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ICC-4C-2000 Industrial Current Controller - 4 Channels

- Graphic user interface *Optotune Cockpit* for control via USB or Ethernet
- Communication interfaces:
  - USB, UART, I2C
  - Ethernet with PoE capability
  - Analog input (0 - 10V)
  - General purpose I/O, alternative usage as SPI
  - 2x SYNC signal
  - 5 x Status LEDs (R/G)
- Software SDKs for Python and C# available.
- RoHS, REACH and CE certified

Mechanical specifications

Dimensions (L x W x H)	164 x 105 x 44	mm
Weight	700	g
USB connector	Micro B, USB 2.0	
Accepted DC Barrel Plug	2.1 I.D. x 5.5 O.D. x 10.0	mm
Output connector	Standard rectangular header, 100” (2.54mm) pitch	34 pins
I/O connector	Standard rectangular header, 100” (2.54mm) pitch	20 pins
Mounting	T-slots for standard M4 nut	

Electrical specifications

Supply voltage range	24 to 48	VDC
PoE specification	PoE+ 803.3at	
Total power consumption (max)	25 (with factory presets)	W

Thermal specifications

Storage temperature	-40 to +85	°C
Operating temperature	0 to 40	°C

Driver outputs

Maximum current (4Ch., simultaneously)	±2000	mA
Minimum current step	0.25	mA
Resolution	14	bits
Output voltage limit (configurable)	6 – 18 (factory default = 10)	V
Output stage topology	Full bridge, filtered PWM (load not grounded)	
Digital communication	Dedicated I2C bus for each channel, 400kHz max.	
I2C logic level (pull-ups implemented)	3.3	V
Power for I2C (each channel separately)	3.3	V
Power for logics, max. current	4 x typ. 100 (each channel overcurrent protected)	mA
Status LED (main + each channel)	Red, Green, Orange LED	

Driver inputs

Analog inputs level (4 channels)	0-10	V
Analog input resolution (each channel)	16	Bits
Analog input BW	40	kHz
Digital inputs	4x GPIO (configurable as SPI), I2C, UART, SYNC_A, SYNC_B, MCU RESET	
Digital inputs logic level	3.3 (**NOT** 5 V tolerant)	V

Standard products

ICC-4C-2000	Controller only
ICC-4C-2000 Extension Kit	• Extension (adapter) board for XPRs (LSR-30) • 15 cm extension cable for adapter board • DIN Rail clamp kit
ICC-4C Power Adapter	Power Adapter, please specify type (EU, CH, US, UK, CN)

