General Description

The CO4017A is a low cost, high performance Single Chip solution for CANopen remote I/O modules and especially designed for automotive and industrial applications. The device offers the complex implementation of the CANopen standards DS301 and DS401 in a single chip. It is suitable for simple low cost applications like sensor interfacing as well as for complex I/O systems.

CO4017A provides up to 32 digital I/O lines, 8 channels convert analog input signals with a resolution of 10 bit. 8 output lines support PWM generation. To support output overload monitoring, a special error interrupt input is provided. All usual baud rates up to 1 MBit are supported.

The CO4017A Chip requires only few external components, just like a crystal, a CAN transceiver and capacitors. To minimize external interface recommendations all output pins have high current drive capability of 4 mA. For interfacing optoisolators no external drivers are required.

A special interrupt feature for the first 8 digital input pins allows high speed reaction on input changes.

Features

- **Single Chip CANopen Controller**
- **According to CiA Draft Standards DS301 Version 4.0 and DS401 Version 2.0**
- **Baud rate up to 1MBit**
- **Various I/O configurations**
- **Internal noise filtering for all inputs with individual setting for each channel**
- **Error interrupt input for output overload monitoring**
- **Output drivers with 4mA**
- **Watchdog output**
- **Temperature ranges up to –40 to 105 °C**
- **Package QFP64**

Applications

The CO4017A CANopen Controller is optimised for automotive and industrial applications such as:

- **Remote I/O Modules for CANopen**
- **CANopen Interface for keyboards and control panels**
- **Low Cost CANopen Interface for sensors like photoelectric reflex switches photo interrupters**
- **Low Cost CANopen Interface for actors like pneumatic valves, warning panels etc.**

CANopen Features

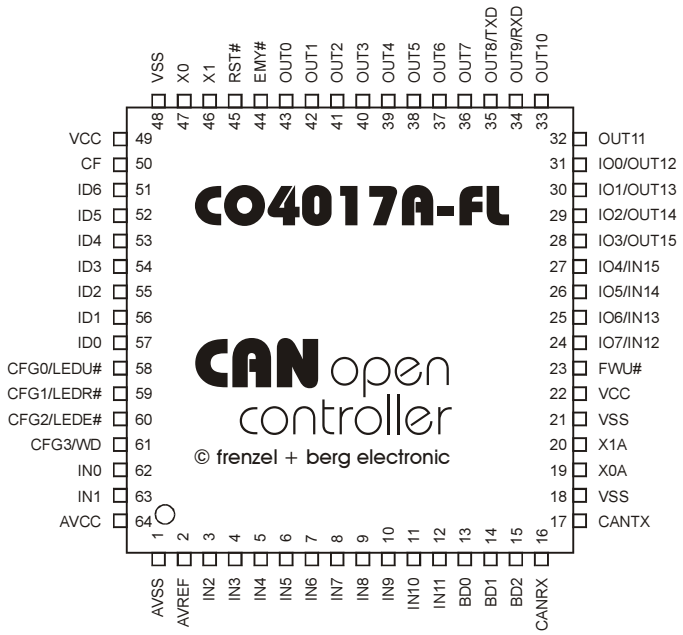
- **4 Transmit- and 4 Receive PDOs**
- **Dynamic PDO mapping**
- **Variable PDO identifier**
- **All CANopen specific PDO transmission types supported: synchronous, asynchronous, event driven, cyclic, acyclic and remote frame dependent.**
- **Event timer and inhibit timer features for all transmit PDOs.**
- **Nodeguarding**
- **Lifeguarding**
- **Heartbeat**
- **Emergency messages**
- **Minimum boot up**

Ordering Information

CO4017A Chip (programmed, licence included)

Part	Temp. Range	Package
CO4017A-FL	-40 °C to 105 °C	QFP64

Pin Assignment



Pin Listing

Pin No.	Pin Name	Funktion
62, 63, 3 to 12	IN0 to IN11	Input channels 0 to 11. Channels 0 to 7 provide analog digital conversion in parallel with digital input detection.
13 to 15	BD0 to BD2	Baud rate selection input
16	CANRX	Receiver input of CAN module
17	CANTX	Transmitter output of CAN module
19	X0A	Sub clock oscillator input
20	X1A	Sub clock oscillator output
23	FWU#	Firmware Update
24 to 31	IO7/IN12 to IO0/OUT12	I/O pins according to configuration mode
23 to 43	OUT11 to OUT0	Output channels 0 to 11. Channels 0 to 7 provide PWM generation.
44	EMY#*	Output overload interrupt input active low
45	RST#	Reset input active low

Pin Listing continued

Pin No.	Pin Name	Funktion
46	X1	Crystal oscillator output
47	X0	Crystal oscillator input
50	CF	Filter capacitor
51 to 57	ID6 to ID0	Identifier selection input
58	CFG0 / LEDU#	Configuration bit 0 Status Led
59	CFG1 / LEDR#	Configuration bit 1 CANopen Run Led
60	CFG2 / LEDE#	Configuration bit 2 CANopen Error Led
61	CFG3 / WD	Configuration bit 3 Watch dog output
64	AVCC	Supply for A/D-Converter
1	AVSS	Ground for A/D-Converter
2	AVREF	Reference Voltage for A/D-Converter
18, 21, 48	VSS	Ground
22, 49	VCC	Power supply

Handling the Device

Preventing latch up

The CO4017A is a CMOS device and may suffer latch up under the following conditions:

1) A voltage higher than VCC or lower than VSS is applied to any pin.
2) Absolute maximum ratings are exceeded
3) AVCC power is provided before VCC supply

Handling unused Pins

The CO4017A provides internal pull up devices, so unused pins may be left unconnected.

Power Supply Pins

Make sure that all ground and power supply pins are connected to the same potential. Do not leave any ground or power pins open. Connect at least two ceramic capacitors of 100 nF and a tantalium capacitor of 1 uF between VCC and VSS as close as possible to the device.

Power Supply for A/D converter

The power supply for the A/D converter must not be turned on before the power supply VCC.
If the A/D converter is not used, connect the pins as follows: AVCC = AVREF = VCC, AVSS = VSS.

Input / output pins

All input and output pins for digital signals are active low, for default configuration. This means for input pins, that inverted pin level is mapped to PDO. For output pins the inverted byte value from received PDO is written to the output pins.
Additional inverting capabilities are supported.
The output pins are not driven after reset until the object 6200.xx is written or the device receives a start node command. This gives the possibility to keep output pins in a defined state using external pull devices until configuration (for example setting of active output polarity) is done.

Pull up/down resistors

The CO4017A provides internal pull up resistors.

Note:
Use pull-up resistors on:
- FWU# (pin 23)
- EMY# (pin 44).

Pin Description

All input / output pins are high impedance during reset. The CO4017A supports internal pull up/down resistors. All input pins have Schmitt trigger characteristics. See chapter “Typical Applications” for additional information.

IN0 to IN11: Digital or analog input pins

The function of IN0 to IN7 depends on setting of configuration bits CFG0 to CFG3 and on the configuration within the object dictionary. See also chapter “Mapping I/O to Object Dictionary” for details.
Note: Digital input pins are active low by default. This means that digital input pins are mapped with inverted values into the corresponding objects.
All digital inputs use internal Schmitt trigger circuits.
The CO4017A provides optional input inverters with individual setting for each channel. See chapter “Object Dictionary” for details.

OUT0 to OUT15: Digital or PWM output pins

Output pins OUT0 to 7 provide PWM generation, that is implemented with the draft standard analog output objects. For PWM generation a base frequency of approx 24 kHz with programmable prescaler is used. Additionally the PWM output can be enabled and disabled directly with the assigned digital output object.
All output pins have high current drive capabilities of approximate 4 mA for direct interfacing of opto couplers without additional drivers.
Note: Digital output pins are active low for default configuration. This means that received output data from PDO is written with inverted values to the output pins.
The CO4017A provides optional output inverters with individual setting for each channel. See chapter “Object Dictionary” for details.

IO0 to IO7: Digital input or output pins

The function of IO0 to IO7 depends on the setting of CFGx. See also chapters “Device Configuration” and “Mapping I/O to Object Dictionary” for details.

X0, X1: Crystal oscillator input

Connect a crystal of 4 MHz between X0 and X1. Use additional ceramic capacitors of 22 pF between X0 and X1 to VSS.

