

Interface commands specbos xxx1

1. General remarks

Direct communication with specbos xxx1 instruments can be done by special commands via the USB interface. This interface is designed as a virtual COM port, so it can be handled similarly to a serial port with the settings 8n1/ no protocol. The allowed transfer rates are 38 400, 115 200 and 921 600 Bd. The default rate is 38 400 Bd.

The following list shows the available commands. They match the SCPI standard regulations, begin with * and have the following key words:

*PARAMeter	Get and set general parameters
*CONfigure	Get and set configuration data
*INITiate	Start a configured measurement
*FETCh	Get data from previous measurement
*READ	Start a configured measurement and get the data (combination of *INIT and *FETCh)
*MEASure	Configure, start the measurement and get the data (combination of *CONF, *INIT and *FETCh)
*CONTRol	Control peripheral components
*CALCulate	Calculate data from the previous measurement
*CALIBrate	Calibrate the unit and get calibration data

These key words can be followed by one or two additional words, separated by colons, and by arguments. It is only necessary to use the indicated capital letters, all other letters are optional.

Several commands can be extended by arguments. The meanings of the arguments are as follows:

tint	Integration time in ms, range from 5 ... 60 000 ms, tint = 0 initiates an adaption of the integration time to get a proper exposure (in preselected borders)																
av	Averaging of measurements (1 ... 32)																
format	Output format <table> <tr><td>0</td><td>no output</td></tr> <tr><td>1</td><td>L/H binary output without length and checksum</td></tr> <tr><td>2</td><td>ASCII output, space separated</td></tr> <tr><td>3</td><td>L/H binary output with length and checksum</td></tr> <tr><td>4</td><td>ASCII output, separated by <CR></td></tr> <tr><td>5</td><td>H/L binary output without length and checksum</td></tr> <tr><td>6</td><td>H/L binary output with length and checksum</td></tr> <tr><td>7</td><td>Raw data with wavelength</td></tr> </table>	0	no output	1	L/H binary output without length and checksum	2	ASCII output, space separated	3	L/H binary output with length and checksum	4	ASCII output, separated by <CR>	5	H/L binary output without length and checksum	6	H/L binary output with length and checksum	7	Raw data with wavelength
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6	H/L binary output with length and checksum																
7	Raw data with wavelength																
function	Selection of output function <table> <tr><td>0</td><td>None</td></tr> <tr><td>1</td><td>exposed spectrum (with shutter opened/ lamp on)</td></tr> <tr><td>2</td><td>dark spectrum</td></tr> <tr><td>3</td><td>reference spectrum (difference of exposed spectrum and dark spectrum)</td></tr> <tr><td>4</td><td>transmission spectrum, unit: ‰</td></tr> <tr><td>5</td><td>absorption spectrum, unit: AU</td></tr> <tr><td>6</td><td>radiometric spectrum, unit: depending from selected calibration file Radiance W/(m²·sr·nm)</td></tr> </table>	0	None	1	exposed spectrum (with shutter opened/ lamp on)	2	dark spectrum	3	reference spectrum (difference of exposed spectrum and dark spectrum)	4	transmission spectrum, unit: ‰	5	absorption spectrum, unit: AU	6	radiometric spectrum, unit: depending from selected calibration file Radiance W/(m ² ·sr·nm)		
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	Irradiance	W/(m ² ·nm)
	Radiant flux	W/nm
	Radiant intensity	W/(sr·nm)
7	Radiometric value, unit: dependend from selected calibration file	
	Radiance	W/(m ² ·sr)
	Irradiance	W/m ²
	Radiant flux	W
	Radiant intensity	W/sr
8	Photometric value, unit: dependend from selected calibration file	
	Radiance	cd/m ²
	Irradiance	lx
	Radiant flux	lm
	Radiant intensity	cd
9	Chromaticity xy	
10	Chromaticity u'v'	
11	Dominant wavelength and color purity	
12	radiometric, photometric, xy and uv values, dominant wavelength and colour purity	
13	Correlated color temperature (CCT)	
14	CRI values	
15	Peak values	
wbeg	Start of wavelength range, in nm (380 ... 779 nm)	
wend	End of wavelength range, in nm (381 ... 780 nm)	
wstp	Wavelength step (1 or 5 nm)	
temp	Color temperature of reference source for CRI calculation	
filenr	Number of calibration file	
	0	Radiance
	1	Irradiance
	2	Radiant flux
	3	Radiant intensity
	4
arg	Other arguments, described in text	

If commands with get and set options are used with ?, the appropriate information if given. If an argument is used, this argument will be set.

