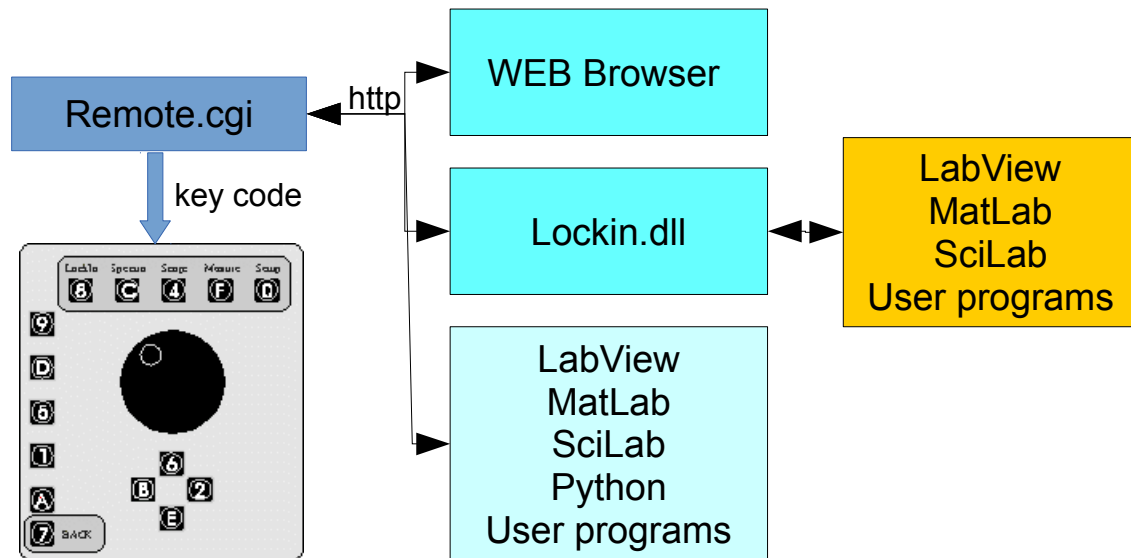


4 REMOTE CONTROL

4.1 ACCESS THROUGH WEB INTERFACE

4.1.1 GENERAL

The communication between the remote computer and the eLockIn is based on TCP (Transmission Control Protocol) and http (Hypertext Transfer Protocol) for transferring HTML files and pictures. Commands are received with the remote.cgi program through an http connection:



Those http commands can be sent through

- a web-browser or
- by any http capable program (LabView, MatLab, ...).

Alternatively, one can use the commands provided by the Lockin.dll library (see chapter Fehler: Referenz nicht gefunden) and the lockin-dll translates them into http commands.

The web server on the eLockIn provides CGI-programs and data files.

Available cgi files are:

- **/cgi-bin/remote.cgi**, which accepts key codes and passes them to the **eLockIn** software by pretending that front panel key are pressed,
- **/cgi-bin/refresh.cgi**, which sends an HTML page containing current channel values

Available data files are:

- **/screen.jpg**, which is an image of the **eLockIn**'s display (see)
- a textfile **/data/lia.dat**, which contains the current values of the channels 1...4.
- a textfile **/setup/lockin.ini**, which contains all settings of the instrument (see chapter 4.1.7)

4.1.1 TECHNICAL REQUIREMENTS

Both the **eLockIn** and the remote computer must be connected to a network. This could be a simple crosslink cable between the two devices, a LAN (Local Area Network) or even the internet.

On start-up, the **eLockIn** will set its IP address to a default value, which can be changed in the **Setup** menu. You have to know this IP address to connect to the **eLockIn**.

4.1.2 AUTHENTICATION

Authentication is required only if the user wants to set parameters on the eLockin.

Before the **eLockIn** can be remote-controlled, the user has to provide a user name and a password. This can either be done by entering the **eLockIn**'s IP address in a web browser and filling in the authorization form, or by calling **/cgi-bin/login.cgi** directly. login.cgi takes a string as argument: ?username=<user>&password=<pass> <user> denotes the user name and <pass> the corresponding password.

Thus, the following http request would authenticate user 'long' by sending his password 'nga':

```
http://192.168.1.7/cgi-bin/login.cgi?username=long
&password=nga
```

4.2 KEY CODES

A program named remote.cgi will be called by the **eLockIn**'s web server when it receives a request for **/cgi-bin/remote.cgi**.

Let's assume a TCP connection has already been established between the remote and the **eLockIn** on port 80 (default for http connections) and the user has identified himself as described in the 'Authentication' section 4.1.2.

