CrossCode™ CX
CrossFire™ BT

Sub User Manual and Reference Handbook for the CrossCode™ BTi and BTe and CrossCode™ CX models,

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CrossCode™ CX/BT

Introduction

The CrossCode™CX CrossFire™ BT is a compact, ruggedised and versatile I/O-module designed for mobile applications. The module is intended for HMI-related I/O (Human-Machine Interface Inputs and Outputs), typically found in a vehicle cabin, a control panel or a handheld remote control unit.

The Module is available in three versions: The CrossFire™ CX, the CrossCode™ BTi and the CrossCode™ BTe. The CrossCode™ BTi and CrossCode™ BTe have a wireless Bluetooth® interface, but the CrossCode™ CX does not. The difference between the BTi and BTe versions is that the BTi has an internal antenna, and the BTe has an external antenna.

This manual will use the name CrossCode™ CX/BT whenever information is relevant to all three versions of the CrossCode™. CrossCode™ BT refers to both the BTi and the BTe.

This manual describes how the CrossCode™ CX/BT should be used. The reader should be familiar with the CANopen standard in order to fully understand the manual.

Functions and Features

- The CrossCode™ CX/BT is a CiA DS 401 I/O module, designed for mobile products such as handheld devices. It has 53 I/O ports which can be individually configured to provide various types of I/O, intended for HMI-related signals such as joysticks, rotary knobs, pushbuttons, LED drivers and instrumentation lighting. The CrossCode™ CX/BT can therefore be configured to have:
  - Up to 35 Digital Outputs
  - Up to 35 Digital Inputs
  - Up to 8 Analog Inputs with 2 software-selectable ranges: 0-5V or 0-28 V.
  - 17 Analog Outputs (LED Drivers)
  - 1 PWM (Pulse-Width Modulated) Output intended for a Backlight Driver
  - 4 Shaft Encoder Inputs (2 pairs)
- There are 4 ports for providing power to other devices.
  - 2 joystick power supply outputs (5 V)
  - 2 peripheral power supply outputs (9 – 32 V)
- Configurable using SDOs (Service Data Object)
- 7 statically-mapped PDOs (Process Data Objects) compliant to DS 401
- Supports use of synch object
- Support for both heartbeat and node guarding
- The **CrossCode™ CX/BT** is an EMCY object producer. The COB ID (Communication Object Identifier) of the EMCY object can be configured.
- Storage for up to 127 Error codes
- Reset function restores settings back to their factory default values.
- Bluetooth® Class 1 wireless serial interface (CrossCode™ BT only)

Technical Data

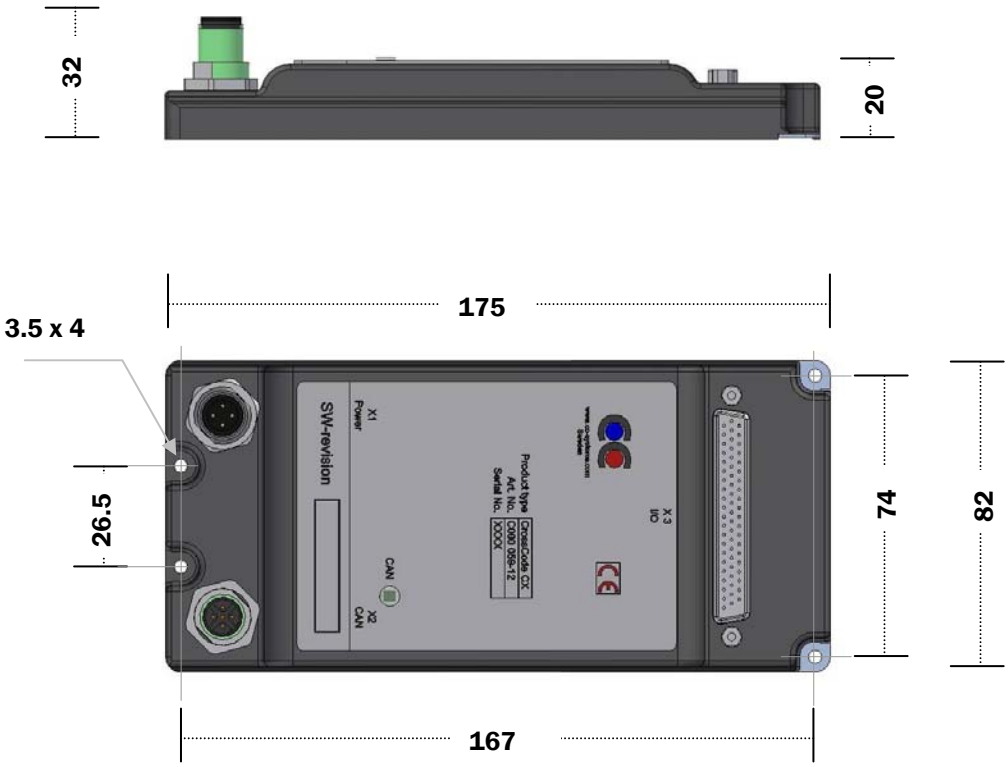
Processor	Fujitsu MB90F
Physical Housing Dimensions Weight	 Plastic enclosure filled with silicon compound L x W x H: 175 x 82 x 32 mm (48 - 60 mm with attached cables) 375 g
Environment Temperature Range Protection rating EMC Conformity	 Operating: -40 ˚C to +75 ˚C IP67 (IEC 60529) ISO 14982 for Emissions, ISO 11452-2 for Immunity
Power Supply Operating voltage Current consumption	 9 to 32 VDC <50 mA at 24V without external load
Indicators	One red/green LED indicator.
CAN interface Communication profile Device Profile Baud Rate Node ID	ISO 11898-2 (High Speed CAN) CANopen I/O module to CiA DS401 20, 50, 100, 125, 250, 500, 800 and 1000 kbit/s 1 to 8 set with connector key, or 1 to 127 set with SDOs
Bluetooth® Interface Range Baud Rate	Wireless serial interface via Bluetooth®, Class 1 100 meters 1 Mbit/s
Connectors	I/O: 62 pole D-SUB CAN: DIN M12 Power: DIN M12
Digital Inputs Input Voltage	 0 – 5 V / 0 – 32 V
Digital Outputs Max Voltage Max Current Protection	 0 – 5 V 4 mA Over-current Protection
Digital Encoder Inputs Voltage Protection	 0 – 5 V, 0 – 36 V Over-voltage Protection
Analog Inputs Input Voltage Input impedance Resolution Conversion Error Protection	 0 – 5 V or 0 – 28 V 1 MΩ or 12.2 kΩ 10 bits +/-3 LSB Over-voltage Protection
Analog Outputs (LED Drivers)	Low-side drivers with independent intensity settings
PWM (Analog) Output Max Voltage Max Current Protection	 9 – 32 V 1 A Short Circuit Protection
Power Outputs Voltage Max Current	Joystick: Peripheral: 5 VDC, 9 – 32 VDC depending on power supplied 0.3 A, 0.1 A
Approvals / Certifications	Bluetooth CiA CE ISO IEC

References

Bluetooth:	http://www.bluetooth.com/
CAN in Automation - CANopen standard:	http://www.can-cia.org
CE Marking:	http://ec.europa.eu/
International Standards Organisation:	http://www.iso.org/
International Electrotechnical Commission	http://www.iec.ch/

Dimensions

The CrossCode™ CX/BT dimensions and placement of the four mounting holes are illustrated below. The four mounting lugs have clearance holes for 3.5 mm bolts. The module weighs 375 grams.



Identification

There is a label on the front of the CrossCode™ CX/BT. On the label there are numbers which identify your unique module. Take note of them. During service and other contact with the supplier it is important to be able to provide these numbers.

Environmental Tolerance

The CrossCode™ CX/BT has been designed to cope with tough environmental demands. Strict tests have been conducted on the unit in order to ensure that it fulfils the expectations of a rugged unit. Much work has been performed to choose and design integral components so that they, in the best possible way and under all circumstances, provide you with a dependable working instrument. In Appendix 1, a list of standards can be found according to which the CrossCode™ CX/BT has been tested and approved.

Despite thorough design requirements and testing specifications, it is always best to install and handle the CrossCode™ CX/BT with care. For more information, read further.

Installation

Your CrossCode™ CX/BT should be installed in such a way that the module is not exposed to any unnecessary stress, heat, vibration or moisture. In this section, some recommendations are made regarding methods for how the unit should be installed.

⚠ If the unit is opened by non-authorised personnel, the warranty becomes void.

Cooling

Although the CrossCode™ CX/BT can operate in relatively high temperatures, cooling should still be considered when installing the CrossCode™ CX/BT. If the unit becomes too warm, it may not perform to its full capacity and, with high temperature, cease to function.

⚠ Inadequate cooling may lead to overheating, causing permanent damage to the unit.

Vibration

⚠ We recommend installing the CrossCode™ CX/BT in such a way that it is not unnecessarily exposed to vibration or other stress.

Rain / Moisture

⚠ The CrossCode™ CX/BT shall preferably be covered or enclosed in order to prevent direct exposure to water.

CrossCode™ CX/BT

Electrical Interface

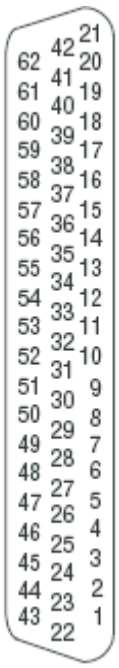
Connectors

Every I/O pin on the CrossCode™ CX/BT is assigned a unique port. The ports are numbered from 1 to 62. Every port may be configured individually in software to one of 6 different I/O types. Not all I/O types are available on all ports. Some ports are reserved for power/GND and have no I/O capabilities.

The port assignments of the CrossCode™ CX/BT are the same as the pin assignments on connector X3. The terms “port” and “pin” may therefore be used interchangeably whenever connector X3 is concerned.