EMY#: Emergency Interrupt

This active low input pin is provided to support output overload monitoring. Connect output from an output overload control circuit to this input pin. If the CO4017A scans a low level on pin EMY#, the device automatic enters the error state given in Object 1029.02 (default enter preoperational state).
Further more the Error Register (index 1001) is set to 0x03, indicating a current error.
Last but not least the device will send an emergency telegram with error code 0x2310 indicating an overload error.
If output overload monitoring is not to be used in your application, make sure, that pin EMY# is forced to logic high level.

VCC, AVCC, VSS, AVSS: Power Supply Pins

Make sure that all ground and power supply pins are connected to the same potential. Do not leave any ground or power supply pins open. Connect decoupling capacitors as close as possible to the device. See chapter “Recommended Operation Conditions” for details

CF: Filter Capacitor input

For correct operation of the CO4017A a ceramic capacitor of 100 nF and a tantalum capacitor of 10uF must be connected from Pin 50 (CF) and VSS. Place this components as close as possible to the CO4017A.

RST#: Reset input pin

For a correct device reset, provide an active low reset signal according to recommended operation conditions to input RST#.

CFG0 to CFG2: Configuration input pins / LED output pins

Set device configuration to preferred operation mode using CFG0 to CFG3. The CO4017A provides internal pull up devices, so it is recommended to leave unused configuration input unconnected. Do not use direct connection to VCC or VSS.
LED-Functions (active low):

CFG0 Chip-Status LED shows the Chip status
Always blinking:
- 10 % Duty cycle indicates no error
- 50 % Duty cycle indicates uncritical error or warning (no NMT state change outputs not in error condition)
- 90 % Duty cycle indicates critical error (NMT state change or outputs in error condition)

CFG1 CANopen RUN LED shows NMT state according to DRP303-3

CFG2 CANopen Error LED shows Error state according to DRP303-3

CFG3/WD: Configuration input / watchdog output

CFG3/WD is scanned during reset to switch the CO4017A to enable additional CAN features. Then CFG3/WD is switched to output and drives the watchdog trigger. To monitor correct device operation, this feature may be used in combination with an external watchdog timer.

Note: CFGx are input pins during start up and output pins in normal operation mode. In order to prevent short circuit overload a series resistor between CFGx and configuration device (example DIP switch) should be used. See also "typical application" for details.

CANRX, CANTX: CAN interface pins

The CAN interface pins may be used for direct connection to CAN transceivers like the 80C251. For longer bus length or noisy or disturbed environments it is strongly recommended to use galvanic isolation with opto couplers between bus interface and CANopen application, to improve system reliability.

Device Configuration

The following sections describe the device configuration with meaning:
1: ViH logic high level
0: ViL logic low level

CAN Identifier

The CAN Identifier will be set with Pins ID0 to ID6. This configuration pins use internal inverter. The ID is set as follows:

ID6	ID5	ID4	ID3	ID2	ID1	ID0	CAN-Identifier
1	1	1	1	1	1	1	Programmable ID
1	1	1	1	1	1	0	1 = 0x01
1	1	1	1	1	0	1	2 = 0x02
1	1	1	1	1	0	0	3 = 0x03
1	1	1	1	0	1	1	4 = 0x04
			….				….
1	0	0	0	0	0	0	63 = 0x3F
0	1	1	1	1	1	1	64 = 0x40
0	1	1	1	1	1	0	65 = 0x41
			….				….
0	0	0	0	0	1	0	125 = 0x7C
0	0	0	0	0	0	1	126 = 0x7E
0	0	0	0	0	0	0	127 = 0x7F

All Identifiers from 1 to 127 are valid settings. Identifier 0 is used to load the ID from object 2100.

Baud rate

The baud rate configuration will be done with configuration inputs BD0 to BD2

BD2	BD1	BD0	CAN-Baud Rate / Bus length		
1	1	1	1	Mbit/sec	25 m *1)
1	1	0	800	kbit/sec	50 m *1)
1	0	1	500	kbit/sec	100 m *2)
1	0	0	250	kbit/sec	250 m *2)
0	1	1	125	kbit/sec	500 m *3)
0	1	0	50	kbit/sec	1000 m *3)
0	0	1	20	kbit/sec	2500 m *3)
0	0	0	10	kbit/sec	5000 m *3)

*1) Calculation without optocouplers.
For optocouplers bus length is reduced for about 4m per 10 nsec propagation delay of employed optocoupler type
*2) Calculation with 40 nsec optocoupler propagation delay
*3) Calculation with 100 nsec optocoupler propagation delay
The calculation of the bus length is based on a line propagation delay of 5 nsec/m.

I/O Configuration

Configuration bits CFG0 to CFG3 select the I/O configuration of the CO4017A chip.

CFG Pins	I/O Configuration	
	Mode	Description
3 2 1 0		
1 1 1 1	0	16 input lines 16 output lines IO7 .. IO4 work as IN12 .. IN15 IO0 .. IO3 work as OUT12 .. OUT15 Output drivers are: Active LOW
0 1 1 1	8	16 input lines 16 output lines IO7 .. IO4 work as IN12 .. IN15 IO0 .. IO3 work as OUT12 .. OUT15 Output drivers are: Active HIGH

also section "Mapping I/O to Object Dictionary" for additional information

Object Dictionary

The CO4017A Single Chip CANopen Controller implements a complex object dictionary for CANopen I/O devices.

For detailed information about CANopen objects see additional brochure "Introduction to CANopen"

DS301: global Objects

Index	Sub-Index	Name	Acc.
0005	-	Dummy 8	wo
0006	-	Dummy 16	wo
0007	-	Dummy 32	wo
1000	-	Device Type	ro
1001	-	Error Register	ro
1002	-	Manufacturer Status Register	ro
1005	-	COB-ID Sync Identifier Sync Object	rw
1008	-	Device Name *2)	ro
1009	-	Hardware Version *2)	ro
100A	-	Software Version *2)	ro
100B	-	Node Id *5)	-
100C	-	Guard Time	rw
100D	-	Life Time Factor	rw
100E	-	COB-ID Guard *5)	-
1014	-	COB ID Emergency	rw
1015	-	Inhibit Time Emergency	rw
1017	-	Producer Heartbeat Time	rw
1018	0	Identity Object	ro
	1	Vendor ID	ro
	2	Product Code	ro
	3	Revision Number	ro
	4	Serial Number	ro
1029	0	Error Behavior	ro
	1	In case of bus errors	rw
	2	In case of output errors	rw
2000	-	Device Manufacturer *3)	ro
2101	-	System Configuration	ro
2102	-	Remapping Enabled Info	ro
2103	-	Enable Guarding Warning	rw
2105	-	Internal Error Code	ro
2110	0	Test Object 01	ro
2110	1	Test Object 01.1	rw
2180	-	CAN Restart Time	rw

For the Object tables all values are shown in hexa-decimal way.
For access type the following settings are valid
ro read only
wo write only
rw read and write access enabled

Notes:
*1) This object cannot be written to in operational device state.
Only use this command in preoperational device state, otherwise the CO4017A will answer requests with SDO abort telegrams.
*2) This objects show the chip type and version as visable strings.
*3) This Objects shows "Frenzel + Berg" as visible string data type.
*4) The New Node Id object gives the possibility to set a Node-Nr independent from the Node-Id Input Bits. With this feature the device may be configured by CAN bus line.
*5) This object is not accessible for the application because of standard conforming reasons.

Note: All “Visible String” data type objects are restricted to a maximum of 20 characters.

The data type entries Index 0005 to 0007 are implemented for compatibility reasons. They may be mapped to PDOs in order to define the appropriate space in the PDO.

For the read only objects following data is set:

Index	Sub.	Name	Value in Hex.
1000		Device Type	000F 0191 h
1018	0	Identity Object	04h
	1	Vendor ID	0000 0058 h
	2	Product Code	0140 1701 h
	3	Revision Number	0 .. 0xFFFFFFFF
	4	Serial Number	0
2101		System Configuration	Set according to the setting of the configuration input bits.

DS301: PDO Parameter Objects

Description of PDO Parameter objects:
These Objects enable dynamic PDO mapping, variable identifier distribution for PDOs and setting of the transmission mode, inhibit and event times.
For the CO4017A setting of all parameters may be done in the device state "operational" as well as in "preoperational" state.

