CO4013-EVA

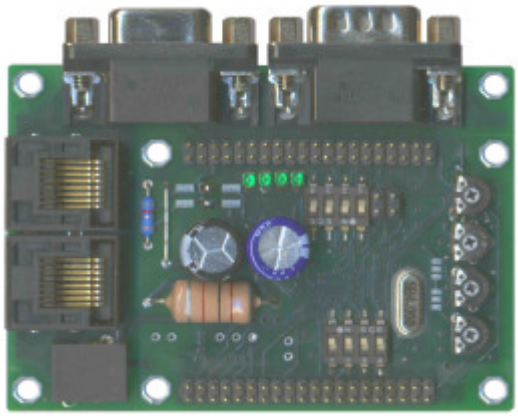
Evaluation Board For CANopen Joystick Controller CO4013

General Description

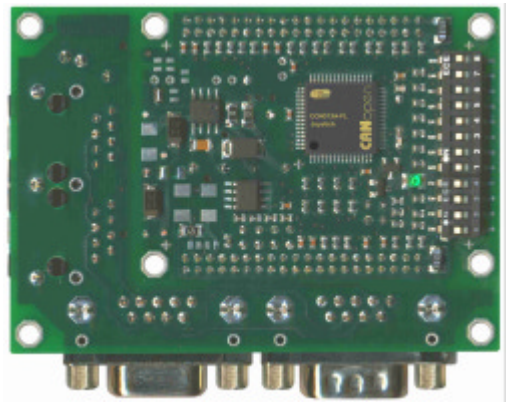
The CO4013EVA is an evaluation board for the high performance single chip controller CO4013A for CANopen Joysticks. It was designed to enable easy startup with this chip.

All I/O signals of the CO4013 and the CAN bus are wired to plugs. This enables direct connection to the Joystick hardware. Additionally the outputs of the CO4013 are indicated by LEDs.

All configuration pins (CAN-ID, Baud rate, operation mode and disable of axis) are wired to DIP-Switches.



Top View



Bottom View

Features

- **Evaluation Board for Single Chip CANopen Controller CO4013 for Joystick applications**
- **According to CiA Draft Standards DS301 Version 4.0 and DS401 Version 2.0 Appendix A**
- **Baud rate up to 1MBit**
- **Connectors for all inputs and outputs**
- **Connectors for CANopen SUB-D9 mail and SUB-D9 female**
- **Connectors for CAN-EASY (2 x RJ45)**
- **Additional LEDs for output lines**
- **Potentiometers for simulation of 4 analog Joystick axis**
- **DIP switches for: operation mode, baud rate, CAN bus termination, disable of axis**
- **CAN Transceiver 80C251**
- **On board power supply 10V..35V DC**
- **128 x 87 mm size**
- **Watchdog output**

CANopen Features

- **2 Transmit- and 1 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.**
- **Node guarding, Life guarding, Heartbeat**
- **Variable SYNC identifier**
- **Emergency messages**
- **Minimum boot up**

Ordering Information

CO4013 Chip (programmed, licence included)

Part	Temp. Range	Package
CO4013A-FL	-40 °C to 85 °C	QFP64
CO4013AE-FL	-40 °C to 105 °C	QFP64

Software licence

Part	Description
CO4013SRL-F	Software runtime licence for Fujitsu MB90F497 controller

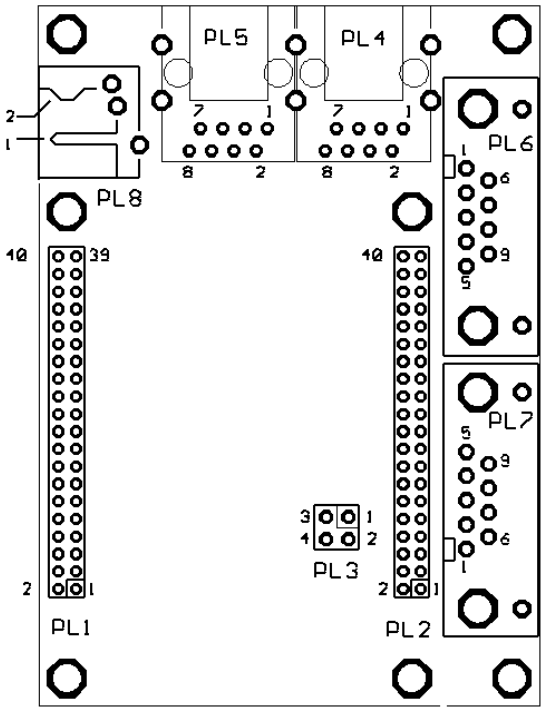
Boards with CO4013 (licence included)

Part	Description
CO4013-EVA	Evaluation board
JOBO4013A	Full feature 4 Axis Joystick board for application
JOBO4013AO	Full feature 4 Axis Joystick board With opto isolated power supply
JOBO4013AE	Full feature 4 Axis Joystick board With extended temperature range (-40°C to 100°C)

Customer specific versions are available on request.

