14 bits, thus **6502-00 Number of distinguishable revolutions** = 16,384 (2^{14})
- Total hardware resolution: = **6501-00 Singleturn resolution** * **6502-00 Number of distinguishable revolutions** = 1,073,741,824 (2^{30})

In the specific installation 2,048 counts/rev. * 1,024 turns are required:

1. Enable the scaling function: **6000-00 Operating parameters**, bit 2 **Scaling function control** = "1"
2. Counts per revolution: **6001-00 Programmable pulse per revolution** = 2,048 (0000 0800h)
3. Total resolution: **6002-00 Programmable total measuring range** = 2048 * 1024 = 2,097,152 (0020 0000h)

NOTE
We suggest setting values which are power of 2 (2^n: 2, 4, ..., 2048, 4096, 8192,...) to be set in the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects to avoid counting errors.
If **6001-00 Programmable pulse per revolution** and/or **6002-00 Programmable total measuring range** values change, the **6003-00 Preset**

value must be updated according to the new resolution. A new preset operation is also required.

NOTE
Any multiturn encoder can be configured so that it works exactly as a singleturn encoder. This is achieved by setting **6002-00 Programmable total measuring range** = **6001-00 Programmable pulse per revolution** (furthermore the **2200-05 Physical Multiturn Resolution [bits]** has to be set to 0). Let's suppose the encoder is set as follows:
6001-00 Programmable pulse per revolution = 8,192
6002-00 Programmable total measuring range = 8,192

So it follows that:

$$\text{Number of revolutions} = \frac{8192\ (\text{6002-00 Programmable total measuring range})}{8192\ (\text{6001-00 Programmable pulse per revolution})} = 1$$

This is exactly the configuration of the singleturn encoder.
Of course the contrary is not possible.

NOTE
Refer to the "7 - Setting-up" section on page 81 for an example of setting the **6002-00 Programmable total measuring range** object.

6003-00 Preset value

[Unsigned32, rw]
This object allows to set the encoder position to a Preset value. The Preset function is meant to assign a desired value to a physical position of the encoder shaft. The chosen position will get the value set next to this object and all the previous and the following positions will get a value according to it. This function is useful, for example, when the zero position of the encoder and the zero position of the axis need to match. The preset value will be set for the position of the encoder in the moment when the preset value is sent. We suggest setting the preset value when the encoder is in stop.
Default = 0000 0000h

EXAMPLE
Let's take a look at the following example to better understand the preset function and the meaning and use of the related objects and commands: **6003-00 Preset value** and **6509-00 Offset value**.

The encoder position which is transmitted results from the following calculation:
Transmitted value = **read position** (it does not matter whether the position is physical or scaled) + **6003-00 Preset value** - **6509-00 Offset value**.
If you never set the **6003-00 Preset value** and you never performed the preset setting, then the transmitted value and the read position are necessarily the same as **6003-00 Preset value** = 0 and **6509-00 Offset value** = 0.
When you set the **6003-00 Preset value** and then execute the preset setting, the system saves the current encoder position in the **6509-00 Offset value** object. It follows that the transmitted value and the **6003-00 Preset value** are the same as read position - **6509-00 Offset value** = 0; in other words, the value set next to the **6003-00 Preset value** object is paired with the current position of the encoder as you wish.

For example, let's assume that the value "50" is set next to the **6003-00 Preset value** object and you execute the preset setting when the encoder position is "1000". In other words, you want to receive the value "50" when the encoder reaches the position "1000".
We will obtain the following information sequence:
Transmitted value = **read position** (="1000") + **6003-00 Preset value** (="50") - **6509-00 Offset value** (="1000") = 50.
The following transmitted value will be:
Transmitted value = **read position** (="1001") + **6003-00 Preset value** (="50") - **6509-00 Offset value** (="1000") = 51.
And so on.

