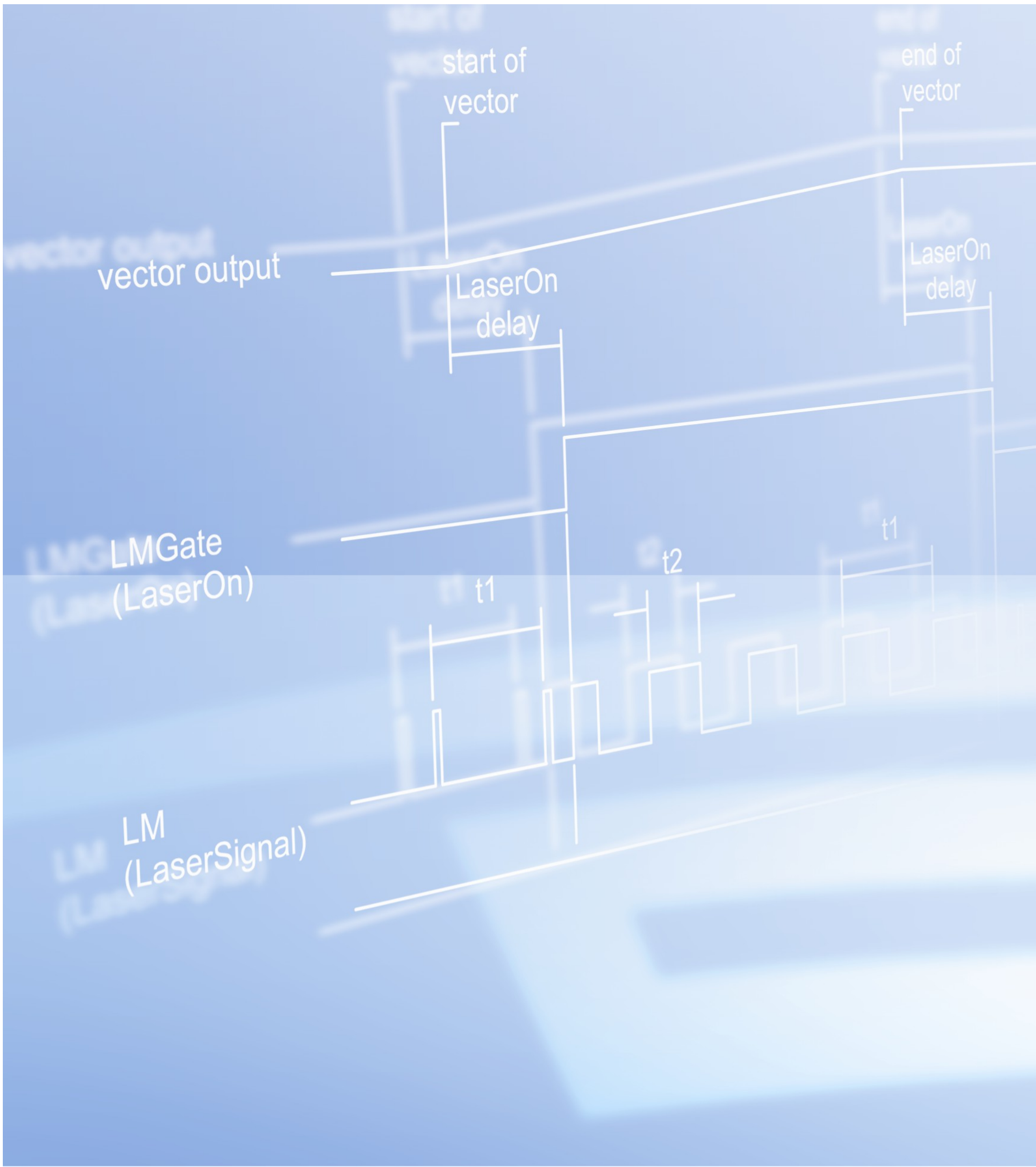
SS-III

Dokumentation of the XY2-100-E-Interface



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1 Overview

Besides the target position the XY2-100 enhanced protocol offers the possibility to send additional commands to the deflection unit and the user can influence the format of the feed-back channel.

In this documentation the innovations regarding SS-III deflection units are explained and differences to the previous SS and SS-II deflection heads are shown.

2 Electrical Interface

With XY2-100-E each axis (x, y and also z) of the deflection units has a data channel to the head and a data channel back to the control card. Additionally each axis has a common clock line and data line. All signals are transmitted electrically and differentially without galvanic isolation.