62-pole I/O Connector (X3)

Conn.Pin	Port	Default Signal	Other Configurations	
X3.1	1	Encoder Input, Shaft 1, A	Digital Input, Digital Output	
X3.2	2	Encoder Input, Shaft 1, B	Digital Input, Digital Output	
X3.3	3	Encoder Input, Shaft 2, A	Digital Input, Digital Output	
X3.4	4	Encoder Input, Shaft 2, B	Digital Input, Digital Output	
X3.5	5	Analog Input	Digital Input, Digital Output	
X3.6	6	Analog Input	Digital Input, Digital Output	
X3.7	7	Analog Input	Digital Input, Digital Output	D-SUB, female, 62-pole
X3.8	8	Analog Input	Digital Input, Digital Output	
X3.9	9	Analog Input	Digital Input, Digital Output	
X3.10	10	Analog Input	Digital Input, Digital Output	
X3.11	11	Analog Input	Digital Input, Digital Output	
X3.12	12	Analog Input	Digital Input, Digital Output	
X3.13	13	GND		
X3.14	14	+5 V_{cc}		
X3.15	15	LED Driver		
X3.16	16	LED Driver		
X3.17	17	LED Driver		
X3.18	18	LED Driver		
X3.19	19	LED Driver		
X3.20	20	LED Driver		
X3.21	21	LED Driver		
X3.22	22	LED Driver		
X3.23	23	LED Driver		
X3.24	24	LED Driver		

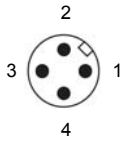


X3.25	25	LED Driver		
X3.26	26	LED Driver		
X3.27	27	LED Driver		
X3.28	28	LED Driver		
X3.29	29	LED Driver		
X3.30	30	LED Driver		
X3.31	31	Bluetooth® Status LED*	LED Driver	
X3.32	32	GND		
X3.33	33	PWM Output		
X3.34	34	GND		
X3.35	35	+24 V_{BATT}		
X3.36	36	Digital Input	Digital Output	
X3.37	37	Digital Input	Digital Output	
X3.38	38	Digital Input	Digital Output	
X3.39	39	Digital Input	Digital Output	
X3.40	40	Digital Input	Digital Output	
X3.41	41	Digital Input	Digital Output	
X3.42	42	Digital Input	Digital Output	
X3.43	43	Digital Input	Digital Output	
X3.44	44	Digital Input	Digital Output	
X3.45	45	Digital Input	Digital Output	
X3.46	46	Digital Input	Digital Output	
X3.47	47	Digital Input	Digital Output	
X3.48	48	Digital Input	Digital Output	
X3.49	49	+5 V_{cc}		
X3.50	50	GND		
X3.51	51	Bluetooth® Channel selection**	Digital Input, Digital Output	
X3.52	52	Bluetooth® Channel selection**	Digital Input, Digital Output	
X3.53	53	Bluetooth® Channel selection**	Digital Input, Digital Output	
X3.54	54	Bluetooth® Role selection**	Digital Input, Digital Output	
X3.55	55	CAN Baud Rate selection	Digital Input, Digital Output	
X3.56	56	CAN Baud Rate selection	Digital Input, Digital Output	
X3.57	57	CAN Baud Rate selection	Digital Input, Digital Output	
X3.58	58	CANopen Node ID selection	Digital Input, Digital Output	
X3.59	59	CANopen Node ID selection	Digital Input, Digital Output	
X3.60	60	CANopen Node ID selection	Digital Input, Digital Output	

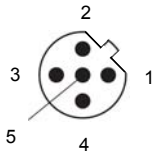
X3.61	61	GND		
X3.62	62	+24 V_{BATT}		

*for CrossCode™ BTe/BTi only. Default for CrossCode™ CX Port 31 is LED Driver.
**for CrossCode™ BTe/BTi only. Default for CrossCode™ CX Ports 51 – 54 is Digital Input.

Power Supply Connector (X1)

Conn.Pin	Port	Default Signal	Comments	DIN M12 x 1 male, 4-pole, A-coded
X1.1	-	+24 V_{BATT}	Main Power Input	
X1.2	-	+24 V_{BATT}	Main Power Input	
X1.3	-	GND	Main Ground Input	
X1.4	-	GND	Main Ground Input	

CAN Connector (X2)

Conn.Pin	Port	Default Signal	Comments	DIN M12 x 1 male, 5-pole, B-coded
X2.1	-	CAN Shield		
X2.2	-	+24 V_{BATT}	Alternative Power Input	
X2.3	-	GND	Alternative Ground Input	
X2.4	-	CANH		
X2.5	-	CANL		

SMA Antenna Connector*

This connector is used to attach an external bluetooth antenna. Only antennas certified to use with Bluegiga circuit (WT11) should be used. If an extension cable shall be used between the unit and the antenna, choose a cable suited for 2,4 GHz.	SMA, Female 

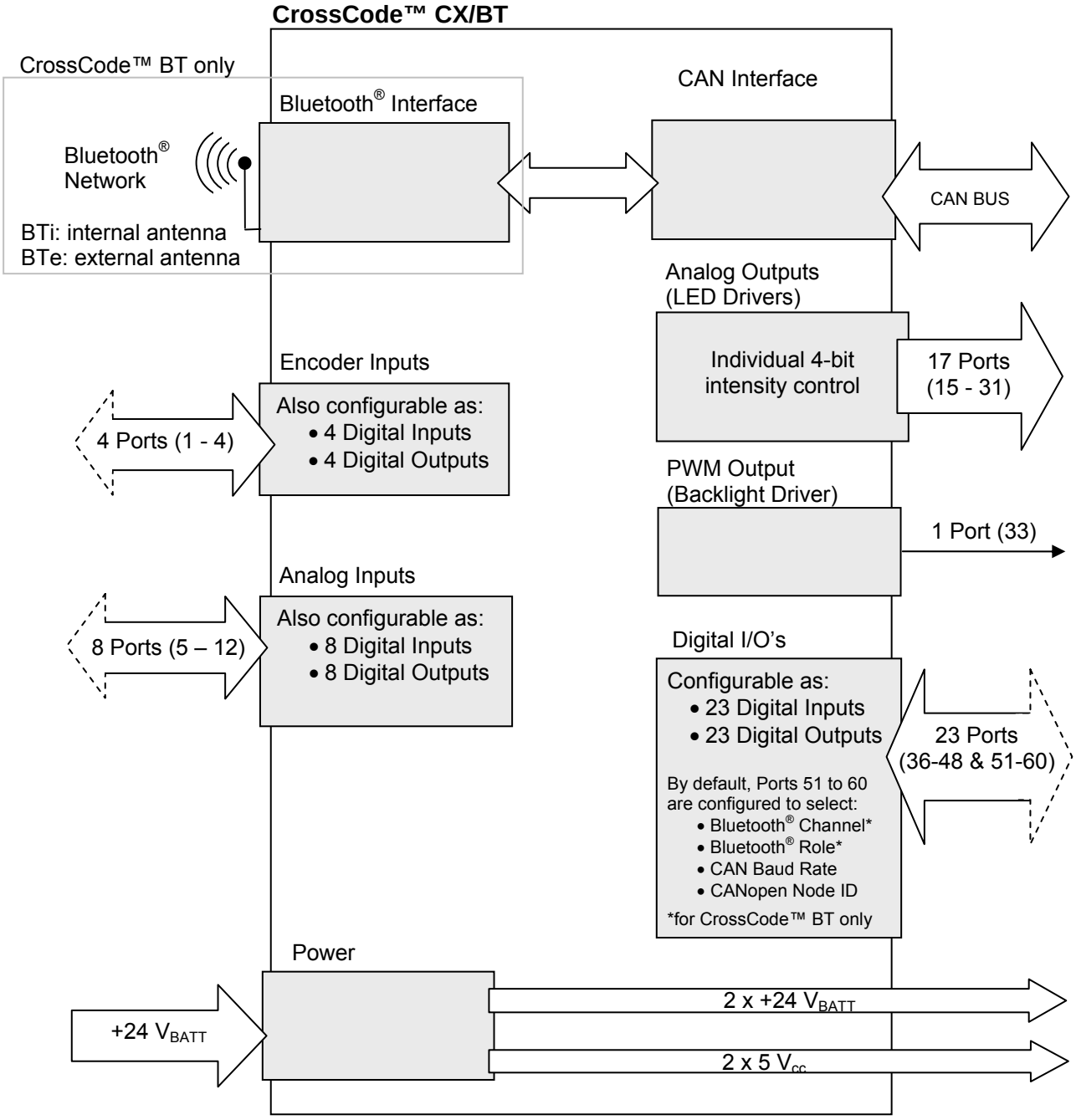
*for CrossCode™ BTe only.

⚠ Notice that the connector illustrations are those which are located on the unit, not those that the attached cables shall have in order to mate with them.

⚠ Use caution when plugging/unplugging connectors. If the pins become bent or damaged they may not function correctly, or in the worst case, the CrossCode™ CX/BT or other equipment may be damaged.

Electrical Interface Overview

The CrossCode™ CX/BT is highly configurable. The following illustration consists of several boxes which represent the main functional groups on the CrossCode™ CX/BT. The arrows leading to and from the functional groups represent I/O, power or communication busses. Where applicable, port configuration, voltage ranges, biases, etc. are selected by sending an SDO to the object dictionary in the Manufacturer Specific Profile Area; index 0x2000 to 0x5FFF.



Electrical Interface Characteristics

Analog Inputs

There are eight Analog Inputs available on the CrossCode™ CX/BT. The eight inputs are all of the same type, and as such, have identical electrical characteristics. The eight inputs are evenly divided into 2 “Voltage Groups”. The input voltage range of Analog Inputs is configured for each Voltage Group as a whole (voltage ranges can not be configured individually). The inputs have a low range from 0 to 5 V and a high range from 0 to 28 V for the respective Voltage Group. Changing the voltage range also affects the input impedance, and accuracy for the group.