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1. Description and Features

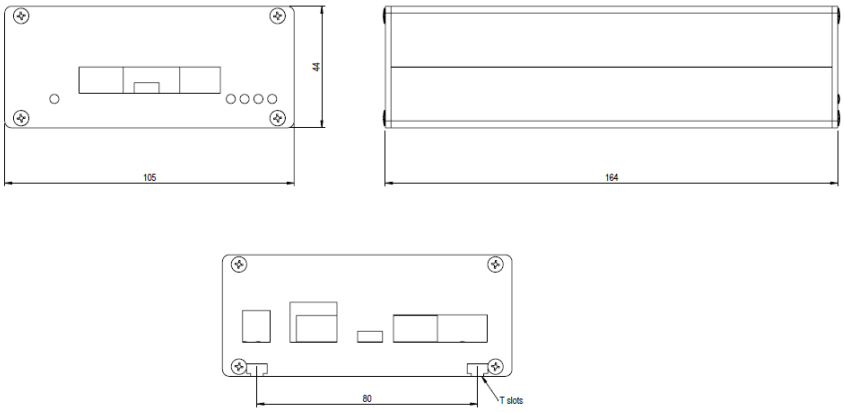


Figure 1: Mechanical layout of ICC-4C-2000

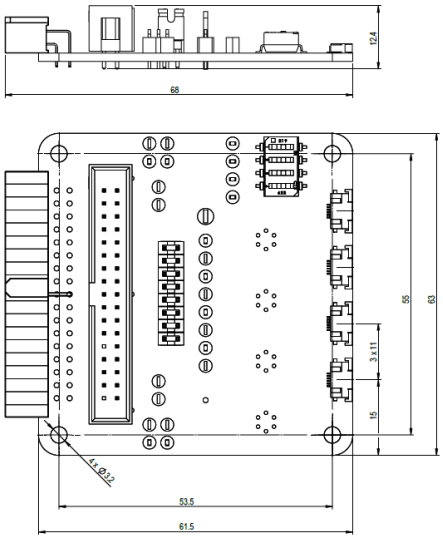
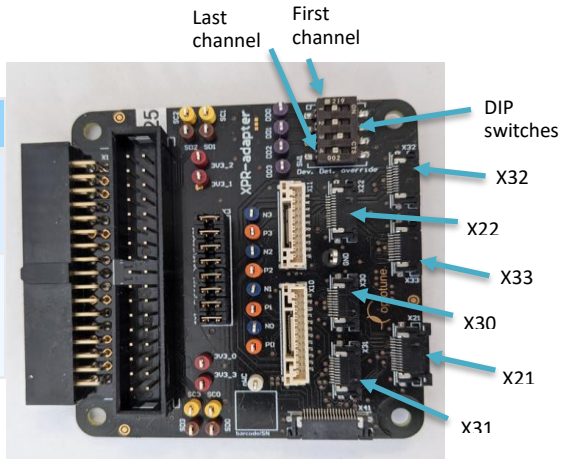


Figure 2: Adapter Board

Connector	X21	X22	X30	X31	X32	X33
Compatible Devices	XPR-20 XPR-33 LSR-30	XPR-20 XPR-33 LSR-30	XPR-9	XPR-9	XPR-9	XPR-9
Current Channels	0 & 1	2 & 3	0	1	2	3

Caution: Do not use same current channels for more than one device.



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1.1 Input/Output connector pinout

Figure 3: Wurth Electronics[1] header 100 mil 90deg

Pin	Signal	Value	Function
1	AnalogIn2	0..10 V	Analog input signal #2
2	AnalogIn3	0..10 V	Analog input signal #3
3	AnalogIn0	0..10 V	Analog input signal #0
4	AnalogIn1	0..10 V	Analog input signal #1
5	nRESET	0..3.3V (CMOS level)	Driver reset signal (inverted level)
6	AGND	-	Analog signal ground
7	USART_EXT_TX	0..3.3V (CMOS level)	UART transmit line
8	SYNC_B	0..3.3V (CMOS level)	Synchronization input B
9	USART_EXT_RX	0..3.3V (CMOS level)	UART receive line
10	SYNC_A	0..3.3V (CMOS level)	Synchronization input A
11	GND	-	Digital ground
12	GPIO3_SPI_MOSI	0..3.3V (CMOS level)	General purpose digital IO #3 or SPI MOSI signal (Trigger OUT/IN)
13	I2C_HOST_SDA	0..3.3V (CMOS level)	I2C data line from host
14	GPIO2_SPI_MISO	0..3.3V (CMOS level)	General purpose digital IO #2 or SPI MISO signal (Trigger OUT/IN)
15	I2C_HOST_SCL	0..3.3V (CMOS level)	I2C clock line from host
16	GPIO1_SPI_NSS	0..3.3V (CMOS level)	General purpose digital IO #1 or SPI SlaveSelect signal (Trigger OUT/IN)
17	GND	-	Digital ground
18	GPIO0_SPI_SCK	0..3.3V (CMOS level)	General purpose digital IO #0 or SCK signal (Trigger OUT/IN)
19	VCC_EXT_IN	24...48 V	External DC supply voltage positive input
20	GND_EXT_IN	-	External DC supply voltage negative input

2. Hardware operation

2.1 ICC-4C-2000 Main status and Channel Status LEDs

LED	Color	Legend
Main Status	Red	Power on, no connection
	Orange	Operation ok (possible error)
	Green	Operation ok
Channel Status	Red	Device error
	Green	Device detected; operation ok

[1] First samples of the ICC-4C-2000 might have a different connector. Please contact us if the connector doesn't look like in the figure above.