2.1 Physically

A standard 25-pin-DSUB-female connector on the deflection unit as well as on the control card is used for data transfer. On an appropriate cable all of the used pins are connected one-to-one.

The negative and positive wires of each differential electrical connection are led as twisted wire pair.

Within some deflection heads (DIG1) some of the pins are reserved for power supply. These pins must not be connected to the control card.

2.1.1 Pinning

Pin Head	Head Input / Output	signal name	control card input / output	Pin control card
1	input	CLK-	output	1
14	input	CLK+	output	14
2	input	SYNC-	output	2
15	input	SYNC+	output	15
3	input	X- Position und command (small mirror)	output	3
16	input	X+ Position und command (small mirror)	output	16
4	input	Y- Position und command (big mirror)	output	4
17	input	Y+ Position und command (big mirror)	output	17

Pin Head	Head Input / Output	signal name	control card input / output	Pin control card
5	input	Z- position und command (focus axis)	output	5
18	input	Z+ position und command (focus axis)	output	18
6	output	Y_stat- feed-back channel	input	6
19	output	Y_stat+ feed-back channel	input	19
7	output	Z_stat- feed-back channel	input	7
20	output	Z_stat+ feed-back channel	input	20
8	output	X_stat- feed-back channel	input	8
21	output	X_stat+ feed-back channel	input	21
9		optionally +15V for Head (not used in case of standard SS-III)	don't connect	9
22			don't connect	22
10			don't connect	10
23	GND	GND	GND	23
11	GND		GND	11
24	GND		GND	24
12		optionally -15V for Head (not used in case of standard SS-III)	don't connect	12
25			don't connect	25
13			don't connect	13
shield		GND		shield

2.1.2 Differences to other producers

Within the deflection units of RAYLASE AG the X-Axis is the one, which the laser hits first. Therefore the X-Mirror is the smaller one.

Some other producers define the axis which is first hit by the laser as Y-Axis.

Comparing the pinning of a RAYLASE head with those of other producers it can therefo re be noticed that the pins of the X and Y channels are swapped. As a result a deflection unit of another manufacturer can be replaced by a RAYLASE SS-III head without further considerations.

2.2 Signale

The maximum frequency of the clock is 10 MHz. 4 MHz are recommended.

As line driver UA9638CD is recommended. As line receiver MAX3096 or UA9637 are recommended. Alternativly AM26LV32 can also be used.

3 Data format

3.1 Timing of an isolated frame

A frame consists of 20 Bits. The last bit of a frame is shown by a '0' on the SYNC line pair (The SYNC line pair serves as latch signal)

During the positiv edge of the CLK+ line, data changes on the X-, Y- and Z-line pairs toward deflection unit.

During the negative edge of the CLK+ line, data changes on the X_stat-, Y_stat- and Z_stat-line pairs from the deflection unit. This means that the feed-back channels are mainly delayed by half clock time compaired to the channel toward deflection unit.