Connectors

The Connectors PL1 and PL2 are also Jumpers for using the board without external hardware (without external Joysticks actors / sensors)



Firmware-Update-Connector (PL3)

Pin No.	Pin Name	Funktion
1	VCC	5V power supply output
2	RX	Receiver input of asynchronous interface
3	TX	Transmitter output of asynchronous interface
4	GND	Common ground

RJ45-CANeasy-Connector (PL4, PL5)

Pin No.	Pin Name	Funktion
4	CANL	L-Line of ISO 11898 CAN-Bus
5	CANH	H-Line of ISO 11898 CAN-Bus
3, 7	GND	Common ground
1, 2, 6, 8	NC	Not Connected

RJ45-CANeasy-Connector (PL6, PL7)

Pin No.	Pin Name	Funktion
2	CANL	L-Line of ISO 11898 CAN-Bus
7	CANH	H-Line of ISO 11898 CAN-Bus
3, 6,	GND	Common ground
1, 4, 5, 7, 8, 9		1:1 Pin to Pin connection of PL6 ←→ PL7
housing	GND	Common ground

Application-Connector (PL1)

Pin No.	Pin Name	Funktion
1, 3, 5, 7, 9, 11, 13, 15	IN0 .. IN7	General purpose digital input
2, 4, 6, 8, 10, 12, 14, 16, 20, 22, 24, 32, 34, 36	GND	Common ground
26, 38	VCC	5V power supply output
28, 40	U0	U0 signal output fixed VCC/2
17,25	Z-IN	Analog Input for axe Z (Wiper of axis poti)
19	Z-POSITIVE	Positive direction input of axis Z or general purpose input
21	Z- NEGATIVE	Positive direction input of axis Z or general purpose input
23	Z-MEM	Axis Z memory input or general purpose digital input
27	Z-0POS	Analog Zero-Position Input for axis Z (Middle of axis poti)
29, 37	W-IN	Analog Input for axe W (Wiper of axis poti)
31	W-POSITIVE	Positive direction input of axis W or general purpose input
33	W-NEGATIVE	Positive direction input of axis W or general purpose input
35	W-MEM	Axis W memory input or general purpose digital input
39	W-0POS	Analog Zero-Position Input for axis W (Middle of axis poti)

Application-Connector (PL2)

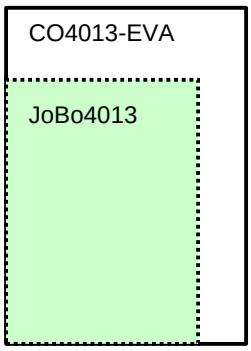
Pin No.	Pin Name	Funktion
1, 3, 5, 13, 15, 17, 35, 37	GND	Common ground
7, 19, 25, 27, 29, 31	VCC	5V power supply output
2	X-POSITIVE	Positive direction input of axis X or general purpose input
4	X- NEGATIVE	Positive direction input of axis X or general purpose input
6	X-MEM	Axis X memory input or general purpose digital input
8, 12	X-IN	Analog Input for axe X (Wiper of axis poti)
10	X-0POS	Analog Zero-Position Input for axis X (Middle of axis poti)
14	Y-POSITIVE	Positive direction input of axis Y or general purpose input
16	Y- NEGATIVE	Positive direction input of axis Y or general purpose input
18	Y-MEM	Axis Y memory input or general purpose digital input
20, 24	Y-IN	Analog Input for axe Y (Wiper of axis poti)
22	Y-0POS	Analog Zero-Position Input for axis Y (Middle of axis poti)
26, 28, 30, 32	L0 .. L3	LED – Outputs (Ri = 1kOhm included)
36	CANH	H-Line of ISO 11898 CAN-Bus
38	CANL	L-Line of ISO 11898 CAN-Bus
39	PGND	Power-In (-)
40	PVCC	Power-In (+)