Index	Sub-Index	Name	Acc.
1400	0	Receive PDO1 Communication Parameter	ro
	1	COB-ID	rw
	2	Transmission Type	rw
	3	Inhibit Time	rw
	4	Reserved	rw
	5	Event Time	rw
1401 … 1403		Receive PDO2 to RPDO4 Communication Parameter same as 1400.00 .. 1400.05	rw
1600	0	Receive PDO1: Parameter mapping	rw
	1 to n	Mapped Object (max. 8 objects mappable)	rw
1601 … 1603		Receive PDO2 to RPDO4 Parameter mapping Same as 1600	rw
1800	0	Transmit PDO1 Communication Parameter	ro
	1	COB-ID	rw
	2	Transmission Type	rw
	3	Inhibit Time	rw
	4	Reserved	rw
	5	Event Time	rw
1801 … 1803		Transmit PDO2 to TPDO4 Communication Parameter same as 1800.00 .. 1800.05	rw
1A00	0	Transmit PDO1 Parameter mapping	rw
	1 to n	Mapped Object (max. 8 objects mappable)	rw
1A01 … 1A03		Transmit PDO2 to TPDO4 Parameter mapping Same as 1A00	rw

Note:
The CO4017A supports 4 receive and 4 transmit PDOs. All Objects for higher PDO numbers are not implemented.

Note:
For detailed information about CANopen objects see additional brochure "Introduction to CANopen"

DS401: I/O Configuration Objects

Index	Sub-Index	Name	Acc.
5100	0 to n	Analog Output PWM enable	rw
5101	0 to n	Analog Output PWM use digital Control	rw

DS401: Digital Input Objects

Index	Sub-Index	Name	Acc.
5002	0 to n	Input Pull Up Enable	rw
6000	0 to n	Read digital input 8 bit	ro
6002	0 to n	Polarity input 8-bit	rw
6005		Global interrupt enable	rw
6006	0 to n	Interrupt mask: any change	rw
6007	0 to n	Interrupt mask rising edge	rw
6008	0 to n	Interrupt mask falling edge	rw
6100	0 to n	Read digital input 16 bit	ro
6120	0 to n	Read digital input 32 bit	ro

DS401: Digital Output Objects

Index	Sub-Index	Name	Acc.
5200	-	Reset Digital Output Object on Error	rw
6200	0 to n	Write Output 8 Bit	rw
6202	0 to n	Change Polarity Output 8 bit	rw
6206	0 to n	Error Mode Output	rw
6207	0 to n	Error State Output	rw
6300	0 to n	Write digital output 16 bit	wo
6320	0 to n	Write digital output 32 bit	wo

DS401: Analog Input Objects

Index	Sub-Index	Name	Acc.
6401	0 to n	Read Analog Input 16 Bit	ro
6421	0 to n	Analog Input Interrupt Trigger	rw
6423		Analog Input global Interrupt Enable	rw
6424	0 to n	Analog Input Upper Limit	rw
6425	0 to n	Analog Input Lower Limit	rw
6426	0 to n	Analog Input Interrupt Delta	rw
6427	0 to n	Analog Input Interrupt Negative Delta	rw
6428	0 to n	Analog input interrupt positive delta	rw
6431	0 to n	Analog input offset integer	rw

Input pins IN0 to IN7 are used as digital and analog input pins in parallel.

DS401: Analog Output Objects

Index	Sub-Index	Name	Acc.
5400	-	Reset Analog Output Object on Error	rw
5402	-	Analog Out PWM Prescaler	rw
5403	-	Analog Out PWM Multiplier	rw
6411	0 to n	Write Analog Output 16 Bit	rw
6443	0 to n	Analog Output Error Mode	rw
6444	0 to n	Analog Output Error Value	rw

Output pins OUT0 to 7 provide PWM generation, that is implemented with the draft standard analog output objects. For PWM generation a base frequency of approx 24 kHz with programmable prescaler is used.

Additionally there is a digital control option for the PWM. If selected, the PWM output can be enabled and disabled directly with the assigned digital output object.

Description of Object Dictionary

The following list gives a short description of all dictionary entries.

Index 0005

This object is implemented to enable reservation of data space in PDOs by mapping dummy entries.

Index	0005
Name	Dummy 8
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	Yes
Value Range	-
Default Value	0

Index 0006

This object is implemented to enable reservation of data space in PDOs by mapping dummy entries.

Index	0006
Name	Dummy 16
Description	-
Data Type	Unsigned 16
Access modes	RO
PDO Mapping	Yes
Value Range	-
Default Value	0

Index 0007

This object is implemented to enable reservation of data space in PDOs by mapping dummy entries.

Index	0007
Name	Dummy 32
Description	-
Data Type	Unsigned 32
Access modes	RO
PDO Mapping	Yes
Value Range	-
Default Value	0

DS301: Global Objects

Index 1000 : Device Type

Description of the device type. The Object gives the CiA device profile number and additionally the functionality of the device.

Index	1000h	
Name	Device Type	
Description	-	
Data Type	Unsigned 32	
Access modes	RO	
PDO Mapping	No	
Value Range	-	
Default Value	Operation Mode	Value of Index
	CO4017A0	0003 0191 h
	CO4017A1	0007 0191 h
	CO4017A2	0007 0191 h
	CO4017A3	0003 0191 h
	CO4017A4	0003 0191 h
	CO4017A5	0007 0191 h
	CO4017A6	0007 0191 h

Index 1001 : Error Register

This object holds an error of the device.

Index	1001h
Name	Error Register
Description	-
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	Yes
Value Range	-
Default Value	-

The error register has the following structure

Bit	Meaning
0	Generic error. This bit is set, if any error is active
1	0
2	0
3	0
4	CAN bus or communication error
5	0
6	0
7	Device Error

Index 1002 : Status Register

This object gives additional information for the device

Index	1002h
Name	Status Register
Description	-
Data Type	Unsigned 32
Access modes	RO
PDO Mapping	Yes
Value Range	-
Default Value	-

Index 1005 : COB-ID Sync

Identifier of Can Object for the Synchronisation message. The CO4017A may only operate in Sync consumer mode. Generating of Sync messages is not possible. Therefore the Identifier for the Sync message can only be set to the value range 1 . 7FFh.

Index	1005h
Name	COB-ID Sync
Description	-
Data Type	Unsigned 32
Access modes	RW
PDO Mapping	No
Value Range	1 .. 7FFh
Default Value	80h

Index 1008 : Device Name

This object shows the name of the device as visible string.

Index	1008h
Name	Device Name
Description	-
Data Type	Visible String
Access modes	RO
PDO Mapping	No
Value Range	The maximum string length is 20 characters
Default Value	“CO4017A”

Index 1009 : Hardware Version

This object shows the hardware version and firmware version as visible string. The output format is compatible to the format of the chip CO4011A.

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

Index 100A : Software Version

This object shows the software version as visible string.

Index	100Ah
Name	Software Version
Description	-
Data Type	Visible String
Access modes	RO
PDO Mapping	No
Value Range	The maximum string length is 20 characters
Default Value	-

Index 100C : Guard Time

The objects at index 100Ch (Guard Time in milli-seconds) and 100Dh (Life Time Factor) are used to implement the life guarding protocol. The Guard Time multiplied with the Life Time Factor gives the Life Time in milliseconds.
It is 0 (zero) if not used.

Index	100Ch
Name	Guard Time
Description	-
Data Type	Unsigned 16
Access modes	RW
PDO Mapping	No
Value Range	
Default Value	0

Index 100D : Life Time Factor

The objects at index 100Ch (Guard Time in milli-seconds) and 100Dh (Life Time Factor) are used to implement the life guarding protocol. The Guard Time multiplied with the Life Time Factor gives the Life Time in milliseconds.
It is 0 (zero) if not used.

Index	100Dh
Name	Life Time Factor
Description	-
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	
Default Value	0

Index 100E : COB-ID Guard

Identifier of Can Object for the Node Guarding protocol. The Object is not represented in the object dictionary because of standard conforming reasons.

Index	100Eh
Name	COB-ID Guard
Description	-
Data Type	Unsigned 32
Access modes	-
PDO Mapping	No
Value Range	-
Default Value	700h + Node-ID

Index 1014 : COB-ID Emergency

Identifier of Can Object for the emergency messages.

Index	1014h
Name	COB-ID Emergency
Description	-
Data Type	Unsigned 32
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	80h + Node-ID

Index 1015 : Inhibit Time Emergency

Inhibit Time for emergency messages. If the Inhibit Time is set to 0, inhibit delay is disabled. The Inhibit Time is a multiple of 100usec, but the CO4017A offers a maximum resolution of 1 millisecond.