If that is the case, commands can be sent to the **eLockIn** device by requesting **/cgi-bin/remote.cgi** via http and passing keys as arguments to it. Those keys are treated the same way as if they were pressed on the **eLockIn** itself. A typical http request would look like the following:

```
http://192.168.1.7/cgi-bin/remote.cgi?S_6_8
```

The request shown above would cause the **eLockIn** to

- dump a screenshot of the display to /screen.jpg ('S'),
- enter the number '6' at the position that is currently focused on the display ('_6_', underscores enclose numbers),
- switch to the **eLockIn** menu ('8').

For a complete list of the commands that can be sent to remote.cgi, see Table 1 or Figure 1. Number to be set in certain sub-menus of the eLockIn have to be placed with two underscores, e.g. "_1063.7_"

All of these key codes (except 'S') correspond to buttons on the front panel of the **eLockIn** (see Figure 1). Therefore the **eLockIn** can be remote-controlled in the same way as if it is operated manually.

<i>Key (char) with remote.cgi</i>	<i>Key (char) with remote2.cgi</i>	<i>ASCII Code</i>	<i>Action</i>
8	A	56	Enter LockIn menu
C	B	67	Enter Spectra menu
4	C	52	Enter Scope menu
F	D	70	Enter Measure menu
0	E	48	Enter Setup menu
9	1	57	These buttons invoke the action displayed next to them on the screen, depending on the current position in the menu tree.
D	2	68	
5	3	53	
1	4	49	
A	5	65	
7	6	55	Go back in menu
+	+	43	Turn Knob Clockwise
-	-	45	Turn Knob Counter Clockwise
S	S	83	Save screenshot

Table 1: Command keys

Specific values can be adjusted either by using buttons (up, down) or by sending numbers to the **eLockIn**. The device accepts numbers wherever the software expects user input. Just like the other commands, numbers need to be passed to '/cgi-bin/remote.cgi', but have to be enclosed by two '_' (underscore).

http://192.168.1.7/cgi-bin/remote2.cgi?A22_100000_8

The command sequence shown above tells the **eLockIn** to

- A ... enter 'LockIn' menu
- 2 ... enter 'Ref' submenu
- 2 ... select the line in which the frequency can be changed
- _100000_ set the frequency to 100000 Hz (which is 100 kHz)
Note: the second "_" after the number is required even if there is no further menu entry.
- 8 ... return to top of the 'LockIn' menu

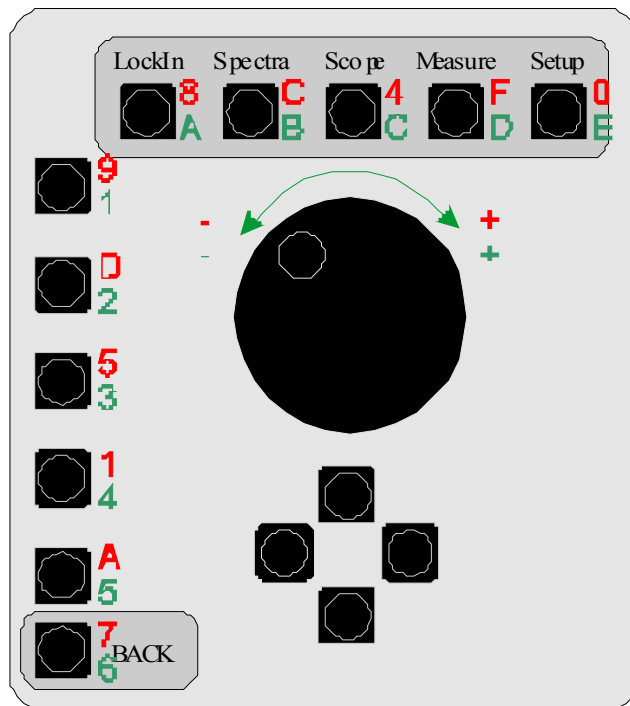


Figure 1: Front Panel knobs and characters/numbers used to address the front panel knobs by Remote Control access with *remote.cgi* and *remote2.cgi*

Other examples are:

Switch the external reference on:

http://192.168.1.7/cgi-bin/remote2.cgi?A25+_

4.1.3 HOW TO SET ANY VALUE IN ANY SUB-MENU

In some sub-menus of the eLockIn series, values are set as numbers (e.g.: frequency is set as number in Hz). In this case, the user needs to set the number itself. In other sub-menus, a limited amount of dedicated values is available, only. The Roll-off, for instance, can be 6 dB/oct, 12 dB/oct or 24 dB/oct -- but never 1 dB/oct. In this case, the user sets the count of the value, which is "0" for 6 dB, "1" for 12 dB and "2" for 24 dB.

