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shaping the future of optics

ECC-1C embedded lens controller

Optotune's ECC-1C allows to control liquid lenses directly from camera or embedded systems, thus offering a compact and convenient solution for fast integration.

Main features:

- Connects directly to cameras and embedded systems
- Current control from -300 to +300 mA in 80uA steps
- Communication interfaces:
  - UART and I2C (autodetect)
  - Analog input (0 - 10V)
  - GPIO trigger
- Read-out of calibration data & temperature for compensation ("Focal Power Mode")
- Graphic user interface *Optotune Cockpit* for control via UART, USB to UART cable available.
- Software SDKs for Python and C# available
- RoHS, REACH and CE certified

Mechanical specifications

Dimensions (L x W x H)	27 x 20 x 5	mm
Weight	5	g
Connector	Hirose HR10G-7R-6SB(73)	

Electrical specifications

Supply Voltage Range	5 / 9-24 Two input voltage ranges (no operating window in between)	VDC
Nominal control current [1]	-300 to 300	mA
Current step	80	uA
Current Repeatability	+/- 1	mA
Max power consumption (5V / 9-24V)	1.5 / 2.5	W
Analog inputs level	0-10	V
Analog input resolution	12	Bits
Analog input impedance	>70	KΩ
Digital inputs / output	GPIO,UART, I2C	
GPIO logic level	3.3	V

[1] Input voltages and thermal limitations apply see Figure 4

Thermal specifications

Operating temperature	0 to 65	°C
Storage temperature	-40 to 85	°C

Interface options

The ECC-1C is best controlled using the digital interfaces UART or I2C. The respective communication protocol is detected automatically. While both protocols offer a pro-mode with register-based command structure, the UART protocol offers also a simple mode based on ASCII text commands. Furthermore, it is also possible to pre-configure a look-up table, which allows for analog 0-10V control, or vector-based waveforms, which can be triggered via the GPIO pin.

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Ordering information

The ECC-1C can be part of Optotune's EL-16-40 lenses or ELMs (electrical lens modules) or ordered separately. Currently two cable options are provided.

Part number	Description
150-347-00	Hirose adapter kit with ECC-1C
150-349-00	USB to UART cable, Hirose connector, 1m
152-219-00	CAB-6-100-M-OE (Hirose to open-ended wire cable, 1m)
149-740-01	EL-16-40-TC-VIS-5D-C-E (Typical EL-16-40 lens with ECC-1C integrated)

