

General

The hipecs-CIO50 is a low-cost CANopen module with 2 input and 2 output lines matching 24 V DC applications. The I/O are high side switching, and isolated from power supply and the CAN bus sub system.

The input lines provide special functionality for counting pulses and events, as well as measuring of period and duty-cycle.

The output lines provide PWM and are short-circuit protected.

CANopen is available according to DS301 and DS401. All usual baud rates up to 1 Mbit/s supported.



Features

- Separate power supply for system/bus and I/O
- 2 digital inputs, isolated, high side switching
- 2 digital outputs isolated, high side switching, +24 V DC/+0.5 A, PWM suitable
- Special features:
 - INO: Event counter (0...100,000 Hz)
period measurement (0.5...0.0001 s)
 - IN1: signal measurement:
period, duty-cycle
- Plastic housing for mounting onto DIN carrier rails
- Operating temperature 0...+55 °C (opt. -40...+70 °C)

CANopen Features

- CAN baud rates up to 1 Mbit/s
- CAN bus ISO11898 with Transceiver TJA1050
- 4 Transmit- and 4 Receive-PDO
- Dynamic PDO Mapping
- Variable PDO Identifier
- CANopen PDO transfer modes: synchronous, asynchronous, event triggered, cyclic, acyclic and RTR
- Event Timer and Inhibit Timer for all Transmit-PDO
- Node-Guarding, Lifeguarding und Heartbeat
- Emergency messages
- Minimum Boot-Up

Ordering information

Part	Order number
hipecs-CIO50-i	EZ00000.2150.00
2/2 digital I/O, CAN isolated, 0...+55 °C	
hipecs-CIO50-ie	EZ00000.3050.01
2/2 digital I/O, CAN isolated, -40...+70 °C	

Technical data

Separate power supply for system/bus and I/O.

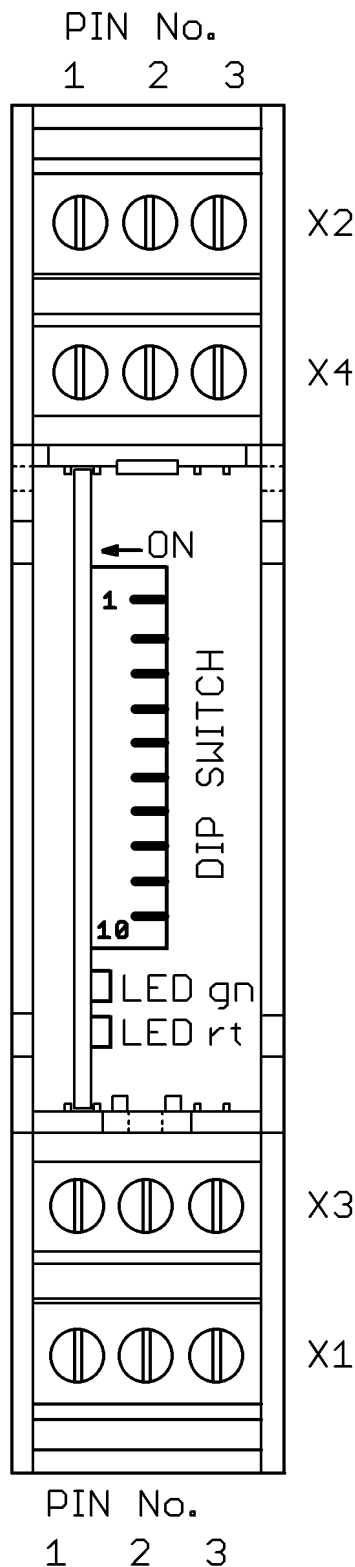
Power supply System	Min.	Norm.	Max.
Supply voltage System/Bus	+11 V DC	+24 V DC	+32 V DC
Current consumption System/Bus	+20 mA (at $V_{CC} = +32$ V DC)	+30 mA	+60 mA (at $V_{CC} = +11$ V DC)
Supply voltage I/O	+11 V DC	+24 V DC	+32 V DC
CAN bus Norm	ISO11898		
CiA Draft Standards	DS301 Version 4.0 and DS401 Version 2.0		
Conformance declaration	CE		
MTBF	5,287,408 hrs		

Digital inputs	
Number of inputs	2
Signal level LOW	< +8.1 V DC
Signal level HIGH	> +8.2 V DC
Min. HIGH-Time for signal measurement	10 μ s
Min. LOW-Time for signal measurement	10 μ s
Max. frequency pulse counting	250 kHz
Delay (CAN reaction time)	typ. 1 ms
Input current at 24 V DC	approx. +5 mA
Isolation from System/Bus	100 V

Digital Outputs	
Number of outputs	2
Switching character	High-side switching
Protection	Short-circuit proof
Isolation from System/Bus	100 V
Signal-Rise-Time (0...70 %)	Typ. 1 μ s [load: 100 ohm]
Signal-Fall-Time (100...30 %)	Typ. 3 μ s [load: 100 ohm]
PWM frequency range	1...24 kHz [adjustable 0.015 Hz up to 2.4 MHz]
PWM resolution	10...65,535 steps
Delay (CAN reaction time)	typ. 1 ms
Loads	resistive, inductive, lamps
Max. output current continuous	+0.5 A
Peak output current	+1.0 A max. 1 s

Connectors and dimensions	
Connectors	Screw clamps
Cable cross-section [mm ²]	0.08...1.5 mm ² (massive/flexible)
Cable cross-section [AWG]	26...14 AWG (massive/flexible)
Stripping length	8 mm
Dimensions housing	approx. 17.8 x 90 x 62 mm (see picture "dimensions!")
Operating temperature	0...+55 °C (optional -40...+70 °C)
Weight module	approx. 60 g

Connectors assignment



Connector X1 (power)

Pin-No.	Name	Description
1	U	+24 V DC
2	GND	Ground
3	G1	Ground outputs

Connector X2 (CAN)

Pin-No.	Name	Description
1	L0	CAN Low
2	H0	CAN High
3	G0	Ground

Connector X3 (digital outputs)

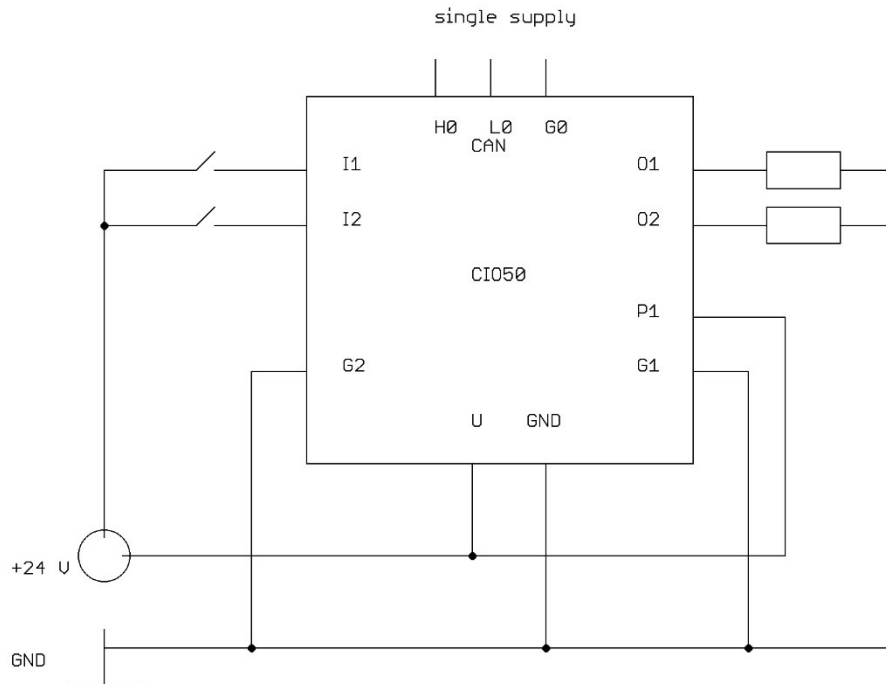
Pin-No.	Name	Description
1	O0	Output 0.0
2	O1	Output 0.1
3	P1	Power outputs