A space sign between command and argument is necessary (not in case of ?).

If a command which accepts arguments is used without arguments, then the configured arguments will be used (exception: tint – see *CONFigure:EXPOsure).

If a command was successfully proceeded it will be answered by an Acknowledge sign (ACK, 06 hex), otherwise "Not acknowledged" (NAK, 15 hex) will be returned.

Several commands can be written successively in one line, they have to be separated by semicolons.

Overview about instrument answers to the firmware commands

Command category	Answer
*PARA *CONF *CONTR	with setting of value and *PARA:SAVE: ACK (06 hex), if value is accepted NACK (15 hex), if value is not accepted with ? (data request): data sequence <CR>
*INIT	ACK (06 hex) immediately after command input BELL (07 hex) after finishing the measurement
*READ *MEAS	ACK (06 hex) immediately after command input BELL (07 hex) after finishing the measurement data sequence <CR> <CR> in case of spectral data output <CR> in case of single value output
ESC	BELL (07 hex)
*FETCH	data sequence <CR> <CR> in case of spectral data output <CR> in case of single value output
*CALC	data sequence <CR>
*CALIB	with get: data sequence <CR> (from version 1.35 <CR> <CR>) with state: value <CR>

2. Parameter Commands

These commands include the basic settings of an instrument. They are set in factory and normally the user has no reason to change them (except the settings for peak calculations, sect. 2.5).

2.1. General settings

*PARAMeter? <CR>	Get a help list of the parameter commands
*RST<CR>	Software reset <u>Example of answer:</u> *RST<CR> : softwarereset *IDN? : get device ID *PARAMeter:CHANnel? : get channel count *PARAMeter:PIXel : get/set pixel count etc.
*IDN? <CR>	Get device ID <u>Example of answer:</u> SB05
*PARAMeter:SPNUMber? <CR>	Get spectrometer number <u>Example of answer:</u> spectrometer number: 2005184
*PARAMeter:SERNumber? <CR>	Get serial number (internal number) <u>Example of answer:</u> serial number: 0012
*PARAMeter:CHANnel? <CR>	Get channel quantity <u>Example of answer:</u> channel count: 1

- *PARAMeter:PIXel? <CR> Get pixel quantity
Example of answer:
pixel: 128
- *PARAMeter:SENSor? <CR> Get sensor type
 TSL 1301: 2
 TSL 1401: 3
 S8378-256: 4
 TSL 1402: 5
 S8378-1024: 6
 MLX 90255: 7
 S 9227-512: 9
 LIS-1024:10
 LIS-1024 sg: 11
 ELIS-128: 26
 ELIS_256: 27
 ELIS-512: 28
 ELIS-1024: 29
 ELIS-256 PB: 32

Example of answer:
Sensor: 3
- *PARAMeter:ADCRResolution arg <CR> Get/ Set ADC resolution
 14 bit: 14
 15 bit: 15
 16 bit: 16 (not allowed for radiometric measurements)

Example of answer:
AdcResolution: 14
- *PARAMeter:ADCVoltage arg <CR> Get/ Set input voltage range of ADC (1 = 2V, 0 = 4V)
Example of answer:
ADC input range: 2V
- *PARAMeter:ADPWdown? <CR> Get power down active (on = 1, off = 0), will be deactivated automatically with the next command
Example of answer:
power down ADC: on
- *PARAMeter:PDAGain arg <CR> Get/ Set PDA gain for Hamamatsu S8378 array (0 = high, 1 = low)
Example of answer:
PDA gain low: 1
- *PARAMeter:PLLCIk? <CR> Get clock multiplier (doubling of clock rate)
Example of answer:
PLL multiplier: off
- *PARAMeter:BAUD arg <CR> Get/ Set baudrate
 38 400 Bd: 384
 115 200 Bd: 115
 921 000 Bd: 921 (default value)