The following tables show the counts of the available values (which equals the "number" that one has to send to the eLockIn) and the related entries ("values") shown in the eLockIn's menu tree :

Set Input range

Number XX	Value
1	"low noise"
10	"normal"
100	"high dyn. reserve"

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?899_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A11_XX_

Menu-Entry: **LockIn-Input-Range**

lockin.ini entry: [InputRange](#)

Set Input Coupling Type

Number XX	Value
0	dc coupled
1	ac coupled
2	dc 50 Ohm
3	ac 50 Ohm

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?89D_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A12_XX_

Menu-Entry: **LockIn-Input-Couple**

lockin.ini entry: [InputCouple](#)

Set Input Time Constant

Number	Value
-9	0.1 μ s
...	...
-1	50 μ s
0	0.1 ms
1	0.2 ms
2	0.5 ms
3	1 ms
4	2 ms
5	5 ms
6	10 ms
7	20 ms
8	50 ms
9	100 ms
10	200 ms
11	500 ms
12	1 s
13	2 s
14	5 s
15	10s
16	20s
17	50s
18	100s
19	200s
20	500s
21	1ks

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?8959__XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A131__XX_
for 1st Lockin Amplifier.

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?8955__XX_
for 2nd Lockin Amplifier.

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?8955__-10_
Sets the time constant of 2nd LIA equal to 1st LIA.

Menu-Entry: **LockIn-Input-Time-Tau** and **LockIn-Input-Time-Tau1**
lockin.ini entry: [InputMode](#)

Set Sync Filter Settings

Number XX	Value
0	"Off"
1	1/f
2	2/f
5	5/f
:	:
:	:
200	200/f

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?895D_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A132_XX_

Menu-Entry: **LockIn-Input-Time-Sync**

lockin.ini entry: Sync0 and SyncLoL

These two entries in the lockin.ini file equal each other.

Set Roll-Off

Number XX	Value
6	6dB/oct
12	12dB/oct
24	24dB/oct

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?891_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A14_XX_

Menu-Entry: **LockIn-Input-Slope**

lockin.ini entries: Rolloff: and RolloffLoL:

These two entries in the lockin.ini file equal each other.

Set Input Configuration

Number XX	Value
0	"A"
1	"A-B"
2	"A&B"

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?89A_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A15_XX_

Menu-Entry: **LockIn-Input-Config**

lockin.ini entry: InputMode:

Set Reference Output Amplitude

Number XX	Value
Any floating point number with a "." as decimal delimiter	Automatically limited to 0 V ... 8 V

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?8D9_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A21_XX_

This call sets the amplitude to 130 mV:

http://192.168.1.7/cgi-bin/remote.cgi?8D9_0.13

Menu-Entry: **LockIn-Ref-Uac[V]**

lockin.ini entry: **Amplitude:** in Volts

Set Reference Output Frequency

Number XX	Value
Any floating point number with a "." as decimal delimiter	Automatically limited

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?8DD_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A22_XX_

This call sets the frequency to 100230.5 Hz:

http://192.168.1.7/cgi-bin/remote.cgi?8DD_100230.5

http://192.168.1.7/cgi-bin/remote2.cgi?A22_100230.5

Menu-Entry: **LockIn-Ref-f[Hz]**

lockin.ini entry: **Frequency:** in Hz

Set Offset Phase for Lia1 and Lia2

Number XX	Value
Any floating point number with a "." as decimal delimiter	Automatically limited to values between -180 deg and 180 deg.

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?8D59_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?A231_XX_

for the phase offset of LIA1

Menu-Entry: **LockIn-Ref-Phase-Phase**

lockin.ini entry: **Phase:**

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?8D5D_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?A232_XX_

for the phase offset of LIA2

Menu-Entry: **LockIn-Ref-Phase1**

lockin.ini entry: **Phase0:**

Set Harmonic

Number XX	Value
Any integer number	Resulting values range between 1 and 15

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?8D1_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A24_XX

Menu-Entry: **LockIn-Ref-Harm**

lockin.ini entry: **Harmonic:**

Set Reference Input Coupling

Number XX	Value
0	RefIn = OFF
1	RefIn = ON
2	LoL active (available only, if LoL mode is implemented)

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?8DA_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?A25_XX

Menu-Entry: **LockIn-Ref-RefIn**

lockin.ini entry: **InputCouple:**

Select Display Channels in the Lockin-Menu

The idea of this function is to select which signal is shown in which of the four rows of the lockin-display screen. At the front panel of the eLockIn, the user would first select a channel 1..4 (Lockin/Display/Channel) and afterwards select the group or the signal that should be shown in the related row. The idea of the entry "Group" is that one gets faster to the desired signal, because switching between groups causes a display of the 1st signal within this group.

In remote control, (LockIn/Display/Group) is not used.