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2.2 Connecting the adaptor board

The adaptor board can be connected directly to the 34-pin output connector or with the extension cable.

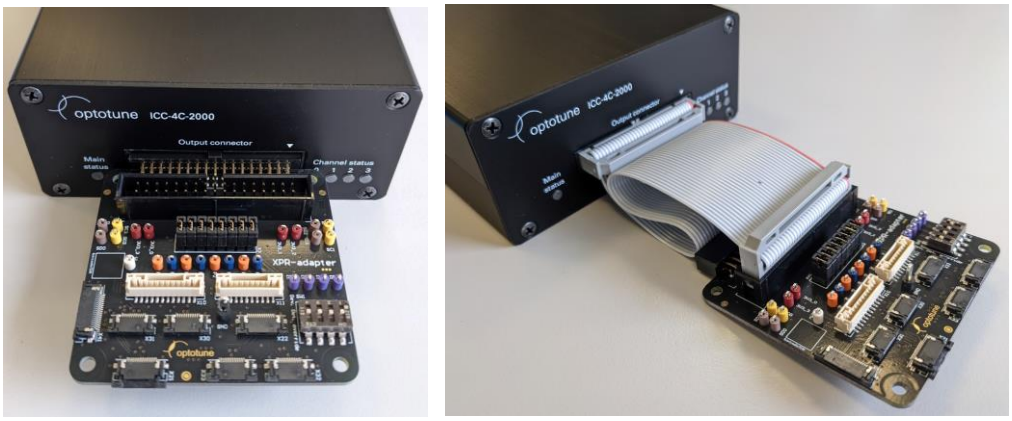

Figure 4: Adaptor board connection options

2.3 Connecting to a device with FPC cable

The Molex flex cable can be plugged directly into the connector of the adaptor board. Open the connector clamp with tweezers. Insert the flex cable fully with the copper pads facing upwards. Close the black clamp. **IMPORTANT**: Do NOT hotplug the flex cable from the adaptor board!

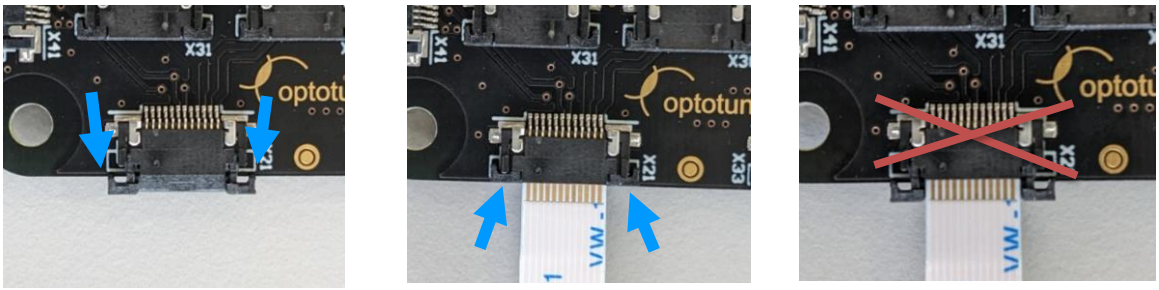

Figure 5: Connection to device with flex cable

3 Input/Output signals

3.1 Output trigger

The signal generator of the ICC-4C outputs a trigger signal from the GPIOx pins (0,1,2,3 depending on the channel) Trigger signal is HIGH (3.3V, max. 5 mA) at phase 0° of the selected waveform and goes LOW in the middle of period. For pulse pattern, it reflects the duty cycle.