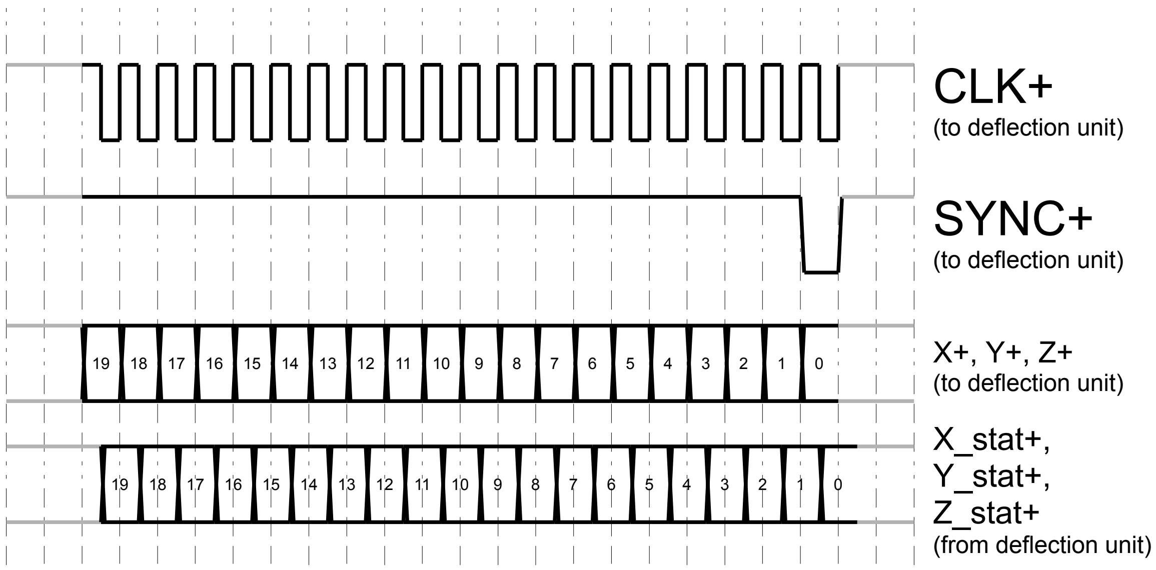

Diagram 1: isolated XY2-100-E frame

Within the diagram 1 a isolated frame is shown. The gray parts of the signals don't be-long to the frame.

3.2 Timing of coherent Frames

Within the diagram 2 the timing of coherent XY2-100-E frames is shown.

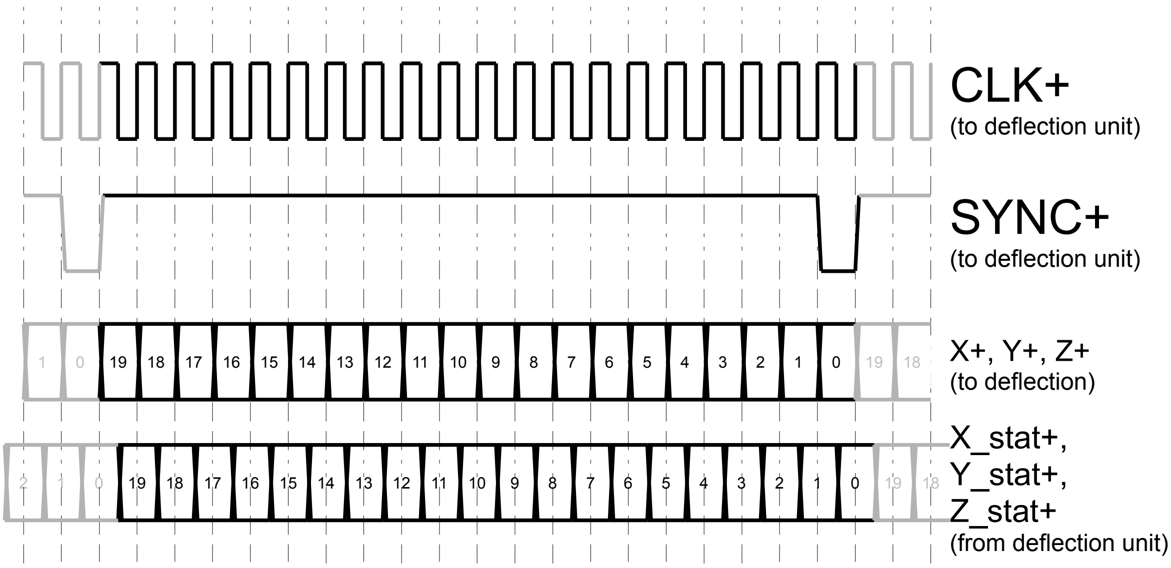

Diagram 2: Coherent XY2-100-E Frames

3.3 Structure of different data frames

Depending on data to be transmitted the XY2-100-E protocol defines different structured frames. The frames of the channels in direction to the deflection unit can be distinguished from each other clearly by statical definition of certain bits.

The frames on the feed-back channels (X|Y|Z_stat) cannot be distinguished from each other clearly. Because the controller card defines the data type of the each feed-back channel, data format is known by the controller card.

3.3.1 Frame types towards deflection unit

Towards the deflection unit there are three different frame types:

1. 16Bit target position (taken from XY2-100 without -E)
2. 16Bit target position (taken from XY2-100 without -E RAYLASE SuperScan and SS-II deflection units)

3. Command frame (according XY2-100-E specification 8 bit command and 8 bit parameter)

These three frame types can be distinguished clearly because of their structure. Within diagram 3 these frame types have been pictured. Different frame types can follow in any arbitrary order. The distinction between 18Bit target position frame and command frame occur by the different parity. This can cause that the deflection unit possibly cannot identify parity error any longer.