To set the preset value you must send the following command:
Set Preset value **6003-00 Preset value** (preset = 1000 = 0000 03E8h)

Master → Encoder (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	23	03	60	00	E8	03	00	00

Encoder → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	03	60	00	00	00	00	00

NOTE

- If the scaling function is disabled (the bit 2 **Scaling function control** in the **6000-00 Operating parameters** object = 0), then the **6003-00 Preset value** must be less than or equal to the "Total hardware resolution" - 1, i.e. (**6501-00 Singleturn resolution** * **6502-00 Number of distinguishable revolutions**) - 1.

- If the scaling function is enabled (the bit 2 **Scaling function control** in the **6000-00 Operating parameters** object =1), then the **6003-00 Preset value** must be lower than the **6002-00 Programmable total measuring range** - 1.

WARNING
Check the value in the **6003-00 Preset value** object and perform the preset operation every time you set a new **Code sequence**, change the SSI encoder specific parameters or change the scaled values (**6001-00 Programmable pulse per revolution** and/or **6002-00 Programmable total measuring range**).

NOTE
Please consider that if the **2200-06 Bypass** object (see on page 60) is set to "1" = enabled, the preset function -even if set and activated- is ignored. If the user sets a preset while the "Bypass mode" is enabled, the operation is not carried out.

NOTE
Please refer to the "7 - Setting-up" section on page 81 for an example of how the **6003-00 Preset value** is to be set.

6004-00 Position value

[Unsigned32, ro]
This object contains the current position value of the encoder.
If the scaling function is enabled, the output value is scaled according to the scaling parameters (see the bit 2 **Scaling function control** in the **6000-00 Operating parameters** object).
The position value is transmitted cyclically or synchronously according to the settings in the **1800 PDO1 parameters** and **1801 PDO2 parameters** objects (see on page 50 ff). See also the **6008-00 High precision position value** object.

6008-00 High precision position value

[Unsigned64, ro]
This object is the same as the **6004-00 Position value** object, yet it is 64-bit long. This object contains the position value. The value is transmitted cyclically or synchronously according to the settings in the **1800 PDO1 parameters** and **1802 PDO3 parameters** objects (see on page 50 ff). See also the **6004-00 Position value** object.

6200-00 Cyclic timer

[Unsigned16, rw]

The cyclic timer value is used in asynchronous transmission mode (**Transmission Type** = FEh) to set the interval between two PDO issues.

If the value next to the **6200-00 Cyclic timer** object ≠ 0, the PDO message is sent cyclically and the interval between two messages is the time set next to the **6200-00 Cyclic timer** object; otherwise, if the value next to the **6200-00 Cyclic timer** object = 0, the PDO message is not sent.

The value is expressed in milliseconds. See on pages 44 and 50 ff.

Default = 0000h

Setting the cyclic time: 6200-00 Cyclic timer (100 ms = 64h)

Master → Encoder

COB-ID	Cmd	Index		Sub	Process data			
600+ID	2B	00	62	00	64	00	-	-

Encoder → Master

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	00	62	00	00	00	-	-

NOTE

Refer to the "7 - Setting-up" section on page 81 for an example of setting the **6200-00 Cyclic timer** object.

6500-00 Operating status

[Unsigned16, ro]

Bit	Function	bit = 0	bit = 1
0	**Code sequence**	CW (clockwise)	CCW (counter-clockwise)
1	not used		
2	**Scaling**	Disabled	Enabled
3 ... 11	not used		
12	**Limit switch min.**	position > **2104-00 Limit switch min.**	position < **2104-00 Limit switch min.**
13	**Limit switch max.**	position < **2105-00 Limit switch max.**	position > **2105-00 Limit switch max.**
14	not used		
15	**Current operating state**	**Stopped** / **Pre-operational**	**Operational**

Code sequence
It shows whether the code sequence (bit 0 **Code sequence** in the **6000-00 Operating parameters** object) is set to clockwise (CW) or counter-clockwise (CCW). If the bit is "=0" the output encoder position value has been set to increase (count up information) when the encoder rotates clockwise (CW); if the bit is "=1" the output encoder position value has been set to increase when the encoder rotates counter-clockwise (CCW). CW and CCW rotations are viewed from the shaft end. To set the code sequence to either CW or CCW you must set the bit 0 **Code sequence** of the **6000-00 Operating parameters** object to 0 / 1. For any further information on setting and using the counting direction function refer to the **6000-00 Operating parameters** object on page 61.