Example of answer:
Baud: 921
- *PARAMeter:ECHO arg <CR> Get/ Set echo mode (only valid after *para:save and *RST)
 Echo on: 1
 Echo off: 0

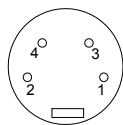
Example of answer:
Echo: 0
- *PARAMeter:CONFig? <CR> Get configuration word (32 bit, setting with password), summary of main flags
Example of answer:
config: 0000652

2.2. Time settings

- *PARAMeter:TINT tint <CR> Get/ Set default integration time (from 5 ... 60 000 ms)
Example of answer:
Tint: 100
- *PARAMeter:SDElay arg <CR> Get/ Set scan delay (time difference between initiating a measurement and its real start, in ms)
Example of answer:
ScanDelay: 400
- *PARAMeter:BORDer arg arg <CR> Get/ Set low and high border for the adaption of integration time (percent of fullscale)
Example of answer:
border: 80 95
- *PARAMeter:FASTscan arg <CR> Get/ Set time to next fast cycle (in ms)
Example of answer:
Fastscan: 50
- *PARAMeter:FLASHlight arg arg <CR> Get/ Set flash light parameters (flash interval in ms and length in μ s)
Example of answer:
FlashPara: 20 20
- *PARAMeter:SPLITTime arg <CR> Get/ Set splitting interval for integration time (arg between 1000 and 6000 ms) for ELIS-1024 array (0 = no split)
Example of answer:
Split time: 5000
- *PARAMeter:FRAME arg <CR> Get/ Set frame mode (0 = DPR mode, frame off, 1 = frame mode, internal shutter, frame on)

2.3. Settings for peripheral units

- *PARAMeter:LAMPenable arg <CR> Get/ Set lamp or shutter active (enable = 1, disable = 0), only if lamp or shutter are enabled, they can be used
Example for answer:
Lamp enable: 1
- *PARAMeter:LAMPpolarity arg <CR> Get/ set lamp or shutter polarity (low = 0, high = 1)
Example of answer:
Lamp low: 1
- *PARAMeter:TRIGger arg <CR> Get/ Set trigger mode (enable = 1, disable = 0), start of a configured measurement with hardware trigger (shortcut with switch or TTL signal), similar to the command *INITiate, last output: 07 (measurement finished, data are ready)
Example of answer:
Trigger: 0



Pin out :	1	Lamp out 5 V CMOS signal (flash lamp trigger)
	2	Meas. trigger input
	4	Ground

- *PARAMeter:TRSLope arg <CR> Get/ Set trigger slope (triggering with switch closing/ falling TTL signal = 1, with switch opening/ rising TTL signal = 0)
Example of answer:
Trigger slope: 0
- *PARAMeter:SHUTter? <CR> Get shutter availability (available = 1 (dark measurement with shutter possible), not available = 0 (only dark compensation possible))
Example of answer:
Shutter: 0

