TECHNICAL INFORMATION:

PRODUCT:	***L-LAS-TB CCD-Line-Laser-Sensor-Series***	Date:	28.08.2007
	Software – state: V2.30		(wk)
TOPIC:	RS232-Interface-Protocol for L-LAS-TB CCD-Sensors PC-Software-Version *L-LAS-TB-Scope V2.30*		

RS232 Interface-Protocol PC ⇔ *L-LAS-TB sensor*

- Standard RS232 serial interface, no hardware handshake
- 3-wire connection: GND, TX0, RX0
- Speed: 19200 baud, 8 data-bits, no parity-bit, 1 stop-bit, binary-mode

The control device (PC or PLC) have to send a frame of *18-words (1 word = 2 byte = 16 bit)* to the *L-LAS-TB* hardware. All words must be transmitted in binary format. The most significant byte must be transmitted first (MSB-first).

METHOD:
The microcontroller of the L-LAS-TB sensor is permanently reading (polling) the input-buffer of the RS-232 module. If the incoming word = *0x0055 (0x55 hexadecimal = 85 decimal)*, this is interpreted as the synchronisation-event **<sync-word>**. After this, the 2.nd word with the order number **<order-word>** is read in by the microcontroller.
The order word **<order-word>**, is followed by 16 further words **<parameter-word>**.
After reading the complete data-frame (18-words = 36 bytes), the *L-LAS-TB* sensor hardware executes the order which is coded at the 2.nd word **<order-word>**.

Format of the parameter-frame:

Word No.	Meaning	Comment
1	**<sync-word>** = 0x0055	hex-code 0x55, binary=0000 0000 0101 0101, dec.=85
2	**<order-word>**	Order word (c.f. table below)
3	parameter POWER	Laser Intensity (0 ... 1000)
4	parameter RS232MODE	RS232-mode STAT=0 / CONT=1 (continous data output)
5	parameter VIDEOTHD	Threshold for edge detection of video signal (1 …ADC-max)
6	parameter ANAMODE	Mode of Analog-output: (0=DIRECT, 1=DIRECT no AVG, 2=MAX-intern-triggerd, 3=MIN-intern-triggerd, 4=MAX-MIN intern-triggerd, 5=MAX-extern-triggered, 6=MIN-extern-triggerd, 7=MAX/MIN extern-triggered).
7	parameter POLARITY	Polarity setting for OUT0, OUT1, (0=DIRECT, 1=INVERSE)
8	parameter E-MODE	Eval-mode (0=L-EDGE, 1=R-EDGE, 2=WIDTH, 3=CENTER)
9	parameter E-BEGIN	Evaluation start-pixel (1 .. E_END-1)
10	parameter E-END	Evaluation end-pixel (E_BEG+1 .. MAXPIXEL)
11	parameter TEACH-VALUE	Teach-value TEACH (1 ...MAXPIXEL)
12	parameter TOLERANCE	Tolerance-value TOL: (0 ... MAXPIXEL/2)
13	parameter OP-MODE	Operation-Mode (LOW = 0 / HIGH = 1) gain or video-readout-mode (ADC-CNV = 1 / DIG-COMP = 0)
14	parameter HARDW-MODE	Enable/disable TOL-potentiometer and Button at Housing (DISABLE-ALL=0, ENABLE-ALL=1,ENABLE-BTN=2, ENABLE POTI=3)
15	parameter SLOPE	Slope parameter for calibration Y=slope*x + intersect Float-value is multiplied with 1024 (TB-50,TB-75) Float value is multiplied with 512 (TB-100)
16	parameter INTERSECT	Intersection parameter Y=slope*x + intersect Intersection has offset of 30000
17	parameter AVERAGE	Average setting: 1,2,4,8,16,32,64,128,256,512 or 1024
18	Parameter DELTATOL	Tolerance for differential mode 1 …MAXPIXEL