Over- and under-voltage protection is provided at +5.5 V and -0.5 V respectively. When operating at the high range, protection comes into effect at +30.5V and -0.55V.

The error associated with the Analog Input conversion is ±3 LSB. This does not take into account the ±1.5% relative error due to noise from the voltage regulator or the ±1.5% relative error due to the tolerances in the resistor divider (high range only). The total error is found using an RMS approach.

Analog Input Interface

Port	Signal Type	Comment	Group
5	Analog Input (8 ports)	Functional Group: Analog Inputs With software-selectable voltage range • Low range: 0 to 5 V • High range: 0 to 28 V	Voltage Group 1
6			
7			
8			
9			Voltage Group 2
10			
11			
12			

Electrical Characteristics for Analog Inputs

Signal Type	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Analog Input	Input Voltage (low range)	0	-	5	V	protection @ -0.5 V /+5.5 V
	Input Voltage (high range)	0	-	27.7	V	Nominally 28 V protection @ -0.55 V /+30.5 V
	Resolution		10		bits	
	Conversion Error		±3		LSB	i.e. 4 bits
	Time constant		100		us	
	Input Impedance	1			MΩ	0 – 5 V range
	Input Impedance		12.2		kΩ	0 – 28 V range
	Input Capacitance		10		nF	placed after 10 kΩ resistor

Analog Outputs (LED Drivers)

Each Analog Output is a low-side driver (n-channel open drain) output rated at 50 mA and 7 V. The outputs are capable of driving LED's, or providing logic outputs with external resistive pull-up to 7 V. Each LED Output has an individual 4-bit control, which provides coarse adjustment of current from fully off to fully on with 14 intensity steps. The intensities are controlled using a built-in PWM technique at 32 kHz.

Analog Output (LED Driver) Interface

Port	Signal Type	Comment
15 – 31 (17 ports)	Analog Outputs (LED Drivers)	Functional Group: Analog Outputs (LED Drivers) Note for CrossCode™ BTi and BTe: Port 31 is reserved for Bluetooth® status LED by default

Electrical Characteristics for Analog Output (LED Driver)

Signal Type	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Analog Output (LED Driver)	Output Voltage	0.1		7	V	• with external pull-up to +7 V • some residual low-state voltage may be present
	Output Current	0	20	50	mA	Open drain, Current Sinking 350 mA is max. current for all 17 Outputs simultaneously
	Resolution		4		bits	provides on, off and 14 levels of intensity
	Frequency		32		kHz	

Digital Inputs

There are two types of Digital Inputs available on the CrossCode™ CX/BT, called Type 1 and Type 2.

Note that some of the Type 1 Digital Inputs (Ports 1 to 4) are not configured as Digital Inputs by default and must be reconfigured. See index 0x2000 of the Object Dictionary.

To best match the inputs, Type 1 Digital Inputs are configurable to have pull-up or pull-down resistors.

- For high-side drivers, configure Digital Inputs with pull-down resistors (default).
- For low-side drivers, configure Digital Inputs with pull-up resistors.
- For bipolar, totem-pole, or "push-pull" signals, configure Digital Inputs as "floating" – i.e. neither pull-up nor pull down resistors.
- Note that most bipolar outputs are capable of driving with pull-up or pull-down resistors present.

The Type 1 Digital Inputs are sub-divided into 4 "Bias Groups". Whether or not the Type 1 Digital Inputs are pull-up, pull-down or floating is selectable for each Bias Group as a whole (ports can not be configured individually). The Bias Groups are configured at index 0x2003 in the Object Dictionary.

Over-voltage protection at the Type 1 inputs will shut down the input transistors over 5 volts but the inputs can still be read at 32 volts without any damage to the unit. In this way, the Type 1 Digital Inputs can accept a wide range of inputs without the need for configuration changes.

Type 2 Digital Inputs are configured as Analog Inputs by default, but may be configured to act as Digital Inputs. To do this, write to index 0x2000 in the Object Dictionary. These inputs have no pull-up/down capabilities, and can therefore only accept bipolar inputs.

The Type 2 Digital Inputs are sub-divided into 2 “Voltage Groups”. Whether or not the Type 2 Digital Inputs are using the high or low range is selectable for each Voltage Group as a whole (ports can not be configured individually). Configuring the voltage range is done at index 0x2001.

Digital Inputs

<table>
<tr><th>Port</th><th>Signal Type</th><th>Comment</th><th>Group</th></tr>
<tr><td>1 to 4</td><td>Digital Input Type 1
(4 ports)</td><td>Functional Group: Encoder Inputs

With software-selectable bias options
• Pull up
• Pull down
• Floating</td><td>Bias
Group 1</td></tr>
<tr><td>5 to 8</td><td rowspan="2">Digital Input Type 2
(8 ports)</td><td rowspan="2">Functional Group: Analog Inputs

With software-selectable voltage range
• Low range: 0 to 5 V
• High range: 0 to 28 V</td><td>Voltage
Group 1</td></tr>
<tr><td>9 to 12</td><td>Voltage
Group 2</td></tr>
<tr><td>36 to 43</td><td rowspan="3">Digital Input Type 1
(8 + 8 + 7 = 23 ports)</td><td rowspan="3">Functional Group: Digital I/O’s

With software-selectable bias options
• Pull up
• Pull down
• Floating</td><td>Bias
Group 2</td></tr>
<tr><td>44 to 48
and
51 to 53</td><td>Bias
Group 3</td></tr>
<tr><td>54 to 60</td><td>Bias
Group 4</td></tr>
</table>

Electrical Characteristics for Digital Inputs

Signal Type	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Digital Input Type 1	Input Voltage	0	-	32	V	over-voltage protection @ 5 V but allows inputs up to 32 V logic high thresh. ≈ 3.5 V
	Input Impedance	9	10	11	kΩ	pull-down configuration
		25	50	100	kΩ	pull-up configuration
		1			MΩ	floating configuration
Digital Input Type 2	Input Voltage (low range)	0	-	5	V	protection @ -0.5 V /+5.5 V
	Input Voltage (high range)	0	-	27.7	V	protection @ -0.55 V /+30.5 V
	Time constant		100		us	
	Input Impedance to GND	1			MΩ	low range
			12.2		kΩ	high range
	Input Capacitance		10		nF	placed after 10 kΩ resistor

Digital Outputs

There are two types of Digital Outputs. There are 27 Digital Outputs of Type 1 and 8 Digital Outputs of Type 2. All of the Type 2 Digital Outputs as well as Ports 1 to 4 and Ports 51 to 60 from the Type 1 Digital Outputs must be reconfigured in order to be used as Digital Outputs. The ports can be reconfigured by writing SDOs to the Object Dictionary in the Manufacturer Specific Profile Area; indices 0x2000 and 0x2010 – 0x2021.

Digital Outputs

Port	Signal Type	Comment
1 to 4	Digital Output Type 1 (4 ports)	Functional Group: Encoder Inputs
5 to 8	Digital Output Type 2 (8 ports)	Functional Group: Analog Inputs
9 to 12		
36 to 43	Digital Output Type 1 (8 + 8 + 7 = 23 ports)	Functional Group: Digital I/O's
44 to 48 and 51 to 53		
54 to 60		

Electrical Characteristics for Digital Outputs

Signal Type	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Digital Output Type 1	High-Level Output Voltage	4.5	5	5.5	V	push-pull
	Output Current	-	2	4 (10)	mA	Maximum average is 4 mA Burst of 10 mA for short times. The overall output current must be less than 50 mA on average.
	Output impedance		510		Ω	limits output current to 10 mA
Digital Output Type 2	High-Level Output Voltage	4.5	5	5.5	V	push-pull
	Output Current		0.3	0.5	mA	
	Output impedance		10		kΩ	

PWM Output

The PWM Output is intended for use as an LCD backlight driver.

PWM Outputs

Port	Signal Name	Comment
33	PWM Output	LCD backlight driver.

Electrical Characteristics for PWM Outputs

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
PWM Output	Output Voltage		24		V	Same as Supply Voltage V_{batt}
	Output Current			1	A	Short Circuit Protected
	Output Frequency	88	90	93	Hz	
	Duty Cycle Range	0	-	100	%	Corresponds to 0x00 – 0xFFFF in software

Encoder Inputs

Ports 1 & 2 and ports 3 & 4 act in pairs to accept inputs from two shaft encoders. The CrossCode™ CX/BT can process these inputs and therefore act as a Shaft *Decoder*.

The Encoder Input port biases are configurable as a whole using Bias Group 1 which can be set in the object dictionary at index 0x2003 to be either pull up, pull down or floating. This port bias must compliment the output type of the encoders you are using.

- For high-side drivers, configure Digital Inputs with pull-down resistors (default).
- For low-side drivers, configure Digital Inputs with pull-up resistors.
- For bipolar, totem-pole, or "push-pull" signals, configure Digital Inputs as "floating" – i.e. neither pull-up nor pull down resistors.

Over-voltage protection at the inputs will shut down the input transistors over 5 volts but the inputs can still be read at 32 volts without any damage to the unit. In this way, the encoder inputs can accept a wide range of inputs without any configuration changes, as long as the logic high threshold is observed.

Shaft Encoder Inputs

Port	Signal Name	Comment
1	Encoder Input	Shaft 1, A
2	Encoder Input	Shaft 1, B
3	Encoder Input	Shaft 2, A
4	Encoder Input	Shaft 2, B

Electrical Characteristics for Encoder Inputs

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Encoder Input	Input Voltage	0		32	V	logic high threshold at ≈ 3.5 V
	Frequency	0	-	25	kHz	Interrupt driven.