2.4. Settings for measurement

- *PARAMeter:OFFSet arg <CR> Get/ Set offset value (-250 ... 250 mV)
Example of answer:
Offset Channel 1: 50
- *PARAMeter:GAIN arg <CR> Get/ Set gain value (1.0 ... 5.0)
Example of answer:
Gain Channel 1: 1.0
- *PARAMeter:FITn arg <CR> Get/ Set wavelength fit parameters
 $\lambda(p) = \text{fit0} + \text{fit1} \cdot p + \text{fit2} \cdot p^2 + \text{fit3} \cdot p^3 + \text{fit4} \cdot p^4$
 p = pixel number
 n= 0 ... 4
Example of answer for fit0:
Fit0 Channel 1: 2.729578e+02
- *PARAMeter:CALIBNumber arg <CR> Get/ Set calibration file to be used for radiometric calculations
 0 – accept signal of hall sensors ab (positions see *CONTR:MHEAD)
 Sensor signal 00: Radiance (No. 1)
 Sensor signal 01 Irradiance (No. 2)
 Sensor signal 10 Radiant flux (No. 3)
 Sensor signal 11 Radiant intensity (No. 4)
 1 ... 20 – use the selected calibration file (No. 1 ... 20)
Example of answer:
calib number: 0
- *PARAMeter:BASIC? <CR> Get configured basic parameters
Example of answer:
*SB05S_1201_VIS_vP VERSION 1.17 230905 S/N 0012
 CHANNELS : 1
 PIXEL PER LINE : 128
 LAMP PREHEAT TIME [ms] : 300
 INTEGRATION TIME [ms] : 100
 CHANNEL 0 FITx^0 : 2.729578E+02
 CHANNEL 0 FITx^1 : 4.833291E+00
 CHANNEL 0 FITx^2 : 4.538542E-03
 CHANNEL 0 FITx^3 : -1.373730E-04
 CHANNEL 0 FITx^4 : 5.293746E-07*
- *PARAMeter:EXTENDED? <CR> Get configured extended parameters
Example of answer:
*fastscan time: 50 ms
 Image sensor: TSL1401
 gain value : 5.00
 offset value : 50 mV
 low gain HAMS8378
 lamp enable
 lamp low activ
 flash intervall : 20 ms
 flash length : 20 us*
- *PARAMeter:BIN? <CR> Get parameters binary (1024 byte)
Example of answer:
*SB05S_1201_VIS_vP VERSION 1.17 230905 sn:
 followed by the parameters in binary format*
- *PARAMeter:BOXCAr arg <CR> Get/ Set boxcar mode (running average of pixels, odd number (1 ... 25), 1 – no boxcar integration)
Example of answer:
Boxcar count : 7

2.5. Settings for peak calculations

These commands can be used for settings for peak search in spectra.

- *PARAMeter:PEAKCount arg <CR> Get/ Set maximum number of peaks
Example of answer:
peak count: 6
- *PARAMeter:PEAKSensitivity arg <CR> Get/ Set peak sensitivity (percent of maximum in spectrum)
Example of answer:
peak sensivity: 80

*PARAMeter:PEAKDistance arg <CR>

Get/ Set peak minimal distance to next peak (nm)

Example of answer:

peak distance: 30

*PARAMeter:PEAKRange arg <CR>

Get/ Set peak search range (difference in nm from peak wavelength)

Example of answer:

peak range: 50

*PARAMeter:PEAKBegin arg <CR>

Get/ Set start wavelength of spectrum for peak search (nm)

Example of answer:

spec begin: 400

*PARAMeter:PEAKEnd arg <CR> Get/ Set end wavelength of spectrum for peak search (nm)

Example of answer:

spec end: 700

*PARAMeter:PKBORDER peaknr wbeg wend <CR>

Get/ set peak ranges of radiometric calculation (for command *CALCulate:PEAK), maximum 16 ranges

Example of answer:

<i>peak</i>	<i>begrng</i>	<i>endrng</i>
1	380	480
2	500	580
3	680	780
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0

2.6. Permanent storage of parameters

After any change of parameters this change has to be saved to make it permanent.

*PARAMeter:SAVE <CR> Write parameters on flash ROM

Example of answer:

ACK (06 hex)

3. Control Commands

These commands are used to control the peripheral elements lamp/ shutter, laser and hall sensors.