The target position (D15 - D0 or D17 - D0) is interpreted as unsigned integer in which D0 is the last significant bit and D15 or D17 the most significant bit.

A command frame transports a command byte (C7 - C0) and a related parameter byte (P7 - P0). The meaning of the parameter byte varies according the command byte.

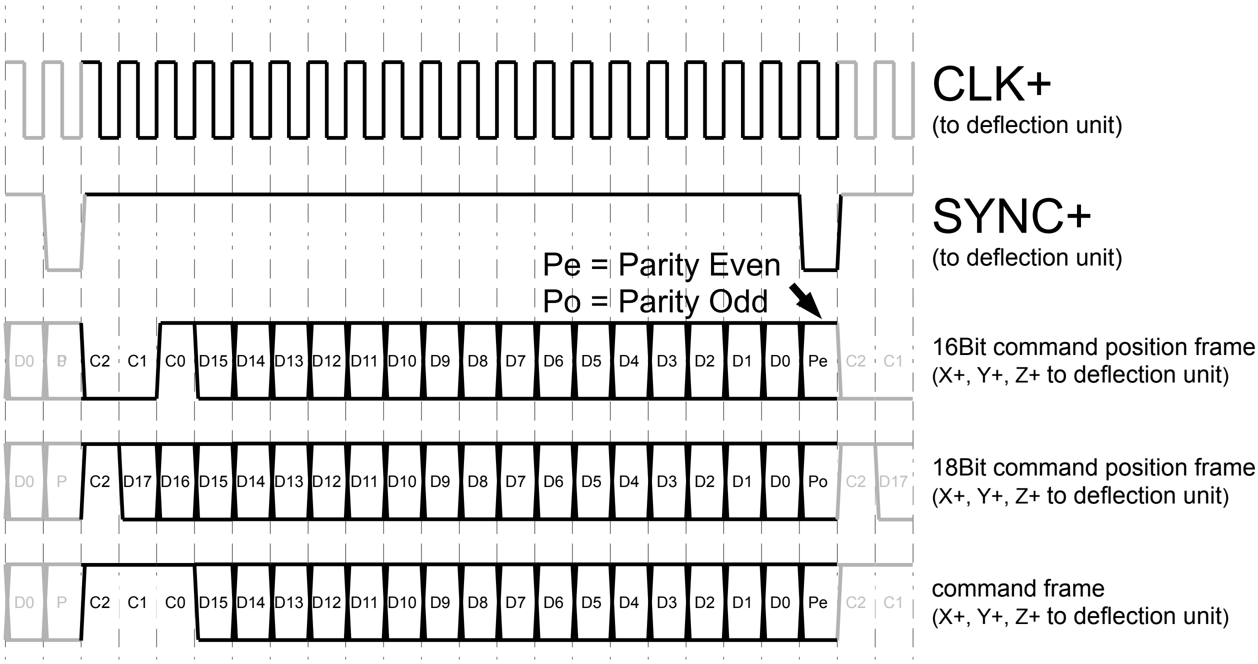

Diagram 3: Frame types towards deflection unit

3.3.2 <u>Frame typs towards control card</u>

On the twisted wires X_stat, Y_stat and Z_stat different Status information for each axis is transferred to the control card.

Because of the downward compatibility there are three different frame types which are not distinguishable from each other because of their structure. This doesn’t matter as the control card and its user exercise the entire control over the received data format via the command frame and therefore the received frame type is known by the user.

Within the diagram 4 three possible feed-back channel frame types are shown.