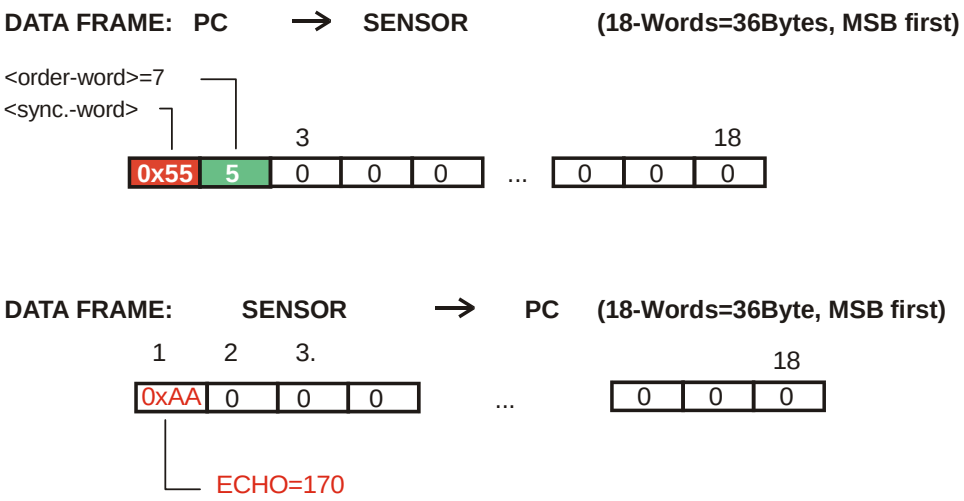
Meaning of the 2nd word of the data-frame: <order-word>		
Value	**Meaning / Action**	
0	Nop	no operation
1	Send parameter from PC into RAM of L-LAS	volatile: 18 words PC ⇒ L-LAS-RAM
2	Get L-LAS-RAM-parameter	18 words, L-LAS-RAM ⇒ PC
3	Send parameter from PC into EEPROM of L-LAS	18 words, PC ⇒ L-LAS-EEPROM
4	Get EEPROM parameters of L-LAS	18 words, L-LAS-EEPROM ⇒ PC
5	Echo check: Get echo of L-LAS, line ok = 0xAA	18 words, 3rd. word=0x00AA (Echo=170)
6	Activate Teach at L-LAS, store in RAM	18 words PC ⇒ L-LAS-RAM
7	Get software version info from L-LAS	36 words, L-LAS ⇒ PC (version-string)
8	**Get measured values out of L-LAS-RAM**	**18 words, L-LAS-RAM ⇒ PC**
9	Get data-buffer-block out of L-LAS-RAM,	64 words, L-LAS-RAM ⇒ PC
11	Reset maxima/minima-values (analog-output-mode)	18 words PC ⇒ L-LAS-RAM

EXAMPLES:

Echo check <order-word>=5

<order-word> = 5

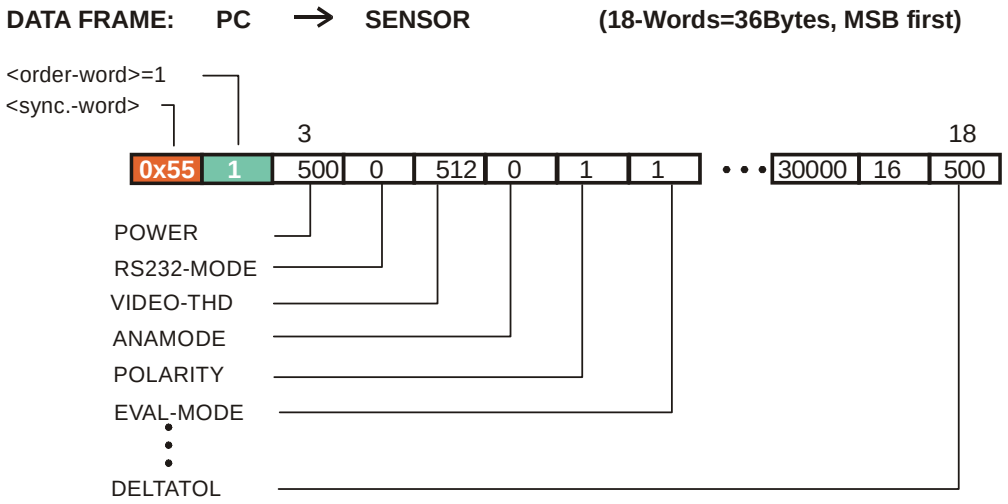
Echo check: send echo in 3rd. word to PC