Number XX	Value for A or A-B harmonic = n	Value for A&B	Group
1	X	X_A	LIA n
2	Y	Y_A	LIA n
3	R	R_A	LIA n
4	Phi	Phi_A	LIA n
5	Uac	Uac	Misc
6	f	f	Misc
7	In	In	Misc
8	AD1	AD1	ADC
...	ADC
15	AD8	AD8	ADC
16	DA1	DA1	DAC
...
23	DA8	DA8	DAC
24	Xn	X_B	LIA1
25	Yn	Y_B	LIA1
26	Rn	R_B	LIA1
27	Phin	Phi_B	LIA1
28	Noise	Noise	Math

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?859_0_5_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A31_0_3_XX_

for the 1st row in the lockin display

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?859_1_5_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A31_1_3_XX_

for the 2nd row in the lockin display

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?859_2_5_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A31_2_3_XX_

for the 3rd row in the lockin display

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?859_3_5_XX_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A31_3_5_XX_

for the 4th row in the lockin display

Menu-Entry: **LockIn-Display-Channel & LockIn-Display-Type**

lockin.ini entry: **ChannelXType:** signal for the Xth channel

Select Display Range in the Lockin-Menu

When a channel gets a new signal, the range of this channel automatically is set to a default value (e.g. [V] for R, X and Y). In order to visualize the value better or if the analogue outputs at the backside of the eLockIn will be used, one might like to show the signals in a different scaling (e.g. 1 mV).

Number XX	Range	Available for channels of type
< = 79	1 fV	X_A Y_A R_A X_B Y_B R_B or X Y R Xn Yn Rn AND Noise
80	2 fV	
82 ..	10 fV	
85 ..	100 fV ..	
88 ..	1 pV ..	
91 ..	10 pV ..	
94 ..	100 pV ..	
97 ..	1 nV ..	
100 ..	10 nV ..	
103 ..	100 nV ..	
106 ..	1 µV ..	
109 ..	10 µV ..	
112 ..	100 µV ..	
115 ..	1 mV ..	
118 ..	10 mV ..	
121 ..	100 mV ..	
124 ..	1 V	
> =125	10 V	
<= 3	10 mV	AD1 to AD8 In
4	100 mV	
5	1 V	
>= 6	10 V	
any	10 V	DA1 to DA8
any	20 MHz	f
Any	180°	Phi_A, Phi_B or Phi, Phin

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?859_0_1_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A31_0_4_XX

for the 1st row in the lockin display

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?859_1_1_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A31_1_4_XX

for the 2nd row in the lockin display

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?859_2_1_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A31_2_4_XX

for the 3rd row in the lockin display

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?859_3_1_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A31_3_4_XX

for the 4th row in the lockin display

Menu-Entry: ***LockIn-Display-Channel & LockIn-Display-Range***

lockin.ini entry: **ChannelXRange:** scaling of the Xth channel

Set output voltages at analogue outputs DA5 to DA8

Number XX	Value
Any floating point number with a "." as decimal delimiter	Automatically limited to -10 V ... 10 V

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?819_4_5_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A41_4_3_XX

for DAC No 5 available at analogue output "Display 1"

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?819_5_5_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A41_5_3_XX

for DAC No 6 available at analogue output "Display 2"

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?819_6_5_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A41_6_3_XX

for DAC No 7 available at analogue output "Display 3"

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?819_7_5_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?A41_7_3_XX

for DAC No 8 available at analogue output "Display 4"

This call sets the value at Display output 2 to 35 mV:

http://192.168.1.7/cgi-bin/remote.cgi?819_5_5_0.035

http://192.168.1.7/cgi-bin/remote2.cgi?A41_5_3_0.035

Menu-Entry: **LockIn-Out-Channel & LockIn-Out-Value**

lockin.ini entry: none

Start and Stop Spectrum Acquisition

This call toggles between Run and Stop of Spectrum acquisition:

HTTP-Call: <http://192.168.1.7/cgi-bin/remote.cgi?C9>

HTTP-Call: <http://192.168.1.7/cgi-bin/remote.cgi?B1>

Menu-Entry: **Spectra-Run**

Get Acquired Spectrum

While a spectrum is acquired, the currently available data are continuously written into an ASCII-file. The user can get this file by calling:

HTTP-Call: <http://192.168.1.7/data/spectra.dat>

In case the spectrum is acquired logarithmically, the **spectra.dat** has the following structure:

```
10000.000000 313952.109451 1.005000 2
9999.998146682532 0.000121845705 44.127700000000 0.000091704069 9999.998146682532
10076.366002144974 0.000088171444 -1.451100000000 0.000082697557 10076.366002144974
10153.329899406146 0.000271010270 -127.491200000000 0.000118058745 10153.329899406146
10230.871212159840 0.000159494045 -155.797400000000 0.000048751126 10230.871212159840
10309.008566712266 0.000123891301 117.353000000000 0.000078561520 10309.008566712266
10387.751276216526 0.000079301988 159.333000000000 0.000050003534 10387.751276216526
10467.080714366415 0.000094011543 -170.926400000000 0.000060973697 10467.080714366415
10547.024820621244 0.000037265766 130.829100000000 0.000140710315 10547.024820621244
```

The first line "10000.000000 313952.109451 1.005000 2" tells that the available data are taken between 10000 Hz and 313.952 kHz. From frequency value to frequency value, the next value is calculated by multiplying with a factor of 1.005000. The "2" at the end of the line stands for logarithmic spectrum acquisition.