Mechanical layout

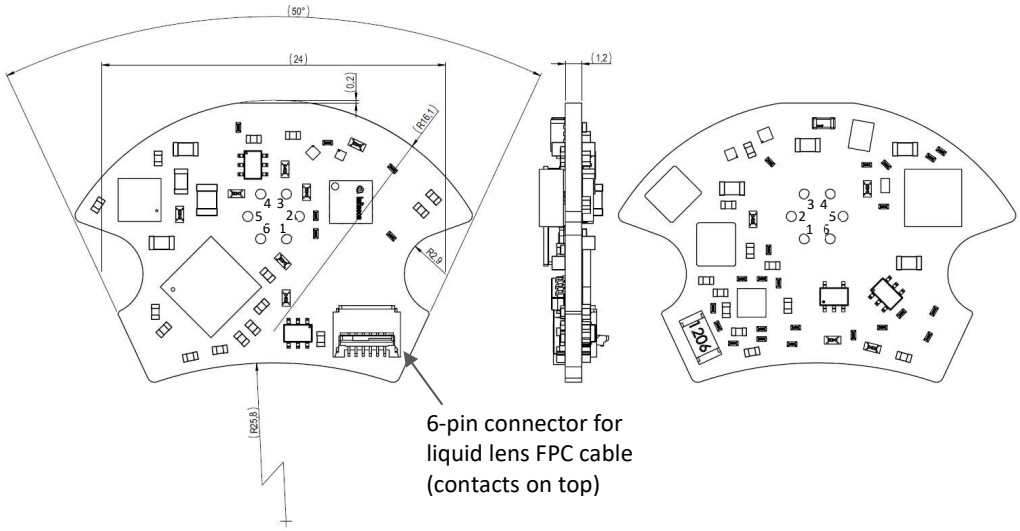

Figure 1: Mechanical drawing of ECC-1C PCB

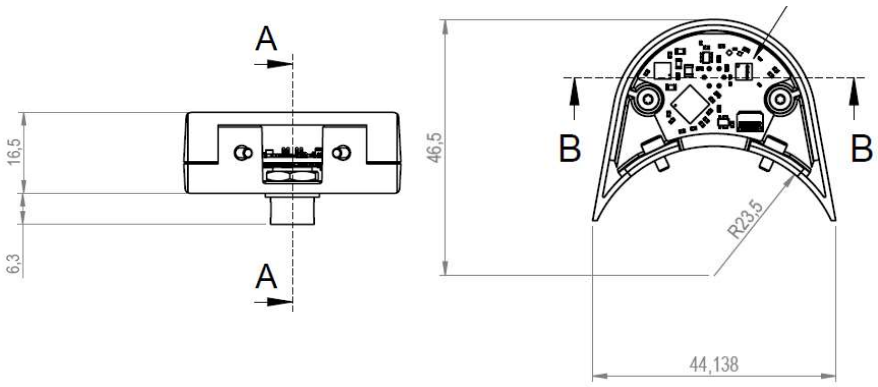

Figure 2: Mechanical drawing of ECC-1C adaptor

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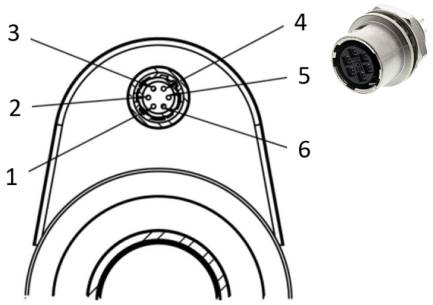
Electrical connection

The electrical connection of the ECC-1C consists of Hirose a female Hirose connector (HR10G-7R-6SB) mounted on the thermoplastic controller housing:



Pin out Hirose connector HR10G-7R-6SB(73)		
Position	**Function**	**Value**
1	GPIO Trigger	3V3 logic
2	Analog In	0-10V
3	UART Tx / I²C SCL	3V3 logic
4	UART Rx / I²C SDA	3V3 logic
5	GND	-
6	VCC input	See electrical specifications on page 1

Figure 3: Electrical connections of ECC-1C featuring (female) Hirose connector

Available drive current vs. temperature

The guaranteed drive current with EL-16-40 available from ECC-1C depends on the voltage supply and ambient temperature as detailed in the graph below (Figure 4):

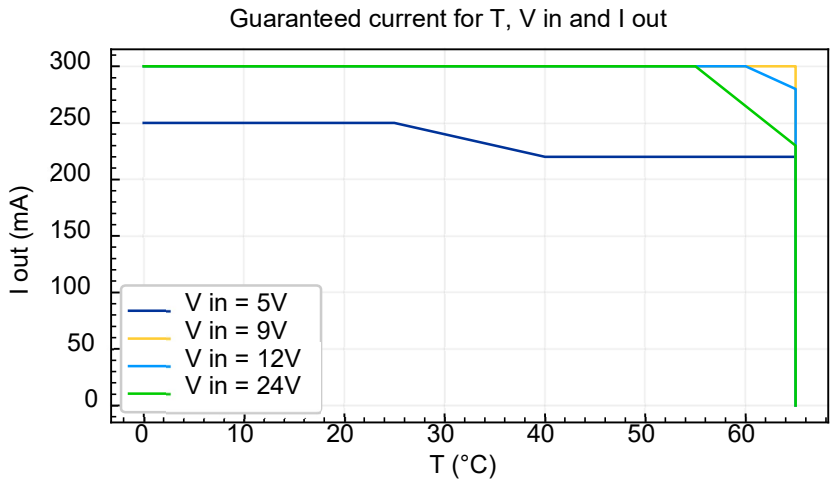


Figure 4: Guaranteed drive current (with specified repeatability of +/- 1 mA) available from ECC-1C