Connector X4 (digital inputs)

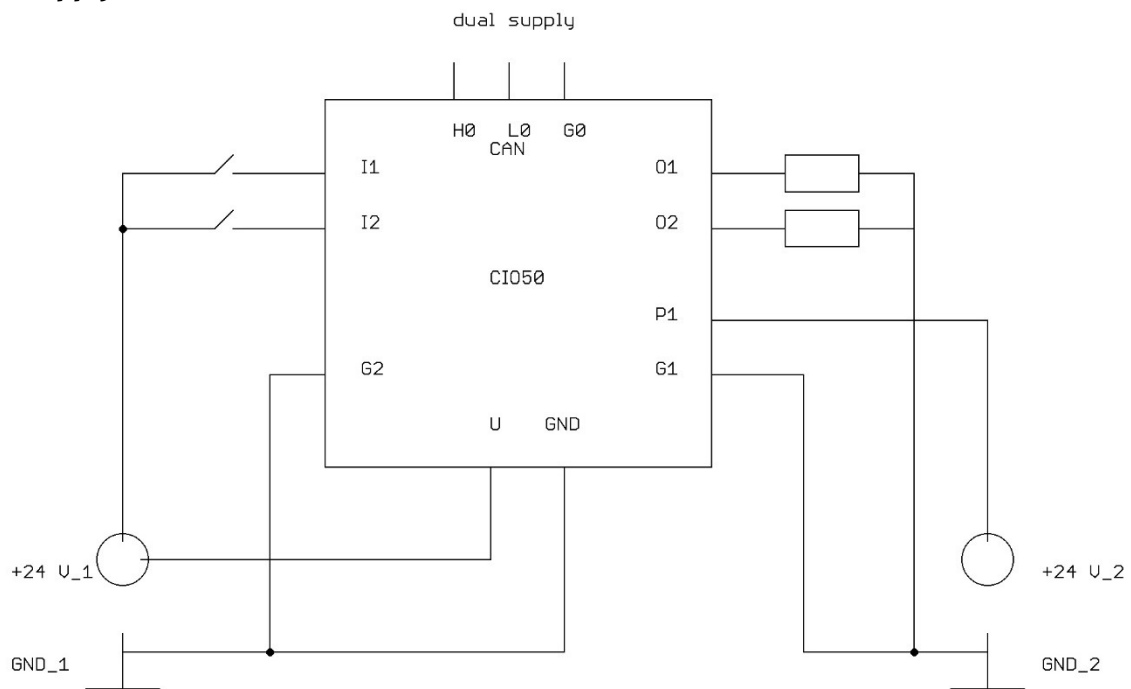
Pin-No.	Name	Description
1	I0	Input 0.0
2	I1	Input 0.1
3	G2	Ground inputs

Wiring diagram

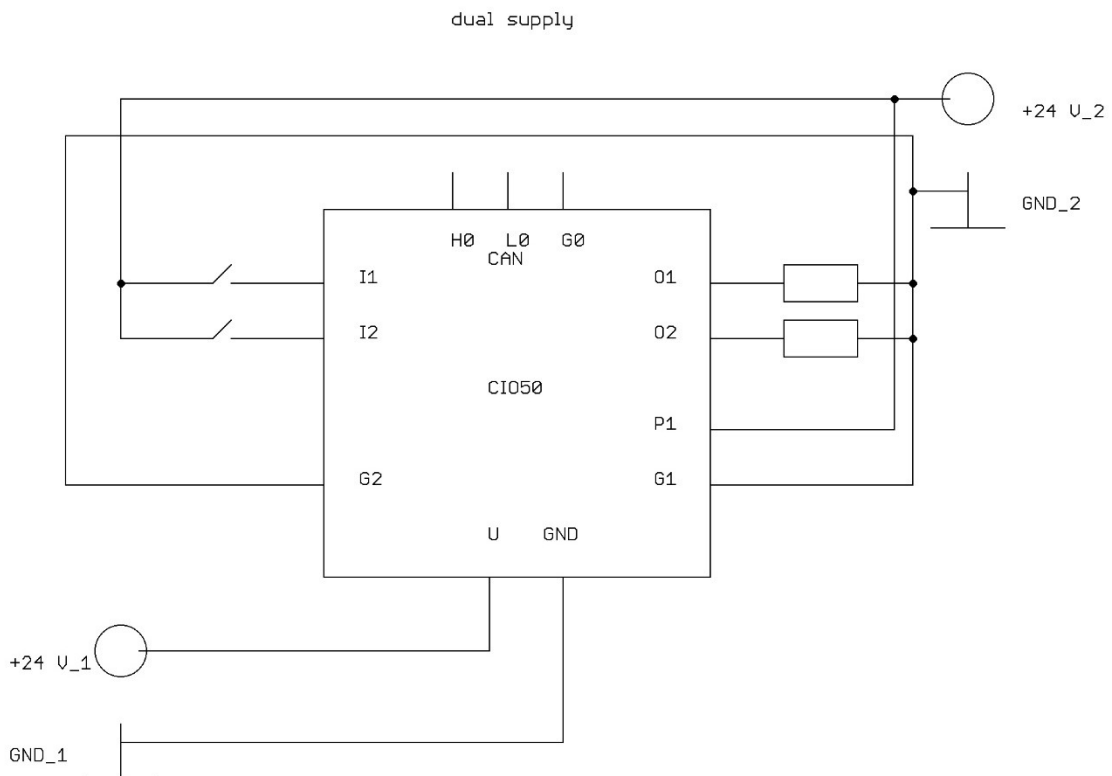
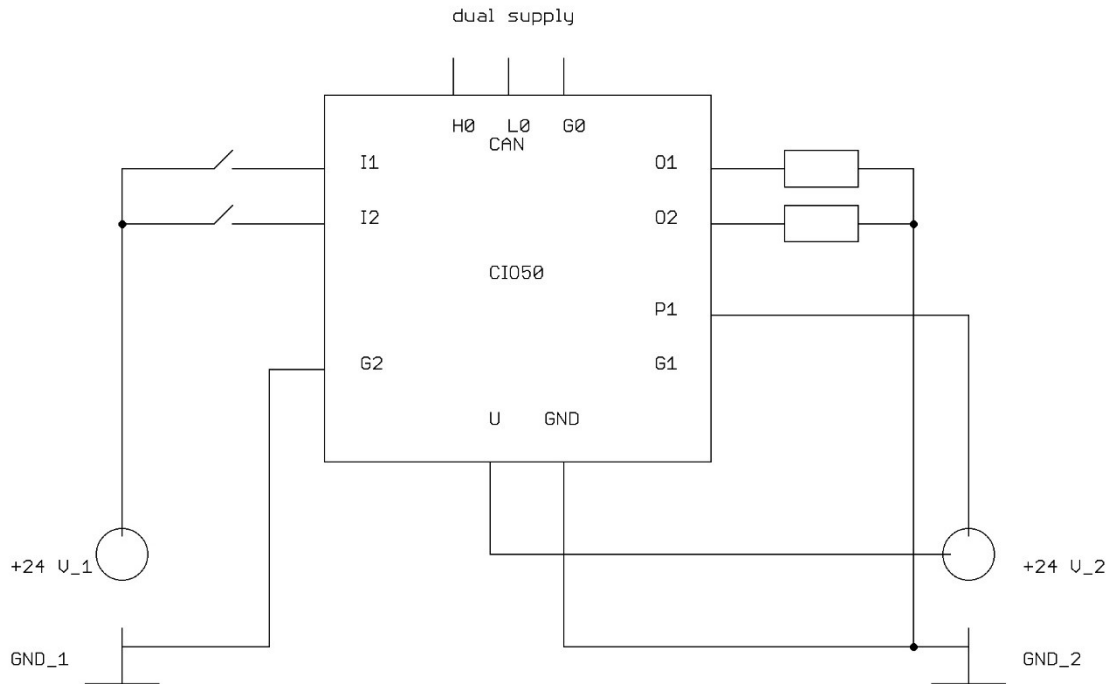
Single supply