Scaling
It shows whether the scaling function (bit 2 **Scaling function control** in the **6000-00 Operating parameters** object) is disabled or enabled. If the value is "=0" the scaling function is disabled; if the value is "=1" the scaling function is enabled. To disable / enable the scaling function you must set the bit 2 **Scaling function control** of the **6000-00 Operating parameters** object to 0 / 1. For any further information on setting and using the scaling function refer to the **6000-00 Operating parameters** object on page 61.

Limit switch min.
If the encoder position is greater than the value set in the **2104-00 Limit switch min.** object, the bit 12 of this object is set to "0".
If the encoder position is less than the value set in the **2104-00 Limit switch min.** object, the bit 12 of this object is set to "1".
To enable this function set the bit 12 **Limit switch min.** of the **6000-00 Operating parameters** object to "1". For any further information on setting and using the lower limit switch refer to the **2104-00 Limit switch min.** object on page 56.

Limit switch max.
If the encoder position is lower than the value set in the **2105-00 Limit switch max.** object, the bit 13 of this object is set to "0".
If the encoder position is greater than the value set in the **2105-00 Limit switch max.** object, bit 13 of this object is set to "1".
To enable this function set the bit 13 **Limit switch max.** of the **6000-00 Operating parameters** object to "1". For any further information on setting and using the higher limit switch refer to the **2105-00 Limit switch max.** object on page 56.

Current operating state
It shows the current operating state of the unit. For further information on the available states see the "6.2 State machine" section on page 40.

bit 15 = 0: Stopped or Pre-operational state;
bit 15 = 1: Operational state.

6501-00 Singleturn resolution

[Unsigned32, ro]

WARNING

This object is active only if the bit 2 **Scaling function control** in the 6000-00 Operating parameters object is set to "=0"; otherwise it is ignored and the system uses the custom values (6001-00 Programmable pulse per revolution and 6002-00 Programmable total measuring range) to calculate the position information.
Furthermore, if the 2200-06 Bypass object (see on page 60) is set to "1" = enabled, the scaling function -even if enabled- is ignored and the position information is outputted as it is.

This object is intended to show the number of physical distinguishable steps each turn provided by the hardware (physical singleturn resolution). The physical singleturn resolution of the connected encoder must be set next to the 2200-04 Physical Singleturn Resolution [bits] object. As soon as the user confirms the value in the 2200-04 Physical Singleturn Resolution [bits] object, the system automatically sets the value in this object accordingly.
If the bit 2 **Scaling function control** in the 6000-00 Operating parameters object is set to "=0" the system uses the value in this object (and the value in the 6502-00 Number of distinguishable revolutions object) to calculate the position information. If the bit 2 **Scaling function control** in the 6000-00 Operating parameters object is set to "=1" the system uses the custom values (6001-00 Programmable pulse per revolution and 6002-00 Programmable total measuring range) to calculate the position information.
If you want to set a custom resolution see the 6001-00 Programmable pulse per revolution object.

NOTE

Refer to the "7 - Setting-up" section on page 81 for an example of how the 6501-00 Singleturn resolution object is to be read.

6502-00 Number of distinguishable revolutions

[Unsigned16, ro]

WARNING

This object is active only if the bit 2 **Scaling function control** in the 6000-00 Operating parameters object is set to "=0"; otherwise it is ignored and the

system uses the custom values (**6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range**) to calculate the position information.
Furthermore, if the **2200-06 Bypass** object (see on page 60) is set to "1" = enabled, the scaling function -even if enabled- is ignored and the position information is outputted as it is.

