

Digital controllable iris- and shutter actuator

Handling and connection tips

1. Pin assignment and interface description

Data communication uses an asynchronous, serial interface, similar to the RS232 standard. In the inactive state, the TXD output is high. Communication is performed by sequences of hexadecimal ASCII-letters “0..9, A..F and some control characters as described in the text below table1”.

The parameters of the serial interface are: 9600 baud; 8 data bits; 1 stop bit; no parity bit. Voltage levels used are in the range **0 volts to 3.3 volts**. The RXD input can accept input voltages up to 5 volts.

The 12 pin LEMO-plug in (FGG.2B.312.CLAD) is configured as indicated by table 1:

Table 1

Pin	Description	Remarks
1	RS-232-DTR	Handshake Signal
2	RS-232-TXD	ser. transmitting data
3	RS-232-RXD	ser. receiving data
4	HWTRIG	shutter open by ext. trigger
5	GND	ground
6	X	flash release signal (shutter opened – short-circuit to XGND)
7	XGND	ground connection for X-signal (potential-free)
8	+5V	voltage supply (power supply)
9	V+ (33...38V)	voltage supply, shutter (power supply)
10	MGND	ground connection for shutter (power supply)
11	GND	ground connection (power supply)
12	GND	ground connection (power supply)

The system will only be ready for iris control, if the signal DTR is 0, and a carriage return linefeed (0x0D 0x0A), a “greater than” sign (>) (0x3E) and a XON (0x11) has been sent by the controller. Otherwise, during DTR = 1, no data can be received by the serial interface! Every command input is confirmed by the command number followed by a colon. Then a XOFF (0x13) will be sent, DTR switches to 1 and the command will be executed. After execution the already mentioned “greater than” sign (>) (0x3E) and a XON (0x11) is send, DTR switches to 0.

For the voltage supply the specially developed power supply, Id.-No.:40292 or Id.-No.:1017971 shall be used.

2. Table of commands

Table 2 shows the command syntax together with a short description of the function:

Table 2

Command	Function
010000	reference drive to greatest mechanical opening
02xx00	positioning of iris, see chapter 3.1
0406x0	programming the product data, see chapter 4
05xxxx	readout of memory, see chapter 5
07xxxx	shutter release, see chapter 3.2
080001	shutter constantly open
080000	shutter close again
0Axxxx	shutter release by external trigger, chapter 3.2 and 3.3
0Bxxxx	shutter opening time, define in ms, chapter 3.2.1 and 3.3

A command is principally composed by 6 hexadecimal ASCII-letters "0...9, A...F", i.e. the command syntax consists **always** by the proper command (see table 2) **and** 4 additional digits (xxxx), which are defined as described later on.

3. Function

After turning on the system the iris control will execute a reference drive up to the mechanical stop which is related to the smallest f-stop number, to find the zero point

The reference drive may also be executed by the command "010000". To save energy, the supply for the stepper motor will be turned off after each setting. By this reason there will be a reference drive before every new iris setting. With this measure the reproducibility of each setting will be guaranteed with high accuracy.

3.1 Iris control

The positioning of the iris to the desired value has to be done by the following command:

"02XX00"

The value of XX is counted hexadecimal according to table 3:

Table 3

Index of iris	XX
1	01
2	02
3	03
4	04
5	05
6	06
7	07
8	08
9	09
10	0A
11	0B
12	0C
13	0D
14	0E
15	0F
16	10
17	11
18	12
19	13
20	14
21	15
22	16
23	17
24	18
25	19
26	1A
27	1B
28	1C
29	1D
30	1E
31	1F
32	20
33	21
34	22
35	23
36	24

Index of iris	XX
37	25
38	26
39	27
40	28
41	29
42	2A
43	2B
44	2C
45	2D
46	2E
47	2F
48	30
49	31
50	32
51	33
52	34
53	35
54	36
55	37
56	38
57	39
58	3A
59	3B
60	3C
61	3D
62	3E
63	3F
64	40
65	41
66	42
67	43
68	44
69	45
70	46
71	47
72	48
73	49
74	4A
75	4B
76	4C
77	4D

The iris index is coupled to a lens-specific f-number, for instance

$$\text{Index } 1 = f/nr. = 2.8$$

$$\text{Index } 77 = f/nr. = 32\text{-}7/10$$

Thus one principally has:

- Index 1 is always the smallest possible f/no. (the greatest possible optical opening),
- Index 77 is the maximum value for the largest f/no. (the smallest possible mechanical opening)

Only the values indicated in table 3 will be accepted. For other values no positioning will be carried out. The 77 values of table 3 are the maximal possible positions. Certain lenses have (by mechanical restrictions) not the full range of iris positions, in that case also fewer values than those indicated in table 3 may be executed. Invalid values will not be executed.

3.2 Shutter control via the serial interface

The following command will execute the different open times for the shutter (including the direct release of the shutter):

Command: "07XX00"

The shutter speed is controlled by an index control. There are 12 different main shutter speeds that reduce or enlarge the shutter speed by a factor of 2. Each one of these 12 steps is subdivided in 10 smaller steps, thus one may control 111 steps in total. The values XX are counted in hex notation and are given in table 4 for the 12 full steps.