In case the spectrum is acquired linearly, the *spectra.dat* has the following structure:

```
10000.000000 10935465.456431 560.000000 1
9999.998146682532 0.000058221416 33.852000000000 0.000129871577 9999.998146682532
30010.006079635659 0.000275890032 -1.688100000000 0.000332576069 30010.006079635659
50020.014012588785 0.000079356642 147.287100000000 0.000084112314 50020.014012588785
70030.021945541914 0.000071338217 -120.204500000000 0.000120957837 70030.021945541914
90040.029878495043 0.000039686128 7.903700000000 0.000013312629 90040.029878495043
110050.047124601275 0.000016372577 -39.679600000000 0.000055554328 110050.047124601275
130060.055057554404 0.000010797937 -104.568600000000 0.000069756012 130060.055057554404
150070.062990507518 0.000051631786 159.696400000000 0.000034116511 150070.062990507518
170080.070923460647 0.000031628665 36.428600000000 0.000027792626 170080.070923460647
190090.088169566880 0.000017286069 113.276700000000 0.000018074870 190090.088169566880
210100.096102520009 0.000039342593 104.797300000000 0.000030390212 210100.096102520009
230110.104035473138 0.000032370389 -31.236300000000 0.000006540351 230110.104035473138
250120.111968426267 0.000002053404 -16.512000000000 0.000015392244 250120.111968426267
270130.119901379396 0.000008369768 -178.343500000000 0.000035894621 270130.119901379396
290140.137147485628 0.000001366333 67.956500000000 0.000023223657 290140.137147485628
```

The first line "10000.000000 10935465.456431 560.000000 1" tells that the available data are taken between 10 kHz and 1.0935 MHz. From frequency value to frequency value, the next value is calculated by adding 560.0 Hz. The "1" at the end of the line stands for linear spectrum acquisition.

Each of the following lines contains the Frequency in Hz and the chosen channels (in the LockIn menu) in their order and physical base unit. Thus , any voltages are saved in [V], phase signals are saved in ° and frequencies in Hz. The Noise channel is saved in [V/sqrt(Hz)].

Select Axis for Spectrum Display

Number XX	Value
0	"Freq"
1..4	Ch1 .. Ch4
5	Ref

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?CD9_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?B21_XX

Note: The vertical scaling on the eLockIn screen is displayed for the last selected axis, only.

Switch between linear and logarithmic Spectrum Acquisition

This feature is provided as Type selection for the frequency axis in *Spectra/Display*.

This call sets the frequency axis to linear spectrum acquisition:

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?CD9_0_D_0_

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?B21_E_2_0

This call sets the frequency axis to logarithmic spectrum acquisition:

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?CD9_0_D_1

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?B21_E_2_1

Menu-Entry: ***Spectra-Display-Axis & Spectra-Display-Type***

Change the Color of displayed Spectra Data

<i>Number XX</i>	<i>Value</i>
1	White
2	Yellow
3	Blue
4	Green
5	Red
6	Cyan
7	Magenta
8	Gray
9	Brown
10-15	White

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?CD9_1_5_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?B21_1_3_XX

Changes color for the 1st channel

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?CD9_4_5_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?B21_4_3_XX

Changes color for the 4th channel

Display Spectra with a vertical Offset to each other

<i>Number XX</i>	<i>Value</i>
Any integer number	Automatically limited to -240 ..240

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?CD9_1_1_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?B21_1_4_XX

Changes the Offset of the 1st channel

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?CD9_3_1_XX

HTTP-Call: http://192.168.1.7/cgi-bin/remote2.cgi?B21_3_4_XX

Changes the Offset of the 4th channel

Set Parameters for Spectrum Acquisition

The exact way, how a spectrum is acquired, is defined with parameters in

Spectra-Acquire

All these parameters can be set with a single HTTP-call:

[http://192.168.1.7/cgi-bin/remote.cgi?](http://192.168.1.7/cgi-bin/remote.cgi?B31_TT_F_F1_5_F2_1_PP_A_DD_)

[B31_TT_F_F1_5_F2_1_PP_A_DD_](http://192.168.1.7/cgi-bin/remote2.cgi?C59_TT_D_F1_3_F2_4_PP_5_DD_)

[http://192.168.1.7/cgi-bin/remote2.cgi?](http://192.168.1.7/cgi-bin/remote2.cgi?C59_TT_D_F1_3_F2_4_PP_5_DD_)

[C59_TT_D_F1_3_F2_4_PP_5_DD_](http://192.168.1.7/cgi-bin/remote2.cgi?C59_TT_D_F1_3_F2_4_PP_5_DD_)

The values ***TT***, ***F1***, ***F2***, ***PP***, and ***DD*** define the spectrum are set according to the following tables:

Table for the type of integration/acquisition:

<i>Number TT</i>	<i>Value</i>
0	Single
1	Conti.
2	Integ.