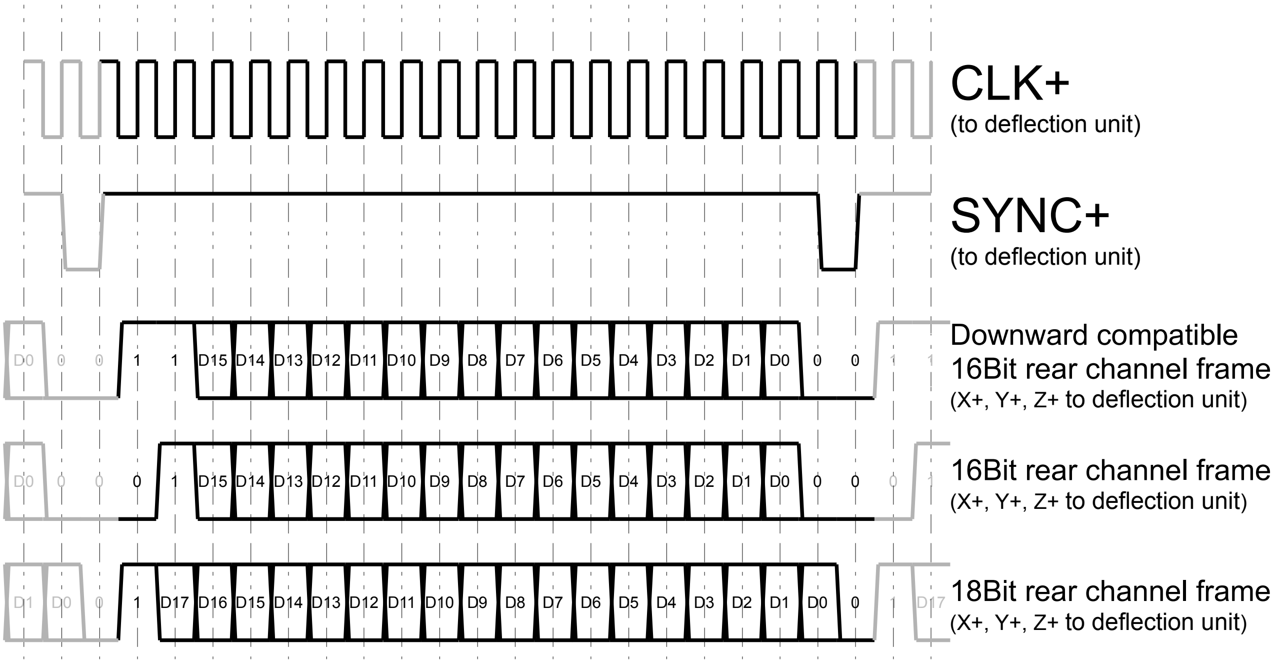

Diagram 4: Frame types towards control card

3.3.2.1 16Bit Downward Compatible Feed-Back Channel Frame

This feed-back channel frame type differs from 16Bit feed-back channel frame by a control bit at the begin of the frame. This frame type accords frame type of the Raylase analogue deflection unit (e.g. SS-II) exactly.

3.3.2.2 16Bit Feed-Back Channel Frame

This is the standard feed-back channel frame type.

3.3.2.3 18Bit Feed-Back Frame

This frame type offers a four times higher accuracy.

3.4 Mixing of frame types

Within the normal mode a 16- or 18-Bit target position is sent in each frame to each axis of the deflection unit. By mounting of a single command frame into the data stream it is possible to influence the behaviour of the head during operating mode. Since during the command frame lasting 10µs no target position can be transmitted the deflection unit interpolates the missing position information from the nearest two sampling points sent by the control card.

4 XY2-100-E Commands

Within this chapter it is described how the behaviour of the deflection unit can be influenced and different status information can be requested by the command frames.

4.1 Structure of a command

A command consists of two Bytes:

1. Command-Code
2. Command-Parameter

These two Bytes are sent to the deflection unit within a command frame with D15-D8 as command code and D7-D0 as command parameter.

Mainly up to 256 different command codes are possible. Within the SS-III not all of the possible commands are used.

The meaning of the command parameters vary dependent on the command code.

4.2 Overview of all Commands

Command-Code	Meaning
0x05	**SetMode**: selects the signal to be sent over the feed-back channel. Described in chapter 4.3.1 SetMode (0x05) on page 18.
0x0A	**UpdatePermanentMemory**: saves the current justifications to ensure that they are available even after re-boot of the deflection unit. Affected settings are: 1. Selected signal for the feed-back channel (SetMode (0x05)) 2. Controller parameter set (SelectControlDefinition (0x11)) 3. Field scaling (SetPositionScale (0x12)) 4. Tracking error range (SetPosAcknowledgeLevel (0x15)) 5. Interpolation time (SetInterpolation (0x90)) described in chapter 4.3.2 UpdatePermanentMemory (0x0A) on page 39.
0x11	**SelectControlDefinition**: switches the tuning of the head. Up to three tunings are preprogrammed. These can be changed. While the tunings are being swit-ched the axis has an undefined state. Described in chapter 4.3.3 SelectControlDefinition (0x11) on page 39.
0x12	**SetPositionScale**: defines the mechanic deflection of the axis. This command is **not supported** by SS-III. described in chapter 4.3.4 SetPositionScale (0x12) on page 40.
0x15	**SetPosAcknowledgelevel**: defines the tracking error range, from which the appropriate bit within the status word is erased. Desribed in chapter 4.3.5 SetPosAcknowledgeLevel (0x15) on page 40.
0x17	**Store/RestoreTransmissionMode**: saves and restores the currently adjusted feed-back channel signal. When paramter 0xFF is being transferred the currently adjusted feed-back channel signal (by SetMode 0x05) will be saved temporally (till re-boot). With the parameter 0x00 the last saved feed-back channel signal (by parameter 0xFF) will be restored. Desribed in chapter 4.3.6 StoreRestoreTransmissionMode (0x17) on page 41.
0x21	**SetEchoMode**: defines the feed-back channel signal on the basis of transfer-red parameter bytes: The bits out of the transferred parameter byte are taken into the upper 8 bits of the feed-back channel. The parameter byte being taken into the lower 8 bits of the feed-back channel is inverted before. Desribed in chapter 4.3.7 SetEchoMode (0x21) on page 41.
0x90	**SetInterpolationTime**: defines the interpolation mode and interpolation time. Desribed in chapter 4.3.8 SetInterpolation (0x90) on page 41.