Index	1015h
Name	Inhibit Time Emergency
Description	-
Data Type	Unsigned 16
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0

Index 1017 : Producer Heartbeat Time

The producer heartbeat time defines the cycle time of the heartbeat. The producer heartbeat time is 0 if it is not used. The time has to be a multiple of 1ms.

Index	1017h
Name	Producer Heartbeat Time
Description	-
Data Type	Unsigned 16
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0

Note:
Either Heartbeat or node guarding may be allowed at the same time. Do not use both protocols at the same time.
See additional brochure for further information about heartbeat protocol.

Index 1018 : Identity Object

The object at index 1018h keeps general information about the device and the manufacturer frenzel + berg elektronik. It cannot be modified.

Index	1018h
Name	Identity Object
Description	-
Data Type	Structure

Index	1018h Subindex 0
Name	Largest SubIndex supported
Description	-
Data Type	Unsigned char
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	4

Index	1018h Subindex 1
Name	Vendor ID
Description	Registration Code of frenzel + berg electronic at the CiA
Data Type	Unsigned 32
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	58h

Index	1018h Subindex 2
Name	Product Code
Description	Internal Product Code for CO4017A at frenzel + berg elektronik
Data Type	Unsigned 32
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	0140 1701 h

Index	1018h Subindex 3
Name	Revision Code
Description	
Data Type	Unsigned 32
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Revision of the device

Index	1018h Subindex 4
Name	Serial Number
Description	
Data Type	Unsigned 32
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	0

Index 1029 : Error Behaviour

With object 1029 the CANopen chip can be configured to enter alternatively the preoperational or the stopped state or remain in the current state in case of a device failure. Device failures shall include the following communication errors:
Bus-off conditions of the CAN interface, Life guarding error, Serious device errors also can be caused by device internal failures.
The value of the Error Classes is as follows:
0 = pre-operational
(only if current state is operational)
1 = no state change
2 = stopped
3 .. 127 = reserved

Index	1029h
Name	Error Behaviour Object
Description	-
Data Type	Structure

Index	1029h Subindex 0
Name	Largest SubIndex supported
Description	-
Data Type	Unsigned char
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	2

Index	1029h Subindex 1
Name	Communication Error
Description	NMT state change in case of communication error
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	00h

Index	1029h Subindex 2
Name	Application Error
Description	NMT state change in case of pin EMY0# is at low level
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	00h

Index 2000 : Device Manufacturer

This Object shows "Frenzel + Berg" as visible string. If OEMs do not want to give access to this entry, it may be removed from the EDS (electronic data sheet).

Index	2000h
Name	Device Manufacturer
Description	-
Data Type	Visible String
Access modes	RO
PDO Mapping	No
Value Range	The maximum string length is 20 characters
Default Value	"Frenzel + Berg"

Index 2101 : System Configuration

This Object returns the operation mode of the CO4017A. It represents the inverted Setting of the configuration input bits CFG0 to CFG3.

Index	2101h
Name	System Configuration
Description	-
Data Type	Unsigned 32
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Depends on CFG0 to CFG3

Index 2102 : Remapping Enabled Info

This Object informs the user whether the system configuration enables remapping of the PDOs.
A value of 0 means that remapping is dsabled, all other values indicate that remapping of the PDOs is enabled.

Index	2102h
Name	Remapping Enabled Info
Description	-
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	1

Index 2103 : Enabled Guarding Warning

This Object enables/disables transmission of emergency messages in case of a node guarding warning.
The condition of a guarding warning is met, if the time between two node guarding frames increases the guarding time given in object 100C independent of the setting of the life time (object 100D). The node guarding warning does not cause any NMT state change or switching the output pins to the error state. It is implemented to give the CANopen master an early information that the guarding interval has already exceeded the predefined value.
0 : Guarding Warning is disabled
1 : Guarding Warning is enabled

Index	2103h
Name	Enable Guarding Warning
Description	-
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0

Index 2105 : Internal Error Code

This Object holds error information of the CANopen controller.

Index	2105h
Name	Internal Error Code
Description	-
Data Type	Unsigned 32
Access modes	RO
PDO Mapping	YES
Value Range	-
Default Value	0 (no error condition)

Index 2110 : Test Object

This Object is implemented for testing purposes and should not be used.
The test entry does not have any functional behaviour.

Index	2110h
Name	Test Object 01
Description	-
Data Type	Structure

Index	2110h Subindex 0
Name	Largest SubIndex supported
Description	-
Data Type	Unsigned char
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	0x01

Index	2110h Subindex 1
Name	Test Object 01
Description	-
Data Type	Unsigned 16
Access modes	RW
PDO Mapping	No
Value Range	100 .. 1000
Default Value	500

Index 2180 : CAN Restart Time

This Object gives the restart time out for the CAN communication layer in case of bus off errors in milliseconds.
If the restart time is set to 0 automatic restart of the device in case of bus off is prohibited.

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

DS301: PDO Parameter Objects

Communication Parameter Objects

The following table shows the communication parameter objects for Index 140x (Receive PDOs) and Index 180x (Transmit PDOs). The tables show Index 1400 as an example for all PDOs
The transmission type (sub-index 2) defines the mode for transmission / reception of the PDO. See table for detailed description of this entry.
Description of transmission type:

Type	PDO transmission				
	cyclic	acyclic	Sync related	Async.	Only on remote
0		X	X		
1-240	X		X		
241-251	Reserved				
252			X		X
253				X	X
254				X	
255				X	

Synchronous transmission types 0-240 and 252 mean that the transmission of the PDO shall be related to the SYNC object. Asynchronous means that the transmission of the PDO is not related to the SYNC object.
A transmission type of zero means that the message shall be transmitted synchronously with the SYNC object but not periodically but only in case of data change.
A value between 1 and 240 means that the PDO is transferred synchronously and cyclically, the transmission type indicating the number of SYNC signals, which are necessary to trigger PDO transmissions or receptions.
The transmission types 252 and 253 mean that the PDO is only transmitted on reception of a remote frame. At transmission type 252, the data is updated (but not sent) immediately after reception of the SYNC object. At transmission type 253 the data is updated at the reception of the remote frame. These values are only possible for transmit PDOs.

Transmission type 255 means, the application event is defined in the device profile. For receive PDOs the reception of a PDO will update the mapped data (normally the analog or digital outputs).
Sub-index 3h contains the inhibit time. This time is a minimum interval for PDO transmission. The value is defined as multiple of 100ms.

In mode 254/255 additionally an event time can be used for TPDO. If an event timer exists for a TPDO (value not equal to 0) the elapsed timer is considered to be an event. The event time is a multiple of 1 ms. This event will cause the transmission of this TPDO in addition to otherwise defined events.
The PDO communication parameter objects have the same structure for all PDOs. The following Objects are used.
Sub-index 4h is reserved.

Index	PDO
1400h	Receive PDO1
1401h	Receive PDO2
1800h	Transmit PDO1
1801h	Transmit PDO2

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

Index	14xxh / 18xxh Subindex 0
Name	Largest SubIndex supported
Description	-
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	2 / 5

Index	14xxh / 18xxh Subindex 1	
Name	COB-ID	
Description	Identifier for CAN-Object for PDO	
Data Type	Unsigned 32	
Access modes	RW	
PDO Mapping	No	
Value Range	-	
Default Value	1400.01	Node-Id + 200h
	1401.01	Node-Id + 300h
	1402.01	Node-Id + 400h
	1403.01	Node-Id + 80000500h
	1800.01	Node-Id + 180h
	1801.01	Node-Id + 280h
	1802.01	Node-Id + 380h
	1803.01	Node-Id + 80000480h

An Identifier of 8xxxxxxxh means, that this PDO is disabled by default and must be enabled from the CANopen master by assigning a valid PDO ID.

Index	14xxh / 18xxh Subindex 2
Name	Transmission Type
Description	-
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0FFh

Index	14xxh / 18xxh Subindex 3
Name	Inhibit Time
Description	-
Data Type	Unsigned 16
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0

Index	14xxh / 18xxh Subindex 4
Name	Reserved
Description	-
Data Type	-
Access modes	-
PDO Mapping	No
Value Range	-
Default Value	-

Index	14xxh / 18xxh Subindex 5
Name	Event Time
Description	-
Data Type	Unsigned 16
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0

PDO Mapping Objects

The following table shows the PDO Mapping Objects. The principle of PDO mapping is the same for all PDOs. The PDO Mapping table is the cross reference between the Object dictionary entries (for example the data of an digital output byte) and the data field inside an PDO data field (position in the data field of a CAN message for PDO transfer).