Table for the amount of data points:

<i>Number PP</i>	<i>Value</i>
10	10
20	20
50	50
... continues logarithmically	...
100000	100000

Table for the delay time per data point:

<i>Number DD</i>	<i>Value</i>
0	0.01*T
1	0.1*T
2	0.2*T
3	0.5*T
4	1*T
5	2*T
6	5*T

The start and the stop frequency F1 and F2 are set like any other real number:

<i>Number F1 or F2</i>	<i>Value</i>
Any floating point number with a "." as decimal delimiter	Automatically limited to the available frequency range of the lockin amplifier

Set Display Settings for Oscilloscope

The exact way, how a spectrum is acquired, is defined with parameters in

Scope-Display

All these parameters can be set with a single HTTP-call:

<http://192.168.1.7/cgi-bin/remote.cgi?>

[4D9_CH_D_Scale_5_Col_1_Offset_](http://192.168.1.7/cgi-bin/remote.cgi?4D9_CH_D_Scale_5_Col_1_Offset_)

The value **CH** defines the channel to be changed with "0" for the time channels and "1" to "4" for the four available display channels. The value **Col** defines the display color for the oscilloscope screen.

Scale defines the scaling of the selected axis. It is defined differently for the time axis (**ScaleH**) and the four vertically displayed channels. For all data given in Volts, the scaling is according to the following table:

Number <i>ScaleV</i> for voltage type channels	Value
0	1μV
1	2μV
2	5μV
3	10μV
4	20μV
5	50μV
6	100μV
7	200μV
8	500μV
9	1mV
10	2mV
11	5mV
12	10mV
13	20mV
14	50mV
15	100mV
16	200mV
17	500mV
18	1V
19	2V
20	5V
21	10V
22	20V
23	50V
24	auto

If the signal available in any channel is a phase or the frequency, the scaling of the oscilloscope display cannot be changed for this channel.

If the Channel **Time** is chosen, only the first two parameters should be set:

http://192.168.1.7/cgi-bin/remote.cgi?4D9_0_D_0_5_ScaleH_

On the oscilloscope screen, **ScaleV** (vertical scaling) is renamed into **ScaleH** (horizontal scaling) and is the given by:

Number <i>ScaleH</i> for the Time channel	Value
0	1μs
1	2μs
2	5μs
3	10us
4	20us
5	50μs
6	100μs
7	200μs
8	500μs
9	1ms
10	2ms
11	5ms
12	10ms
13	20ms
14	50ms
15	100ms
16	200ms
17	500ms
18	1s
19	2s
20	5s

The color value **Col** is set by:

Number <i>Col</i>	Value
1	White
2	Yellow
3	Blue
4	Green
5	Red
6	Cyan
7	Magenta
8	Gray
9	Brown
10-15	White

If the Channel **freq** is chosen, only the first two parameters should be set:

http://192.168.1.7/cgi-bin/remote.cgi?4D9_0_D_1_5_ScaleH_

The value of **ScaleH** (horizontal scaling) and is the given by:

<i>Number ScaleH for the Time channel</i>	<i>Value</i>
>= 4	50kHz
5	20kHz
6	10kHz
7	5kHz
8	2kHz
9	1kHz
10	500Hz
11	200Hz
12	100Hz
13	50Hz
14	20Hz
15	10Hz
16	5Hz
17	2Hz
18	1Hz
19	0.5Hz
>= 20	0.2Hz

The example:

HTTP-Call: http://192.168.1.7/cgi-bin/remote.cgi?4D9_Ch_5_Col_

changes color for the Chth data channel.

The Offset makes it possible not to show all data on top of each other, but to move the vertically. The number **Offset** is simply an integer between -4 and 4.

4.1.4 EXAMPLES FOR KEYCODE OPERATION

The following examples are not complete at all, however, they explain the basic operation of the device through the KeyCode. Thus, even never described or new entries in the menu can be accessed by simply following a very simple schemata:

the lowest entry usually is decoded as "_0_" and following entries simply count up from this lowest entry.

KeyCodes cannot only be used from the remote.cgi (as shown here), but also by the DLL.