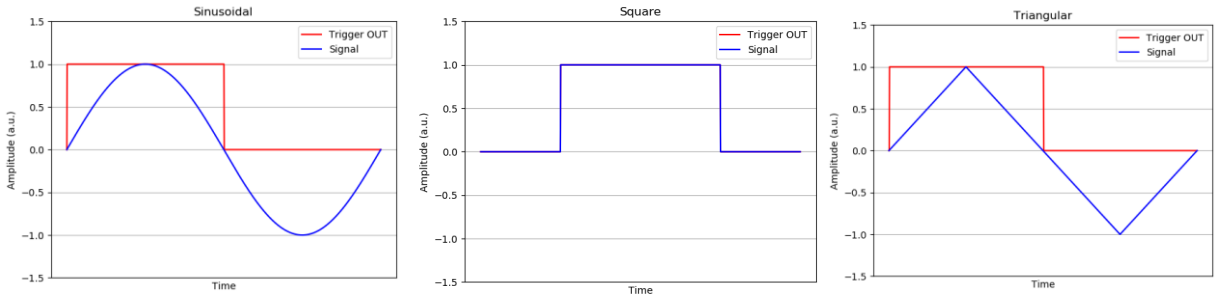

Figure 6: Different waveforms overlapped with the corresponding Trigger OUT signal

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3.2 Input trigger

The signal generator of the ICC-4C can be synchronized with an external input trigger. When the trigger input signal goes HIGH (max 3.3V), the selected waveform starts off at phase 0°. There are two options:

- SYNC_A pin: an input signal to this pin synchronizes all channels simultaneously
- GPIOx: by default, GPIOx pins are programmed to be used as trigger output (see previous paragraph). They can be reprogrammed to be used as trigger input for single channels (0,1,2,3). In this case, trigger input function is overridden by GPIOx and hence any signal on SYNC_A is ignored.

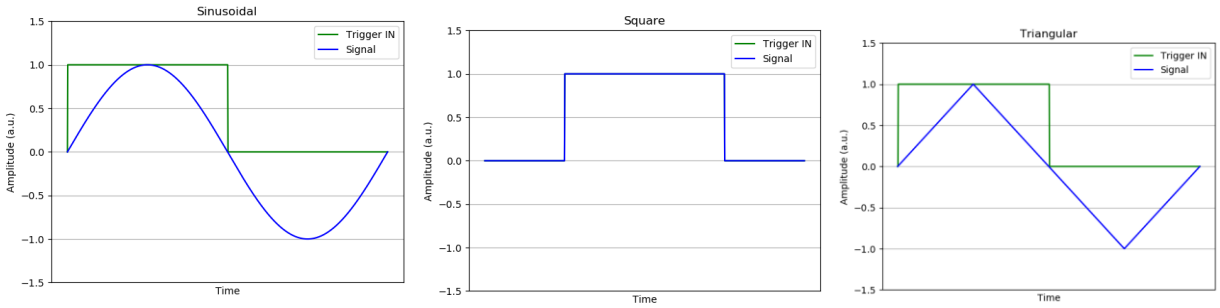

Figure 7: Different waveforms overlapped with an exemplary Trigger IN signal

3.3 Analog Input

Each individual channel of the ICC-4C-2000 can be controlled via a dedicated 0-10 V analog input. The resolution of the ADC is 16 bits. The analog input can me mapped to a certain current range on the corresponding channel. Always respect the RMS and peak current limitations of the attached device.
For additional information on how to setup the analog mapping, please refer to the Optotune Cockpit software manual.

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4 Simple mode communication

Simple mode communication is RS-232 based serial communication interface that can be used to communicate to the device via a Serial Terminal (e.g. *Termite*, *Putty.* Baudrate: 256000, Parity: N, Stop bits: 1, Data bits: 8) or via *Telnet Client* (on Windows OS), if Ethernet communication is used. It employs a set of ASCII characters commands and answers to interact with ICC-4C driver features. Commands and answers are terminated by character sequence CR, LF (resp. 0x0D, 0x0A). The protocol is not case sensitive and white spaces are ignored.

General simple answer is a response of ICC-4C to commands in simple communication mode.

Simple communication mode reply	Description
OK[CR][LF]	Command accepted and performed without limits.
NO[CR][LF]	Command not accepted, for any reason.
OL[CR][LF]	Command not accepted, because parameter reached lower limit.
OU[CR][LF]	Command not accepted, because parameter reached upper limit.
ERROR[CR][LF]	Command not available.

Further, simple mode answers are described within the specific command description.