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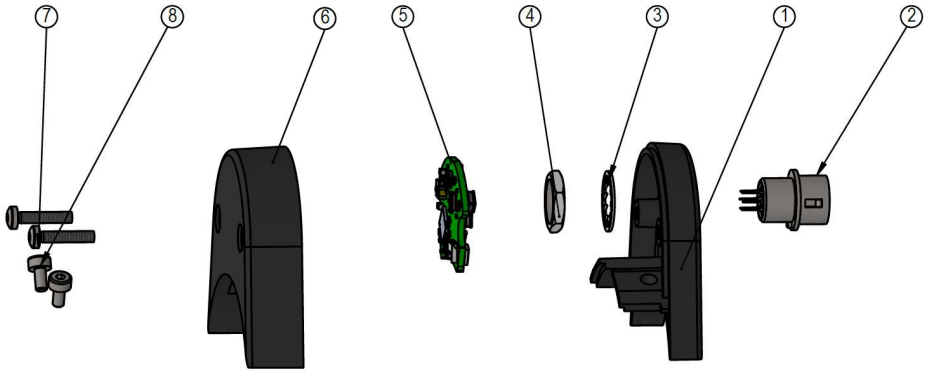
ECC-1C adapter kit (P/N 150-347-00)

This adapter kit allows for addition of ECC-1C to EL-16-40-threaded lenses and many ELMs (electrical lens modules. The kit consists of:



Position	Quantity	Part number	Description
1	1	134-606-00	Housing bottom
2	1	132-281-01	HR10G-7R-6SB(73) connector
3	1	132-281-02	HR10G-7R-6P washer
4	1	132-281-03	HR10G-7R-6P nut
5	1	146-399-00	ECC-1C PCBA
6	1	134-607-00	Housing top
7	2	134-658-00	Screw, K20x10 BN20138
8	2	134-657-00	Screw, M2x4, DIN912 BN610

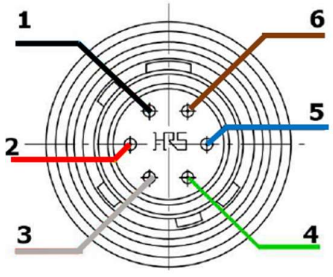
(items 1-5 are provided pre-assembled, the rest in plastic zip bags)

Cable accessories

Optotune provides two cabling options for the ECC-1C:

1. 150-349-00: USB to UART cable, Hirose connectors, 1m. Contains USB type-A integrated UART converter (Silicon Labs CP2102)
2. 152-219-00: CAB-6-100-M-OE (Hirose to open-ended wire cable, 1m)

Pin	Cable Color	Function
1	Black/thin	GPIO trigger
2	Red/thin	Analog In
3	Grey/thin	Tx/SCL
4	Green/thin	Rx/SDA
5	Blue/thick	GND
6	Brown/thick	VCC



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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). It employs a set of ASCII characters commands and answers to interact with ECC-1C. Commands and replies are terminated by character sequence CR, LF (resp. 0x0D, 0x0A). The protocol is not case sensitive and white spaces are ignored.

Simple mode command	Description
START[CR][LF]	Controller answers “OK” if controller is ready to use and device is detected. Otherwise “ERROR” is received.
STATUS[CR][LF]	Controller 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 controller’s firmware. Note: no answer is sent via serial line
GOTODFU[CR][LF]	Starts controller’s loader for firmware update. 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: ANAA1234[CR][LF]”.
GETDEVICESN[CR][LF]	Answers with serial number of a device connected. Example: “Device: ANAA1234[CR][LF]”
SETCURRENT=%float[CR][LF]	Set current value. Command supports decimal parameter value in mA units. Current value is limited either by power capabilities of ECC-1C controller itself or connected device.
GETCURRENT[CR][LF]	Answers with value of active current. Returned value is decimal number in units of milliamperes, Example: “15.6[CR][LF]”
SETFP=%float[CR][LF]	Sets focal power. Command supports decimal parameter value in units of diopters. Focal power is limited to detected lens device capability.
GETFP[CR][LF]	Answers with focal power. Returned focal power is a decimal number in diopters. If no lens is detected, it returns “NO”.
GETFPMIN[CR][LF]	Answers with focal power lower limit of lens device connected. Returned focal power is decimal value in diopters. If no lens is detected, it returns “NO”.
GETFPMAX[CR][LF]	Answers with focal power upper limit of lens device connected. Returned focal power is a decimal value in diopters. If no lens is detected, it returns “NO”.
GETTEMP[CR][LF]	Answers with actual temperature of device connected. Returned temperature is a decimal value in units of degree Celsius. Example : ”27.54[CR][LF]”.
SETTEMPLIM=%f[CR][LF]	Set operational temperature limit in degree Celsius

Simple 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.