Power-Input-Connector (PL8)

Pin No.	Pin Name	Funktion
1	PVCC	Power-In (+)
2	PGND	Power-In (-)

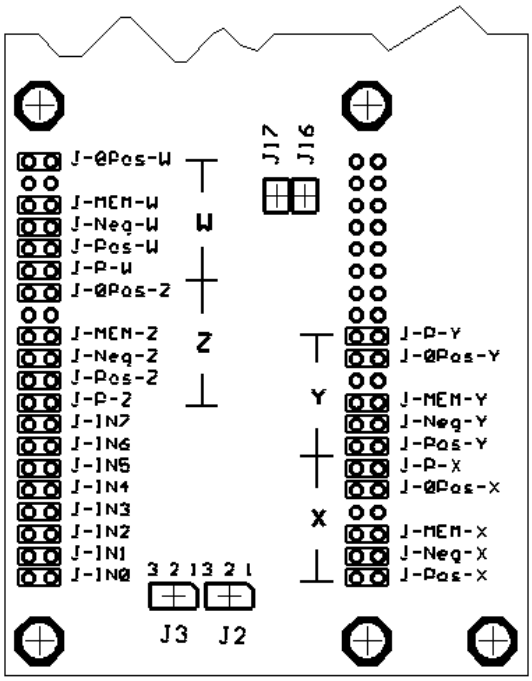
Joystick Board Information

The JoBo4011 board is identical with the left bottom aria of the evaluation board. This is also an available product from frenzel + berg elektronik. There are only a few differences in components and placement. (See data sheet JoBo4013 for details)



Jumper Settings

For joystick hardware simulation, you can use Jumpers on PL1 and PL2 as shown in the following figure. But note, there are any constellations witch might cause short circuits between VCC and GND. So look first for the Jumper and DIP-Switch descriptions for correct usage.

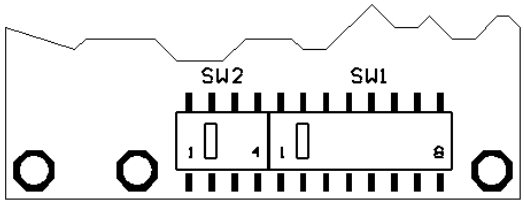


Jumper Settings

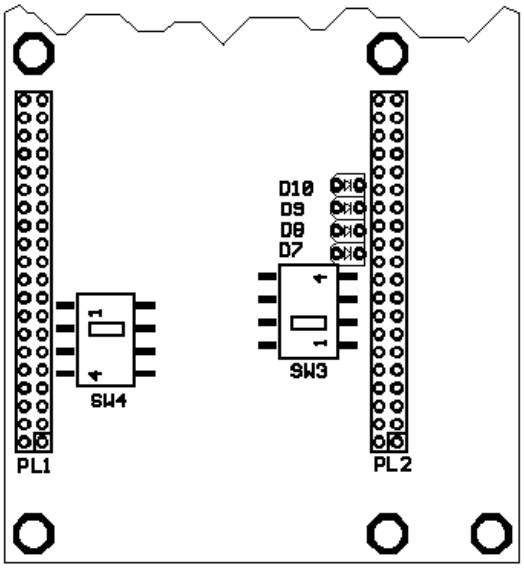
Each Jumper might be replaced by switch or bush button to enable the same feature if the board is not only used for evaluation but will be directly connected to joystick hardware.

Jumper	*Pos.*	*Function*
J1	-	Only factory setting allowed. J1 is on the bottom side and was correctly set from the factory. Do never change this setting.
J2, J3	1-2	Normal operation mode (factory default setting)
	2-3	Firmware update mode
J-IN…	open	General purpose input not active (low active)
	close	Input activated
J-P-…	open	The corresponding on board potentiometer for this axis simulation not connected
	close	On board potentiometer for axis simulation is connected to the position input *(Note: A short circuit is possible if the corresponding switch of SW4 is on. Make sure, that the switch is off before setting this jumper or before connecting an external potentiometer)*
J-Pos-…	close	Positive direction input not active (low active)
	close	Input activated
J-Neg-…	open	Negative direction input not active (low active)
	close	Input activated
J-Mem-…	open	Memory function input not active (low active)
	close	Input activated
J-0Pos-…	open	Simulates a broken cable of the axis potentiometer
	close	Simulates the midpoint tap of the corresponding axis potentiometer