Subindex 0 determines the valid number of objects that have been mapped. The CO401SIE04 allows a maximum of 8 mapped objects for each PDO. For changing the PDO mapping first subindex 0 must be set to 0 (mapping is deactivated). Then the objects can be remapped. When a new object is mapped by writing a subindex between 1 and 8, the device may check whether the object specified by index /subindex exists. If the object does not exist or the object cannot be mapped, the SDO transfer will be aborted.

Subindexes 1 to 8 keep the pointers of the mapped objects as unsigned 32 values. The value is 0 if there is no mapped object. The structure for these pointers is as follows.

MSB LSB

Byte3	Byte2	Byte1	Byte0
Mapped index		Subindex	Length

Mapped Index and Subindex together are the Pointer to the Object dictionary data to be mapped at this location.
Length gives the length of the mapped object in bits.

Index	160xh / 1A0xh
Name	Receive / Transmit PDO Mapping Parameters
Description	-
Data Type	Array

Index	160xh / 1A0xh Subindex 0
Name	Largest SubIndex supported
Description	Number of mapped objects
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	See table below

Index	160xh / 1A0xh Subindex 1 to 8
Name	Mapped object
Description	
Data Type	Unsigned 32
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	See table below

Receive PDOs
The CANopen chip CO4017A uses the following default mapping entries for receive PDO mapping:

Index	Entry	Explanation
Receive-PDO1		
1600.00	2	RPDO1: 2 mapped objects
1600.01	62000108h	Digital Output Byte0
1600.02	62000208h	Digital Output Byte1
Receive-PDO2		
1601.00	4	RPDO2: 4 mapped objects
1601.01	64110110h	Analog output PWM 0
1601.02	64110210h	Analog output PWM 1
1601.03	64110310h	Analog output PWM 2
1601.04	64110410h	Analog output PWM 3
Receive-PDO3		
1602.00	4	RPDO3: 4 mapped objects
1602.01	64110510h	Analog output PWM 4
1602.02	64110610h	Analog output PWM 5
1602.03	64110710h	Analog output PWM 6
1602.04	64110810h	Analog output PWM 7
Receive-PDO4		
1603.00	0	RPDO4: 0 mapped objects

Transmit PDOs
The CANopen chip CO4017A uses the following default mapping entries for transmit PDO mapping:

Index	Entry	Explanation
Transmit - PDO1		
1A00.00	2	TPDO1: 2 mapped objects
1A00.01	60000108h	Digital Input Byte0
1A00.02	60000208h	Digital Input Byte1
Transmit – PDO2		
1A01.00	4	TPDO2: 4 mapped objects
1A01.01	64010110h	Analog Input Integer 0
1A01.02	64010210h	Analog Input Integer 1
1A01.03	64010310h	Analog Input Integer 2
1A01.04	64010410h	Analog Input Integer 3
Transmit – PDO3		
1A02.00	4	TPDO3: 4 mapped objects
1A02.01	64010510h	Analog Input Integer 4
1A02.02	64010610h	Analog Input Integer 5
1A02.03	64010710h	Analog Input Integer 6
1A02.04	64010810h	Analog Input Integer 7
Transmit – PDO4		
1A03.00	0	TPDO4: 0 mapped objects

DS401: I/O Configuration Objects

The following objects are describing the objects for configuration of the output channels.

The input channels IN0 to IN7 provide digital input signal processing as well as analog digital conversion of these channels in parallel. The input channels IN8 to IN15 provide only digital input signal processing. Please note, that IN12 to IN15 are scanned from IO7 to IO4 pins in hardware configuration mode 0.

For the output channels OUT0 to OUT7, the CANopen master has to configure the operation mode. With object 5100 the output mode for each channel may be set individually. Object 5101 add digital control to the analog output PWM channels. If digital control is enabled for analog PWM output, the corresponding output pin is only driven with the PWM signal, if the associated digital output channel is set. Otherwise the PWM output is forced to a duty cycle of 0x00.

Index 5100 : Analog Output PWM Enable

This object is implemented in order to configure the CO4017As output channels to either digital or analog PWM mode.

Index	5100h
Name	Analog Output PWM Enable
Description	-
Data Type	Array

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	Number of digital output bytes

Index	Subindex 1 to Nr of input lines
Name	Analog Output PWM Enable
Description	There is a individual bit for each output line. Bit0 enables/disables PWM for channel 0 Bit1 enables/disables PWM for channel 1 etc
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0x00 All channels set for digital Mode

Note:
This object is implemented for all output channels, but PWM generation is only supported for OUT0 .. OUT7.
In order to keep compatibility with future chip versions, that might support additional PWM channels, it is strongly recommended to leave the configuration bits for unsupported channels unchanged.

Note:
If the output channel is set for digital output mode, the PWM duty cycle written to object 6411 is forced to 0x00. So the user has to set Object 5100.xx before writing the PWM duty cycle to analog output object 6411.

Index 5101 : Analog Output PWM use digital Control

This object is implemented in order to add digital control to the analog PWM output channels. If set, the PWM channel is only enabled, if the corresponding bit within the digital output object 0x6200.xx is set. Resetting the bit of the digital output object disables the PWM, but does not change the duty cycle written to object 6411. So the digital control may be used to switch a preconfigured PWM channel on or off.
If the output channel is set for digital output mode, this object has no functionality.

Index	5101h
Name	Analog Output PWM use digital Control
Description	-
Data Type	Array

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	Number of digital output bytes

Index	Subindex 1 to Nr of input lines
Name	Analog Output PWM use digital Control
Description	There is a individual control bit for each output line. Bit0 enables/disables digital control for channel 0 Bit1 enables/disables digital control for channel 1 etc
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0x00 No digital control for PWM channels

Please note, that the object is implemented for all output channels, but PWM generation is only supported for OUT0 .. OUT7.
In order to keep compatibility with future chip versions, that might support additional PWM channels, it is strongly recommended to leave the configuration bits for unsupported channels unchanged.

DS401: Digital Input Objects

The following objects are describing the functionality of the digital input lines of the CO4017A. The CO4017A supports 8, 16 and 32 bit access to the digital inputs.

The number of digital input bytes depends on the selected operation mode.
The mapping of the I/O lines to object 6000 is explained in chapter "Mapping I/O to Object Dictionary"

Index 5002 : Input Pull Up Enable

This object enables/disables the pull up resistors at the digital input lines. Each bit represents the pull up register of the associated input channel.

Index	5002h
Name	Input Pull Up Enable
Description	-
Data Type	Array

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Number of digital input bytes

Index	Subindex 1 to Nr of input bytes
Name	Input Pull Up Enable Byte n
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	
Default Value	0xFF

Index 6000 : Read Digital Input 8 Bit

This object represents the digital input bytes. The value of the input lines is written to this object. Please note, that input pins are active low by default, so the inverted pin level is written to the input objects.

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

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Number of digital input bytes

Index	Subindex 1 to Nr of input bytes
Name	Digital Input 8 Bit Byte n
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	Yes
Value Range	-
Default Value	-

Index 6100 : Read Digital Input 16 Bit

This object enables 16-Bit access to the digital input bytes. The Object addresses the same data area as object 6000 but using unsigned integer data type. See Index 6000 for further details.

Index 6120 : Read Digital Input 32 Bit

This object enables 32-Bit access to the digital input bytes. The Object addresses the same data area as object 6000 but using unsigned long data type. See Index 6000 for further details.

Index 6002 : Polarity Input 8 Bit

With this object, the digital inputs may be inverted. See also Index 6000 for additional information.