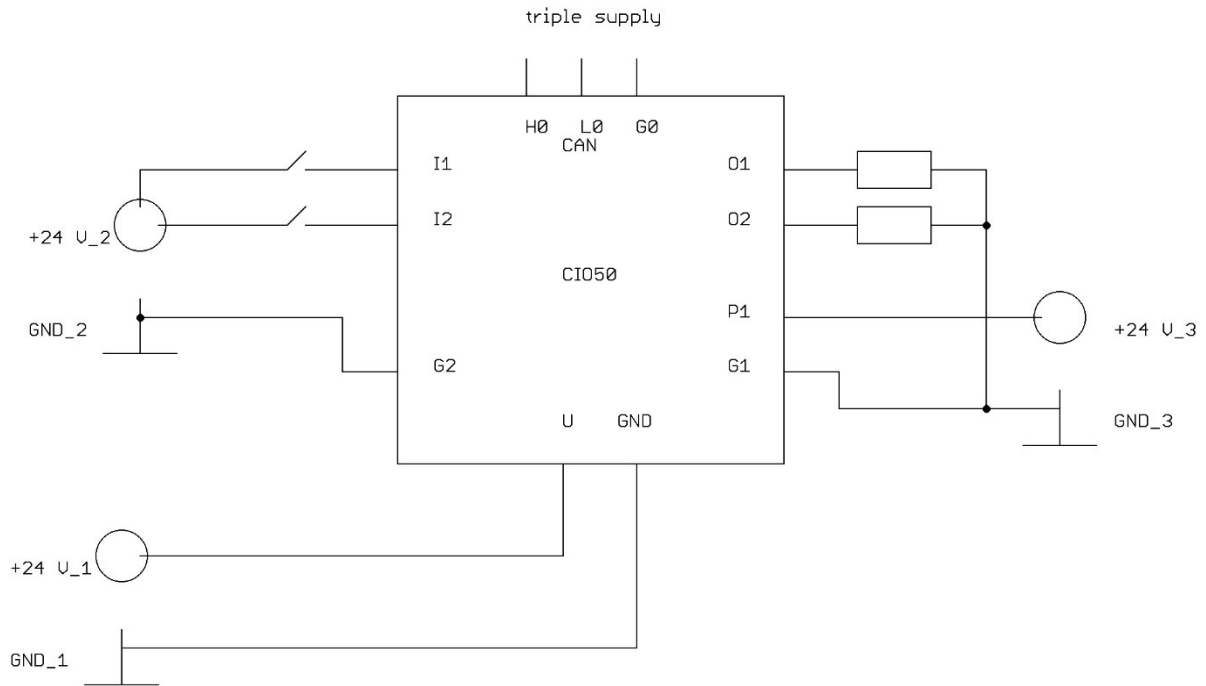
Dual supply



Dual supply (continuation)



Triple supply



Configuration Dip-Switch

Configuration of node-ID, baud rate and termination via DIP-Switch.
The switches are inside the housing (open lid).

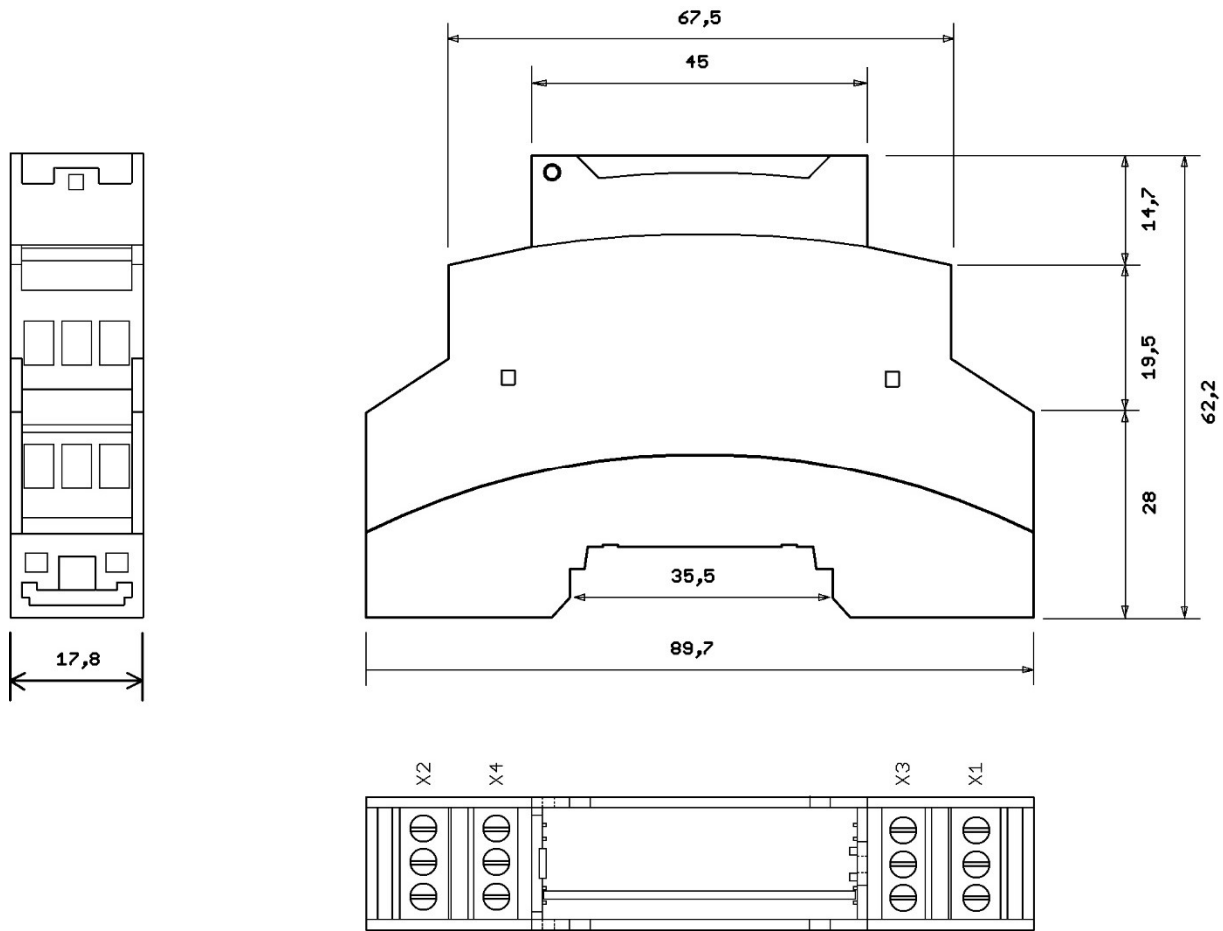
Switch Number										Description
1	2	3	4	5	6	7	8	9	10	
RT										RT Termination CAN-Bus
	BD2	BD1	BD0							BDx Baud rate CAN-Bus
				ID5	ID4	ID3	ID2	ID1	ID0	IDx Select Node-ID
ON										CAN-Termination on (120 Ohm)
OFF										CAN-Termination off
	OFF	OFF	OFF							1 Mbit/s
	OFF	OFF	ON							800 kBit/s
	OFF	ON	OFF							500 kBit/s
	OFF	ON	ON							250 kBit/s
	ON	OFF	OFF							125 kBit/s
	ON	OFF	ON							50 kBit/s
	ON	ON	OFF							20 kBit/s
	ON	ON	ON							Reserved
				OFF	OFF	OFF	OFF	OFF	OFF	Reserved
				OFF	OFF	OFF	OFF	OFF	ON	Node-ID = 1
				OFF	OFF	OFF	OFF	ON	OFF	Node-ID = 2
				OFF	OFF	OFF	OFF	ON	ON	Node-ID = 3
			