DIP-Switch-Overview



Bottom View



Top View

DIP-Switch SW1

DIP	***Name***	***Funktion***
1..7	ID0..ID6	Bit 0 .. Bit 6 of CAN Identifier
8	LEDON	If ON, the on board LED's are activated. Off for using external LED

DIP switch SW1							
Switch No. and CO4013 Pin							Function
7 ID6	6 ID5	5 ID4	4 ID3	3 ID2	2 ID1	1 ID0	
X	X	X	X	X	X	X	Node ID
OFF	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	reserved
OFF	**OFF**	**OFF**	**OFF**	**OFF**	**OFF**	**ON**	Node ID = 1
OFF	**OFF**	**OFF**	**OFF**	**OFF**	**ON**	**OFF**	Node ID = 2
..	..	..	..	..	..	..	
ON	**ON**	**ON**	**ON**	**ON**	**ON**	**OFF**	Node ID = 126
ON	**ON**	**ON**	**ON**	**ON**	**ON**	**ON**	Node ID = 127

DIP-Switch SW2

DIP	***Name***	***Funktion***
1	R	ON = CAN-Termination resistor = 120 Ohm OFF = No Termination
2..4	BD0..BD2	Bit 0 .. Bit 2 CAN baud rate

DIP switch SW2				
Switch Nr and CO4013 Pin				Function
1	2	3	4	
	BD0	BD1	BD2	
	X	X	X	Baud rate selection
	OFF	**OFF**	**OFF**	1 Mbit / sec
	ON	**OFF**	**OFF**	800 kbit / sec
	OFF	**ON**	**OFF**	500 kbit / sec
	ON	**ON**	**OFF**	250 kbit / sec
	OFF	**OFF**	**ON**	125 kbit / sec
	ON	**OFF**	**ON**	50 kbit / sec
	OFF	**ON**	**ON**	20 kbit / sec
	ON	**ON**	**ON**	10 kbit / sec
R				Bus-Termination
ON				Termination 120 Ohm
OFF				No termination

DIP-Switch SW3

DIP	***Name***	***Funktion***
1..4	CF0..CF3	Bit 0 .. Bit 3 CAN baud rate

Switch No. and CO4013 Pin				Mode	Description
4	3	2	1		
CF3	CF2	CF1	CF0		
OFF	OFF	OFF	OFF	0	Memory function with push button internal analog value freeze
OFF	OFF	OFF	ON	1	Memory function with push button no internal analog value freeze
OFF	OFF	ON	OFF	2	Memory function with switches internal analog value freeze
OFF	OFF	ON	ON	3	Memory function with switches no internal analog value freeze
OFF	ON	OFF	OFF	4	No memory function
OFF	ON	OFF	ON	5	reserved *1)
OFF	ON	ON	OFF	6	reserved *1)
OFF	ON	ON	ON	7	reserved *1)
0	x	X	X		reserved *1)

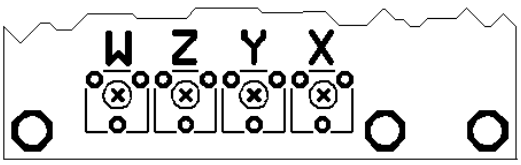
DIP-Switch SW4

Note: A short circuit is possible if the corresponding Jumper J-P-… is closed or an external potentiometer is connected while the switch was turned on. To disable an axis without malfunction make sure, that the J-P-… is open and no external potentiometer is connect to this channel before.

DIP	*Name*	*Funktion*
1	DW	ON = axis W disabled
2	DW	ON = axis Z,W disabled
3	DW	ON = axis Y,Z,W disabled
4	DW	ON = axis X .. W disabled

Note: The enabled axis must be in an ascending order. Do not disable an axis, if you want to use another axis with higher number. Disabling of an axis will cause disable of all axis with higher numbers automatically. (X=1, Y=2, Z=3, W=4)
For example, if you disable axis 3 (pin Z-IN is connected to pin CFG0/LED), axis 4 (W-IN) will be disabled by default.

On Board Axis Potentiometer



With the on board axis potentiometer the Joystick position can be simulated.