*CONTRol? Get a help list of the control commands

*CONTRol:LASER arg <CR> Get/ Set laser status (1 – laser on, 0 – laser off)

Example of answer:

laser: 0

*CONTRol:MHEAD? <CR> Get measuring head configuration “ab” (signal of hall sensors)

Sensor signal 00: Radiance measurement (= 0)

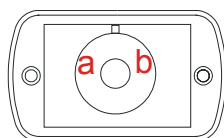
Sensor signal 01 Irradiance measurement (= 1)

Sensor signal 10 Radiant flux measurement (= 2)

Sensor signal 11 Radiant intensity measurement (= 3)

Example of answer:

mhead: 0



Front view of SCB 1201 with positions of Hall sensors

*CONTRol:LAMP arg <CR> Get/ Set lamp/ shutter status (1 – lamp on, shutter opened, 0 – lamp off, shutter closed)
Example of answer:
lamp: 1

4. Configure Commands

These commands can be used to change the default status of several arguments. These arguments and their default values are as follows:

tint	set with *PARAMeter:TINT
function	1 (measurement of exposed spectrum)
format	4 (ASCII output, separated by <CR>)
av	1 (no averaging)
exposure mode	0 (uses previous tint, see *CONFigure:EXPOSure)
wbeg	380 nm
wend	780 nm
wstp	5 nm

*CONFigure? Get a help list of the configuration commands

*CONFigure:TINT tint <CR> Get/ Set integration time (from 5 ... 60 000 ms), in contradiction to *PARA:TINT the configured time will be saved only temporarily
Example of answer:
Tint: 100

*CONFigure:EXPOSure arg <CR> Get/ Set handling of integration time
0 – uses previous tint (default value)
1 – always adaption of tint
2 – uses configured tint (*CONF:TINT)
Example of answer:
Exposure: 0

*CONFigure:AVERage av <CR> Get/ Set the number of measurement scan for average calculation (1 ... 32)
Example of answer:
Average: 5

*CONFigure:FUNction function <CR> Get/ Set measurement function
Example of answer:
Previous function: 1
Configured function: 7

*CONFigure:FORMat format <CR> Get/ Set output format
Example of answer:
Previous format: 2
Configured format: 4

*CONFigure:WRANge wbeg wend wstp <CR> Get/ Set wavelength range
Example of answer:
Wave begin: 380
Wave end: 780
Wave step: 1.0

*CONFigure:WSTP wstp <CR> Get/ Set wavelength step width (1 or 5 nm)
Example of answer:
Wave step: 5.0

*CONFigure:ALL tint av format function <CR> Get/ Set all measurement parameters (except wavelength range and step)
Example of answer:
Tint: 100
Average: 1
Format: 2
Function: 1
Adaption: 1

*CONFigure:DEFault <CR> Set all measurement parameters to the default values (see above)

5. Initiate and Abort Commands

*INITiate <CR> Run a pre configured measurement (without data output)

ESC Abort a running measurement

6. Read Command

*READ format <CR> Initiate a configured measurement and output of data

7. Fetch Commands

A *FETCH command can only be used if the appropriate measurement was proceeded before.

*FETCH? Get a help list of the fetch commands

*FETCH format <CR> Output of previous measurement

*FETCH:LIGHT format <CR> Output of exposed spectrum values

*FETCH:DARK format <CR> Output of dark spectrum values

*FETCH:REFERence format <CR> Output of reference values

*FETCH:TRANSmision format <CR>
Output transmission values

*FETCH:SPRADiance format <CR>
Output spectral radiance values

*FETCH:RADIOmetric format <CR>
Output radiometric value

*FETCH:PHOTOmetric format <CR>
Output photometric value

*FETCH:CHROMXY format <CR> Output of xy values

*FETCH:CHROMUV format <CR> Output of u'v' values

*FETCH:DWLPE format <CR> Output of dominant wavelength and color purity

*FETCH:ALLVAlue format <CR> Output of radiometric-, photometric-, xy- and uv values, dominant wavelength and colour purity

*FETCH:CCT format <CR> Output of CCT
Example of answer:
color temperature[°K]: 3007

*FETCH:CRI format <CR> Output of CRI values
Example of answer:
color temperature of reference source: 2968 °K
CRI_DC: 3.681963e-04
CRI_Ra: 99.3
CRI_R01: 99.2
CRI_R02: 99.8
CRI_R03: 99.1
....