				ON	ON	ON	ON	OFF	OFF	Node-ID = 60
				ON	ON	ON	ON	OFF	ON	Node-ID = 61
				ON	ON	ON	ON	ON	OFF	Node-ID = 62
				ON	ON	ON	ON	ON	ON	Node-ID = 63

CAN Signal-LED

The LED are located behind the lid. States are coded according to DRP303-3.

LED	Farbe	Funktion
RUN-LED	green	off no supply or faulty flickering CAN not started flashing Stopped blinking Preoperational on Operational
ERR-LED	red	Off no error 1x flashing CAN module in Error Warning State 2x flashing Node-Guarding error on Bus-Off

Dimensions



All measurements in millimeter (mm)

CANopen Object Dictionary

DS301: global objects

Index	Sub-Index	Name	Access
0005	-	Dummy 8	r/o
0006	-	Dummy 16	r/o
0007	-	Dummy 32	r/o
1000	-	Device Type	r/o
1001	-	Error Register	r/o
1002	-	Manufacturer Status Register	r/o
1005	-	COB-ID SYNC	r/o
1008	-	Device Name	r/o
1009	-	Hardware Version	r/o
100A	-	Software Version	r/o
100C	-	Guard Time	r/w
100D	-	Life Time Factor	r/w
100E	-	COB-ID Guard	-
1014	-	COB ID Emergency	r/w
1015	-	Inhibit Time Emergency	r/w
1016	0	Consumer Heartbeat Time	r/o
	1	Consumer Heartbeat Time 1	r/w
	2	Consumer Heartbeat Time 2	r/w
	3	Consumer Heartbeat Time 3	r/w
	4	Consumer Heartbeat Time 4	r/w
1017	-	Producer Heartbeat Time	r/w
1018	0	Identity Object	r/o
	1	Vendor ID	r/o
	2	Product Code	r/o
	3	Revision Number	r/o
	4	Serial Number	r/o
1029		Error Behavior Object	r/o
	1	Communication error	r/w
	2	Application error	r/w

All index values are hexadecimal. Values in tables are hexadecimal (0x...) or decimal.

r/o read only
w/o write only
r/w read and write

All visible string data types are 20 characters at max.

DS301: PDO Parameter objects

Description of PDO Parameter. With these indexes, dynamic PDO-Mapping, free selection of IDs, transmission type, inhibit and event time is possible. These settings are selectable in “operational” as well as “preoperational” mode.

Index	Sub-Index	Name	Access
1400	0	Receive-PDO1 Communication Parameter	r/o
	1	COB-ID	r/w
	2	Transmission Type	r/w
1401...1403		Receive-PDO2 to RPDO4 Communication Parameter same as 1400	r/w
1600	0	Receive-PDO1 Parameter mapping	r/w
	1 to n	Mapped objects (max. 8 objects mappable)	r/w
1601...1603		Receive-PDO2 to RPDO4 Parameter mapping same as 1600	r/w
1800	0	Transmit-PDO1 Communication Parameter	r/o
	1	COB-ID	r/w
	2	Transmission Type	r/w
	3	Inhibit Time	r/w
	4	Reserved	r/w
	5	Event Time	r/w
1801...1803		Transmit-PDO2 to TPDO4 Communication Parameter same as 1800	r/w
1A00	0	Transmit-PDO1 Parameter mapping	r/w
	1 to n	Mapped objects (max. 8 objects mappable)	r/w
1A01...1A03		Transmit-PDO2 to TPDO4 Parameter mapping same as 1A00	r/w

Specific objects

Index	Sub-Index	Name	Access
2000	-	Device Manufacturer	r/o
2009	0	Serial Number 64 Bit	r/o
	1	Serial Number 64 Bit LSDW	r/o
	2	Serial Number 64 Bit MSDW	r/o
2101	-	System Configuration	r/o
2102	-	Remapping Enabled Info	r/o
2103	-	Enable Guarding Warning	r/w
2105	-	Internal API State	r/o
2110	0	Conformance Test Object	r/o
	1	Range Check Object	r/w
2180	-	CAN Restart Time	r/w

DS401: digital inputs

Index	Sub-Index	Name	Access
6000	0 to n	Read digital input 8 bit	r/o
6002	0 to n	Polarity input 8 bit	r/w
6005	-	Global Interrupt Enable	r/w
6006	0 to n	Interrupt Mask Any Change	r/w
6007	0 to n	Interrupt Mask Rising Edge	r/w
6008	0 to n	Interrupt Mask Falling Edge	r/w
6100	0 to n	Read Digital Input 16 Bit	r/o
6120	0 to n	Read Digital Input 32 Bit	r/o

DS401: digital outputs

Index	Sub-Index	Name	Access
5200	-	Reset Output Object on Error	r/w
6200	0 to n	Write Output 8 Bit	r/w
6206	0 to n	Error Mode Output	r/w
6207	0 to n	Error State Output	r/w
6300	0 to n	Write Digital Output 16 Bit	w/o
6320	0 to n	Write Digital Output 32 Bit	w/o

Product related specific objects sorted by function

Index	Sub-Index	Name	Access
4000	-	Counter Value for IN0	r/o
4001	-	Counter Control for IN0	r/w
4008	-	Counter Mode for IN0	r/w

Counter

Index	Sub-Index	Name	Access
4100	-	IN0 Period	r/o
4107	-	IN0 Pulse Measuring Enable	r/w
4108	-	IN0 Pulse Measuring Edge Time Out	r/w
4110	-	IN1 Period	r/o
4111	-	IN1 High Time	r/o
4112	-	IN1 Low Time	r/o
4117	-	IN1 Pulse Measuring Enable	r/w
4118	-	IN1 Pulse Measuring Edge Time Out	r/w

**Pulse
measuring**

Index	Sub-Index	Name	Access
5100	0 to n	Output PWM Value	r/w
5101	0 to n	Output PWM Control	r/w
5102	0 to n	Output PWM Steps	r/w
5107	-	Output PWM Prescaler	r/w

PWM

Object dictionary (description)

Following comes a short description of every dictionary entry.