Mapping I/O to Object Dictionary

I/O-Mapping in Mode 0

Memory Push Button with internal freeze

Operation mode 0 CF 3 = 1 CF 2 = 1 CF1 = 1 CF0 = 1 EDS-file: CO4013A0.EDS Memory function available (internal) with push button with internal analog value freeze (analog axis value Object 6401 will not change if memory flip-flop is set) 16 direction- and general purpose digital input lines 4 diagnostic LED output lines for freezing feature								
Data Mapping to Dictionary								
Index. SubIndex	Mapped I/O Signal bit/value							
	7	6	5	4	3	2	1	0
6000.01 MEMORY- Input Or -Flip-Flop	0	0	0	0	W -MEM (Flip-Flop)	Z	Y	X
6000.02 Direction-Input	W-N	W-P	Z-N	Z-P	Y-N	Y-P	X-N	X-P
	P POSITIVE input N NEGATIVE input (inverted input polarity)							
6000.03 General-Purpose Input	IN7 .. IN0							
6401.01	X-Axis proportional value (16 bit)							
6401.02	Y-Axis proportional value (16 bit)							
6401.03	Z-Axis proportional value (16 bit)							
6401.04	W-Axis proportional value (16 bit)							

Default PDO Mapping	
PDO	Mapped Data
RPDO1	Not implemented
TPDO1	6000.01 Memory Input 6000.02 Direction Input 6000.03 General-Purpose Input
TPDO2	6401.01 X-Axis proportional value 6401.02 Y-Axis proportional value 6401.03 Z-Axis proportional value 6401.04 W-Axis proportional value

I/O-Mapping in Mode 1

Memory Push Button no internal freeze

Operation mode 1 CF 3 = 1 CF 2 = 1 CF1 = 1 CF0 = 0 EDS-file: CO4013A1.EDS Memory function available (by application) with push button no internal analog value freeze (change of analog axis value will change Object 0x6401) 16 direction- and general purpose digital input lines 4 diagnostic LED output lines for freezing feature								
Data Mapping to Dictionary								
Index. SubIndex	Mapped I/O Signal bit/value							
	7	6	5	4	3	2	1	0
6000.01 MEMORY- Input Or -Flip-Flop	0	0	0	0	W -MEM (Flip-Flop)	Z	Y	X
6000.02 Direction-Input	W-N	W-P	Z-N	Z-P	Y-N	Y-P	X-N	X-P
	P POSITIVE input N NEGATIVE input (inverted input polarity)							
6000.03 General- Purpose Input	IN7 .. IN0							
6401.01	X-Axis proportional value (16 bit)							
6401.02	Y-Axis proportional value (16 bit)							
6401.03	Z-Axis proportional value (16 bit)							
6401.04	W-Axis proportional value (16 bit)							

Default PDO Mapping	
PDO	Mapped Data
RPDO1	Not implemented
TPDO1	6000.01 Memory Input 6000.02 Direction Input 6000.03 General-Purpose Input
TPDO2	6401.01 X-Axis proportional value 6401.02 Y-Axis proportional value 6401.03 Z-Axis proportional value 6401.04 W-Axis proportional value

I/O-Mapping in Mode 2

Memory Switch with internal freeze

Operation mode 2 CF 3 = 1 CF 2 = 1 CF1 = 0 CF0 = 1 EDS-file: CO4013A2.EDS Memory function available (internal) with switch with internal analog value freeze (analog axis value Object 6401 will not change if memory flip-flop is set) 16 direction- and general purpose digital input lines 4 general purpose output lines								
Data Mapping to Dictionary								
Index. SubIndex	Mapped I/O Signal bit/value							
	7	6	5	4	3	2	1	0
6000.01 MEMORY- Input Or -Flip-Flop	0	0	0	0	W -MEM (Flip-Flop)	Z	Y	X
6000.02 Direction-Input	W-N	W-P	Z-N	Z-P	Y-N	Y-P	X-N	X-P
	P POSITIVE input N NEGATIVE input (inverted input polarity)							
6000.03 General- Purpose Input	IN7 .. IN0							
6200.01 General- Purpose Output	-	-	-	-	OUT3 .. OUT0			
6401.01	X-Axis proportional value (16 bit)							
6401.02	Y-Axis proportional value (16 bit)							
6401.03	Z-Axis proportional value (16 bit)							
6401.04	W-Axis proportional value (16 bit)							

Default PDO Mapping	
PDO	Mapped Data
RPDO1	6200.01 General-Purpose Output
TPDO1	6000.01 Memory Input 6000.02 Direction Input 6000.03 General-Purpose Input
TPDO2	6401.01 X-Axis proportional value 6401.02 Y-Axis proportional value 6401.03 Z-Axis proportional value 6401.04 W-Axis proportional value