This object is intended to show the number of physical revolutions provided by the hardware (physical multiturn resolution). The physical multiturn resolution of the connected encoder must be set next to the **2200-05 Physical Multiturn Resolution [bits]** object. As soon as the user confirms the value in the **2200-05 Physical Multiturn Resolution [bits]** object, the system automatically sets the value in this object accordingly.
The **Total hardware resolution** results from **6501-00 Singleturn resolution** * **6502-00 Number of distinguishable revolutions**.
If the bit 2 **Scaling function control** in the **6000-00 Operating parameters** object is set to "=0" the system uses the value in this object (and the value in the **6501-00 Singleturn resolution** object) to calculate the position information. If the bit 2 **Scaling function control** in the **6000-00 Operating parameters** object is set to "=1" the system uses the custom values (**6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range**) to calculate the position information.
If you want to set a custom number of turns see the **6001-00 Programmable pulse per revolution** and **6002-00 Programmable total measuring range** objects.

NOTE
Refer to the "7 - Setting-up" section on page 81 for an example of how the **6502-00 Number of distinguishable revolutions** object is to be read.

6504-00 Supported alarms

[Unsigned16, ro]
This object contains the information on the alarms supported by the encoder.
No alarms are supported in this encoder.
Default = 0000h (Alarms not supported).

6506-00 Supported warnings

[Unsigned16, ro]
This object contains the information on the warnings supported by the encoder.
No warnings are supported in this encoder.
Default = 0000h (Warnings not supported).

6507-00 Profile and software version

[Unsigned32, ro]
It shows the version of both the profile and the software.
Version of the profile for encoders = 3.1
Software version = 1.1
Default = 0301 0101h

6508-00 Operating time

[Unsigned32, ro]
This object contains the information on the operating time. The operating time monitor stores the operating time for the encoder expressed in operating hours. The operating time is stored in the encoder non-volatile memory as long as the encoder is power supplied.
This object is currently not used in this encoder.
Default = FFFF FFFFh (not used)

6509-00 Offset value

[Integer32, ro]

As soon as you activate the preset, the current position of the encoder is saved in this object. The offset value is then used in the preset function in order to calculate the encoder position value to be transmitted. To zero set the value in this object you must upload the factory default values (see the **1011-01 Restore default parameters** object on page 49).

For any further information on the preset function and the meaning and use of the related objects and commands **6003-00 Preset value** and **6509-00 Offset value** refer to page 67.
Default = 0000 0000h

650A-01 Module identification

[Integer32, ro]
This object contains the manufacturer-specific offset value. This is the difference between the physical zero position of the encoder (zero set mechanically) and the zero position set by the manufacturer (zero set via software).
Default = 0000 0000h

650B-00 Serial number

[Unsigned32, ro]
This object contains the serial number of the converter.
This object is currently not used in this converter.
Default = FFFF FFFFh (not used)

NOTE

Save the new values using the store parameters function (see the **1010-01 Store parameters** object). If the power is turned off or in case of **Reset node** and **Restore node** commands, the parameters not saved are lost.

6.9 SDO abort codes

Here follows the list and meaning of the SDO abort codes indicated by CANopen but not necessarily supported by the manufacturer. For complete information please refer to the "SDO abort transfer protocol" section in the "CiA Draft Standard 301" document available at the address www.can-cia.org.