DS301: Global objects

Index 0005

Dummy for spaces in PDO mapping (8-bit length).
Can be used, more than once.

Index	0005
Name	Dummy 8
Description	
Data Type	Unsigned 8
Access	r/o
PDO Mapping	Yes
Value Range	-
Default Value	0

Index 0006

Dummy for spaces in PDO mapping (16-bit length).
Can be used, more than once.

Index	0006
Name	Dummy 16
Description	
Data Type	Unsigned 16
Access	r/o
PDO Mapping	Yes
Value Range	-
Default Value	0

Index 0007

Dummy for spaces in PDO mapping (32-bit length).
Can be used, more than once.

Index	0007
Name	Dummy 32
Description	
Data Type	Unsigned 32
Access	r/o
PDO Mapping	Yes
Value Range	-
Default Value	0

Index 1000: Device Type

This index contains a description of the device type. Within are encoded the CiA profile code and additional specifications of the device.

Index	1000
Name	Device Type
Description	-
Data Type	Unsigned 32
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	0x0083 0191

Index 1001: Error Register

This index contains the internal error code in case of emergency.

Index	1001
Name	Error Register
Description	-
Data Type	Unsigned 8
Access	r/o
PDO Mapping	Yes
Value Range	-
Default Value	-

The error register is built as shown. If more than one error occur, the values are combined via logical OR.

Bit	Description
0	Common error. This bit is set with every error.
1	0
2	0
3	0
4	CAN bus or communication error
5	0
6	0
7	Device error

Index 1002: Status Register

This index contains additional status information of the device.

Index	1002
Name	Status Register
Description	-
Data Type	Unsigned 32
Access	r/o
PDO Mapping	Yes
Value Range	-
Default Value	-

Index 1005: COB-ID SYNC

This index sets the COB-ID for SYNC messages.

This device is a receiving device. SYNC production is not supported.

Index	1005
Name	COB-ID Sync
Description	-
Data Type	Unsigned 32
Access	r/w
PDO Mapping	No
Value Range	1...0x7FF
Default Value	0x80

Index 1008: Device Name

This index contains the device name as a visible string.

¹⁾ xxx: Number of the product

Index	1008
Name	Device Name
Description	-
Data Type	Visible String
Access	r/o
PDO Mapping	No
Value Range	The maximum string length is 20 characters
Default Value	"hipecs-CIOxxx ¹⁾ "

Index 1009: Hardware Version

This index contains the revision code of the hardware as visible string.

Index	1009
Name	Hardware Version
Description	-
Data Type	Visible String
Access	r/o
PDO Mapping	No
Value Range	The maximum string length is 20 characters
Default Value	-

Index 100A: Software Version

This index contains the firmware version as visible string.

Index	100A
Name	Software Version
Description	-
Data Type	Visible String
Access	r/o
PDO Mapping	No
Value Range	The maximum string length is 20 characters
Default Value	-

Index 100C: Guard Time

Together with index 100D, this index represents the lifeguarding protocol. Values are in milliseconds.

Guard Time multiplied by Life Time Factor results in Life Time.

Set up 0 (zero), if not used.

Index	100C
Name	Guard Time
Description	-
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	
Default Value	0

Index 100D: Life Time Factor

Together with index 100C, this index represents the lifeguarding protocol. Values are factors.

Guard Time multiplied by Life Time Factor results in Life Time.

Set up with 0 (zero), if not used.

Index	100D
Name	Life Time Factor
Description	-
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	
Default Value	0

Index 100E: COB-ID Guard

This index contains the ID for guarding protocol.

Index	100E
Name	COB-ID Guard
Description	-
Data Type	Unsigned 32
Access	-
PDO Mapping	No
Value Range	-
Default Value	0x700 + Node-ID

Index 1014: COB-ID Emergency

This index sets the ID for emergency messages.

Index	1014
Name	COB-ID Emergency
Description	-
Data Type	Unsigned 32
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0x80 + Node-ID

Index 1015: Inhibit Time Emergency

This index sets up a delay for transmitting any emergency. This device supports a delay with an interval of one millisecond.

Index	1015
Name	Inhibit Time Emergency
Description	-
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0 (disabled)

Index 1016: Consumer Heartbeat Time

Index 1016 is used to monitor the Heartbeat Consuming of up to four nodes.

Index	1016
Name	Consumer Heartbeat Time
Description	-
Data Type	Structure

Attention:

Heartbeat monitoring starts with the reception of the first heartbeat.
The Producer Time should be greater than the Consumer Time.
Ahead of the first heartbeat, the Producers status is unknown.

Index	1016.00
Name	Number of indexes supported
Description	-
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	4

Structure of the Consumer Heartbeat Time

MSB		LSB	
Byte3	Byte2	Byte1	Byte0
Reserved	Node-ID	Heartbeat time	

Index	1016.01...1016.04
Name	Consumer Heartbeat Time 1...4
Description	-
Data Type	Unsigned 32
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

Index 1017: Producer Heartbeat Time

This index sets up the heartbeat cycle in an interval of one millisecond.
If it is not used, set up 0 (zero).

Attention:

Use either Heartbeat or Node-Guarding. Both at once is not allowed.

Index	1017
Name	Producer Heartbeat Time
Description	-
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

Index 1018: Identity Object

This index contains common information about the device and the manufacturer, frenzel + berg electronic GmbH & Co.KG. It cannot be modified.

Index	1018
Name	Identity Object
Description	-
Data Type	Structure

Index	1018.00
Name	Number of indexes supported
Description	-
Data Type	Unsigned char
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	4

Registration code of frenzel + berg electronic GmbH & Co.KG at the CiA

Index	1018.01
Name	Vendor ID
Description	
Data Type	Unsigned 32
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	0x58

Internal product code of the product at frenzel + berg electronic GmbH & Co.KG

Index	1018.02
Name	Product Code
Description	
Data Type	Unsigned 32
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	0x0300 5000

Index	1018.03
Name	Revision Code
Description	
Data Type	Unsigned 32
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	Revision of the device

Index	1018.04
Name	Serial Number
Description	
Data Type	Unsigned 32
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	0

Index 1029: Error Behavior

This index sets up whether the device switches its operating state in case of emergency, or not. Possible changes are Pre-Operational or Stopped. No change at all and keeping the current state is possible, too.

As communication error counts, e.g., Bus-Off, Heartbeat, Guarding or internal errors of the device.

The values of the states are as follows:

0	Pre-Operational (only if Operational)
1	no change
2	Stopped
3...255	reserved

Index	1029
Name	Error Behavior Object
Description	-
Data Type	Structure

Index	1029.00
Name	Number of indexes supported
Description	-
Data Type	Unsigned char
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	2

Index	1029.01
Name	Communication Error
Description	NMT state change in case of communication error
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

Index	1029.02
Name	Application Error
Description	NMT state change in case of internal error due to hardware malfunction
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

DS301: PDO Parameter Objects

Communication Parameter Objects

The transmission type for Transmit- and Receive-PDO are set up with sub-index 2.

Type	PDO transmission				
	cyclic	acyclic	synchronous	asynchronous	RTR
0		X	X		
1-240	X		X		
241-251	Reserved				
252			X		X
253				X	X
254				X	
255				X	

The synchronous transmission types 0...240 and 252 are dependent on the SYNC signal. Asynchronous transmission is independent from the SYNC.