SEND parameter to L-LAS-RAM <order-word>=1

<order-word> = 1

Send actual parameters and store the frame into L-LAS-RAM

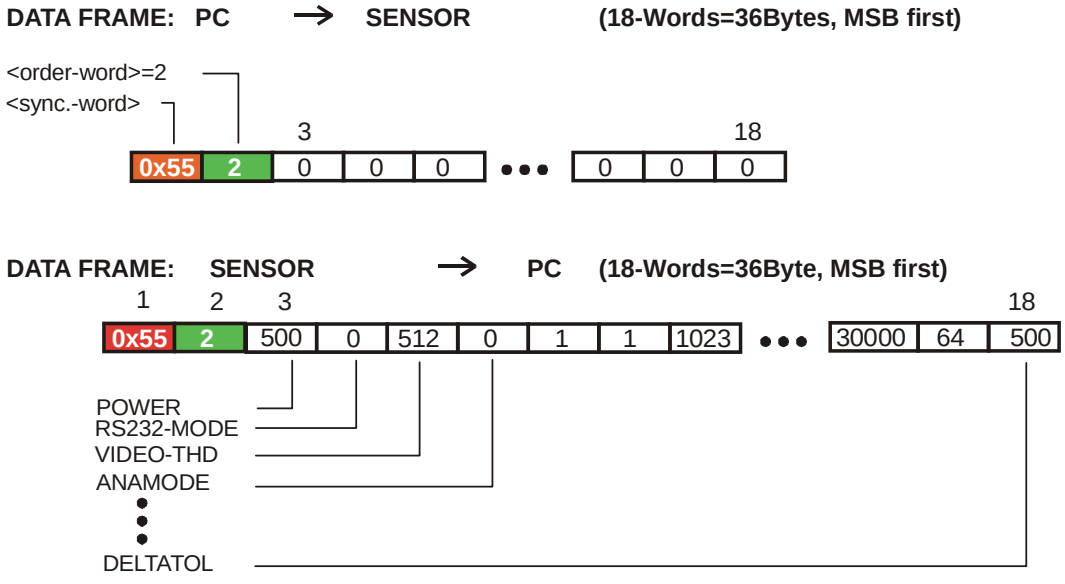


The transmitted data frame is echoed back to the PC by the SENSOR !!!

GET L-LAS-RAM parameter <order-word>=2

<order-word> = 2

GET L-LAS RAM parameter



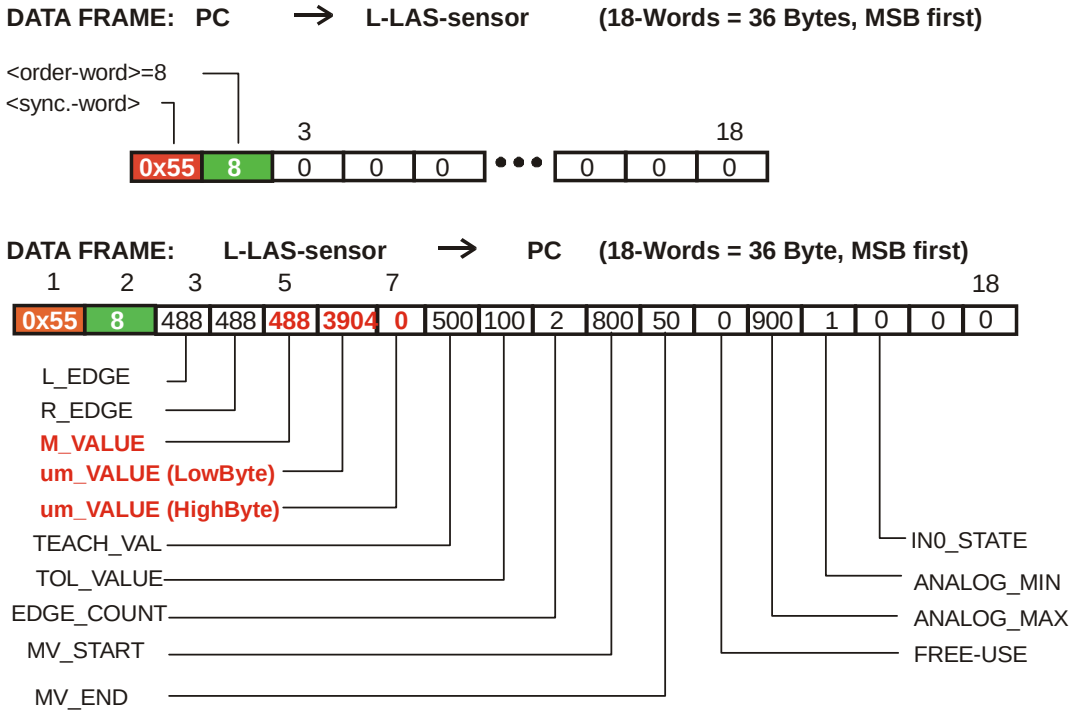
GET measured-values of L-LAS-sensor <order-word>=8