Set Frequency

Code:

http://192.168.1.7/cgi-bin/remote.cgi?8DD_1040_

Description:

8 ... enter Lockin menu
D ... enter Ref entry
D ... select Freq entry inside the Ref menu
_ ... tells that a parameter is following
1040 ... is the new frequency value in Hz = 1.04 kHz
_ finalizes the data transfer (never forget this final underscore)

Set Reference Output Amplitude

Code:

http://192.168.1.7/cgi-bin/remote.cgi?8D9_0.15_

Description:

8 ... enter Lockin menu
D ... enter Ref entry
9 ... Select Uac entry inside the Ref menu
_ ... tells that a parameter is following
0.15 ... is the new reference output amplitude value in V (= 150 mV)
_ finalizes the data transfer (never forget this final underscore)

Set PLL Input to Low

Code:

http://192.168.1.7/cgi-bin/remote.cgi?0D5_0_

Function: toggles the type of reference input for the PLL mode

Description:

0 ... enter Setup menu
D ... enter Misc entry
D ... select PLL entry inside the Misc menu
_ ... tells that a parameter is following
0 ... is the lowest entry in this menu and equals "PLL/Low"
_ finalizes the data transfer (never forget this final underscore)

Set Oscilloscope to Start

Code:

http://192.168.1.7/cgi-bin/remote.cgi?49_0_

Function: stops the oscilloscope screen from data acquisition.

Description:

4 ... enter Osci menu
9 ... select Run entry inside the Misc menu
_ ... tells that a parameter is following
1 ... equals the 2nd entry in this menu which is "STOP"
_ finalizes the data transfer (never forget this final underscore)

How to set multiple parameters at once

After finishes one entry with "_", one can simply add further entries from the current menu situation, which means that it is not required always to return to the top-most

menu "LockIn" or "Spectra".

For instance, when keycode "859_1_0_" was used to enable the entry Channel inside [Lockin/Display], one can simply continue to enter values in the Scale entry (key code "1") by adding "1_124_". The total key code:

```
http://192.168.1.7/cgi-bin/remote.cgi?859_0_1_124_
```

simultaneously makes sure that channel 1 is selected and its value is set to 1 V display range. The only limit is the length of the complete string which is about 128 characters.

Example Code

```
http://192.168.1.7/cgi-bin/remote.cgi?  
859_0_1_124_9_1_1_124_9_2_1_124_9_3_1_124_
```

Function: sets the display ranges of all 4 displayed channels to 1 V. The code shown with dark yellow background (9_0_1_124_) simply repeats by changing the channel number, only. 9_2_1_124_, for example, sets the display range for channel 3.

4.1.5 RETRIEVING SCREENSHOTS

The screen shot of the eLockIn display screen is saved with the command

```
http://192.168.1.7/cgi-bin/remote.cgi?S
```

After receiving the key code 'S', the **eLockIn** will save its current display content as a JPEG image in '/screen.jpg'. Then it can be retrieved by a web browser calling:

```
http://192.168.1.7/screen.jpg
```

or any program such as the Delphi example shipped with the **eLockIn**

4.1.6 RETRIEVING CHANNEL VALUES

If you are interested in obtaining actual channel values as ASCII file, you can either use the HTML file sent by /cgi-bin/refresh.cgi or the text file /data/lia.dat. To extract pure data from refresh.cgi's answer, surrounding HTML tags have to be cut away. On the other hand, lia.dat provides pure numbers and is faster.

4.1.7 GET INTERNAL SETTINGS AND STATUS INFORMATION

The current settings of the **eLockIn** are stored in a file ./setup/lockin.ini, which is available through the web-interface:

```
http://192.168.1.7/setup/lockin.ini
```

This file contains:

```
Amplitude: 0.0200  
Frequency: 1001.00  
Timeconstant: 9  
Rolloff: 24  
InputRange: 1  
Phase: 10.0
```

```

Harmonic: 1
AmplCaretPos: 3
FreqCaretPos: 4
FreqCaretPosTail: 2
PhaseCaretPos: 5
DisplayChannel: 2
Channel1Type: 3
Channel1Range: 120
Channel2Type: 4
Channel2Range: 7
Channel3Type: 26
Channel3Range: 120
Channel4Type: 27
Channel4Range: 7
InputCouple: 0
InputMode: 2
RefInFlag: 0
TimeConstLoL: 6
RollOffLoL: 24
SyncLoL: 0
Sync0: 0
Phase0: 0.0
EndOK

```

Frequency and amplitude are given as values in Hz and in V, respectively, while the phase is shown in degree. All other data are stored in the numeric code provided in the tables in section 4.1.3.

Additionally, the state of the internal overload is provided by sending:

```
http://192.168.1.7/cgi-bin/remote.cgi
```

As result, the eLockin sends

"idle 0"	if no overload is active
"idle 1"	if the frequency range is exceeded (blue exclamation mark)
"idle 2"	if the AD-converter input is in overlaod (red exclamation mark)
"idle 3"	if both overload states are active.

4.1.8 EXAMPLE PROGRAM: LOCKINREMOTE

LockInRemote is an example program written in Borland Delphi 6 and designed to show the possibilities of remote-controlling an *eLockIn*. Its graphical user interface (GUI) looks similar to the front panel and each button works the same way the real one does.