Abort code	Description
0503 0000h	Toggle bit not alternated.
0504 0000h	SDO protocol timed out.
0504 0001h	Client/server command specifier not valid or unknown.
0504 0002h	Invalid block size (block mode only).
0504 0003h	Invalid sequence number (block mode only).
0504 0004h	CRC error (block mode only).
0504 0005h	Out of memory.
0601 0000h	Unsupported access to an object.
0601 0001h	Attempt to read a write only object.
0601 0002h	Attempt to write a read only object.
0602 0000h	Object does not exist in the object dictionary.
0604 0041h	Object cannot be mapped to the PDO.
0604 0042h	The number and length of the objects to be mapped would exceed PDO length.
0604 0043h	General parameter incompatibility reason.
0604 0047h	General internal incompatibility in the device.
0606 0000h	Access failed due to an hardware error.
0607 0010h	Data type does not match, length of service parameter does not match
0607 0012h	Data type does not match, length of service parameter too high
0607 0013h	Data type does not match, length of service parameter too low
0609 0011h	Sub-index does not exist.
0609 0030h	Invalid value for parameter (download only).
0609 0031h	Value of parameter written too high (download only).
0609 0032h	Value of parameter written too low (download only).
0609 0036h	Maximum value is less than minimum value.
060A 0023h	Resource not available: SDO connection
0800 0000h	General error
0800 0020h	Data cannot be transferred or stored to the application.
0800 0021h	Data cannot be transferred or stored to the application because of local control.
0800 0022h	Data cannot be transferred or stored to the application because of the present device state.
0800 0023h	Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails

	because of an file error).
0800 0024h	No data available

6.10 Emergency (EMCY) objects

Emergency (EMCY) objects are triggered by the device when an internal error occurs.

Structure of the EMCY message:

IDENTIFIER	CAN Data Byte			
COB-ID(hex)	0	1	2	3...7
see the 1014-00 COB-ID EMCY object	Error code		Error Sub-register	Specific code
	LSB	MSB	01	00...00

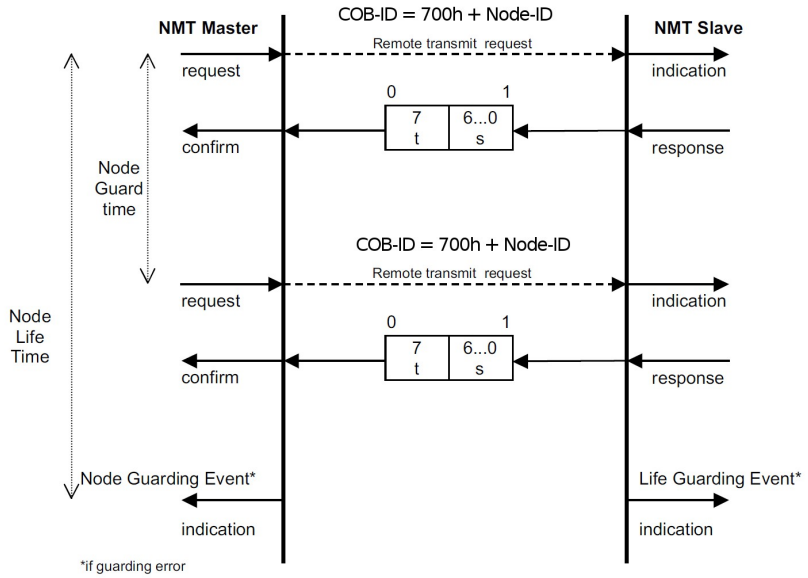
Available error codes indicated by CANopen but not necessarily supported by the manufacturer:

Error code	Description
0000h	Error reset or no error
1000h	Generic error, **Node guarding error**
2000h	Current – generic error
2100h	Current, CANopen device input side – generic
2200h	Current inside the CANopen device – generic
2300h	Current, CANopen device output side – generic
3000h	Voltage – generic error
3100h	Mains voltage – generic
3200h	Voltage inside the CANopen device – generic
3300h	Output voltage – generic
4000h	Temperature – generic error
4100h	Ambient temperature – generic
4200h	Device temperature – generic
5000h	CANopen device hardware – generic error
5530h	**Flash memory error**
6000h	CANopen device software – generic error
6100h	Internal software – generic
6200h	User software – generic
6300h	Data set – generic