I/O-Mapping in Mode 3

Memory Switch no internal freeze

Operation mode 3 CF 3 = 1 CF 2 = 1 CF1 = 0 CF0 = 0 EDS-file: CO4013A3.EDS Memory function available (by application) with switch no internal analog value freeze (change of analog axis value will change Object 0x6401) 16 direction- and general purpose digital input lines 4 general purpose output lines								
Data Mapping to Dictionary								
Index. SubIndex	Mapped I/O Signal bit/value							
	7	6	5	4	3	2	1	0
6000.01 MEMORY- Input Or -Flip-Flop	0	0	0	0	W -MEM (Flip-Flop)	Z	Y	X
6000.02 Direction-Input	W-N	W-P	Z-N	Z-P	Y-N	Y-P	X-N	X-P
	P POSITIVE input N NEGATIVE input (inverted input polarity)							
6000.03 General- Purpose Input	IN7 .. IN0							
6200.01 General- Purpose Output	-	-	-	-	OUT3 .. OUT0			
6401.01	X-Axis proportional value (16 bit)							
6401.02	Y-Axis proportional value (16 bit)							
6401.03	Z-Axis proportional value (16 bit)							
6401.04	W-Axis proportional value (16 bit)							

Default PDO Mapping	
PDO	Mapped Data
RPDO1	6200.01 General-Purpose Output
TPDO1	6000.01 Memory Input 6000.02 Direction Input 6000.03 General-Purpose Input
TPDO2	6401.01 X-Axis proportional value 6401.02 Y-Axis proportional value 6401.03 Z-Axis proportional value 6401.04 W-Axis proportional value

I/O-Mapping in Mode 4

No Memory function

Operation mode 4 CF 3 = 1 CF 2 = 0 CF1 = 1 CF0 = 1 EDS-file: CO4013A4.EDS No Memory function 20 direction- and general purpose digital input lines 4 general purpose output lines								
Data Mapping to Dictionary								
Index. SubIndex	Mapped I/O Signal bit/value							
	7	6	5	4	3	2	1	0
6000.01 MEMORY- Input Or -Flip-Flop	0	0	0	0	0	0	0	0
	All Memory flags forced to 0							
6000.02 Direction-Input	W-N	W-P	Z-N	Z-P	Y-N	Y-P	X-N	X-P
	P POSITIVE input N NEGATIVE input *1)							
6000.03 General- Purpose Input	IN7 .. IN0 *1)							
6000.04 General- Purpose Input	0	0	0	0	IN11 .. IN8 *1)			
6200.01 General- Purpose Output	-	-	-	-	OUT3 .. OUT0 *1)			
6401.01	X-Axis proportional value (16 bit)							
6401.02	Y-Axis proportional value (16 bit)							
6401.03	Z-Axis proportional value (16 bit)							
6401.04	W-Axis proportional value (16 bit)							

Default PDO Mapping	
PDO	Mapped Data
RPDO1	6200.01 General-Purpose Output
TPDO1	6000.01 Memory Input (forced to 0) 6000.02 Direction Input 6000.03 General-Purpose Input 6000.04 General-Purpose Input
TPDO2	6401.01 X-Axis proportional value 6401.02 Y-Axis proportional value 6401.03 Z-Axis proportional value 6401.04 W-Axis proportional value

*1) Note: The CO4013 has inverted input/output pin polarity.

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.