Type 0 is triggered by the SYNC, however, a transmission is only made, if the PDO data changes.

A value between 1 and 240 says the transmission is synchronous and cyclic. The transmission type represents the needed number of SYNCs for triggering the PDO.

Type 252 triggers a transmission with the next available SYNC, but only if a RTR releases the PDO.

Type 253 transmits the PDO immediately, however, only on RTR.

With type 254 and 255, the manufacturer or the device profile set the conditions.

An inhibit time can be set in sub-index 3. The PDO are triggered by their conditions, but only transmitted if the inhibit time is up. This time is set as a multiple of 100 µs, a value of 0 (zero) renders the function useless.

In mode 254/255, an additional Event Time is set. This timer running out is considered an event. The time is set as a multiple of 1 ms. This event triggers a PDO transmission in addition to other possible events.

Index 1400 is an example for Receive-PDO and index 1800 is an example for Transmit-PDO.

Index	PDO
1400...14xx	Receive-PDO1...Receive-PDOxx
1800...18xx	Transmit-PDO1...Transmit-PDOxx

Index	14xx/18xx
Name	Receive-/Transmit-PDOx Communication Parameters
Description	-
Data Type	Structure

Index	14xx.00/18xx.00
Name	Number of indexes supported
Description	-
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	2/5

1400.01	ID + 200	1800.01	ID + 180
1401.01	ID + 80000300	1801.01	ID + 80000280
1402.01	ID + 80000400	1802.01	ID + 80000380
1403.01	ID + 80000500	1803.01	ID + 80000480

The table shows the default PDO-ID values.
An Identifier von 8xxxxxxx means the PDO is rendered inactive. The CAN master has to assign a valid PDO-ID.

See table on top of the chapter.

Multiple of 1 μ s.

Multiple of 1 ms.

Index	14xx.01/18xx.01
Name	COB-ID
Description	Identifier for CAN-Object for PDO
Data Type	Unsigned 32
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	

Index	14xx.02/18xx.02
Name	Transmission Type
Description	-
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0xFF

Index	18xx.03
Name	Inhibit Time
Description	-
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

Index	18xx.04
Name	Reserved
Description	-
Data Type	-
Access	-
PDO Mapping	No
Value Range	-
Default Value	-

Index	18xx.05
Name	Event Time
Description	-
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

PDO mapping objects

The following table shows the PDO mapping entries. This is the same for all PDO. The mapping table is a linking index for entries of the object dictionary (e.g. data of digital outputs) and position in the PDO.

Sub-Index 0 gives the number of valid entries. The hipecs-CI050 supports up to eight entries each PDO. In order to change the mapping, sub-index 0 has to be set to 0 (zero) first (inactive). Now the entries can be altered. If a new entry is mapped, the hipecs-CI050 checks whether the entry is valid or not. Invalid entries result in an abort.

All eight sub-indexes are pointer to the entries. A value of 0 (zero) means no entry. The pointer's structure is:

MSB		LSB	
Byte3	Byte2	Byte1	Byte0
mapped index		sub-index	Length

Index and sub-index combined are the pointer; Length is the data length of the pointer's target in bit.

Index	160x/1A0x
Name	Receive-/Transmit-PDO Mapping Parameters
Description	-
Data Type	Array

Index	160x/1A0x.00
Name	Number of indexes supported
Description	Number of mapped objects
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	See table below

Index	160x/1A0x.01...160x/1A0x.08
Name	Mapped object
Description	
Data Type	Unsigned 32
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	See table below

Receive-PDO

The hipecs-CI0xx¹⁾ uses this default configuration for Receive-PDO.

Index	Entry	
Receive-PDO1		
1600.00	1	
1600.01	62000108	Digital output 0.0...0.1
Receive-PDO2		
1601.00	1	
1601.01	40010010	Counter Control IN0
Receive-PDO3		
1602.00	2	
1602.01	51000110	Output PWM Value 1
1602.02	51000210	Output PWM Value 2
Receive-PDO4		
1603.00	0	

Transmit-PDO

The hipecs-CI0xx¹⁾ uses this default configuration for Transmit-PDO.

Index	Entry	
Transmit-PDO1		
1A00.00	1	
1A00.01	60000108	Digital input 0.0...0.1
Transmit-PDO2		
1A01.00	1	
1A01.01	40000020	Counter Value IN0
Transmit-PDO3		
1A02.00	1	
1A02.01	41000020	IN0 Signal Period
Transmit-PDO4		
1A03.00	2	
1A03.01	41100020	IN1 Signal Period
1A03.02	41110020	IN1 Signal High Time

¹⁾ xxx: Number of the product

Specific Objects

Index 2000: Device Manufacturer

Index	2000
Name	Device Manufacturer
Description	-
Data Type	Visible String
Access	r/o
PDO Mapping	No
Value Range	The maximum string length is 20 characters
Default Value	„FRENZEL + BERG“

Index 2009: Serial Number 64 Bit

This index contains the serial number of this device.

Index	2009
Name	Serial Number 64 Bit
Description	-
Data Type	Array

Index	2009.00
Name	Number of indexes supported
Description	-
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	2

Index	2009.01
Name	Serial Number Low Double Word
Description	Bits 0...31 of the serial number
Data Type	Unsigned 32
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	-

Index	2009.02
Name	Serial Number High Double Word
Description	Bits 32...63 of the serial number
Data Type	Unsigned 32
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	-

Index 2101: System Configuration

This index shows the current operating mode of the device.

Index	2101
Name	System Configuration
Description	-
Data Type	Unsigned 32
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	0

Index 2102: Remapping Enabled Info

This index shows, whether remapping the PDO is allowed or prohibited.

0 = remapping prohibited

1 = remapping allowed

Index	2102
Name	Remapping Enabled Info
Description	-
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	1

Index 2103: Enabled Guarding Warning

This index enables an additional warning when Node-Guarding is used.

The CAN master is given an early report for an imminent Node-Guarding failure.

The warning is triggered when the Guard Time is up (Index 100C).

The NMT state remains unaffected.

Index	2103
Name	Enable Guarding Warning
Description	-
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

Index 2105: Internal Error Code

These are internal error messages of the CANopen controller.

Index	2105
Name	Internal Error Code
Description	-
Data Type	Unsigned 32
Access	r/o
PDO Mapping	Yes
Value Range	-
Default Value	0 (no error condition)

Index 2110: Test Object

This index is for internal test purposes only. It possesses no function and is not to use.

Index	2110
Name	Test Object 01
Description	-
Data Type	Structure

Index	2110.00
Name	Number of indexes supported
Description	-
Data Type	Unsigned char
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	1

Index	2110.01
Name	Range Check Object
Description	-
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	100...1000
Default Value	500

Index 2180: CAN Restart Time

With this index, the restart time for the CAN communication in case of a Bus-Off error is defined. The value is set in milliseconds.

0 (zero) disables this function.

Index	2180
Name	CAN Restart Time
Description	-
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	0...50000
Default Value	1000 (restart after one second)

DS401: digital inputs

Index 6000: Read Digital Input 8 Bit

This index represents the values of the digital inputs.

Index	6000
Name	Digital Input 8 Bit
Description	-
Data Type	Array

Index	6000.00
Name	Number of indexes supported
Description	
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	-

Index	6000.01...6000.xx
Name	Digital Input 8 Bit
Description	
Data Type	Unsigned 8
Access	r/o
PDO Mapping	Yes
Value Range	-
Default Value	-

Index 6100: Read Digital Input 16 Bit

Same specifications as index 6000, only with 16-bit-access.