7000h	Additional modules – generic error
8000h	Monitoring – generic error
8100h	Communication – generic
8110h	CAN overrun (objects lost)
8120h	CAN in error passive mode
8130h	Life guard error or heartbeat error
8140h	Recovered from bus off
8150h	CAN-ID collision
8200h	Protocol error - generic
8210h	PDO not processed due to length error
8220h	PDO length exceeded
8230h	DAM MPDO not processed, destination object not available
8240h	Unexpected SYNC data length
8250h	RPDO timeout
9000h	External error – generic error
F000h	Additional functions – generic error
FF00h	Device specific – generic error

6.11 Node guarding protocol

This protocol is used to detect remote error in the network. Each NMT Slave uses one remote COB for the Node Guarding protocol. This protocol implements the provided initiated Error Control services.



S: the state of the NMT Slave

4: STOPPED
5: OPERATIONAL
127: PRE-OPERATIONAL

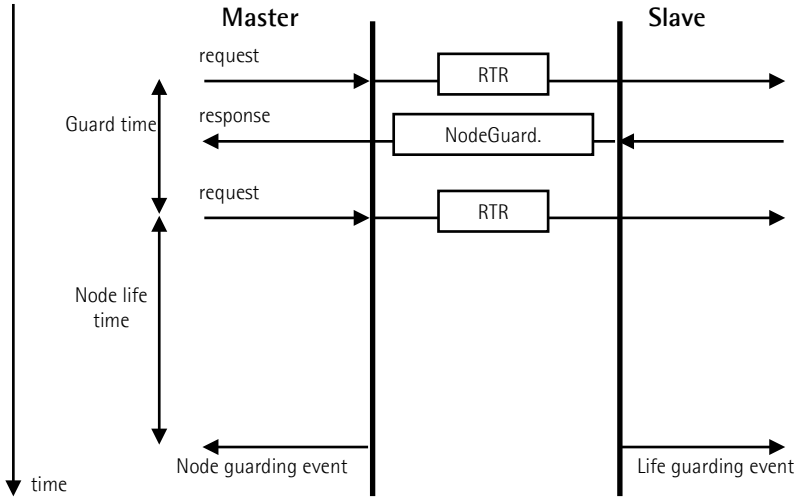
t: Toggle bit. The value of this bit must alternate between two consecutive responses from the NMT Slave. The value of the Toggle bit of the first response after the Node Guarding protocol becomes active is 0. The Toggle bit in the Node Guarding protocol is only reset to 0 when reset_communication is passed (no other change of the state resets the Toggle bit). If a response is received with the same value of the Toggle bit as in the preceding response then the new response is handled as if it was not received.

The NMT Master polls each NMT Slave at regular time intervals. This time-interval is called the guard time (see the **100C-00 Guard time** object) and may be different for each NMT Slave. The response of the NMT Slave contains the state of that NMT Slave. The **node life time** is given by the **100C-00 Guard time** object value multiplied by the **100D-00 Life time factor** object value. The node life time can be different for each NMT Slave. If the NMT Slave has not been polled during its life time, a remote node error is indicated through the 'Life Guarding Event' service.
A remote node error is indicated through the 'Node guarding event' service if:

- the remote transmit request is not confirmed within the node life time;
- the reported NMT Slave state does not match the expected state.

If it has been indicated that a remote error has occurred and the errors in the guarding protocol have disappeared, it will be indicated that the remote error has been resolved through the 'Node Guarding Event' and 'Life Guarding Event' services.

At system boot the "Node guarding protocol" is disabled; this protocol is enabled automatically as soon as the Master device sends an RTR message (Remote Transmission Request) the first time.



100C-00 Guard time: interval between two RTR messages.

Node life time: maximum time available for the encoder to receive an RTR message.