Power Interface

Power Interface Electrical Characteristics

Parameter	Value			Unit	Comment
	Min	Typ	Max		
Supply Voltage V_{BATT}	9	24	32	V	Load-dump protected
Supply Current CrossCode™ CX	50	100	500*	mA	Depending on load
Supply Current CrossCode™ BT	55	105	520*	mA	Depending on load

* Note: does not include PWM Output current (backlight driver) equal to max. 1 Amp.

CAN Interface
Before a CAN Network can be established, the baud rate must be the same for every device, whereas the CANopen Node ID must be uniquely assigned to each device.

The CAN Baud Rate and CANopen Node ID can be configured in hardware by jumpering various pins low or high. Alternatively, these parameters may also set by writing to the Object Dictionary using SDOs. The following tables describe how to jumper the ports if these parameters are to be set via hardware.

CAN Baud Rate Selection

Baud Rate	Port 55	Port 56	Port 57
0 = 1000 kbit/s – default*	0	0	0
1 = 800 kbit/s	0	0	1
2 = 500 kbit/s	0	1	0
3 = 250 kbit/s	0	1	1
4 = 125 kbit/s	1	0	0
5 = 100 kbit/s	1	0	1
6 = 50 kbit/s	1	1	0
7 = 20 kbit/s	1	1	1

*assumes no pins are jumpered and Bias Group 4 is pull down (default setting)

- State 0 is reached by wiring the corresponding selector pin to GND
- State 1 is reached by wiring the corresponding selector pin to +5 V_{CC} or +24 $V_{BATT.}$

CANopen Node ID Selection

CANopen Node ID	Port 58	Port 59	Port 60
1 – default*	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
….			
8	1	1	1

*assumes no pins are jumpered and Bias Group 4 is pull down (default setting)

- Logic 0 is achieved by wiring the corresponding selector pin to GND
- Logic 1 is achieved by wiring the corresponding selector pin to +5 V_{CC} or +24 $V_{BATT.}$

Bluetooth® Interface (CrossCode™ BTi/BTe only)

Working together with the CrossLink BTC module, the CrossCode™ BT can be used as a mobile device which is linked to a fixed CAN network on a vehicle, or in a plant. This effectively creates a wireless CAN bridge. The two units are linked as a master/slave pair so that they can only communicate with one another. By these means, there is no risk of having other wireless devices interfering.

The CrossCode™ BT operates as a class 1 Bluetooth® device, and supports Bluetooth® Version 1.2. The range given in the table below is a result of the Class 1 designation, which distinguishes this device from Class 2 and Class 3 devices which have a range of only 10 m and 1 m respectively.

⚠ Although the CrossCode™ BT has Bluetooth® capabilities:

- it can communicate only with other CC-Systems Nodes.
- it transmits only CAN messages over the Bluetooth® network.

Bluetooth® Interface Characteristics

Parameter	Value			Unit	Comment
	Min	Typ	Max		
Range		100	200	m	
Baud rate			1000	kbit/s	

Before a Bluetooth® Network can be established, the Bluetooth® Channel must be the same for each device, and the Bluetooth® Role must be set up so that there is one Master and one Slave.

The Bluetooth® Channel and Role is configured in hardware by default. Use jumpers to tie the appropriate pins low or high. Alternatively, the Bluetooth® Channel and Role may also set by writing to the Object Dictionary using SDOs. Indices 0x2020 and 0x2021 are used to set the Bluetooth® Channel and Role as well as to enable/disable Bluetooth® selector pins. The following tables describe how to jumper the ports if these parameters are to be set via hardware.

Bluetooth® Role Selection

Bluetooth® Role	Port 54
Server (Slave) – default*	0
Client (Master)	1

*assumes no pins are jumpered and Bias Group 4 is pull down (default setting)

- Logic 0 is achieved by wiring the corresponding selector pin to GND.
- Logic 1 is achieved by wiring the corresponding selector pin to +5 V_{CC} or +24 $V_{BATT.}$

Bluetooth® Channel Selection

Bluetooth® Channel	Port 51	Port 52	Port 53
1 – default*	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	0
….			
8	1	1	1

*assumes no pins are jumpered and Bias Group 3 is pull down (default setting)

- Logic 0 is achieved by wiring the corresponding selector pin to GND.
- Logic 1 is achieved by wiring the corresponding selector pin to +5 V_{CC} or +24 $V_{BATT.}$

Establishing or Modifying the Bluetooth® Network:

To set up a wireless Bluetooth® Network, follow the steps below.

1. If you are modifying an existing Bluetooth® Network, turn off any devices that will be removed from the network.
2. Turn on any devices that will remain/be added to the new Bluetooth® Network.
3. Designate a Bluetooth Role for each of the devices. The designation is arbitrary. The Bluetooth Role may be set to either Client or Server. The Bluetooth® Role is set using SDOs at index 0x2020 of the object dictionary. Both devices in the network cannot have the same Role.
4. Both units must be on the same Bluetooth® Channel. Set using SDOs (index 0x2021).

⚠ If you are modifying an existing Bluetooth Network, you must change to a different Bluetooth® Channel than the one previously used.

⚠ At pairing it is important that only two units with the same channel number are powered on at the same time. After the pairing procedure, several pairs can run in parallel with the same channel number since the connection within the pairs is made with the MAC address and the channel is only used to control whether the channel has changed since the last pairing.

5. Turn off both devices.
6. Initiate Bluetooth Pairing by turning on power to the Server.
   - The Server will set its Bluetooth® Name to a name that contains its Channel (for example “BT_Module_x”, where x is the Server’s Bluetooth® Channel).
7. Turn on power to the Client
   - The Client will search for the name “BT_Module_y”, where y is the Client’s Bluetooth® Channel
   - If the Client and Server have the same Bluetooth® Channel then the Server will be found.
   - When the Client finds the Server, it will store the Server BT address (the unique address of the Bluetooth chip) in its EEPROM. Bluetooth Pairing is now complete.

The next time the units start, the Client will not search for the Server; instead it will just connect directly to the Server BT address stored in the EEPROM. This is to speed up the connection, since the search takes around 70 seconds.

Wired CAN takes precedence over Bluetooth®, which means that to set up a Bluetooth® connection no bus should be connected to the CAN connector.

If a wired bus is connected after power up of the CrossCode™ CX the unit will detect the bus within about 10 seconds. If a CrossCode™ BT doesn't detect a wired bus at power up the unit will continuously wait for a Bluetooth® connection. To be able to connect it to wired CAN the unit has to be restarted after wired a bus is connected.

LED indicators

LED indicators

LED Description	Condition	Meaning
Status	Blinking[3] Green	Preoperational Mode
	Solid Green	Operational mode, Communication OK
	Single Flash[2], Green	Stopped Mode
	Solid Red	Bus off
	Single Flash[2], Red	CAN error state
	Double Flash, Red	Guarding of other node failed
	Off	No CrossCode™ CX/BT power, or voltage too low.
Bluetooth® Status[1]	Solid Blue	Bluetooth® OK
	Off	Bluetooth® Communication error

1) CrossCode™ BT only. This LED is not provided but is designed to be wired to port 31.
2) Single Flash in this case mean blinking with about 1 Hz
3) About 3 Hz.

Observe that the red and green LEDs can operate in parallel.

CrossCode™ CX/BT

CANopen Interface

Parameter Overview

- The CrossCode™ CX/BT supports the CANopen protocol.
- The CANopen Node ID, CAN Baud Rate, (as well as Bluetooth Role and Channel on the CrossCode™ BT) are set by default to be configured through H/W (hardware) via the selector pins described in chapters 2.3.8 and 2.3.9. The appropriate pins are reserved under index 0x2000 and can not be used for other I/O unless a valid value is set by writing SDOs to the appropriate index of the OD:
  - CANopen Node ID — See index 0x2010
  - CAN Baud Rate — See index 0x2011
  - Bluetooth Channel (CrossCode™ BT only) — See index 0x2021
  - Bluetooth Role (CrossCode™ BT only) — See index 0x2020.

⚠ Note that the values determined from the selector pins do not overwrite these indices.

- The CrossCode™ CX/BT supports both heartbeat and node guarding.
- The CrossCode™ CX/BT is an NMT slave device. It is a heartbeat producer.
- The CrossCode™ CX/BT is a SYNCH message consumer.

EMCY Object Overview

The following error codes are supported according to DS-401 and DS-301. Up to 127 errors codes are stored at index 0x1003 of the object dictionary.

EMCY Object

Error code	Error register	Manufacturer-Specific Error Field	Meaning
0x8110	0x1	Not used	Buffer overrun. A CAN buffer overrun has occurred in the CrossCode™ CX/BT. Index 0x1029 specifies the action to take when this error occurs.
0x6100	0x1	SW error code	An internal software error has occurred. This error can be a result of a bug in the software. Please note the manufacturer specific error field of the message, and report the error to CrossControl. Index 0x1029 specifies the action to take when this error occurs.
0x8130	0x1	Not used	Guarding of node failed. This will occur if the CrossCode™ CX/BT is guarded with Node Guarding and the master has failed to send a guarding remote frame within the time specified in object 0x100C. Error will also occur if the CrossCode™ CX/BT is configured as a heartbeat consumer with object 0x1016 and another node has failed to send its heartbeat message. Index 0x1029 specifies the action to take when this error occurs.
0x8210	0x11	Not used	PDO not processed because of length error. A PDO with the wrong length has been received and thereby ignored. Index 0x1029 specifies the action to take when this error occurs
0x8140	0x1	Not used	The CrossCode™ CX/BT has recovered from Bus off.
0x8120	0x1	Not used	The CrossCode™ CX/BT has recovered from CAN error state.
0x1000	0x1	0x1	The CrossCode™ CX/BT runs in EEPROM Error mode. This means that the EEPROM has malfunctioned. The CrossCode™ CX/BT reverts to the default values for EEPROM, instead of the real values in EEPROM. The CrossCode™ CX/BT can still work as desired if all the desired settings are sent by SDOs at startup.