Simple mode command	Description
START[CR][LF]	Driver answers “OK” if driver is ready to use and device is detected. Otherwise “ERROR” is received.
STATUS[CR][LF]	Driver answers with status encoded within 4Bytes information Example: “0x00015000[CR][LF]”. See next section for further description of the status bytes.
RESET[CR][LF]	Restarts driver’s firmware. Note: no answer is sent via serial line
GOPRO[CR][LF]	Starts binary protocol-based mode of serial communication. Serial message CRC is not checked.
GOPROCRC[CR][LF]	Starts binary protocol-based mode of serial communication. Serial message CRC is checked.
GETID[CR][LF]	Answers with firmware serial number. Example: “14352500-00-A[CR][LF]”.
GETVERSION[CR][LF]	Answers with firmware version number. Example: “1.0.740706[CR][LF]”.
GETGITSHA1	Answers with 40 bytes hexadecimal GIT build identification. Example : “eb8115e6b04814f0c37146bbe3dbc35f3e8992e0[CR][LF]”
GETSN[CR][LF]	Answers with board and device serial number. Example: “Board: CDAA0057, Device: ANAA722[CR][LF]”.
GETDEVICESN[CR][LF]	Answers with serial number of a device connected depending on active channel. Example: “Device: ANAA722[CR][LF]”
DETECTDEVICE[CR][LF]	Runs device autodetection on active channel. When detection is successful, answers with device name. Example: “XPR[CR][LF]”
SETCHANNEL=%int[CR][LF]	Set active channel. Channel index of ICC-4C is 0-3. Command is used as predecessor of other commands applying on active channel of ICC-4C driver.
GETCHANNEL[CR][LF]	Get active channel returns an integral number of active/selected channel, 0-3 for ICC-4C driver. Example: “2[CR][LF]”
SETCURRENT=%float[CR][LF]	Set current value for active channel. Command supports decimal parameter value in mA units. Current value is limited either by power capabilities of ICC driver itself or connected device.
GETCURRENT[CR][LF]	Answers with value of active channel current setpoint. Returned value is decimal number in units of milliamperes, Example: “15.6[CR][LF]”
GETTEMP[CR][LF]	Answers with actual temperature of device connected to active channel. Returned temperature is a decimal value in units of degrees of Celsius. Example : ”27.54[CR][LF]”.
SETTEMPLIM=%f[CR][LF]	Set operational temperature limit for selected channel in degrees of Celsius

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4.1 Driver status (refers to “STATUS” command)

The driver “error status” is a 32 bits information about driver itself or a device connected to a certain channel.

The “error status” might have active state, when error status is present or inactive, when error status was present, but currently is inactive.

Byte	Status bit	Driver status
0	0	Fault on channel 0 – active
	1	Fault on channel 0 – inactive
	2	Fault on channel 1 – active
	3	Fault on channel 1 – inactive
	4	Fault on channel 2 – active
	5	Fault on channel 2 – inactive
	6	Fault on channel 3 – active
	7	Fault on channel 3 – inactive
1	0	Driver overheat status – active
	1	Driver overheat status – inactive
	2	Channel 0: device not detected – active
	3	Channel 0: device not detected – inactive
	4	Channel 1: device not detected – active
	5	Channel 1: device not detected – inactive
	6	Channel 2: device not detected – active
	7	Channel 2: device not detected – inactive
2	0	Channel 3: device not detected – active
	1	Channel 3: device not detected – inactive
	2	Channel 0: Device supply 3.3V power overcurrent – active
	3	Channel 0: Device supply 3.3V power overcurrent – inactive
	4	Channel 1: Device supply 3.3V power overcurrent – active
	5	Channel 1: Device supply 3.3V power overcurrent – inactive
	6	Channel 2: Device supply 3.3V power overcurrent – active
	7	Channel 2: Device supply 3.3V power overcurrent – inactive
3	0	Channel 3: Device supply 3.3V power overcurrent – active
	1	Channel 3: Device supply 3.3V power overcurrent – inactive
	2	I2C communication error – active
	3	I2C communication error – inactive
	4	EEPROM reading error -active
	5	EEPROM reading error – inactive
	6	Hall sensor out of range – active
	7	Hall sensor out of range - inactive

5 Binary communication protocol

The documentation for the binary communication protocol (pro mode) with additional functionalities is available on request.

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