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

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Number of digital input bytes

Index	Subindex 1 to Nr of input bytes
Name	Polarity Input 8 Bit Byte n
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0

Index 6005 : Global Interrupt Enable

This object enables or disables globally the interrupt behaviour without changing the interrupt masks.
In event-driven mode the device transmits the input values depending on the interrupt masks in objects 6006h, 6007h, and 6008h and the PDO transmission type.
TRUE (1)= global interrupt enabled
FALSE (0)= global interrupt disabled

Index	6005h
Name	Global Interrupt Enable
Description	-
Data Type	Boolean
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	TRUE

Index 6006 : Interrupt Mask Any Change

This object determines, which input lines shall activate an interrupt by any change of the input line. Both negative and positive edge will cause an interrupt, if enabled.
An interrupt will cause a PDO transmission in case of event driven transmission mode.
1 = interrupt enabled
0 = interrupt disabled

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

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Number of digital input bytes

Index	Subindex 1 to Nr of input bytes
Name	Interrupt Mask any change
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0FFh (interrupt enabled)

Index 6007 : Interrupt Mask Low to High

This object has the same structure and behaviour as object 6006h but will cause interrupts only on rising edge of object index 6000. Note that input lines are active low, so rising edge of input data (object 6000) means falling edge of input port line.
Default value is 0.

Index 6008 : Interrupt Mask High to Low

This object has the same structure and behaviour as object 6006h but will cause interrupts only on falling edge of object index 6000. Note that input lines are active low, so falling edge of input data (object 6000) means rising edge of input port line.
Default value is 0.

DS401: Digital Output Objects

The following objects are describing the functionality of the digital output lines of the CO4017A. The CO4017A supports 8, 16 and 32 bit access to the digital outputs.

The number of digital output lines depends on the selected operation mode.
The mapping of the I/O lines to object 6200 is explained in chapter "Mapping I/O to Object Dictionary"

Index 5200 : Output Reset on Error Option

This Object selects the function for error handling if a critical error is detected.
If the value is 0, the Outputs objects 6200.xx will keep unchanged. The ports will be set to their error state given in object 6207 as long as the error is active. If error condition ends, the outputs will return to the state according to the output object 6200h.
If the value is 1, the Outputs error handling depends on the objects 6206h and 6207h and the output object 6200 will be overwritten with the error output state according to objects 6206 and 6207.

Index	5200h
Name	Output Reset on Error Option
Description	-
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	1

Index 6200 : Write to Digital Output

With object 6200, the digital outputs of the CO4017A can be written to. The Output port bits of the CO4017A device are active low by default, that means, that a bit value of “1” within the output object drives a low level on the output pin.

If an output channel is configured for analog PWM generation by setting the corresponding bit within object 5100.xx and digital control for this channel is activated by setting the corresponding bit within object 5101, the digital output object switches the PWM generation on or off. In this case, object 6202 (Polarity Output) is ignored and a bit value of “1” always switches PWM generation on.

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

Index	Subindex 0
Name	
Description	Number of mapped objects
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	NO
Value Range	-
Default Value	Number of digital output bytes

Index	Subindex 1 to Nr of output bytes
Name	Write to digital output
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	YES
Value Range	-
Default Value	0

Index 6300 : Write Digital Output 16 Bit

This object enables 16-Bit access to the digital output bytes. The Object addresses the same data area as object 6200 but using unsigned integer data type. See Index 6200 for further details.

Index 6320 : Write Digital Output 32 Bit

This object enables 32-Bit access to the digital output bytes. The Object addresses the same data area as object 6200 but using unsigned long data type. See Index 6200 for further details.

Index 6202 : Polarity Output 8 Bit

With this object, the digital outputs may be inverted. See also Index 6200 for additional information.

Index	6202h
Name	Polarity Output 8 Bit
Description	-
Data Type	Array

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Number of digital output bytes

Index	Subindex 1 to Nr of input bytes
Name	Polarity Output 8 Bit Byte n
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0

Index 6206 : Error Mode Output 8 Bit

This object indicates, whether an output is forced to a predefined value (given in object 6207) in case of a device error.

1 = Output will be forced to the value selected in object 6207

0 = Output will be unchanged even in case of an error condition.

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

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Number of digital output bytes

Index	Subindex 1 to Nr of output bytes
Name	Error Mode Output 8 Bit Byte n
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0FFh (Take error condition from object 6207)

Index 6207 : Error Value Output 8 Bit

This object selects the level the outputs are forced to in case of device error mode if the error mode (object 6206 is enabled)
1 = Output will be forced to active state
0 = Output will be forced to inactive state.
Note: Outputs of CO4017A are active low.

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

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Number of digital output bytes

Index	Subindex 1 to Nr of output bytes
Name	Error Value Output 8 Bit Byte n
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0 (Inactive, high level)

DS401: Analog Input Objects

The following objects are describing the functionality of the analog input lines of the CO4017A.

The number of analog input bytes depends on the selected operation mode. Please note, that for configuration mode 0 analog to digital conversion is done in parallel with the digital input scanning.

Index 6401 : Read Analog Input 16 Bit

Object 6401, represents the value of the analog channels. The 16 bit conversion result of the analog input voltage is a signed value. The input pins are scanned only for positive voltages, so the valid range for object 6401 is 0x00 to 0x7FFF representing input voltage range from 0 to AVref

The mapping of the I/O lines to object 6401 is explained in chapter "Mapping I/O to Object Dictionary"

Index	6401h
Name	Read Analog Input
Description	-
Data Type	Array

Index	Subindex 0
Name	
Description	Number of mapped objects
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	NO
Value Range	-
Default Value	Number of analog input bytes

Index	Subindex 1 to Nr of input lines
Name	Read Analog Input
Description	
Data Type	Signed 16
Access modes	RO
PDO Mapping	YES
Value Range	-
Default Value	-

Index 6421 : Analog Input Interrupt Trigger

Object 6421 selects the event that shall cause a transmission interrupt for the selected analog channel.

There is one Subindex for each channel to enable individual setting according to application requirements.

Table of possible Trigger Conditions:

Bit Nr	Interrupt Trigger Selection
0	Input voltage greater than Upper Limit
1	Input voltage less than Lower Limit
2	Input changed by more than Delta
3	Input reduced more than Negative Delta
4	Input increased more than Positive Delta
5 to 7	Reserved (must be forced to zero)

Index	6421h
Name	Analog Input Interrupt Trigger
Description	-
Data Type	Array

Index	Subindex 0
Name	
Description	Number of mapped objects
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	NO
Value Range	-
Default Value	Number of analog input lines

Index	Subindex 1 to Nr of input lines
Name	Analog Input Interrupt Trigger
Description	Selects trigger condition
Data Type	Unsigned 8 (See Table of Trigger Conditions)
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	7

Index 6423 : Analog Input Interrupt Enable

This object enables or disables globally the interrupt behaviour without changing the interrupt masks.
The interrupt is disabled by default, in order to avoid transmission of analog input values.

TRUE (1)= global interrupt enabled
FALSE (0)= global interrupt disabled

Index	6423h
Name	Analog Input Interrupt Enable
Description	-
Data Type	Boolean
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	FALSE

Index 6424/5/6/7/8 : Analog Input Interrupt Limits

These objects give the Limit for generation of interrupts. All objects have the same structure.
The function of the interrupt limit is only enabled, if the corresponding bit of object 6421 is set.
All values of limit parameters are signed 32. So the user must take care not to exceed the range of the input data objects.

Note especially for limit calculations
For calculation whether an interrupt (PDO transmission) must be generated or not, the analog input data object (6401.xx) is always evaluated as signed value, even if an offset is set to simulate an unsigned value.

Table of Limit Function

Object	Object Name and Function
6424	Analog Input Upper Limit Generate interrupt if input voltage is greater than or equal to Upper Limit (6424)
6425	Analog Input Lower Limit Generate interrupt if input voltage is less than Lower Limit (6425)
6426	Analog Input Interrupt Delta Generate interrupt if input voltage changed by more than Interrupt Delta
6427	Analog Input Negative Delta Generate interrupt if input voltage reduced by more than Negative Delta
6428	Analog Input Positive Delta Generate interrupt if input voltage in-creased by more than Positive Delta

Index	6424/5/6/7/8/9
Name	See table above
Description	-
Data Type	Array

Index	Subindex 0
Name	
Description	Number of mapped objects
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	NO
Value Range	-
Default Value	Number of analog input lines

Index	Subindex 1 to Nr of input lines
Name	See table above
Description	
Data Type	Integer 32
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0

DS401: Analog (PWM) Output Objects

The following objects are describing the functionality of the PWM output lines of the CO4017A.
The PWM generation for output channels OUT0 to OUT7 is done with the analog output objects of the draft standard.
Please note that PWM generation is disabled by default and must be configured by the CANopen master during device start up.