Receive PDOs: Digital Outputs, Analog (PWM) Outputs

This section describes the Receive PDO information to the CrossCode™ CX/BT. The information received on these PDOs will directly affect the CrossCode™ CX/BT outputs.

There are no Digital Outputs configured by default. To reconfigure the ports, the index 0x2000 is used. The sub-index corresponds to the port number. Selector ports 51 to 60 may also be reserved by indices 0x2010 to 0x2021. These ports can be released by specifying valid values to the appropriate index. For further information, see description of the Object Dictionary.

Analog Outputs (LED Drivers) 15 to 31 have 4 bits each to set their intensity on RPDO 2 and Byte 3 of RPDO 3. Note, however, that Port 31 is reserved for Bluetooth® Status LED on the CrossCode™ BT.

Receive PDO 3 also receives the duty cycle setting for the PWM Output (Backlight Driver), Port 33.

RPDO 4 is unused.

Receive PDO 1: COB ID 200h + Node ID

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0..7 Digital Output Ports 36 – 43	0..4 Digital Output Ports 44 – 48 5..7 Digital Output Ports 51 – 53	0..6 Digital Output Ports 54 – 60 7 X	0..7 Digital Output Ports 5 - 12	0..3 Digital Output Ports 1 - 4 4..7 X	0..7 X	0..7 X	0..7 X

Note: Only bits that corresponds to port configured as Digital Output will be used
X denotes unused (spare) bits

Receive PDO 2: COB ID 300h + Node ID

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0..3 LED Output Port 15 4..7 LED Output Port 16	0..3 LED Output Port 17 4..7 LED Output Port 18	0..3 LED Output Port 19 4..7 LED Output Port 20	0..3 LED Output Port 21 4..7 LED Output Port 22	0..3 LED Output Port 23 4..7 LED Output Port 24	0..3 LED Output Port 25 4..7 LED Output Port 26	0..3 LED Output Port 27 4..7 LED Output Port 28	0..3 LED Output Port 29 4..7 LED Output Port 30

The four bit values (0x0 to 0xF) represent the intensity level of each LED where 0x0 = off, 0xF = max.

Receive PDO 3: COB ID 400h + Node ID

Byte 1 (LSB)	Byte 2 (MSB)	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Duty Cycle for PWM Output Port 33		0..3: LED Output Port 31* 4..7: X	0..7 X	0..7 X	0..7 X	0..7 X	0..7 X

X denotes unused (spare) bits
*CrossCode™ CX only, reserved for Bluetooth® Status LED on the CrossCode™ BT.

Transmit PDOs: Digital Inputs and Analog Inputs

This section describes the Transmit PDO information from the CrossCode™ CX/BT. The information transmitted on these Transmit PDOs directly reflects the status of the CrossCode™ CX/BT inputs.

To reconfigure the ports, the index 0x2000 is used. The sub-index corresponds to the port number. Selector ports 51 to 60 may also be reserved by indices 0x2010 to 0x2021. These ports can be released by specifying valid values to the appropriate index (This reconfiguration is not necessary since selector ports are sent via PDO just as Digital Inputs). For further information, see description of the Object Dictionary.

The default transmission type for all Transmit PDOs is 255 (Event Triggered). This means that the Transmit PDOs will be sent only when a change occurs. The inhibit time parameter for all PDOs is used, and is set to 500 by default. This means that all PDOs will be sent at a maximum

transmission rate of every 50 milliseconds. This helps to avoid flooding the CAN bus. Transmission type and inhibit time are set at 0x1800 in the Object Dictionary.

The PDOs of the node are mapped by default to the I/O following the mapping described in DS401:

Transmit PDO 1: COB-ID 180h + Node ID

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0..7 Digital Input Ports 36 – 43	0..4 Digital Input Ports 44 – 48 5..7 Digital Input / Selector Ports 51 – 53	0..6 Digital Input / Selector Ports 54 – 60 7 X	0..7 Digital Input Ports 5 - 12	0..3 Digital Input Ports 1 - 4 4..7 X	0..7 X	0..7 X	0..7 X

* Only bits that correspond to ports configured as Digital Inputs will be transmitted.
X denotes unused (spare) bits

Transmit PDO 2: COB-ID 280h + Node ID

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Analog Input Port 5*		Analog Input Port 6*		Analog Input Port 7*		Analog Input Port 8*	

* Value will only be valid if port is configured as Analog Input.

Transmit PDO 3: COB-ID 380h + Node ID

Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Analog Input Port 9*		Analog Input Port 10*		Analog Input Port 11*		Analog Input Port 12*	

* Value will only be valid if port is configured as analog input.

Ports 1 & 2 and ports 3 & 4 act in pairs to accept inputs from two shaft encoders. The CrossCode™ CX/BT can process these inputs and therefore act as a Shaft *Decoder*.

There are two signals from each encoder, called A and B. By comparing the states of these two digital signals, magnitude and direction information are extracted. This information allows the CrossCode™ to either add or subtract subsequent pulses to a cumulative total which represents the shaft position.

The CrossCode™ CX/BT supports quadrature decoding, which means a 1000-line encoder, for example, will generate a shaft position of 4000 pulses per revolution.

The shaft position is relative and must therefore be reset to zero at startup or when the mechanism is in its home position. For more details refer to the Object Dictionary, sub-index 0x200A.

Transmit PDO 4: COB-ID 480h + Node ID

Byte 1 (LSB)	Byte 2	Byte 3	Byte 4 (MSB)	Byte 5 (LSB)	Byte 6	Byte 7	Byte 8 (MSB)
Shaft 1 Position				Shaft 2 Position			

Shaft Position is reported in number of pulses

Object Dictionary

Communication Profile Area; index 0x1000 to 0x1FFF

Index	S-Idx	Type	Default	Saved	Description
0x1000	0	u32, ro	0xf0191	-	Device type. DS401, analog in/out, digital in/out
0x1001	0	u8, ro	0	-	Error Register: Bit coded as specified in DS301
0x1003	0	u32, ro	0	-	Pre-Defined Error Field: Number of entries. Value is increased each time a new error is encountered.
	1..127	u32, ro	0	-	Error Code History: New sub indices are created every time new error is encountered.
0x1005	0	u32, rw	0x80	No	COB ID Synch Object SYNC configuration as specified in DS301. This module cannot generate sync messages.
0x1008	0	str, ro	CrossCode CX/BT	-	Device name.
0x1009	0	str, ro	1.0	-	Hardware version.
0x100A	0	str, ro	1.0	-	Software version.
0x100C	0	u16, rw	0	No	Guard time as specified in DS301.
0x100D	0	u8, rw	0	No	Life time factor as specified in DS301.
0x1014	0	u32, rw	0x80 + Node ID	No	EMCY COB ID as specified in DS301.
0x1016	0	u8, rw	0	No	Heartbeat: Number of entries. (Number of heartbeat-guarded nodes)
	1 - 127	u32, rw	0	No	Heartbeat: Consumer Time. Monitoring time for node xx as specified in DS301.
0x1017	0	u16, rw	0	Yes	Producer heartbeat time as specified in DS301.
0x1018	0	u8, ro	4	-	Identity Object: Number of entries
	1	u32, ro	0xF2	-	Vendor ID.
	2	u32, ro	TBD	-	Product code.
	3	u32, ro	0	-	Revision number.
	4	u32, ro	0	-	Serial number.
0x1029	0	u8, rw	9	No	Error Behaviour: Number of entries. 0 = Preoperational (if already operational) 1 = no state change 2 = Stopped
	1	u8, rw	0	No	Communication (mandatory) Not used.
	2	u8, rw	0	No	Bus off.
	3	u8, rw	0	No	CAN error state.
	4	u8, rw	0	No	CAN buffer overrun.
	5	u8, rw	0	No	SW error.
	6	u8, rw	0	No	Guarding of other node failed.

Index	S-Idx	Type	Default	Saved	Description
	7	u8, rw	0	No	Heartbeat from other node failed.
	8	u8, rw	1	No	PDO with wrong length received.
	9	u8, rw	1	No	EEPROM runs in error mode (revert to default values because EEPROM failed).
					Communication Parameters for Receive PDOs
0x1400	0	u8, ro	5	-	Receive PDO 1: Number of entries.
	1	u32, rw	0x200 + Node ID	No	COB ID for receive PDO 1 Digital Outputs
	2	u8, rw	255	No	Transmission type for receive PDO 1.
	3	u16, rw	0	No	Inhibit time. Not used for receive PDOs.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer. Not used for receive PDOs.
0x1401	0	u8, ro	5	-	Receive PDO 2: Number of entries.
	1	u32, rw	0x300 + Node ID	No	COB ID for receive PDO 2.
	2	u8, rw	255	No	Transmission type for receive PDO 2.
	3	u16, rw	0	No	Inhibit time. Not used for receive PDOs.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer. Not used for receive PDOs.
0x1402	0	u8, ro	5	-	Receive PDO 3: Number of entries.
	1	u32, rw	0x400 + Node ID	No	COB ID for receive PDO 3.
	2	u8, rw	255	No	Transmission type for receive PDO 3.
	3	u16, rw	0	No	Inhibit time. Not used for receive PDOs.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer. Not used for receive PDOs.
0x1403	0	u8, ro	0	-	Receive PDO 4: Number of entries. Unused.
	1	u32, rw	0x500 + Node ID	No	COB ID for receive PDO 4. Unused
	2	u8, rw	255	No	Transmission type for receive PDO 4. Unused.
	3	u16, rw	0	No	Inhibit time. Unused.
	4	-	-	-	Unused.
	5	u16, rw	0	No	Event timer. Unused.
					PDO Mappings for Receive PDOs
0x1600	0	u8, rw	5	No	Receive PDO 1: Number of entries. Maximum 8.
	1	u32, rw	0x62000108	No	First mapped object for receive PDO 1. (Digital Output Ports 36 to 43)
	2	u32, rw	0x62000208	No	Second mapped object for receive PDO 1. (Digital Output Ports 44 to 53)
	3	u32, rw	0x62000308	No	Third mapped object for receive PDO 1. (Digital Output Ports 54 to 60)
	4	u32, rw	0x62000408	No	Fourth mapped object for receive PDO 1.