4.3 Description of commands

4.3.1 SetMode (0x05)

This command selects the signal which is sent on the feed-back channel of the appropriate axis. Within the following table all of the possible feed-back channel data types and their corresponding parameter byte are listed.

Byte	Description	Frame-Type
0x00	Status word 0x00	16Bit Feed-Back Channel Frame
0x01	Actual Angular Position 0x01	16Bit Feed-Back Channel Frame
0x02	Set Angular Position 0x02	16Bit Feed-Back Channel Frame
0x03	Position Error 0x03	16Bit Feed-Back Channel Frame
0x04	Actual Current 0x04	16Bit Feed-Back Channel Frame
0x05	Relative Galvo Control 0x05	16Bit Feed-Back Channel Frame
0x06	Actual Angular Velocity 0x06	16Bit Feed-Back Channel Frame
0x14	Galvanometer Scanner Temperature 0x14 (nicht unterstützt)	16Bit Feed-Back Channel Frame
0x15	Servo Board Temperature 0x15	16Bit Feed-Back Channel Frame
0x16	AGC Voltage (0x16) (nicht unterstützt)	16Bit Feed-Back Channel Frame
0x17	DSP Core Supply Voltage (0x17)	16Bit Feed-Back Channel Frame
0x18	Analog Section Voltage (0x18)	16Bit Feed-Back Channel Frame
0x1A	AD Converter Supply Voltage (0x1A)	16Bit Feed-Back Channel Frame
0x1B	AGC Current (0x1B)	16Bit Feed-Back Channel Frame
0x1D	Relative Galvo Heating Output (0x1D)	16Bit Feed-Back Channel Frame
0x1E	Serial Number Low (0x1E)	16Bit Feed-Back Channel Frame
0x1F	Serial Number High (0x1F)	16Bit Feed-Back Channel Frame

Byte	Description	Frame-Type
0x20	Article Number Low (0x20)	16Bit Feed-Back Channel Frame
0x21	Article Number High (0x21)	16Bit Feed-Back Channel Frame
0x22	Firmware Version Number (0x22)	16Bit Feed-Back Channel Frame
0x23	Calibration (0x23)	16Bit Feed-Back Channel Frame
0x24	Aperture (0x24)	16Bit Feed-Back Channel Frame
0x25	Wavelength (0x25)	16Bit Feed-Back Channel Frame
0x26	Tuning Number (0x26)	16Bit Feed-Back Channel Frame
0x27	Data Type Selected (0x27)	16Bit Feed-Back Channel Frame
0x28	Current Operational State Low (0x28)	16Bit Feed-Back Channel Frame
0x29	Current Operational State High (0x29)	16Bit Feed-Back Channel Frame
0x2A	Stop Event Code (0x2A)	16Bit Feed-Back Channel Frame
0x2B	Flags on Stop Low (0x2B)	16Bit Feed-Back Channel Frame
0x2C	Flags on Stop High (0x2C)	16Bit Feed-Back Channel Frame
0x2F	Running Time Seconds (0x2F)	16Bit Feed-Back Channel Frame
0x30	Running Time Minutes (0x30)	16Bit Feed-Back Channel Frame
0x31	Running Time Hours (0x31)	16Bit Feed-Back Channel Frame
0x32	Running Time Days (0x32)	16Bit Feed-Back Channel Frame
0x3F	Position Value Scale Setting (0x3F)	16Bit Feed-Back Channel Frame
0x80	Compatible Statusword (0x80)	16Bit Downward Compatible Feed-Back Channel Frame
0x81	Actual Angular Position 18Bit (0x81)	18Bit Feed-Back Frame
0x82	Set Angular Position 18Bit (0x82)	18Bit Feed-Back Frame
0x83	Position Error 18Bit (0x83)	18Bit Feed-Back Frame