Index 5400 : Output Reset on Error Option

This object selects the function for error handling if a critical error is detected.
If the value is 0, the Outputs objects 6411.xx will keep unchanged. The ports will be set to their error state given in object 6444 as long as the error is active. If error ends, the outputs will return to the state according to the output object 6411h.
If the value is 1, the Outputs error handling depends on the objects 6443h and 6444h and the output object 6411 will be overwritten with the error output state according to objects 6443 and 6444.

Index	5400h
Name	Output Reset on Error Option
Description	-
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	1

Index 5402 : PWM Prescaler

This object prescales the cpu frequency for the resulting PWM frequency.
Base frequency is approx 24 kHz.

Index	5402h
Name	PWM Prescaler
Description	-
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	1 .. 250
Default Value	1

Index 5403 : PWM Multiplier

This object multiplies the PWM base frequency in order to achieve higher PWM output frequencies than 24 kHz.
The multiplier is given as exponent of two, so the factor for the PWM can be set from 1 to 8.

Index	5403h
Name	PWM Multiplier
Description	-
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	0..3 0 : PWM factor = 2^0 = 1 1 : PWM factor = 2^1 = 2 2 : PWM factor = 2^2 = 4 3 : PWM factor = 2^3 = 8
Default Value	0

Please note: Increasing the PWM base frequency decreases the PWM resolution by the same factor.

For example PWM Multiplier is set to
0: PWM factor = 1, PWM resolution = 10 bits
1: PWM factor = 2, PWM resolution = 9 bits
2: PWM factor = 4, PWM resolution = 8 bits
3: PWM factor = 8, PWM resolution = 7 bits

Index 6411 : Write Analog PWM Output

With object 6411, the PWM outputs of the CO4017A can be written. For the PWM generation there is a configuration from the CANmaster needed and also a digital control option implemented. See objects 5100, 5101 and 6200 for more information.

PWM resolution is 10 bit, but in order to keep compatibility to the standard an to other application using higher resolutions, the 10 bit value must be left shifted within the object.
This gives a positive value range from 0 to 7FFFh.

0	Duty cycle is 0 % (output permanently switched off)
4000h	Duty cycle is 50 %
7FFFh	Duty cycle is 100 % (output permanently switched on)

Please note, that Output port bits of the CO4017A device are active low by default.

The mapping of the I/O lines to object 6411 is explained in chapter "Mapping I/O to Object Dictionary"

Index	6411h
Name	Write to digital output
Description	-
Data Type	Array

Index	Subindex 0
Name	
Description	Number of mapped objects
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	NO
Value Range	-
Default Value	Number of digital output bytes

Index	Subindex 1 to Nr of outputs
Name	Write to analog (PWM) output
Description	
Data Type	Integer 16
Access modes	RW
PDO Mapping	YES
Value Range	0 .. 0x7FFF
Default Value	0

Index 6443 : Error Mode Output 16 Bit

This object indicates, whether an output is forced to a predefined value (given in object 6444) in case of a device error.
1 = Output will be forced to the value selected in object 6444
0 = Output will be unchanged even in case of an error condition.

Index	6443h
Name	Error Mode Output 16 Bit
Description	-
Data Type	Array

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Number of analog (PWM) outputs

Index	Subindex 1 to Nr of outputs
Name	Error Mode Output 8 Bit n
Description	
Data Type	Unsigned 8
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0001h (Take error condition from object 6444)

Index 6444 : Error Value Output 32 Bit

This object selects the level the outputs are forced to in case of device error mode if the error mode (object 6443 is enabled)
1 = Output will be forced to active state
0 = Output will be forced to inactive state.
Note: Outputs of CO4017A are active low.

Index	6207h
Name	Error Value Output 32 Bit
Description	-
Data Type	Array

Index	Subindex 0
Name	Nr of Subobjects
Description	
Data Type	Unsigned 8
Access modes	RO
PDO Mapping	No
Value Range	-
Default Value	Number of digital output bytes

Index	Subindex 1 to Nr of outputs
Name	Error Value Output 32 Bit n
Description	
Data Type	Integer 32
Access modes	RW
PDO Mapping	No
Value Range	-
Default Value	0 (Inactive, high level)

Emergency Messages

The CANopen chip supports several emergency messages. For all emergencies the same structure is used:

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

EMY-Code: Emergency-Error-Code according to DS301
1001: Content of Object 1001
Chip-EC: Chip-Error-Code as unsigned 32 value

Chip-Error-Code (hex)	May change		Description
	NMT	I/O	
8000 0000	X	X	CAN bus is bus off
4000 0000			CAN bus in error warning state
2000 0000			Node guarding warning
3000 0000	X	X	Life guarding error
0000 0001	X	X	Output Overload detected
0000 0000			Wake up from Power down

Emergency 2000 0000 (Node guarding warning) must be enabled with object 2103.

If more than one error is active at the same time, the bitmap of the CO4011-Codes for all active errors are combined with a logical or conjunction.

Some of the emergencies may cause a NMT state change and/or may force the output pins to the error state. This behaviour depends on the setting of object 1029.

If there is more than one error active at the same time, the Error Codes for all errors are logical OR combined and transmitted in one emergency message. This guarantees, that the last transmitted emergency message represents the complete system error state.

The ID for emergency transmission is fixed to:
0x80 + $NodeID.

List of emergency messages:

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

This warning occurs, if the masters fails to transmit the guarding remote frame within the specified Guard Time object 100C and if transmission is enabled in object 2103

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

This error occurs, if the masters fails to transmit the guarding remote frame within the specified Life Time (Guard Time object 100C multiplied with Life Time Factor object 100D)

Output Overload Error							
10	23	01	00	01	00	00	00

This error occurs, if the output overload interrupt input pin (EMY# pin 44) is active low.

CAN Bus in Error Warning state							
00	81	01	00	00	00	00	40

This error occurs, if the chips internal CAN module is in error warning state.

Return from CAN Bus OFF							
40	81	01	00	00	00	00	C0

This message indicates a return from Bus OFF state.

Mapping I/O to Object Dictionary

The mapping of the I/O channels depends on the setting of configuration bits CFG0 to CFG3.
All possible configurations are shown in individual tables. Select the table for your application according to I/O requirements.

Summary of operation modes

The following table shows a summary of possible operation modes.

CFG Pins	I/O Configuration	
	Mode	Description
3 2 1 0		
1 1 1 1	0	16 input lines (0 .. 5V) IN0 .. IN11 : channels 0 .. 11 IO7 .. IO4 work as IN12 .. IN15 IO7 → IN12 : channel 12 IO6 → IN13 : channel 13 IO5 → IN14 : channel 14 IO4 → IN15 : channel 15 16 output lines (active LOW) OUT0 .. OUT : channels 0 .. 11 IO0 .. IO3 work as OUT12 .. OUT15 IO0 → OUT12 : channel 12 IO1 → OUT13 : channel 13 IO2 → OUT14 : channel 14 IO3 → OUT15 : channel 15
0 1 1 1	8	equal mode 0 16 input lines (0 .. 5V) 16 output lines (active HIGH)
x x x x		Reserved *1)

*1) These modes are reserved for future use and must not be set. Selecting the reserved modes may cause improper operation of the device.

The selected operation mode may be read via object 2101h from the object dictionary.

Note:
Setting of configuration must be fixed. The CO4017A scans the setting of CFG0 to CFG3 only during reset. Changing of configuration on the fly is not allowed and may cause improper operation of the device.
Note that configuration pins are input during reset but may be switched to output during operation. See Pin Description for additional information.