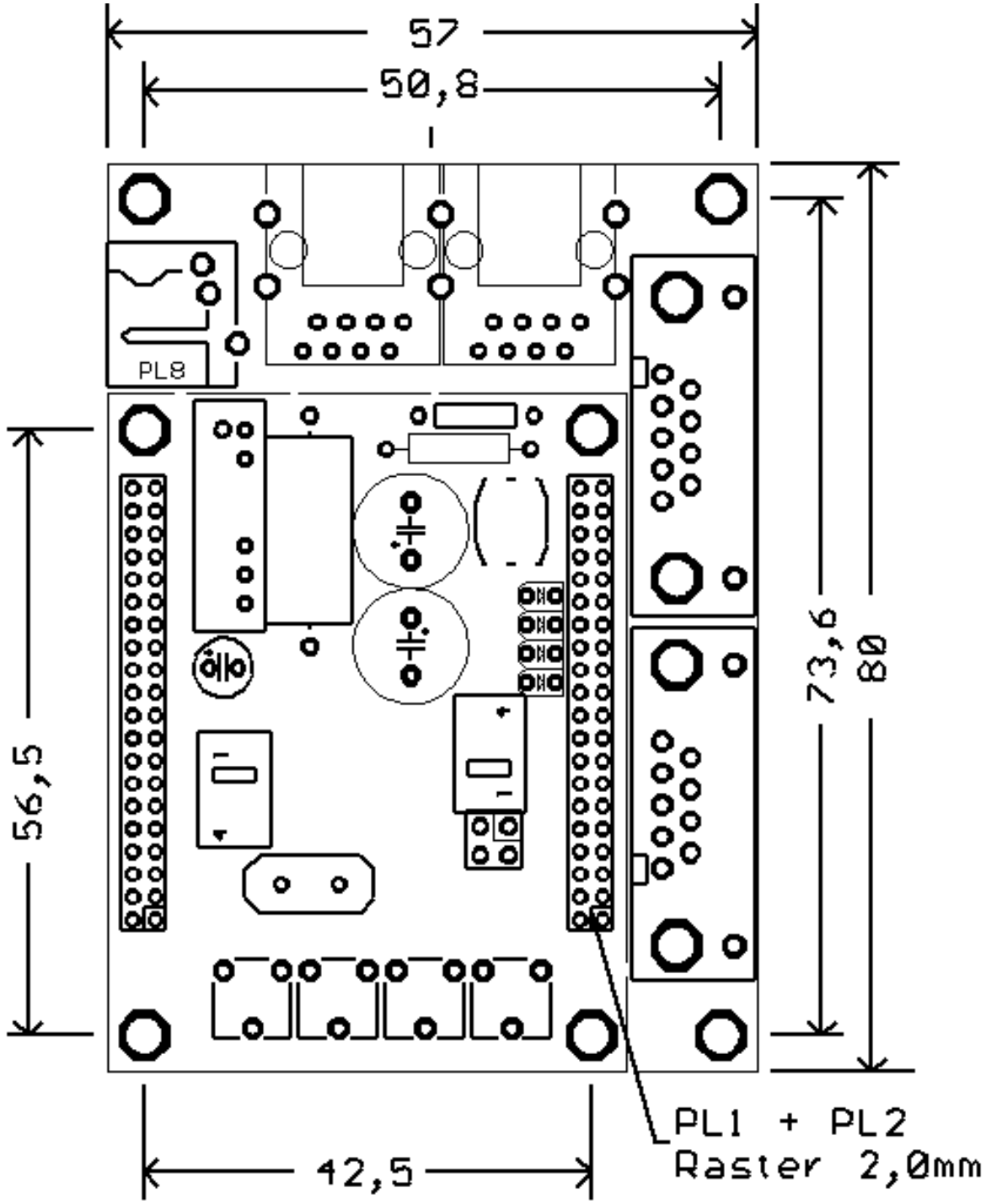
Parameter	Symbol	Rated Value		Units	Remarks
		Min.	Max.		
Power supply voltage	PVCC	0	36	V	
Analog power supply voltage	AVCC	0	VCC	V	VCC = +5V DC
Analog reference voltage	AVREF	0	VCC	V	
Input voltage	Vi	– 0.3	+ 6.0	V	Vi < VCC + 0.3V
Output voltage	Vo	– 0.3	+ 6.0	V	Vo < VCC + 0.3V
L level maximum output 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}		500	mW	
Operating temperature	T_A	0	+70	^oC	CO4013A
Storing temperature	T_A	-55	+150	^oC	

Operation Conditions / Characteristics

Functional operation should be restricted to recommended operation conditions.

Parameter	Symbol	Rated Value			Units	Remarks
		Min.	Typ.	Max.		
Power supply voltage	PVCC	10		35	V	
Analog power supply voltage	AVCC		VCC	VCC	V	VCC = +5.0
Analog reference voltage	AVREF		VCC	VCC	V	VCC = +5.0
Power supply current	I_{CC}			300	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	VSS = 0,VCC = +5.0
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	1	2	ms	No additional bus distribution delay
Maximum CANopen Delay bus telegram to output pin	t_{DBTO}	0.05	1	2	ms	
Watchdog trigger frequency	f_{WDT}	0.5	1	2	kHz	Delayed max. 500 ms after reset
Maximum Power dissipation	P_{MAX}			300	mW	
Operating temperature	T_A	0		+70	^oC	CO4013A

Package Dimension CO4013A



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Schematics