Index 6120: Read Digital Input 32 Bit

Same specifications as index 6000, only with 32-bit-access.

Index 6002: Polarity Input 8 Bit

With this index, the values of the digital inputs can be inverted.

Index	6002
Name	Polarity Input 8 Bit
Description	-
Data Type	Array

Index	6002.00
Name	Number of indexes supported
Description	
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	-

Index	6002.01...6002.xx
Name	Polarity Input 8 Bit
Description	
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

Index 6005: Global Interrupt Enable

This index enables a global interrupt without changing the setups of the interrupt masks. In event mode the values are transmitted depending on indexes 6006, 6007, 6008 und the transmission type.

TRUE (1) = interrupt enable
FALSE (0) = interrupt disable

Index	6005
Name	Global Interrupt Enable
Description	-
Data Type	Boolean
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	TRUE

Index 6006: Interrupt Mask Any Change

This index gives whether an interrupt is created by any change. If enabled, both rising and falling edges are considered valid. Interrupts trigger PDO transmissions in event mode.

Index	6006
Name	Interrupt Mask any change
Description	-
Data Type	Array

Index	6006.00
Name	Number of indexes supported
Description	
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	-

1 = Interrupt enable
0 = Interrupt disable

Index	6006.01...6006.xx
Name	Interrupt Mask any change
Description	
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0xFF (interrupt enabled)

Index 6007: Interrupt Mask Low to High

Same specifications as index 6006, but only rising edges are valid. Default is 0 (zero) (disabled).

Index 6008: Interrupt Mask High to Low

Same specifications as index 6006, but only falling edges are valid. Default is 0 (zero) (disabled).

DS401: digital outputs

Index 5200: Output Reset on Error Option

This index determines whether the outputs restore their original states after acknowledging and dealing with a critical error.

0 (zero) maintains the original states of index 6200.xx. In case of an error, the outputs are set according to indexes 6206 and 6207. After the error cleared, the states of index 6200.xx are restored.

1 and greater overwrites the outputs permanently. The original states are not restored, since index 6200.xx is overwritten with the safe-states of error handling.

Index	5200
Name	Output Reset on Error Option
Description	-
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	1

Index 6200: Write to Digital Output

With this index the digital outputs are set.

Index	6200
Name	Write to digital output
Description	-
Data Type	Array

Index	6200.00
Name	Number of indexes supported
Description	
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	-

Index	6200.01...6200.xx
Name	Write to digital output
Description	
Data Type	Unsigned 8
Access	r/w
PDO Mapping	Yes
Value Range	-
Default Value	0

Index 6300: Write Digital Output 16 Bit

Same specifications as index 6200, only with 16-bit-access.

Index 6320: Write Digital Output 32 Bit

Same specifications as index 6200, only with 32-bit-access.

Index 6206: Error Mode Output 8 Bit

With this is set, whether the outputs change to predefined states (index 6207) in case of an error.

Index	6206
Name	Error Mode Output 8 Bit
Description	-
Data Type	Array

Index	6206.00
Name	Number of indexes supported
Description	
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	-

1 = output changes according to index 6207
0 = output does not change

Index	6206.01...6206.xx
Name	Error Mode Output 8 Bit
Description	
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0xFF

Index 6207: Error Value Output 8 Bit

With this index, the error states for the outputs are predefined.

Index	6207
Name	Error Value Output 8 Bit
Description	-
Data Type	Array

Index	6207.00
Name	Number of indexes supported
Description	
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	-

0 = output disabled
1 = output enabled

Index	6207.01...6207.xx
Name	Error Value Output 8 Bit
Description	
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0 (Inactive, high level)

Product related specific objects sorted by function

Counter

Index 4000: Counter Value

This index shows the amount of ticks from the event counter on input IN0.0.

Index	4000
Name	Counter Value
Description	Counter Value for IN0
Data Type	Unsigned 32
Access	r/o
PDO Mapping	Yes
Value Range	0...4,294,967,295
Default Value	0

Index 4001: Counter Control

This index controls the counter on IN0.

Bit 0 (enable) and bit 4 (reset) are the control switches.

Bit 0 = 0 (counter stopped)

Bit 0 = 1 (counter started)

Bit 4 = 0 (n.a.)

Bit 4 = 1 (counter reset)

Index	4001
Name	Counter Control
Description	Counter Control for IN0 Counter
Data Type	Unsigned 16
Access	r/w
PDO Mapping	Yes
Value Range	-
Default Value	0 (disabled)

Index 4008: Counter Mode

Reserved!

Do not change!

Index	4008
Name	Counter Mode
Description	RESERVED
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0 (do not change)

Index 4100: IN0 Period

This index shows the period of IN0 measured in microseconds.

Attention:

This device supports only periods > 10 μ s (f < 100 kHz)

Index	4100
Name	IN0 Period
Description	Measured IN0 Period
Data Type	Unsigned 32
Access	r/w
PDO Mapping	Yes
Value Range	-
Default Value	0

Pulse measurement**Index 4107: IN0 Pulse Measuring Enable**

This index activates the pulse measuring on IN0.
Only measuring period is supported.

Only bit 0 (zero) is a control switch.

Bit 0 = 0 (measuring deactivated)
Bit 0 = 1 (measuring activated)

Index	4107
Name	IN0 Pulse Measuring Enable
Description	-
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

Index 4108: IN0 Pulse Measuring Edge Time Out

This index sets a time-out delay for resetting the measured values to 0 (zero).

Delay is set in ms.

Index	4108
Name	IN0 Pulse Measuring Edge Time Out
Description	-
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	0...60,000
Default Value	0

Index 4110: IN1 Period

This index shows the period of IN1 measured in microseconds.

Attention:
This device supports only periods > 10 μ s (f < 100 kHz)

Index	4110
Name	IN1 Period
Description	Measured IN1 Period
Data Type	Unsigned 32
Access	r/w
PDO Mapping	Yes
Value Range	-
Default Value	0

Index 4111: IN1 High Time

This index shows the pulse high time of IN1 in microseconds.

Index	4111
Name	IN1 High Time
Description	Measured IN1 high time
Data Type	Unsigned 32
Access	r/w
PDO Mapping	Yes
Value Range	-
Default Value	0

Index 4112: IN1 Low Time

This index shows the pulse low time of IN1 in microseconds.

Index	4112
Name	IN1 Low Time
Description	Measured IN1 low time
Data Type	Unsigned 32
Access	r/w
PDO Mapping	Yes
Value Range	-
Default Value	0

Index 4117: IN1 Pulse Measuring Enable

This index activates the pulse measuring on IN1. Measuring period and pulse high/low time are supported.

Only bit 0 (zero) is a control switch.

Bit 0 = 0 (measuring deactivated)
Bit 0 = 1 (measuring activated)

Index	4117
Name	IN1 Pulse Measuring Enable
Description	-
Data Type	Unsigned 8
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

Index 4118: IN1 Pulse Measuring Edge Time Out

This index sets a time-out delay for resetting the measured values to 0 (zero).

Delay is set in ms.

Index	4118
Name	IN1 Pulse Measuring Edge Time Out
Description	-
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	0...60,000
Default Value	0

PWM

Index 5100: Output PWM Value

This index sets the PWM value.

Index	5100
Name	Output PWM Value
Description	-
Data Type	Array

Index	5100.00
Name	Number of indexes supported
Description	-
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	2

Setting of the duty-cycle.

