Description of the communication interface for the beam stabilisation system *"Compact"*

1. UART settings:

Encoding type: ASCII / binary
Baudrate: 115200 Bit/s
UART Setting: 8-N-1 (8 Data bits, No parity, one stop bit)

Each command consists of three uppercase letters followed by optional parameters and return values. The commands can be set either via the GUI or via an external controller. The commands and the semicolons are sent as ASCII characters and the parameters are transmitted binary-coded as unsigned short, short or char values. The byte order of 2 byte parameters or values is high byte first. The return values are also transferred binary-coded.

2. Type of values and parameters:

Type	Size
unsigned short	16 bits = 2 bytes
unsigned char	8 bits = 1 byte
short	16 bits = 2 bytes

Command parameters	Description and valid values
m (unsigned short)	Number of data blocks to be transmitted in a live stream (1-65500, 0=endless)
r (unsigned short)	Sampling rate for data blocks in samples/s
s (unsigned char)	Stage number to be selected (1 = stage1, 2 = stage2, 3 = both (only for software trigger))
p (unsigned short)	P-factor of control loop (0 – 5000mV)
o (short)	Offset for target position on detector (-5000mV – +5000mV)
a (unsigned char)	Axis to be selected (x or y)
d (short)	Drive value for direct piezo positioning (-5000mV – +5000mV)
b (unsigned char)	Baudrate (1 = 115200, 9 = 921600)

Return values	Description
A1 (unsigned char)	Stabilisation of stage1 active or not active, 1 = active, 0 = not active
A2 (unsigned char)	Stabilisation of stage2 active or not active, 1 = active, 0 = not active
E1 (unsigned char)	Stabilisation of stage1 enabled or disabled, 1 = enabled, 0 = disabled
E2 (unsigned char)	Stabilisation of stage2 enabled or disabled, 1 = enabled, 0 = disabled
DX1 (short)	Detector1, beam position on x-axis (-5000mV – +5000mV)
DY1 (short)	Detector1, beam position on y-axis (-5000mV – +5000mV)
DI1 (unsigned short)	Detector1, intensity (0 – 8000mV)
DX2 (short)	Detector2, beam position on x-axis (-5000mV – +5000mV)
DY2 (short)	Detector2, beam position on y-axis (-5000mV – +5000mV)
DI2 (unsigned short)	Detector2, intensity (0 – 8000mV)
RX1 (short)	Piezo range of x-axis, stage1 (0 – 10000mV)
RY1 (short)	Piezo range of y-axis, stage1 (0 – 10000mV)
RX2 (short)	Piezo range of x-axis, stage2 (0 – 10000mV)
RY2 (short)	Piezo range of y-axis, stage2 (0 – 10000mV)
p (unsigned short)	P-factor of control loop (0 – 5000mV)
o (short)	Offset for target position on detector (-5000mV – +5000mV)

3. Commands from external devices to the stabilisation system

Command	Description	Parameter	Comment
Command set for the real-time representation of the measured data			
S1S;	Start One Shot One time transmission of the measured data block.	Returns: • **0; (1; for error)** • **A1, A2** • **DX1, DY1, DI1** • **DX2, DY2, DI2** • **RX1, RY1** • **RX2, RY2** • ;	The measured data are transmitted in the given order one by one as a data block. The end of the block is marked with a semicolon.
SLS**mr**;	Start Live Stream Starts continuous transmission of data blocks	Parameters: • **m**: Number of data blocks to be transferred • **r**: Sampling rate for data blocks Returns: • **0; (1; for error)** Stream: • **A1, A2** • **DX1, DY1, DI1** • **DX2, DY2, DI2** • **RX1, RY1** • **RX2, RY2** • ; ...	The measured data are transmitted in the given order one by one as a data block (see figure 2). **m**-data blocks will be transmitted. The end of a block is marked with a semicolon. 1 ≤ **m** ≥ 65500, 0=endless The sampling rate **r** specifies the time interval during the transmission of two measurement packages. 1 ≤ **r** ≥ 500 samples/s error 1; if **m, r** out of range **Remark: No Timestamp**
CLS;	Clear Live Stream	Returns: • Rest of data block; • 0; (1; for error)	Stop the transmission of measured data.
Command set for individual parameters			
SSH**s**;	Start Set&Hold	Parameters: • **s**: Stage number Returns: • 0; (1; for error)	Activation of stage **s**. Freezes the last position on detector of stage **s** as target position for closed loop stabilisation. Value is stored in non-volatile memory. Error if stabilisation is “active”
CSH**s**;	Clear Set&Hold	Parameters: • **s**: Stage number Returns: • 0; (1; for error)	Deactivation of stage **s**. Reset target position to “0” on detector of stage **s**.
SPF**sp**;	Set P-Factor	Parameters: • **s**: Stage number • **p**: p-factor of control loop Returns: • 0; (1; for error)	For setups with extreme short or long distances between mirrors and detectors it is possible to optimize the stabilisation performance by the p-factor. Choose **p**=0 for external P-settings. Value is stored in non-volatile memory.
GPF**s**;	Get P-Factor	Parameters: • **s**: Stage number Returns: • 0; (1; for error) • **p**: p-factor of control loop • ;	Request for p-factor.
SAI**sao**;	Set Adjust-In	Parameters: • **s**: Stage number • **a**: axis for position shift • **o**: offset for target position Returns: • 0; (1; for error)	This command allows to align the laser beam electronically. An offset **o** is added to the detector signal to shift the target position for the closed loop stabilisation. Choose **o**=0 for external adjustment. Value is stored in non-volatile memory.