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Control via analog input

The ECC-1C can be controlled via a dedicated 0-10 V analog input. The resolution of the ADC is 12 bits. The analog input can me mapped to Current or Focal power (if applicable) of the connected lens. Both linear and non-linear mapping are possible.

For additional information on how to setup the analog mapping, please refer to the Optotune Cockpit software manual.

Waveforms with output or input trigger

The ECC-1C has a build in signal generator, which can be configured for different types of waveforms:

- Sine
- Rectangle
- Triangle
- Saw tooth
- Pulse
- Steps
- Any custom vector

By default, the controller outputs a trigger signal on the GPIO pin. 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.

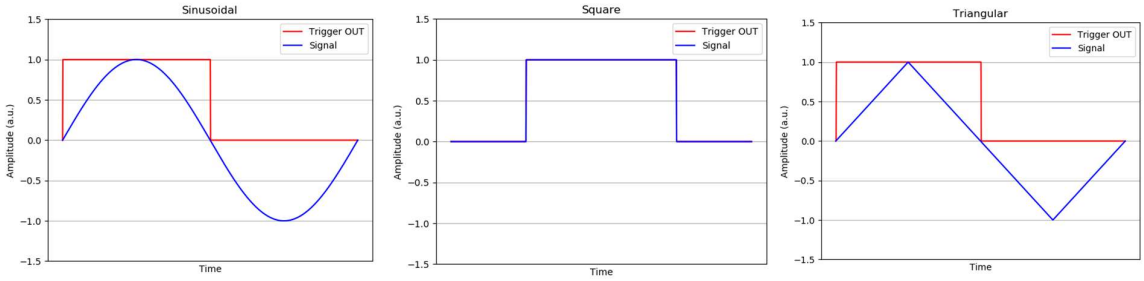

Figure 5: Different waveforms overlapped with the corresponding Trigger OUT signal

The signal generator can also 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°.

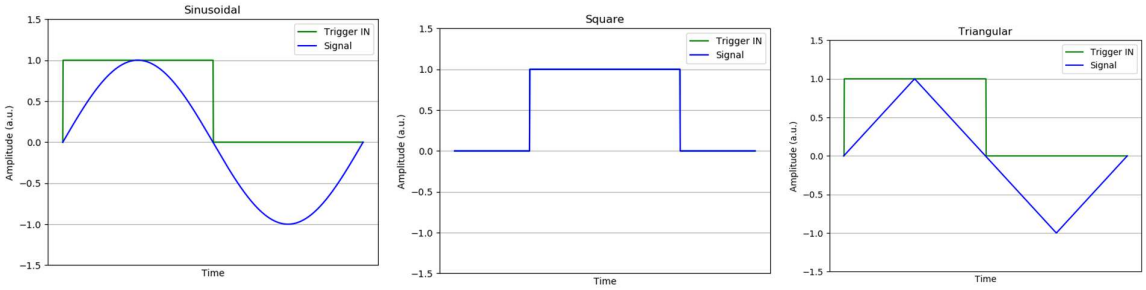

Figure 6: Different waveforms overlapped with an exemplary Trigger IN signal

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Safety and compliance

The product fulfills the RoHS and REACH compliance standards. The customer is solely responsible to comply with all relevant safety regulations for integration and operation.

For more information on optical, mechanical, and electrical parameters, please contact sales@optotune.com

Supporting documentation (available on request)

The following support documentation is available on request:

- Firmware documentation and I2C/UART communication protocol
- ECC-1C Slave I2C communication protocol
- Installation guide for ECC-1C adapter kit

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