A correct value is equal or less then index 5102.

Index	5100.01...5100.xx
Name	Output PWM Value
Description	
Data Type	Unsigned 16
Access	r/w
PDO Mapping	Yes
Value Range	0...65,535
Default Value	0

Index 5101: Output PWM Control

With this index the controls for PWM are set up. PWM is either activated with this very index directly or an additional control via index 6200 is used.

Index	5101
Name	Output PWM Control
Description	-
Data Type	Array

Index	5101.00
Name	Number of indexes supported
Description	-
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	2

Only bit 0 (PWM enable) and bit 1 (control output) are functional. Changing Bit 0 from 1 to 0 also the associated index 5100 will be set to 0.

Bit 0 = 0 (PWM disabled)

Bit 0 = 1 (PWM enabled)

Bit 1 = 0 (PWM direct activation)

Bit 1 = 1 (PWM activation via digital output)

Index	5101.01...5101.xx
Name	Output PWM Control
Description	
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	-
Default Value	0

Index 5102: Output PWM Steps

This index sets the number of steps for the PWM.

Index	5102
Name	Output PWM Value
Description	-
Data Type	Array

Index	5102.00
Name	Number of indexes supported
Description	-
Data Type	Unsigned 8
Access	r/o
PDO Mapping	No
Value Range	-
Default Value	2

Index	5102.01...5102.xx
Name	Output PWM Value
Description	
Data Type	Unsigned 16
Access	r/w
PDO Mapping	Yes
Value Range	0...65,535
Default Value	0

Index 5107: Output PWM Prescaler

This index sets a divisor (prescaler) of the PWM base frequency.

PWM frequency = 24 MHz (base frequency)/prescaler

Index	5107
Name	Output PWM Prescaler
Description	Prescaler for the PWM frequency
Data Type	Unsigned 16
Access	r/w
PDO Mapping	No
Value Range	1...24,000
Default Value	250

Samples for producing PWM

		steps index 5102								
		10	...100	...1000	...10000	...20000	...30000	...40000	...60000	...65535
prescaler index 5107	1	2,400,000	240,000	24,000	2,400	1,200	800	600	400	366.217
	2	1,200,000	120,000	12,000	1,200	600	400	300	200	183.108
	3	800,000	80,000	8,000	800	400	266.667	200	133.333	122.072
	...10	240,000	24,000	2,400	240	120	80	60	40	36.622
	...100	24,000	2,400	240	24	12	8	6	4	3.662
	...1000	2,400	240	24	2.400	1.200	0.800	0.600	0.400	0.366
	...10000	240	24	2.400	0.240	0.120	0.080	0.060	0.040	0.037
	...20000	120	12	1.200	0.120	0.060	0.040	0.030	0.020	0.018
	...24000	100	10	1.000	0.100	0.050	0.033	0.025	0.017	0.015

Frequency in Hz

Note: Inaccuracies may occur if odd values are selected. Recommended frequency range is 1 to 24 kHz.

frequency of the PWM	=	24MHz / (prescaler index 5107 * steps index 5102)	[Hz]
Example prescaler 10 and Steps 1000	=	24000000 / (10 * 1000)	= 2,400 [Hz]

duty of the PWM	=	duty index 5100 / steps index 5102	*100 [%]
Example duty 1 and steps 1000	=	1 / 1000	*100 = 0,1 [%]
Example duty 10 and steps 1000	=	10 / 1000	*100 = 1 [%]
Example duty 250 and steps 1000	=	250 / 1000	*100 = 25 [%]
Example duty 500 and steps 1000	=	500 / 1000	*100 = 50 [%]
Example duty 850 and steps 1000	=	850 / 1000	*100 = 85 [%]

Emergency messages

All possible emergency messages of this device have the same structure as follows:

Byte								
0	1	2	3	4	5	6	7	
EMY-Code			1001	0	CIO-Code			

EMY-Code: Error code according to DS301
 1001: Value of index 1001
 CIO-Code: Error code as unsigned 32-bit-value

CIO-Code (hex)	Change		Description
	NMT	I/O	
1000 0000	X	X	Heartbeat Consumer Error
2000 0000			Node-Guarding Warning
3000 0000	X	X	Lifeguarding Error
4000 0000			CAN is in Error-Warning-State
8000 0000	X	X	Device was Bus-Off

The Node-Guarding warning has to be activated with index 2103.
 If more than one error occurs, the messages are combined by using logic OR.
 Some errors have to change the NMT state and/or cause a change of the output states. This behavior depends on the settings of index 1029.

The ID for emergency messages is fixed to 0x80 + Node-ID.

List of emergency messages:

A defined Heartbeat-Producer was not able to send the Heartbeat telegram.

Heartbeat Consumer Error							
30	81	01	00	00	00	00	10

The master is not able to do a RTR on the node.

Node-Guarding Warning							
30	81	01	00	00	00	00	20

The Lifeguarding time is up.

Life-Guarding Error							
30	81	11	00	00	00	00	30

The internal CAN module is in Error-Warning-State.

CAN is in Error-Warning-State							
00	81	01	00	00	00	00	40

Successful return from Bus-Off.

Return from Bus-Off							
40	81	01	00	00	00	00	80

I/O Mapping (quick reference)

2 digital inputs/2 digital outputs EDS file: hipecs_CIO-yyy.edss ¹⁾	
Mapping in object dictionary	
Index	mapped data
4000.00	Counter Value
4100.00	IN0 Period
4110.00	IN1 Period
4111.00	IN1 High Time
4112.00	IN1 Low Time
5100.01/5100.02	Output PWM Value 1/2
6000.01	Input 0.0...0.1
6200.01	Output 0.0...0.1

Default PDO Mapping	
PDO	mapped data
RPDO1	6200.01 Digital output 0.0...0.1
RPDO2	4001.01 Counter Control
RPDO3	5100.01 Output PWM Value 1 5100.02 Output PWM Value 2
TPDO1	6000.01 Digital inputs 0.0...0.1
TPDO2	4000.00 Counter Value
TPDO3	4100.00 IN0 Period
TPDO4	4110.00 IN1 Period 4111.00 IN1 High Time

08) yyy: Number of the product

History

Version	Release date	Changes/Remarks
V1.440_R000	22.03.2013	First release
V1.570_R000	05.09.2014	Update firmware Change: PWM-Prescaler from min. 3 to min. 2 Change: PWM frequency from max. 8 kHz to max. 12 kHz
V1.570_R001	20.10.2014	Additional temperature range -40...+70 °C
V1.570_R002	18.02.2015	Update ordering information
V1.570_R003	03.11.2015	CAN baud rate 10 kBit/s deleted (no longer supported)
V1.720_R000	23.11.2015	Update firmware Change: PWM-Prescaler from min. 2 to min. 1 Change: PWM frequency from max. 12 kHz to max. 24 kHz
V2.100_R000	05.04.2017	Update firmware New: index 5102 PWM Steps Change: index 5100 from 0...1,000 to 0...65,535 New: Samples for producing PWM Release data sheet in new design
V2.100_R001	08.01.2020	Update: weight of module (technical data)
V2.221_R000	13.03.2020	Update firmware New: Index 4108 IN0 Pulse Measuring Edge Time Out New: Index 4118 IN1 Pulse Measuring Edge Time Out Typing/spelling/formatting errors fixed
V2.221_R001	14.02.2025	Update: PWM parameter description with example

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