*FETCH:PEAK format <CR> Output of peak values

8. Measure Commands

The measure commands contain a measurement scan and the following output of data.

* MEASure? Get a help list of the measure commands

*MEASure tint av format <CR> Run measurement with parameters and output of data
Raw data: ADC counts as unsigned integer word (2 Byte, MSB first)
Radiometric data:

Example of answer:
5361 4714 4744 4669 4787 4652 4826 4744 4780 4745 4846 4724 4829 4739 4835 4708
4704 4546 4817 4652 4819 4748 4757 4711 4749 4696 4730 4708 4782 4740 4818 4655
4791 4687 4737
5362

*MEASure:DARKspectra tint av format <CR>
Run dark measurement, tint ≠ 0
output raw data ADC counts as unsigned integer word (2 Byte, MSB first)

- *MEASure:LIGHTspectra tint av format <CR>
Run light measurement (exposed spectrum – opened shutter or lamp switched on)
output raw data ADC counts as unsigned integer word (2 Byte, MSB first)
- *MEASure:REFERence tint av format <CR>
Run reference measurement (Difference between light measurement and previously
obtained dark measurement), same integration time as during dark scan is obligatory
output raw data ADC counts as unsigned integer word (2 Byte, MSB first)
- *MEASure:TRANSMission format <CR>
Run light measurement and calculate the ratio to the actual reference spectrum (both
dark signal subtracted)
- *MEASure:SPRADlance tint av format <CR>
Run spectral radiometric measurement
Example of answer:
WL[nm] RAD[W/(sr*m²*nm)]

380 2.77656364e+00 3.24814868e+00 3.61431837e+00 3.96225500e+00
400 4.43705416e+00 5.07714462e+00 5.52717924e+00 6.09837151e+00
... .
- *MEASure:RADIOmetric tint av <CR>
Run radiometric measurement
Example of answer:
radiance[W/(sr*m²)] : 1.452e²
- *MEASure:PHOTOmetric tint av <CR>
Run photometric measurement
Example of answer:
luminance[cd/m²] : 2.417e³
- *MEASure:CHROMXY tint av <CR>
Run xy measurement
Example of answer:
x: 0.4423
y: 0.4067
- *MEASure:CHROMUV tint av <CR>
Run u'v' measurement
Example of answer:
u': 0.2521
v': 0.5229
- *MEASure:DWLPE tint av <CR>
Run dominant wavelength and color purity measurement
Example of answer:
dominant wavelength[nm]: 583.0
colour purity: 53.9
- *MEASure:ALLVAlue tint av <CR>
Run a measurement for radiometric-, photometric-, xy-, u'v'-values,
dominant wavelength and colour purity
Example of answer:
radiance[W/(sr*m²)] : 1.452e²
luminance[cd/m²] : 2.417e³
x: 0.4392
y: 0.4053
u': 0.2515
v': 0.5222
dominant wavelength[nm]: 583.0
colour purity: 53.4
- *MEASure:CCT tint av <CR>
Run Correlated Color Temperature (CCT) measurement
Example of answer:
color temperature[°K]: 3007

*MEASure:CRI tint av <CR> Run CRI measurement (according to CIE 13.3)
Example of answer:
 color temperature[°K]: 3016
 color temperature of reference source: 3016 °K
 CRI_DC: 3.109599e-04
 CRI_Ra: 99.2
 CRI_R01: 99.1
 CRI_R02: 99.8
 CRI_R03: 99.3
 CRI_R04: 99.0
 CRI_R05: 99.2
 CRI_R06: 99.8
 CRI_R07: 99.3
 CRI_R08: 98.5
 CRI_R09: 97.0
 CRI_R10: 99.7
 CRI_R11: 99.0
 CRI_R12: 99.3
 CRI_R13: 99.3
 CRI_R14: 99.5

*MEASure:PEAK <CR> Run measurement and peak calculation
 - integration time adaption
 - reference measurement
 - peak search
 - calculation of radiometric values for each peak range (set with
 *PARAMeter:PKBORDER)
 - output of data

9. Calculation commands

The calculation commands use the previously obtained measuring data.