Node life time = **100C-00 Guard time** * **100D-00 Life time factor**.
"Node guarding" is enabled if **Node life time** ≠ 0.

If the Slave does not receive an RTR message before the **Node life time** has expired, it warns activating a "Life Guarding Event". Furthermore the red LED starts flashing so indicating the Node guarding error, **1001-00 Error register** and **1003 Pre-defined error field** objects are updated and an error message is sent.
To reset the error send a **Reset node** command.

7 - Setting-up

Here following are some examples of transmission between Master and Slave devices.
A generic "ID" value is used to indicate the unit address; the address of the Master is always 0. All values are expressed in hexadecimal notation.

7.1 Setting the Operational, Pre-operational state

NMT message — Master → Slave

	COB-ID	Cmd	Node
Operational:	000	01	ID
Pre-operational:	000	80	ID

7.2 Reading the value of the physical resolution per revolution

6501-00 Singleturn resolution

Master → Encoder

COB-ID	Cmd	Index		Sub	Process data			
601	40	01	65	00	-	-	-	-

Encoder → Master

COB-ID	Cmd	Index		Sub	Process data			
581	43	01	65	01	A0	A1	A2	A3

steps/rev. = ((A3<<24) | (A2<<16) | (A1<<8) | A0)

7.3 Reading the number of physical revolutions

6502-00 Number of distinguishable revolutions

Master → Encoder

COB-ID	Cmd	Index		Sub	Process data			
601	40	02	65	00	-	-	-	-

Encoder → Master

COB-ID	Cmd	Index		Sub	Process data			
581	43	02	65	01	B0	B1	B2	B3

N. rev. =((B3<<24) | (B2<<16) | (B1<<8) | B0)

7.4 Setting the resolution per revolution

6001-00 Programmable pulse per revolution (2^{16}=0001 0000h)

Master → Slave (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	23	01	60	00	00	00	01	00

Slave → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	01	60	00	00	00	00	00

7.5 Setting the total resolution

6002-00 Programmable total measuring range (2^{30}=4000 0000h)

Master → Slave (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	23	02	60	00	00	00	00	40

Slave → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	02	60	00	00	00	00	00

7.6 Setting the Operating parameters

6000-00 Operating parameters

(**Code sequence**: 0 = CW, **Scaling function control**: 1 = enabled, **Limit switch min.** / **Limit switch max.**: 0 = disabled)

Master → Slave (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	2B	00	60	00	04	00	-	-

Slave → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	00	60	00	00	00	-	-

7.7 Setting the Preset value

6003-00 Preset value (preset = 1000 = 0000 03E8h)

Master → Slave (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	23	03	60	00	E8	03	00	00

Slave → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	03	60	00	00	00	00	00

7.8 Setting the Sync counter

1801 PDO2 parameters sub 2 (n = 5 = 05h)

Master → Slave (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	2F	01	18	02	05	-	-	-

Slave → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	01	18	02	00	-	-	-

7.9 Disabling the Sync mode

1801 PDO2 parameters sub 1
Read COB-ID used by PDO2:

Master → Slave (Req request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	40	01	18	01	-	-	-	-

Slave → Master (Req reply)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	43	01	18	01	B0	B1	B2	B3

COB-ID used by PDO2 = ((B3<<24) | (B2<<16) | (B1<<8) | B0)
set the most significant bit to 1:

```
B3 |= 0x80;
```

Set new COB-ID used by PDO2 (**1801 PDO2 parameters** sub 1):

Master → Slave (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	23	01	18	01	B0	B1	B2	B3

Slave → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	01	18	01	00	00	00	00

7.10 Enabling the Cyclic mode

Set cyclic time **6200-00 Cyclic timer** (100 ms = 64h)

Master → Slave (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	2B	00	62	00	64	00	-	-

Slave → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	00	62	00	00	00	-	-

Read COB-ID used by PDO1 (**1800 PDO1 parameters** sub 1):