LockInRemote uses a TClientSocket object to set up a TCP connection to the *eLockIn*, working in non-blocking mode.

After starting the program, the screen will still be empty, because authentication is required first. Click **LockIn**→**Authenticate** to open the authentication menu. Enter your user name, password and the *eLockIn*'s IP and click '**Connect**'. If the *eLockIn* is found and your authentication data are valid, you will be logged in.

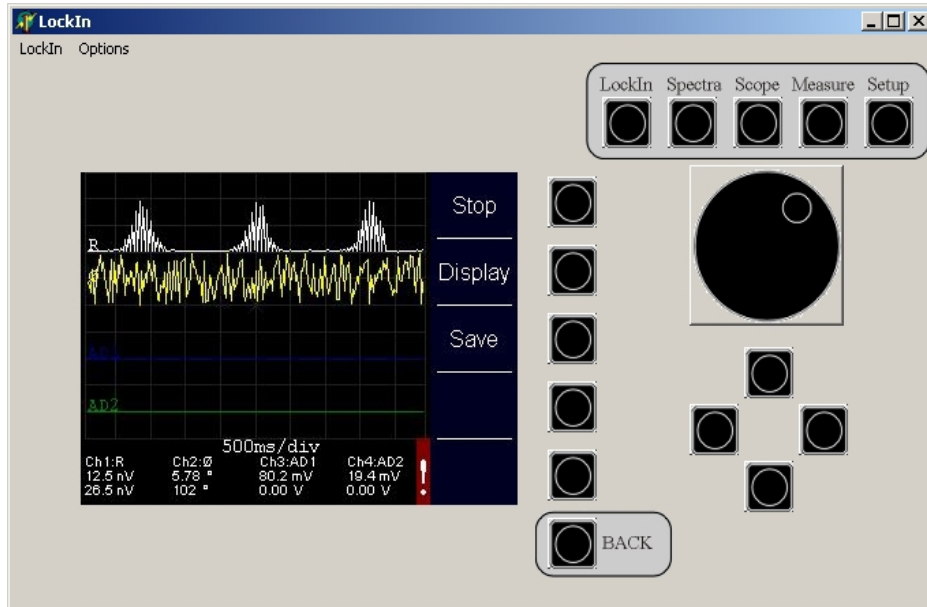


Figure 2: LockInRemote program surface.

Now you may want to select '**Auto Refresh...**' from the '**Options**' menu in order to choose how the *eLockIn*'s data should be presented:

- Auto-Refresh Screen causes the program to retrieve a new screenshot continuously. This is useful if you want to navigate through the menu tree.
- Auto-Refresh Channel displays current channel data
- Auto-Refresh Off disables Auto-Refresh

It is possible to get new screen/channel data by refreshing them manually as well.

The '**Options**' menu also offers a simple speed test. Click '**Test Speed**' to check the abilities of your network connection. Choose a number and click '**Test**'. The same picture will be retrieved n times from the *eLockIn*, while time is measured. Later, speed and time per picture will be displayed.

All the buttons on the right side of the panel have the same functionality as their counterparts on the *eLockIn*. The row of buttons next to the screen represents different meanings, depending on which option is currently assigned to them on the display.

If you need to pass parameters to the *eLockIn*, choose '**Set Value**' from the '**LockIn**' menu. Enter parameters/values as described above (no underscores needed here!).

4.3 REMOTE CONTROL FOR THE eLOCKIN IN PYTHON

In Python, the *eLockIn* can be remote controlled by simply addressing its web-interface with the key-codes translated by the remote.cgi (or remote2.cgi). The provided Python examples are tested with Python 3.5.2 and with matplotlib.

Depending on which version of the CGI is used, you have to import eLockinRemote for remote.cgi or eLockinRemote2 for remote2.cgi in Python. The function calls defined in the main library are the similar for both versions of the library.

Conveniently, the following py-files are provided:

- eLockinRemote.py/ eLockinRemote2.py two versions of the main library, definition of function calls
- run_spectra.py example run/stop spectra, get spectra data and plot
- function_calls.py example for the usage of functions calls from the eLockinRemote library

All files should be in the same program directory.

In any Python script, first import the eLockinRemote Library (or eLockinRemote2) with

```
import eLockinRemote
```

and then connect to the eLockin with the following call:

```
eLockinRemote2.login()
```

before using any function calls. Any missing function can be easily added by following the scheme provided in the library. In order to address not yet described buttons and entries, simply transfer the key code and append a "_0_" for the first entry ("_1_" for 2nd entry and so on) or "_xxx_" for entering a number xxx.

If you're using a custom IP-address for the eLockin, you have to change the IP in eLockinRemote.py (or eLockinRemote2.py).