Byte	Description	Frame-Type
0x90	Interpolation Configuration (0x90)	18Bit Feed-Back Frame

4.3.1.1 Status word 0x00

Identification			SetMode Parameter	
Statusword			0x00	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	2x Unsigned 8Bit	-
Description				

Corresponds to the status word of the standard XY2-100 (without -E)

The status word consists of 8 Bit which are repeated in upper and lower Byte.

Bit 15 and Bit 7 = 1 : axis at work; = 0 : failure

Bit 14 and Bit 6 = 1 : galvo temperature normal; = 0 : galvo temperature failure (Within SS-III always OK, as this temperature is not measured)

Bit 13 and Bit 5 = 1 : position of the Z-Axis inside tracking failure window (currently not implemented and always 1)

Bit 12 and Bit 4 = 1 : position of the X-axis (little mirror) inside of the tracking error windows (The tracking error window can be configured by the command SetPosAcknowledgeLevel (0x15) as discribeb in chapter 4.3.5 on page 40)

Bit 11 and 3 = 1 : position of the Y-axis (tall mirror) inside of the tracking failure windows

Bit 10 and 2 = 1 : auto calibration sensor inactive (or always 1 if no auto calibration exists)

Bit 9 and 1 = always 0

Bit 8 and 0 = always 1

4.3.1.2 Actual Angular Position 0x01

Identification			SetMode Parameter	
Actual Angular Position			0x01	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-32768	-	32767	Signed 16Bit	-
Description				
Measured actual position of the mirror as 16Bit signed integer 0 means that the axis stays in the mittle of the field. As this measured value is noisy it is possible that the field border is exceeded. In this case the delivered value is saturated on the possible minimum or maximum value. If the actual value is -32768 or + 32768, the actual measured value has been very probably undercut or exceeded then. This feed-back channel signal is also available with 18Bit resolution: Actual Angular Position 18Bit (0x81) (Kapitel 4.3.1.37 auf Seite 37)				

4.3.1.3 Set Angular Position 0x02

Identification			SetMode Parameter	
Set Angular Position			0x02	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-32768	-	32767	Signed 16Bit	-
Description				
Internal command position of the mirror as 16Bit signed integer 0 means that the axis has to stay in the mittle of the field. This value cannot under- or overflow as the range equates to the (unsigned-) command positi-on of the each command channel exactly. Under certain circumstances (in failure case or short after switching on the supply voltage) the internal command position within the deflection unit is not equal to the commanded position via XY2-100 interface. This feed-back channel signal is also available with 18 Bit resolution: (Chapter 4.3.1.38 on page 37)				

4.3.1.4 Position Error 0x03

Identification		SetMode Parameter		
Position Error		0x03		
Range				
Minimal	Nominal	Maximal	Data type	Unit
-32768	-	32767	Signed 16Bit	-
Description				
Delivers signed integer which is calculated from Set Angular Position – Actual Angular Position. This value can overflow (e.g. when a command step from one to the other end of the field is executed). In case of a under- or overflow the value is saturated to -32768 or +32767. Even if this value is nearby to 0 it is not guaranteed that the particular mirror stays on the target position as the internal command position (can be requested via Set Angular Position 0x02) must not comform to the commanded position. This can occur when the axis has not booted yet or when an error occurs. Also in case of a transmission error of the command position the axis doesn't stay at the target position. This feed-back channel signal is also available with 18Bit resolution: Position Error 18Bit (0x83) (chapter 4.3.1.39 on page 38)				

4.3.1.5 Actual Current 0x04

Identification		SetMode Parameter		
Actual Current		0x04		
Range				
Minimal	Nominal	Maximal	Data type	Unit
-32768	-	32767	Signed 16Bit	mA
Description				
Delivers the galvo current measured within the feed-back channel as signed integer as mA. A saturation can but won't occur as the range dimensioned large enough. The maximum current can be +-10A approximately.				