CFG Mode 0 & Mode 8 : 16 in / 16 out

Operation mode 0 & mode 8 CFG3 = 1 & 0 CFG 2 = 1 CFG1 = 1 CFG0 = 1 EDS-file: CO4017A0.EDS								
Data Mapping to Dictionary								
Index. SubIndex	Mapped I/O Signal bit/value							
	7	6	5	4	3	2	1	0
6000.01	IN7 to IN0							
6000.02	IO4 to IO7				IN11 to IN8			
6200.01	OUT7 to OUT0							
6200.02	IO3 to IO0				OUT11 to 8			
6401.01	IN0							
6401.02	IN1							
6401.03	IN2							
6401.04	IN3							
6401.05	IN4							
6401.06	IN5							
6401.07	IN6							
6401.08	IN7							
6411.xx	Selected with object 5100							

Default PDO Mapping	
PDO	Mapped Data
RPDO1	6200.01 digital output OUT0 to 7 6200.02 digital output OUT8 to 15
RPDO2	6411.01 analog PWM output 0 6411.02 analog PWM output 1 6411.03 analog PWM output 2 6411.04 analog PWM output 3
RPDO3	6411.05 analog PWM output 4 6411.06 analog PWM output 5 6411.07 analog PWM output 6 6411.08 analog PWM output 7
TPDO1	6000.01 digital input IN0 to IN7 6000.02 digital input IN8 to IN15
TPDO2	6401.01 analog input 0 6401.02 analog input 1 6401.03 analog input 2 6401.04 analog input 3
TPDO2	6401.05 analog input 4 6401.06 analog input 5 6401.07 analog input 6 6401.08 analog input 7

Analog Input Voltage range : 0V .. AVREF			
Vin	Obj-Value	Vin	Obj-Value
0V	0	AVREF/2	0x4000
AVREF	0x7FFF		

Analog Output PWM range : 0x0000 .. 0x7FFF			
Vin	Obj-Value	Vin	Obj-Value
0V	0	AVREF/2	0x4000
AVREF	0x7FFF		

Absolute Maximum Ratings

Stresses greater than those listed parameters may cause permanent damage to the device. Functional operation should be restricted to recommended operation conditions. Exposure to absolute maximum rating conditions for extended times may affect reliability.

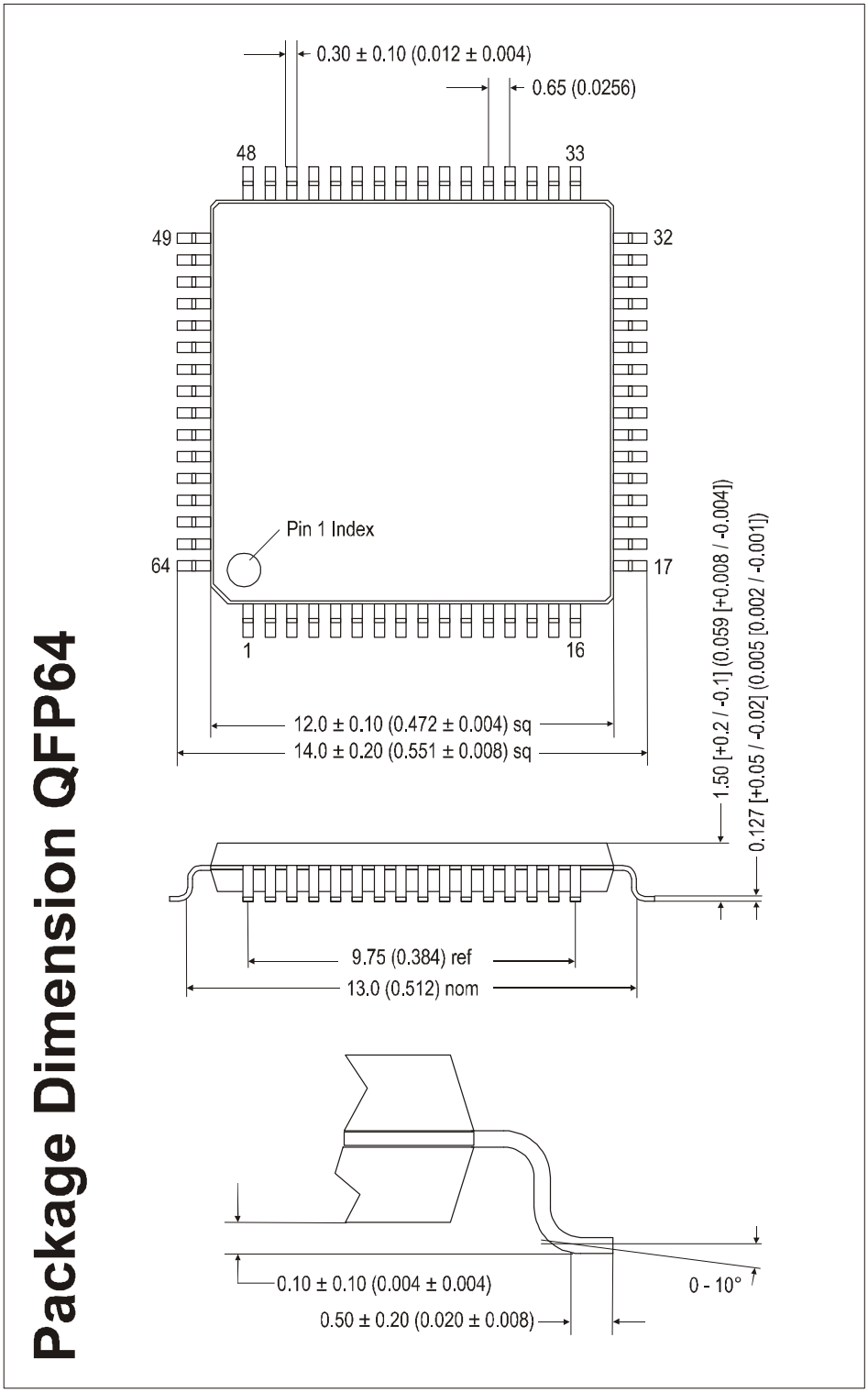
Parameter	Symbol	Rated Value		Units	Remarks
		Min.	Max.		
Power supply voltage	VCC	VSS – 0.3	VSS + 6.0	V	
Analog power supply voltage	AVCC	VSS – 0.3	VCC	V	
Analog reference voltage	AVREF	VSS – 0.3	VCC	V	
Input voltage	Vi	VSS – 0.3	VSS + 6.0	V	Vi < VCC + 0.3V
Output voltage	Vo	VSS – 0.3	VSS + 6.0	V	Vo < VCC + 0.3V
L level maximum output current	I_{OLMAX}		15	mA	Time < 20 msec
L level maximum output current	I_{OL}		4	mA	
H level maximum output current	I_{OHMAX}		15	mA	Time < 20 msec
H level maximum output current	I_{OH}		4	mA	
Maximum Power dissipation	P_{MAX}		300	mW	
Operating temperature	T_A	-40	+105	°C	CO4017A
Storing temperature	T_A	-55	+150	°C	

Recommended Operation Conditions and Characteristics

Functional operation should be restricted to recommended operation conditions.

Parameter	Symbol	Rated Value			Units	Remarks
		Min.	Typ.	Max.		
Power supply voltage	VCC	3.0	3.3 / 5.0	5.5	V	
Analog power supply voltage	AVCC		VCC	VCC	V	
Analog reference voltage	AVREF	3.0		VCC	V	
Power supply current	I_{CC}		35	50	mA	All inputs V_{IL} or V_{IH} All outputs open
Input H voltage	V_{IH}	0.8 * VCC		VCC + 0.3	V	
Input L voltage	V_{IL}	VSS – 0.3		0.2 * VCC	V	
Output H voltage	V_{OH}	VCC – 0.5			V	I_{OH} = -4.0 mA
Output L voltage	V_{OL}			0.4	V	I_{OL} = 4.0 mA
Input leakage current	I_{LKC}	-5		5	uA	
Crystal frequency	f_{osc}		4		MHz	
Reset pulse width	t_{res}	10			us	
Power on rise time	t_{RESLH}	0.05		30	ms	
Maximum CANopen Delay input pin to bus telegram	t_{DITB}	0.05	0.5	2	ms	No additional bus distribution delay
Maximum CANopen Delay bus telegram to output pin	t_{DBTO}	0.05	0.5	2	ms	
Watchdog trigger periode	T_{WDT}	0		10	ms	Delayed max. 500 ms after reset
Maximum Power dissipation	P_{MAX}			300	mW	
Operating temperature	T_A	-40		+105	°C	CO4017A

Package Dimension CO4017A



Typical Application: EVA board for CO4017A

Version History and Notes

The following table shows all relevant changes of the CO4017A. during product life time.

Version	Date	Changes
1.500	Dec/08/2009	First version
1.520	Jan/25/2010	New configuration mode with inverted output polarity
1.540	Feb/12/2010	New object 5002 to enable/disable internal pull up resistor at input pins
1.710	Dec/07/2011	BugFix : LED2 is working now BugFix : ID6 pin is working now
1.720	Dec/12/2011	BugFix : Recover from Bus Off error using object 2180 is working now
1.820	Oct/29/2015	New object 5403
1.820	Sep/20/2017	Added information on pull-up resistors

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