*CALCulate? Get a help list of the calculation commands

*CALCulate:RADIOmetric wbeg wend <CR>
 Run radiometric calculation
Example of answer:
radiance [W/(sr*m²)] : 1.452e²

*CALCulate:PHOTOmetric wbeg wend <CR>
 Run photometric calculation
Example of answer:
 luminance [cd/m²] : 2.417e³

*CALCulate:CHROMXY wbeg wend <CR>
 Run xy calculation

*CALCulate:CHROMUV wbeg wend <CR>
 Run u'v' calculation

*CALCulate:DWLPE wbeg wend <CR>
 Run dominant wavelength and colour purity calculation

*CALCulate:ALLVAlue wbeg wend <CR>
 Run calculation of radiometric-, photometric-, xy-, uv-values as well as
 of dominant wavelength and colour purity

*CALCulate:CCT wbeg wend <CR>
 Run Correlated Color Temperature (CCT) calculation

*CALCulate:CRI temp <CR> Run CRI measurement (the argument temp is used for the reference source
 calculation, without argument the measured CCT will be used), calculation according
 to CIE 13.3 publication
Example of answer:
 color temperature of reference source: 4000 °K
 CRI_DC: 2.984050e-02
 CRI_Ra: 79.0
 CRI_R01: 84.9
 CRI_R02: 95.4
 CRI_R03: 71.0
 CRI_R04: 72.7
 CRI_R05: 84.3
 CRI_R06: 89.4
 CRI_R07: 74.8
 CRI_R08: 59.3
 CRI_R09: 34.9

```

CRI_R10:      84.1
CRI_R11:      73.1
CRI_R12:      74.3
CRI_R13:      91.7
CRI_R14:      82.3

```

- *CALCulate:PEAK <CR> Run peak calculation
 - peak search
 - calculation radiometric values for each peak range (set with *PARAMeter:PKBORDER)
- *CALCulate:LINT:DARK wbeg wend wstp <CR>
 Linear interpolation of dark values (wstp ≥ 0.1 nm)
Example of answer:

```

400.0  4775.31
402.0  4764.11
404.0  4752.92
406.0  4786.45
408.0  4829.23
410    4848.74
... .

```
- *CALCulate:LINT:LIGHT wbeg wend wstp <CR>
 Linear interpolation of light values (wstp ≥ 0.1 nm)
- *CALCulate:LINT:REFER wbeg wend wstp <CR>
 Linear interpolation of reference values (wstp ≥ 0.1 nm)
- *CALCulate:LINT:TRANS wbeg wend wstp <CR>
 Linear interpolation of transmission values (wstp ≥ 0.1 nm)
- *CALCulate:SPLIN:DARK wbeg wend wstp <CR>
 Spline interpolation of dark values (wstp ≥ 0.1 nm)
Example of answer:

```

400.0  4.94943506e+03
402.0  4.78587012e+03
404.0  4.74870703e+03
406.0  4.78368457e+03

```
- *CALCulate:SPLIN:LIGHT wbeg wend wstp <CR>
 Spline interpolation of light values (wstp ≥ 0.1 nm)
- *CALCulate:SPLIN:REFER wbeg wend wstp <CR>
 Spline interpolation of reference values (wstp ≥ 0.1 nm)
- *CALCulate:SPLIN:TRANS wbeg wend wstp <CR>
 Spline interpolation of transmission values (wstp ≥ 0.1 nm)
- *CALCulate:SPLIN:SPRAD wbeg wend wstp <CR>
 Spline interpolation of spectral radiometric data (wstp ≥ 0.1 nm)

10. Calibration commands

specbos xxx1 can store up to 20 calibration files (#1 ... #20). The first four addresses are provided for the basic measuring modes, selected with the hall sensor signal of the measuring head (see *PARAMeter:CALIBNumber).