Index	S-Idx	Type	Default	Saved	Description
					(Digital Output Ports 5 to 12)
	5	u32, rw	0x62000508	No	Fifth mapped object for receive PDO 1. (Digital Output ports 1 to 4)
	6 - 8	u32, rw	-	No	Sixth to eighth mapped object for receive PDO 1. Unused.
0x1601	0	u8, rw	8	No	Receive PDO 2: Number of entries. Maximum 8.
	1	u32, rw	0x64110108	No	First mapped object for receive PDO 2. (LED Output Ports 15 & 16)
	2	u32, rw	0x64110208	No	Second mapped object for receive PDO 2. (LED Output Ports 17 & 18)
	3	u32, rw	0x64110308	No	Third mapped object for receive PDO 2. (LED Output Ports 19 & 20)
	4	u32, rw	0x64110408	No	Fourth mapped object for receive PDO 2. (LED Output Ports 21 & 22)
	5	u32,rw	0x64110508	No	Fifth mapped object for receive PDO 2. (LED Output Ports 23 & 24)
	6	u32,rw	0x64110608	No	Sixth mapped object for receive PDO 2. (LED Output Ports 25 & 26)
	7	u32,rw	0x64110708	No	Seventh mapped object for receive PDO 2 (LED Output Ports 27 & 28)
	8	u32,rw	0x64110808	No	Eighth mapped object for receive PDO 2. (LED Output Ports 29 & 30)
0x1602	0	u8, rw	2	No	Receive PDO 3: Number of entries. Maximum 8.
	1	u32, rw	0x64110A10	No	First mapped object for receive PDO 3. (PWM Output Port 33)
	2	u32, rw	0x64110908	No	Second mapped object for receive PDO 3. bits 0..3: LED 31
	3 – 8	u32, rw	0	No	Third to eighth mapped object for receive PDO 3. Unused
0x1603	0	u8, rw	0	No	Receive PDO 4: Number of entries. Maximum 8. unused.
					Communication Parameters for Transmit PDOs
0x1800	0	u8, ro	5	-	Transmit PDO 1: Number of entries.
	1	u32, rw	0x180 + Node ID	No	COB ID for transmit PDO 1.
	2	u8, rw	255	No	Transmission type for transmit PDO 1.
	3	u16, rw	500	No	Inhibit time for transmit PDO 1.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 1.
0x1801	0	u8, ro	5	-	Transmit PDO 2: Number of entries.
	1	u32, rw	0x280 + Node ID	No	COB ID for transmit PDO 2.
	2	u8, rw	255	No	Transmission type for transmit PDO 2.
	3	u16, rw	500	No	Inhibit time for transmit PDO 2.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 2.
0x1802	0	u8, ro	5	-	Transmit PDO 3: Number of entries.
	1	u32, rw	0x380 +	No	COB ID for transmit PDO 3.

Index	S-Idx	Type	Default	Saved	Description
			Node ID		
	2	u8, rw	255	No	Transmission type for transmit PDO 3.
	3	u16, rw	500	No	Inhibit time for transmit PDO 3.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 3.
0x1803	0	u8, ro	5	-	Transmit PDO 4: Number of entries.
	1	u32, rw	0x480 + Node ID	No	COB ID for transmit PDO 4.
	2	u8, rw	255	No	Transmission type for transmit PDO 4.
	3	u16, rw	500	No	Inhibit time for transmit PDO 4.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 4.
					PDO Mappings for Transmit PDOs
0x1A00	0	u8, rw	5	No	Transmit PDO 1: Number of entries. Maximum 8.
	1	u32, rw	0x60000108	No	First mapped object for transmit PDO 1. (Digital Input Ports 36 to 43)
	2	u32, rw	0x60000208	No	Second mapped object for transmit PDO1 (Digital Input Ports 44 to 53)
	3	u32, rw	0x60000308	No	Third mapped object for transmit PDO 1. (Digital Input Ports 54 to 60)
	4	u32, rw	0x60000408	No	Fourth mapped object for transmit PDO 1. (Digital Input Ports 5 to 12)
	5	u32, rw	0x60000508	No	Fifth mapped object for transmit PDO 1. (Digital Input Ports 1 to 4)
	6 – 8	u32, rw	-	No	Sixth to eighth mapped object for transmit PDO 1. Unused.
0x1A01	0	u8, rw	4	No	Transmit PDO 2: Number of entries. Maximum 8.
	1	u32, rw	0x64010116	No	First mapped object for transmit PDO 2. (Analog Input Port 5)
	2	u32, rw	0x64010216	No	Second mapped object for transmit PDO2 (Analog Input Port 6)
	3	u32, rw	0x64010316	No	Third mapped object for transmit PDO 2. (Analog Input Port 7)
	4	u32, rw	0x64010416	No	Fourth mapped object for transmit PDO 2. (Analog Input Port 8)
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for transmit PDO 2. Unused.
0x1A02	0	u8, rw	4	No	Transmit PDO 3: Number of entries. Maximum 8.
	1	u32, rw	0x64010516	No	First mapped object for transmit PDO 3. (Analog Input Port 9)
	2	u32, rw	0x64010616	No	Second mapped object for transmit PDO3 (Analog Input Port 10)
	3	u32, rw	0x64010716	No	Third mapped object for transmit PDO 3. (Analog Input Port 11)
	4	u32, rw	0x64010816	No	Fourth mapped object for transmit PDO 3. (Analog Input Port 12)

Index	S-Idx	Type	Default	Saved	Description
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for transmit PDO 3. Unused.
0x1A03	0	u8, rw	2	No	Transmit PDO 4: Number of entries. Maximum 8.
	1	u32, rw	64020120	No	First mapped object for transmit PDO 4.
	2	u32, rw	64020220	No	Second mapped object for transmit PDO4
	3 – 8	u32, rw	-	No	Third to eighth mapped object for transmit PDO 4. Unused.

Note on Mapping Addresses

The mapping area controls where the received data in the receive PDOs will be stored. If these values are not changed then the default values will be used. The values can be read as follows:

E.g.: 0x62000108:

6200 = address in manufacturer specific area of Object Dictionary.
01 = sub index 1
08 = 1 byte (10 = 2 bytes, 20 = 4 bytes, etc.)

Object Dictionary - continued
Manufacturer Specific Profile Area; index 0x2000 to 0x5FFF

Index	S-Idx	Type	Default (Possible)	Saved	Description
0x2000	0	u8, ro	62	-	Port Configuration: Number of entries. Valid values are: 0 = Analog Input 1 = Analog Output, which also includes: • LED Drivers • PWM Output 2 = Digital Input 3 = Digital Output 4 = Pulse Counter Input (not available) 5 = Shaft Encoder Input
	1	u8, rw	5 (2,3)	Yes	Port configuration for port 1: If 5 is used, Port 2 must also be set to 5.
	2	u8, rw	5 (2,3)	Yes	Port configuration for Port 2: If 5 is used, Port 1 must also be set to 5.
	3	u8, rw	5 (2,3)	Yes	Port configuration for Port 3: If 5 is used, Port 4 must also be set to 5.
	4	u8, rw	5 (2,3)	Yes	Port configuration for Port 4: If 5 is used, Port 3 must also be set to 5.
	5	u8, rw	0 (2,3)	Yes	Port configuration for Port 5:
	6	u8, rw	0 (2,3)	Yes	Port configuration for Port 6:
	7	u8, rw	0 (2,3)	Yes	Port configuration for Port 7:
	8	u8, rw	0 (2,3)	Yes	Port configuration for Port 8:
	9	u8, rw	0 (2,3)	Yes	Port configuration for Port 9:
	10	u8, rw	0 (2,3)	Yes	Port configuration for Port 10:
	11	u8, rw	0 (2,3)	Yes	Port configuration for Port 11:
	12	u8, rw	0 (2,3)	Yes	Port configuration for Port 12:
	13	u8, ro	-	-	Unused.
	14	u8, ro	-	-	Unused.
	15	u8, rw	1	Yes	Port configuration for Port 15:
	16	u8, rw	1	Yes	Port configuration for Port 16:
	17	u8, rw	1	Yes	Port configuration for Port 17:
	18	u8, rw	1	Yes	Port configuration for Port 18:
	19	u8, rw	1	Yes	Port configuration for Port 19:
	20	u8, rw	1	Yes	Port configuration for Port 20:
	21	u8, rw	1	Yes	Port configuration for Port 21:
	22	u8, rw	1	Yes	Port configuration for Port 22:
	23	u8, rw	1	Yes	Port configuration for Port 23:
	24	u8, rw	1	Yes	Port configuration for Port 24:
	25	u8, rw	1	Yes	Port configuration for Port 25:
	26	u8, rw	1	Yes	Port configuration for Port 26:
	27	u8, rw	1	Yes	Port configuration for Port 27:

Index	S-Idx	Type	Default (Possible)	Saved	Description
0x2000	28	u8, rw	1	Yes	Port configuration for Port 28:
	29	u8, rw	1	Yes	Port configuration for Port 29:
	30	u8, rw	1	Yes	Port configuration for Port 30:
	31	u8, rw	1	Yes	Port configuration for Port 31: Note: Reserved for Status LED on CrossCode™ BT.
	32	u8, ro	-	-	Unused.
	33	u8, rw	1	Yes	Port configuration for Port 33:
	34	u8, ro	-	-	Unused.
	35	u8, ro	-	-	Unused.
	36	u8, rw	2 (3)	Yes	Port configuration for Port 36:
	37	u8, rw	2 (3)	Yes	Port configuration for Port 37:
	38	u8, rw	2 (3)	Yes	Port configuration for Port 38:
	39	u8, rw	2 (3)	Yes	Port configuration for Port 39:
	40	u8, rw	2 (3)	Yes	Port configuration for Port 40:
	41	u8, rw	2 (3)	Yes	Port configuration for Port 41:
	42	u8, rw	2 (3)	Yes	Port configuration for Port 42:
	43	u8, rw	2 (3)	Yes	Port configuration for Port 43:
	44	u8, rw	2 (3)	Yes	Port configuration for Port 44:
	45	u8, rw	2 (3)	Yes	Port configuration for Port 45:
	46	u8, rw	2 (3)	Yes	Port configuration for Port 46:
	47	u8, rw	2 (3)	Yes	Port configuration for Port 47:
	48	u8, rw	2 (3)	Yes	Port configuration for Port 48:
	49	u8, ro	-	-	Unused.
	50	u8, ro	-	-	Unused.
	51	u8, rw	2 (3)	Yes	Port configuration for Port 51:
	52	u8, rw	2 (3)	Yes	Port configuration for Port 52:
	53	u8, rw	2 (3)	Yes	Port configuration for Port 53:
	54	u8, rw	2 (3)	Yes	Port configuration for Port 54:
	55	u8, rw	2 (3)	Yes	Port configuration for port 55:
	56	u8, rw	2 (3)	Yes	Port configuration for port 56:
	57	u8, rw	2 (3)	Yes	Port configuration for port 57:
	58	u8, rw	2 (3)	Yes	Port configuration for port 58:
	59	u8, rw	2 (3)	Yes	Port configuration for port 59:
	60	u8, rw	2 (3)	Yes	Port configuration for port 60:
	61	u8, ro	-	-	Unused.
	62	u8, ro	-	-	Unused.
	0	u8, ro	9	-	Voltage Range: Number of entries. 5 = 0 – 5 volts 28 = 0 – 28 volts

Index	S-Idx	Type	Default (Possible)	Saved	Description
0x2001	1 – 4	u8, ro	0	-	Unused.
	5	u8, rw	5 (28)	Yes	Voltage range for Voltage Group 1. (Ports 5,6,7,8):
	6 – 8	u8, ro	0	-	Unused.
	9	u8, rw	5 (28)	Yes	Voltage range for Voltage Group 2. (Ports 9,10,11,12):
0x2002	0	u8, ro	0	-	Logic Threshold for Analog Inputs being used as Digital Inputs: Number of Entries: Unused.
0x2003	0	u8, ro	54	-	Port Bias: Number of Entries. This index specifies the bias of the Port. 0 = pull down 1 = pull up 2 = floating
	1	u8, rw	0 (1,2)	Yes	Port Bias: Bias Group 1 (Ports 1 to 4)
	2 – 35	u8, ro	0	-	Unused.
	36	u8, rw	0 (1,2)	Yes	Port Bias: Bias Group 2 (Ports 36 to 43)
	37 – 43	u8, ro	0	-	Unused.
	44	u8, rw	0 (1,2)	Yes	Port Bias: Bias Group 3 (Ports 44 to 53)
	45 - 53	u8, ro	0	-	Unused.
	54	u8, rw	0 (1,2)	Yes	Port Bias: Bias Group 4 (Ports 54 to 60)
0x200A	0	u8, ro	4	Yes	Shaft Encoder Parameters: No. of Entries. There are two pairs of shaft encoders on Ports 1, 2 and 3, 4. Shaft 1 Position is given on sub-index 1, while Shaft 2 Position is on sub-index 3.
	1	u32,rw	0	Yes	Shaft 1 Position To set, overwrite with new value
	2	u32,ro	0	Yes	Unused.
	3	u32,rw	0	Yes	Shaft 2 Position To set, overwrite with new value.
	4	u32,ro	0	Yes	Unused.
0x2010	0	u8, rw	0 (0 – 127)	Yes	CANopen Node ID. The CANopen Node ID must be unique. The new CANopen Node ID is activated when the node is restarted or reset. Possible values are: 0 = as per selector pins (ch. 2.3.8) 1 to 127 = valid ID More node IDs are possible using SDOs than using the selector pins. (Valid values

Index	S-Idx	Type	Default (Possible)	Saved	Description
					are 1 – 127 compared to 1 – 8 with pins.)
0x2011	0	u8, rw	8 (0 – 8)	Yes	CAN Baud Rate. All nodes must use the same Baud Rate. The new Baud Rate is activated when the node is restarted or reset. Possible values are: 0 = 1000 kbit/s 1 = 800 kbit/s 2 = 500 kbit/s 3 = 250 kbit/s 4 = 125 kbit/s 5 = 100 kbit/s 6 = 50 kbit/s 7 = 20 kbit/s 8 = as per selector pins (ch. 2.3.8)
0x2012	0	u8, rw	0	No	Reset EEPROM function. By writing a nonzero value to this index, the EEPROM will reset to its default values the next time the node is restarted or reset.
0x2020	0	u8, rw	0 (1,2)	Yes	Requested Bluetooth® Role (CrossCode™ BT only) There must be one Master and one slave in the Bluetooth® network. The value is activated when the node is restarted or reset. Possible values are: 0 = as per selector pins (ch. 2.3.9) 1 = Bluetooth® Client (Master) 2 = Bluetooth® Server (Slave)
0x2021	0	u8, rw	0 (0 – 8)	Yes	Requested Bluetooth® Channel (CrossCode™ BT only) All nodes on the same network must have the same Bluetooth® Channel. The value is activated when the node is restarted or reset. Possible values are: 0 = as per selector pins (ch. 2.3.9) 1 to 8 = Bluetooth® Channels 1 to 8.
0x2022	0	u8, ro	0	No	Current Bluetooth® Channel (CrossCode™ BT only) Upon successful Bluetooth® pairing, the Bluetooth® Channel is stored here. 0 = not successful 1 to 8 = Bluetooth® Channels 1 to 8.

Index	S-Idx	Type	Default (Possible)	Saved	Description
0x2100	0	u32,rw	62	Yes	Port Initialisation: Number of Entries. The Port Initialisation State or Value for each Output Port is set upon entry into pre-operational mode according to the respective sub-index herein. For Digital Output Ports, 0 = logic low 1 = logic hi For LED Driver Analog Output Ports, 4 LSBs are used to set the LED intensity For LCD Backlight Driver Port 33, 16 LSBs to set backlight brightness.
	1	u32,rw	0 (1)	Yes	Port Initialisation for Port 1: Only used if Ports 1 and 2 are configured as Digital Outputs
	2	u32,rw	0 (1)	Yes	Port Initialisation for Port 2: Only used if Ports 1 and 2 are configured as Digital Outputs
	3	u32,rw	0 (1)	Yes	Port Initialisation for Port 3: Only used if Ports 3 and 4 are configured as Digital Outputs
	4	u32,rw	0 (1)	Yes	Port Initialisation for Port 4: Only used if Ports 3 and 4 are configured as Digital Outputs
	5	u32,rw	0 (1)	Yes	Port Initialisation for Port 5: Only used if configured as Digital Output
	6	u32,rw	0 (1)	Yes	Port Initialisation for Port 6: Only used if configured as Digital Output
	7	u32,rw	0 (1)	Yes	Port Initialisation for Port 7: Only used if configured as Digital Output
	8	u32,rw	0 (1)	Yes	Port Initialisation for Port 8: Only used if configured as Digital Output
	9	u32,rw	0 (1)	Yes	Port Initialisation for Port 9: Only used if configured as Digital Output
	10	u32,rw	0 (1)	Yes	Port Initialisation for Port 10: Only used if configured as Digital Output
	11	u32,rw	0 (1)	Yes	Port Initialisation for Port 11: Only used if configured as Digital Output
	12	u32,rw	0 (1)	Yes	Port Initialisation for Port 12: Only used if configured as Digital Output
	13	u32,rw	-	-	Unused.
	14	u32,rw	-	-	Unused.
	15	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 15:
	16	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 16:
	17	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 17:
	18	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 18:
	19	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 19:
	20	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 20:

Index	S-Idx	Type	Default (Possible)	Saved	Description
0x2100	21	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 21:
	22	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 22:
	23	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 23:
	24	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 24:
	25	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 25:
	26	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 26:
	27	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 27:
	28	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 28:
	29	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 29:
	30	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 30:
	31	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 31:
	32	u32,ro	-	-	Unused.
	33	u32,rw	0 (0 – 15)	Yes	Port Initialisation for Port 33:
	34	u32,ro	-	-	Unused.
	35	u32,ro	-	-	Unused.
	36	u32,rw	0 (1)	Yes	Port Initialisation for Port 36: Only used if configured as Digital Output
	37	u32,rw	0 (1)	Yes	Port Initialisation for Port 37: Only used if configured as Digital Output
	38	u32,rw	0 (1)	Yes	Port Initialisation for Port 38: Only used if configured as Digital Output
	39	u32,rw	0 (1)	Yes	Port Initialisation for Port 39: Only used if configured as Digital Output
	40	u32,rw	0 (1)	Yes	Port Initialisation for Port 40: Only used if configured as Digital Output
	41	u32,rw	0 (1)	Yes	Port Initialisation for Port 41: Only used if configured as Digital Output
	42	u32,rw	0 (1)	Yes	Port Initialisation for Port 42: Only used if configured as Digital Output
	43	u32,rw	0 (1)	Yes	Port Initialisation for Port 43: Only used if configured as Digital Output
	44	u32,rw	0 (1)	Yes	Port Initialisation for Port 44: Only used if configured as Digital Output
	45	u32,rw	0 (1)	Yes	Port Initialisation for Port 45: Only used if configured as Digital Output
	46	u32,rw	0 (1)	Yes	Port Initialisation for Port 46: Only used if configured as Digital Output
	47	u32,rw	0 (1)	Yes	Port Initialisation for Port 47: Only used if configured as Digital Output
	48	u32,rw	0 (1)	Yes	Port Initialisation for Port 48: Only used if configured as Digital Output
	49	u32,ro	-	-	Unused.
	50	u32,ro	-	-	Unused.
	51	u32,rw	0 (1)	Yes	Port Initialisation for Port 51: Only used if configured as Digital Output

Index	S-Idx	Type	Default (Possible)	Saved	Description
0x2100	52	u32,rw	0 (1)	Yes	Port Initialisation for Port 52: Only used if configured as Digital Output
	53	u32,rw	0 (1)	Yes	Port Initialisation for Port 53: Only used if configured as Digital Output
	54	u32,rw	0 (1)	Yes	Port Initialisation for Port 54: Only used if configured as Digital Output
	55	u32,rw	0 (1)	Yes	Port Initialisation for Port 55: Only used if configured as Digital Output
	56	u32,rw	0 (1)	Yes	Port Initialisation for Port 56: Only used if configured as Digital Output
	57	u32,rw	0 (1)	Yes	Port Initialisation for Port 57: Only used if configured as Digital Output
	58	u32,rw	0 (1)	Yes	Port Initialisation for Port 58: Only used if configured as Digital Output
	59	u32,rw	0 (1)	Yes	Port Initialisation for Port 59: Only used if configured as Digital Output
	60	u32,rw	0 (1)	Yes	Port Initialisation for Port 60: Only used if configured as Digital Output
	61	u32,ro	-	-	Unused.
	62	u32,ro	-	-	Unused.