Master → Slave (Req request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	40	00	18	01	-	-	-	-

Slave → Master (Req reply)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	43	00	18	01	B0	B1	B2	B3

COB-ID used by PDO1 = ((B3<<24) | (B2<<16) | (B1<<8) | B0)
set the most significant bit to 0:

```
B3 &= 0x7F;
```

Set new COB-ID used by PDO1 (**1800 PDO1 parameters** sub 1):

Master → Slave (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	23	00	18	01	B0	B1	B2	B3

Slave → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	00	18	01	00	00	00	00

NOTE

Save the new values using the store parameters function (see the **1010-01 Store parameters** object). If the power is turned off or in case of **Reset node** and **Restore node** commands, the parameters not saved are lost.

8 - Default parameters list

Default values are expressed in hexadecimal notation.

Parameters list	Default values		
1000-00 Device type	0002 0196		
1001-00 Error register	00		
1003 Pre-defined error field	-		
1005-00 COB_ID SYNC message	0000 0080		
1008-00 Manufacturer device name	IF55ROT_CB*		
1009-00 Manufacturer hardware version	-		
100A-00 Manufacturer software version	-		
100C-00 Guard time	0000		
100D-00 Life time factor	00		
1014-00 COB-ID EMCY	0000 0080+NODE-ID		
1015-00 Inhibit time EMCY	0000		
1018 Identity object, sub 1	0000 012E		
1018 Identity object, sub 2	0000 000B		
1018 Identity object, sub 3	0001 0001		
1800 PDO1 parameters, sub 1	4000 0180+NODE-ID		
1800 PDO1 parameters, sub 2	FE		
1801 PDO2 parameters, sub 1	4000 0280+NODE-ID		
1801 PDO2 parameters, sub 2	01		
1802 PDO3 parameters, sub 1	C000 0380+NODE-ID		
1802 PDO3 parameters, sub 2	01		
1A00-01 TPDO1 mapping parameter, sub 1	6004 0020		
1A01-01 TPDO2 mapping parameter, sub 1	6004 0020		
1A02-01 TPDO3 mapping parameter, sub 1	6008 0040		
2104-00 Limit switch min.	0000 0010		
2105-00 Limit switch max.	001F FFF0		
2200-01 Code Type (BIN/GRAY)	00		
2200-02 SSI Protocol	00		
2200-03 Number of SSI clocks	20		
2200-04 Physical Singleturn Resolution [bits]	10		
2200-05 Physical Multiturn Resolution [bits]	0E		
2200-06 Bypass	00		
3000-00 Baud rate	05		
3001-00 Node-ID	01		
6000-00 Operating parameters Code sequence Scaling function control Limit switch min. Limit switch max.	0000 0 0 0 0		
6001-00 Programmable pulse per revolution	0001 0000		
6002-00 Programmable total measuring range	4000 0000		
6003-00 Preset value	0000 0000		

6200-00 Cyclic timer	0000		
6500-00 Operating status	0000		
6504-00 Supported alarms	0000		
6506-00 Supported warnings	0000		
6507-00 Profile and software version	0301 0101		
6508-00 Operating time	FFFF FFFF		
6509-00 Offset value	0000 0000		
650A-01 Module identification	0000 0000		
650B-00 Serial number	FFFF FFFF		

* Text string

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Document release	Release date	Description	HW	SW	EDS file version
1.0	01.09.2015	1st issue	1.0	1.0	V1
1.1	09.12.2015	General review	1.0	1.0	V1
1.2	01.10.2019	New firmware, new EDS files, bypass function added and related parameters updated, setting range updated in some parameters, new POWER SUPPLY DIP switch	1.0	1.1	V2

Dispose separately

Lika Electronic
Via S. Lorenzo, 25 • 36010 Carrè (VI) • Italy

Tel. +39 0445 806600
Fax +39 0445 806699

info@lika.biz • www.lika.biz