* CALIBrate? Get a help list of the calibration commands

*CALIBrate:GET filenr <CR> Read selected (filenr) calibration file
 Units of spectral data:
 Radiance counts/ Ws/(m².sr.nm)
 Irradiance counts/ Ws/(m².nm)
 Radiant flux counts/ Ws/nm
 Radiant intensity counts/ Ws/(sr.nm)

Example of answer:

```

Radiance
Remark
380
780
1
538
3.637039e+03
3.690917e+03
3.758527e+03
... .

```

*CALIBrate:SET filenr <CR> Write selected (filenr) calibration file

*CALIBrate:CLEAR filenr <CR> Clear selected (filenr) calibration file

- *CALIBrate:EXECute fileNr <CR> Run calibration with selected lamp file, store into head or manually selected calibration file (fileNr), with integration time adaption
- | | |
|---|----------------------------|
| 0 | User calibration lamp file |
| 1 | 1172 |
| 2 | OL 455 |
| 3 | OL 455-100 |
| 4 | OL 455 – irradiance (90 k) |
- *CALIBrate:STATus? <CR> Get calibration status (hex number of bit code), file n = 2ⁿ⁻¹
Example of answer:
 23: file 1, file 2 and file 6 are valid
- *CALIBrate:LAMP:SET file <CR> Write user lamp file (Nr. 0)
 File format:
- | |
|--|
| Quantity (Radiance, Irradiance, Radiant flux or Radiant intensity) |
| Remark |
| Wbeg |
| Wend |
| Wstp |
| First value |
| Second value |
| |
- Units of spectral data:
- | | |
|-------------------|---------------------------|
| Radiance | W/(m ² ·sr·nm) |
| Irradiance | W/(m ² ·nm) |
| Radiant flux | W/nm |
| Radiant intensity | W/(sr·nm) |
- *CALIBrate:LAMP file <CR> Get lamp file (Nr. 1 ... 3), in 1 nm steps

11. Examples of measurement procedures

11.1. Raw data measurement

Task:

Start a measurement with fixed integration time of 100 ms, 2 scans for averaging, prior dark measurement, output of measured data, corrected by dark measurement as list with wavelengths, only between 400 and 500 nm in steps of 5 nm

```
*CONF:TINT 100 <CR>
*CONF:FORM 7 <CR>
*CONF:FUNC 2 <CR>
*CONF:WRAN 400 500 5 <CR>
*CONF:EXPO 2 <CR>
*INIT <CR>
*MEAS:REFER <CR>
```

11.2. Radiometric data measurement

Task:

Start of measurement after a waiting time for shutter opening (400 ms), adaption of integration time between 80 and 90 % of full scale, output of spectral data in ASCII formate (wavelength step 1 nm) and output of radiance of full wavelength range and of selected wavelength range 720 ... 760 nm and CRI with a fixed reference color temperature of 2856K

```
*PARA:SDEL 400 <CR>
*PARA:BORD 80 90 <CR>
*PARA:SAVE <CR>
*CONF:EXPO 1 <CR>
*CONF:FUNC 6 <CR>
*CONF:WSTP 1 <CR>
*READ 2 <CR>
*FETCH:RADIO <CR>
*CALC:RADIO 700 760 <CR>
*CALC:CRI 2856 <CR>
```

12. Essential Parameter to be set

Don't forget to use *PARA:SAVE, if you have changed parameters!

*PARA:PIX	Pixel quantity
*PARA:SENS	Type of sensor
*PARA:TINT	Integration time
*PARA:SDEL	Waiting time between triggering of a measurement and real start of exposure
*PARA:SHUT	Shutter available (1)
*PARA :LAMPE	(Lamp/) Shutter active (1)
*PARA :LAMPP	(Lamp/) Shutter polarity (low = 0, high = 1)
*PARA:BOXCA	Set to desired value, = 0, if this correction should be switched off
*CONF:EXPO	Mode of handling of integration time
*CONF:AVER	Averaging