Object Dictionary - continued
Device specific entries (DS401); index 0x6000 – 0x9FFF

Index	S-Idx	Type	Default	Saved	Description
0x6000	0	u8, ro	5	-	Digital Inputs: Number of entries.
	1	u8, ro	0	No	Digital Input Port 36 to 43 Bit 0 – Port 36 Bit 1 – Port 37 Bit 2 – Port 38 Bit 3 – Port 39 Bit 4 – Port 40 Bit 5 – Port 41 Bit 6 – Port 42 Bit 7 – Port 43 Each bit is only used when the corresponding port is configured as Digital Input.
	2	u8, ro	0	No	Digital Input Ports 44 to 53. Bit 0 – Port 44 Bit 1 – Port 45 Bit 2 – Port 46 Bit 3 – Port 47 Bit 4 – Port 48 Bit 5 – Port 51 Bit 6 – Port 52 Bit 7 – Port 53 Each bit is only used when the corresponding port is configured as Digital Input.
	3	u8, ro	0	No	Digital Input Ports 54 to 60. Bit 0 – Port 54 Bit 1 – Port 55 Bit 2 – Port 56 Bit 3 – Port 57 Bit 4 – Port 58 Bit 5 – Port 59 Bit 6 – Port 60 Each bit is only used when the corresponding port is configured as Digital Input.
	4	u8, ro	0	No	Digital Input Ports 5 to 12. Bit 0 – Port 5 Bit 1 – Port 6 Bit 2 – Port 7 Bit 3 – Port 8 Bit 4 – Port 9 Bit 5 – Port 10 Bit 6 – Port 11 Bit 7 – Port 12 Each bit is only used when the corresponding port is configured as Digital Input.

Index	S-Idx	Type	Default	Saved	Description
0x6000	5	u8,ro	0	-	Digital Input Ports 1 to 4. Bit 0 – Port 1 Bit 1 – Port 2 Bit 2 – Port 3 Bit 3 – Port 4
0x6200	0	u8, ro	5	-	Digital Outputs: Number of entries.
	1	u8, rw	0	No	Digital Output Port 36 to 43 Bit 0 – Port 36 Bit 1 – Port 37 Bit 2 – Port 38 Bit 3 – Port 39 Bit 4 – Port 40 Bit 5 – Port 41 Bit 6 – Port 42 Bit 7 – Port 43 Each bit is only used when the corresponding port is configured as Digital Output.
	2	u8, rw	0	No	Digital Output Ports 44 to 53. Bit 0 – Port 44 Bit 1 – Port 45 Bit 2 – Port 46 Bit 3 – Port 47 Bit 4 – Port 48 Bit 5 – Port 51 Bit 6 – Port 52 Bit 7 – Port 53 Each bit is only used when the corresponding port is configured as Digital Output.
	3	u8, rw	0	No	Digital Output Ports 54 to 60. Bit 0 – Port 54 Bit 1 – Port 55 Bit 2 – Port 56 Bit 3 – Port 57 Bit 4 – Port 58 Bit 5 – Port 59 Bit 6 – Port 60 Each bit is only used when the corresponding port is configured as Digital Output.
	4	u8, rw	0	No	Digital Output Ports 5 to 12. Bit 0 – Port 5 Bit 1 – Port 6 Bit 2 – Port 7 Bit 3 – Port 8 Bit 4 – Port 9 Bit 5 – Port 10 Bit 6 – Port 11 Bit 7 – Port 12 Each bit is only used when the corresponding port is configured as Digital Output.

Index	S-Idx	Type	Default	Saved	Description
0x6200	5	u8,rw	0	No	Digital Output Ports 1 to 4 Bit 0 – Port 1 Bit 1 – Port 2 Bit 2 – Port 3 Bit 3 – Port 4
0x6401	0	u8, ro	8	-	Analog Inputs: Number of entries.
	1	u16, ro	0	-	Analog Input Port 5. Only used when Port 5 is configured as Analog Input.
	2	u16, ro	0	-	Analog Input Port 6. Only used when Port 6 is configured as Analog Input.
	3	u16, ro	0	-	Analog Input Port 7. Only used when Port 7 is configured as Analog Input.
	4	u16, ro	0	-	Analog Input Port 8. Only used when Port 8 is configured as Analog Input.
	5	u16, ro	0	-	Analog Input Port 9. Only used when Port 9 is configured as Analog Input.
	6	u16, ro	0	-	Analog Input Port 10. Only used when Port 10 is configured as Analog Input.
	7	u16, ro	0	-	Analog Input Port 11. Only used when Port 11 is configured as Analog Input.
	8	u16, ro	0	-	Analog Input Port 12. Only used when Port 12 is configured as Analog Input.
0x6402	0	u8, ro	2	-	Analog Inputs – 32 bit: Number of entries.
	1	u32,ro	0	-	Shaft Encoder 1 Position (Ports 1 and 2) Only if configured as Shaft Encoder Input.
	2	u32,ro	0	-	Shaft Encoder 2 Position (Ports 3 and 4) Only if configured as Shaft Encoder Input.
0x6411	0	u8, ro	10	-	Analog Outputs: Number of entries.
	1	u8, rw	0	No	Analog Output (LED Driver) Ports 15, 16.
	2	u8, rw	0	No	Analog Output (LED Driver) Ports 17, 18.
	3	u8, rw	0	No	Analog Output (LED Driver) Ports 19, 20.
	4	u8, rw	0	No	Analog Output (LED Driver) Ports 21, 22.
	5	u8, rw	0	No	Analog Output (LED Driver) Ports 23, 24
	6	u8, rw	0	No	Analog Output (LED Driver) Ports 25, 26.
	7	u8, rw	0	No	Analog Output (LED Driver) Ports 27, 28.
	8	u8, rw	0	No	Analog Output (LED Driver) Ports 29, 30.
	9	u8, rw	0	No	Analog Output (LED Driver) Port 31 (used only if configured as LED Driver)
	10	u16, rw	0	No	Analog Output (Backlight Driver) Port 33.

CrossCode™ CX/BT

Appendix 1 – Environmental Tolerances

Environmental Tolerances

Environmental Test	Level			Standard
High temperature	Functional During test +75 °C, 24 hours Functional After test +85 °C, 16 hours			IEC 60068-2-2
Low temperature	Functional During test -40 °C, 24 hours Functional After test -40 °C, 16 hours			IEC 60068-2-1
Change of temperature	Functional During test -40 °C – +50 °C, 5 °C/min 2 test cycles x 24 hours			IEC 60068-2-14 Nb
Damp heat cyclic	Functional During test +25 °C / +55 °C, Rel. Humidity > 90% 6 test cycles x 24 hours			IEC 60068-2-30 Db
Shock	Functional During test 50 g / 6 ms 1000 impulses in 6 directions			IEC 60068-2-29
Vibration	Functional During test sinusoidal 3.5 mm 10 – 27 Hz 10 g 27 – 500 Hz 2 hours in 3 directions			IEC 60068-2-6
Electrical Transients	Conducted transients Pulse 1: -50 V / 2 ms 2: +25 V / 2 ms 3a: -220 V / 10 ms 3b: +220 V / 10 ms 4: -5 V 5: +70 V			ISO 7637-2
EMC Susceptibility (Component)	RF electromagnetic field 30 V/m 30 – 1000 MHz 80% AM 1 kHz sine			ISO 11452-2
	Bulk Current Injection 60 mA 20 – 200 MHz 80% AM 1 kHz sine			ISO 11452-4
EMC Emissions (Component)	Frequency MHz	Narrowb. dBμV/m	Broadb. dBμV/m	ISO 14982
	30-75 75-400 400-1000	54-44 44-55 55	64-54 54-65 65	
Electrostatic Discharge	4 kV contact, 8 kV air			ESD EN 61000-4-2
Enclosure	IP67			IEC 60529

CrossCode™ CX/BT

Technical Support

Contact your reseller or supplier for help with possible problems with your CrossCode™ CX/BT. In order to get the best help, you should have access to your CrossCode™ CX/BT and be prepared with the following information before you contact support.

- Part number and serial number of the unit, which you find on the brand label
- Date of purchase, which is found on the invoice
- The conditions and circumstances under which the problem arises
- LED indicator colours and blink patterns.
- EMCY object Error Codes (if possible)
- Description of external equipment which is connected to the CrossCode™ CX/BT

CrossCode™ CX/BT

Trade Mark, etc.

CrossCode™ CX/BT

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