GAI**sa**;	Get Adjust-In	Parameters: • **s**: Stage number • **a**: axis for position shift Returns: • 0; (1; for error) • **o**: offset for target position • ;	Request for offset value of the Adjust-In function.
SDA**sad**;	Set Drive Actuator	Parameters: • **s**: Stage number • **a**: axis for position shift • **d**: drive value for Piezo Returns: • 0; (1; for error)	This command allows to drive the Piezos directly while the stabilisation is deactivated. That way the start position of the piezos before activating the stabilisation can be optimized to achieve a faster settling time in stabilised position.
SEA**s**;	Set External Activation	Parameters: • **s**: Stage number Returns: • 0; (1; for error)	Enable closed loop laser beam stabilisation of stage **s** to go active when laser power is high enough or ADDA is triggered.
CEA**s**;	Clear External Activation	Parameters: • **s**: Stage number Returns: • 0; (1; for error)	Disable closed loop laser beam stabilisation of stage **s**.
GEA;	Get External Activation	Returns: • 0; (1; for error) • **E1, E2** • ;	Request if closed loop stabilisation is enabled (**E1,2**=1) or disabled (**E1,2**=0) to go active when laser power is high enough or ADDA is triggered.
GAS;	Get Active Signal	Returns: • 0; (1; for error) • **A1, A2** • ;	Request if closed loop stabilisation is active or not. Please note that the stabilisation will be inactive automatically if the laser is off or the intensity on detectors < 0,5V or ADDA freezes actuators (even for **E1,2**=1).
STF**s**;	Set Trigger Freeze	Parameters: • **s**: Stage number 1, 2, or 3 Returns: • 0; (1; for error)	Starts the ADDA-module to freeze the last position of actuator of stage **s**. Remark: This trigger command corresponds to the external hardware trigger (TTL=low) with the same priority.
CTF**s**;	Clear Trigger Freeze	Parameters: • **s**: Stage number 1, 2, or 3 Returns: • 0; (1; for error)	Deactivates ADDA-module of stage **s** to return to closed loop stabilisation. Remark: This trigger command corresponds to the external hardware trigger (TTL=high) with the same priority.
SHS;	Set Handshaking	Returns: • 0; (1; for error)	Sets hardware handshaking for serial communication. Adjustment is stored in non-volatile memory.
CHS;	Clear Handshaking	Returns: • 0; (1; for error)	Deactivates hardware handshaking for serial communication. Adjustment is stored in non-volatile memory.
SBR**b**;	Set Baudrate	Parameters: • **b**: Baudrate Returns: • 0; (1; for error)	Reinitialises UART-module with a new baudrate. (if b = 1 then baudrate = 115200, if b = 9 then baudrate = 921600) Adjustment is stored in non-volatile memory.
GSF;	Get Status Flag	Returns: • 0; (1; for error) • Status byte • ;	Request for system status information (see Figure 3).
GID;	Get Identifier	Returns: • 0; (1; for error) • **48 byte long, product information number**	Request for product information. In contrast to the other returns the model, serial number and firmware version are transferred as ASCII characters.

4. Transmit / receive logic

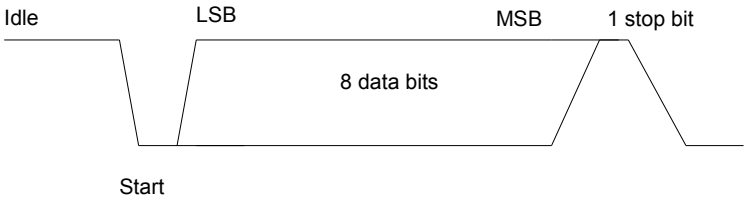

Figure 1: Character Frame

The transmit logic to the hardware performs parallel to serial conversion on the data read from the external device. The control logic outputs the serial bit stream beginning with the start bit and follow by 8 data bits (LSB first) and one stop bit (s. figure 1). The byte order for 2 byte values is high byte first.

Figure 2 shows the order and length of the received data with the command SLS**mr**;

0	;	A1	A2	DX1	DY1	DI1	DX2	DY2	DI2	RX1	RY1	RX2	RY2	;	A1	...
1byte	1byte	1byte	1byte	2byte	...								2byte	1byte	1byte	

Figure 2: Stream Frame

Figure 3 shows the order and length of the received data with the command GSF;

0	;	Res.	A2	A1	OnOff2	OnOff1	Adj2	Adj1	P-F	;
1byte	1byte			1byte						1byte

Figure 3: 4Byte long answer of GSF; command

Where A1 & A2 shows if stages are active (1) or not (0), OnOff 1 & OnOff2 if stages are enabled (1) or disabled (0), Adj1 & Adj2 if adjust function is set for software (1) or external signal (0) and P-F shows if P-factor function is set for software (1) or external signal (0).