Table 4:

Shutter index	Open time [s]	XX
1	1/60	01
11	1/30	0B
21	1/15	15
31	1/8	1F
41	1/4	29
51	1/2	33
61	1	3D
71	2	47
81	4	51
91	8	5B
101	16	65
111	32	6F

These hex-values for the finer steps may be easily calculated: The desired shutter index in decimal notation simply has to be converted in hex-values, some examples see table 5:

Table 5

Open time [s]	Shutter index	XX
1/60 + 1/10 open time step	2	02
1 + 5/10 open time step	66	42
16 + 6/10 open time step	107	6B

3.2.1 Shutter control defined in ms-intervals

Command: "0BXXYY"

The value of XXYY defines the open time in hex-notation. XX is the first and YY the second parameter of the 16 bit (Max) wide time value, i.e. XX and YY are -as always- HEX-values. Via this command the shutter open time may be set between 16 ms (0x0010) and 65,535 ms (0xFFFF). Remark: the shutter time should not be smaller than 16 ms (0x0010), because in that case a secure function may not be guaranteed. As an example the command "0B011A" will be explained:

0B is the command to define the shutter time in ms,

01 means 1 * 256 ms

1A means 26 ms

in all: 282 ms

After giving this command the shutter time is set to 282 ms. With the command "07xxxx" or after the input of "0AxxNN" (xx not equal 00) -this command will be explained in the next section- and after an external trigger signal the shutter will be opened arbitrary times with an open time of 282 ms. Hence with the command „0BXXYY“ the shutter time according to table 4 will be disabled. Remark: the shutter time is now set by the value of XXYY. The command "0B0000" has a particular meaning: since the open time 0 does not exist, this command will switch back into the normal shutter time mode defined by the table 4, i.e. if you want to turn back from the shutter times defined in ms to the values of table 4 you have to send

the command „0B0000“. Also after switching off and on again the Power supply, the mode setting is according to the table.

3.2.2 Permanent opening and closing via ser. command

The command "080001" opens the shutter. So you can see, the change of the iris. To close the shutter again and to set the shutter control to the normal mode, send the command "080000".

3.3 Shutter control via external trigger

The definition of the shutter open time and the "Time Out" procedure after closing the shutter is given by the following command:

Command: "0AXXNN"

The values for XX are given in table 4.

"Time out" is the time the micro controller waits until the control is given back to the normal serial mode.

A new release of the shutter will give the same time out.

The Time Out NN may be varied in steps of 50 ms from 1*50 ms up to 255 (corresponding to 0xFF).

50 ms = 12.75 s. Also here NN must be given in Hex numbers.

Example for the command:

"0A0114"

0A is the command for external trigger

01 Open time of 1/60 s after external trigger

14 is the waiting time for an additional external trigger ("Time Out", which corresponds to 0x14 (20 dec.)*50 ms = 1s.

Hence, also in this case a command consists of 6 hex digits as in section 3.1 and 3.2.

A special case is the input of "NN" = 00. In this case the iris/shutter control waits indefinitely for a new external trigger with the same open time. This means the shutter may be reopened repeatedly without giving an additional command via the serial interface. To exit this mode one has to send 3 times an ESC-sequence.

3.3.1 Permanent opening via external trigger

Permanent opening of the shutter is given by the index "XX" = 00.

Example: The command "0A0014<cr>" will open the shutter starting with the negative slope of "HWTRIG" and the shutter remains open until the signal "HWTRIG" will go high. If the signal "HWTRIG" is already low, the shutter will open after having received the command "0A0014" via the serial interface. If there is no further signal within (in the example within 0x14(20dec)*50ms = 1 s) the time out, the external trigger mode will be finished.

As in section 3.3, the time out duration may be set to infinity by "NN" = 00 (last two digits). To exit this mode one has to send 3 times an ESC-sequence. It is possible to interrupt the shutter opening and to change the iris control. By the command "0A0000" the shutter opening will be reactivated again, if the "HWTRG" remains constant low.

If all the other counters had the value "zero", the above data sequence would have the value $0x040000 + 0x0102$ which is $0x0102$. This corresponds to 262 402 shutter releases. The access number on each block ends with the 262144st access ($0x040000$). After that the counter is set to the next block. Hence a full block always has the value $0x040000$. A total count of 3 670 016 is possible.

All three blocks between $0x720$ and $0x7FF$ can be added but also the value $0x700$, which points to the last used block: $0x00 \rightarrow 0x720$; $0x10 \rightarrow 730$ a. s. o. This byte is an address offset, which saves some transmission time.

4. Principle remarks

During the command execution, i.e. during iris control, shutter control and time out no commands may be received by the serial interface. The system will send an XOFF ($0x13$) to the computer followed by the execution of the command and finally an XON ($0x11$) to indicate readiness for a new command. Every command execution (shutter or time out) may be interrupted by an arbitrary digit. In order to have quicker and more sure synchronization, it is recommended to send 3 ESC-sequences.

5. Plug in power supply Id.-No.:40292, or desk power supply Id.-Nr.:1017971

Input: 110-264 V AC, via EURO plug in, or country-specific power cable
 output power: 0 ... 8 W net

Protection class: II

Output: via 4-pin miniature plug in (Binder 99-0410-00-04), pin assignment according table 7:

Table 7

Pin	Signal
1	MGND
2	V+ (33V)
3	+5V
4	GND

The signal is according table 1.

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