<order-word> = 8

The µController sends the actual measured values to the PC.

The 5. word of the data-frame represents the actual measured value: **M_VALUE**.

The 6 and 7th. word of the data-frame represents the measured value in micrometer: **um_VALUE**.



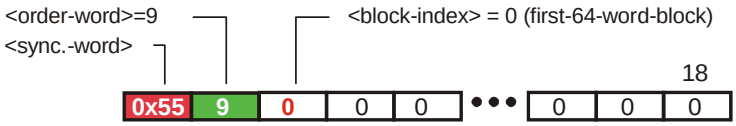
L_EDGE := left edge of ccd-intensity profile
R_EDGE := right edge of ccd-intenity profile
M_VALUE := measured value (= left edge because EVALMODE=0)
um_VALUE_LB := measured value (LOW-BYTE) in micrometer
um_VALUE_HB := measured value (HIGH-BYTE) in micrometer
TEACH-VAL := teach value
TOL-VALUE := tolerance value
EDGE_COUNT := number of detected edges
MV_START := mean value of the first 8 pixel of the evaluation range of the CCD-line
MV_END := mean value of the last 8 pixel of the evaluation range of the CCD-line
FREE_USE := not used
ANALOG_MAX := currently stored maximum-analog-value (analog-output)
ANALOG_MIN := currently stored minimum-analog-value (analog-output)
IN0_STATE := state of digital-input IN0,IN1,Button (0,1,2,4,7)

GET L-LAS-sensor DATA-BUFFER <order-word>=9

<order-word> = 9

Due to limited RAM memory at the L-LAS-sensor, the data buffers have to be sent to the PC in blocks of 64-words one after the other. The data buffer contents the 256-pixel of the intensity-profile which is measured at the CCD-receiver.

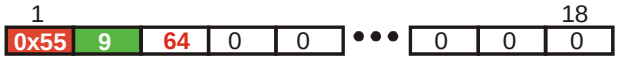
Step1: DATA FRAME: PC → L-LAS-sensor (18-Words=36Bytes, MSB first)



DATA FRAME: L-LAS-sensor → PC (64-Words = 128Byte, MSB first)

First block of 64 words are the first 64 pixel of the intensity-profile

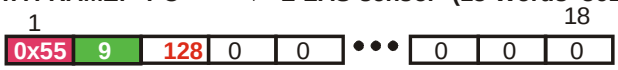
Step2: DATA FRAME: PC → L-LAS-sensor (18-Words=36Bytes, MSB first)



DATA FRAME: L-LAS-sensor → PC (64-Words = 128Byte, MSB first)

2nd. block of 64 words: pixel 65 to 128

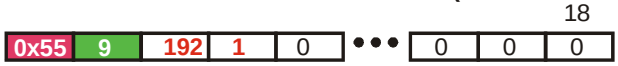
Step3: DATA FRAME: PC → L-LAS-sensor (18-Words=36Bytes, MSB first)



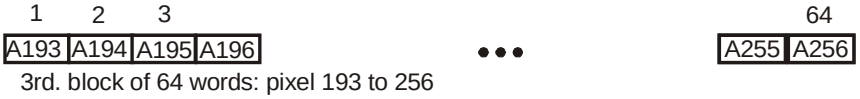
DATA FRAME: L-LAS-sensor → PC (64-Words = 128Byte, MSB first)

3rd. block of 64 words: pixel 129 to 192

Step4: DATA FRAME: PC → L-LAS-sensor (18-Words=36Bytes, MSB first)



DATA FRAME: L-LAS-sensor → PC (64-Words = 128Byte, MSB first)



3rd. block of 64 words: pixel 193 to 256