4.3.1.6 Relative Galvo Control 0x05

Identification		SetMode Parameter		
Relative Galvo Control		0x05		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-1000	-	1000	Signed 16Bit	Per thousand
Description				
Delivers the commanded current of the galvanometer as signed integer within the unit per thousand. +-1000 per thousand accords +-10A.				

4.3.1.7 Actual Angular Velocity 0x06

Identification		SetMode Parameter		
Actual Angular Velocity		0x06		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-32768	-	32767	Signed 16Bit	Bit/ms
Description				
Delivers current speed of the mirror of the appropriate axis within Bit/ms. In case of under- or overflow the value will be saturated on -32768 or +32767.				

4.3.1.8 Galvanometer Scanner Temperature 0x14

Identification		SetMode Parameter		
Galvanometer Scanner Temperature		0x014		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	300 (30°C)	-	Signed 16Bit	°C
Description				
Delivers current temperature of the galvanometer as signed integer in 1/10°C. As no sensor exists, always +30°C (300) is delivered.				

4.3.1.9 Servo Board Temperature 0x15

Identification		SetMode Parameter		
Servo Board Temperature		0x015		
Range				
Minimal	Nominal	Maximal	Data type	Unit
-400 (-40°C)	-	1200 (120°C)	Signed 16Bit	°C
Description				
Delivers the actual temperature of the servo board as signed integer in 1/10°C. When the temperature value 80°C is exceeded, the axis is deactivated until the temperature falls below 78°C .				

4.3.1.10 AGC Voltage (0x16)

Identification		SetMode Parameter		
AGC Voltage		0x016		
Range				
Minimal	Nominal	Maximal	Data type	Unit
-	0	-	Signed 16Bit	-
Description				
Within the SS-III systems AGC voltage is not measured. Therefore this value is always 0.				

4.3.1.11 DSP Core Supply Voltage (0x17)

Identification		SetMode Parameter		
DSP Core Supply Voltage		0x17		
Range				
Minimal	Nominal	Maximal	Data type	Unit
1,75V (175)	1,9V (190)	2,15V (215)	Signed 16Bit	1/100 V
Description				
Delivers the actual core voltage of the processor as signed integer in 1/100V. The nominal value is 1.9 V. When the limits are exceeded the axis is deactivated.				

4.3.1.12 Analog Section Voltage (0x18)

Identification		SetMode Parameter		
Analog Section Voltage		0x18		
Range				
Minimal	Nominal	Maximal	Data type	Unit
10V (1000)	12V (1200)	14V (1400)	Signed 16Bit	1/100 V
Description				
Delivers the positive supply voltage of the detector curcuit as signed integer in 1/100 V. The nominal value is 12 V. When the limits are exceeded the axis is deactivated.				

4.3.1.13 AD Converter Supply Voltage (0x1A)

Identification		SetMode Parameter		
AD Converter Supply Voltage		0x1A		
Range				
Minimal	Nominal	Maximal	Data type	Unit
2,3V (230)	2,5V (250)	2.7V (270)	Signed 16Bit	1/100 V
Description				
Delivers the positive supply voltage of the AD converter as signed integer in 1/100 V. The nominal value is 2.5 V. When the limits are exceeded the axis is deactivated.				

4.3.1.14 AGC Current (0x1B)

Identification		SetMode Parameter		
AGC Current		0x1B		
Range				
Minimal	Nominal	Maximal	Data type	Unit
28mA (28)	60mA (60)	100mA (100)	Signed 16Bit	mA
Description				
Delivers the AGC current of the position detector as signed integer in mA. The nominal value is 60mA. When the limits are exceeded the axis is deactivated.				

4.3.1.15 Relative Galvo Heating Output (0x1D)

Identification			SetMode Parameter	
Relative Galvo Heating Output			0x1D	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
0	0	0	Signed 16Bit	-
Description				
Since SS-III doesn't own galvo heating this value is always 0.				

4.3.1.16 Serial Number Low (0x1E)

Identification			SetMode Parameter	
Serial Number Low			0x1E	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Unsigned 16Bit	-
Description				
Delivers the lower 16Bit of the 32Bit serial number of the deflection unit. Together with Serial Number High (0x1F) the 32Bit serial number is built. Calculation of the serial number is 65536 * Serial Number High (0x1F) + Serial Number Low (0x1E)				

4.3.1.17 Serial Number High (0x1F)

Identification			SetMode Parameter	
Serial Number High			0x1F	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Unsigned 16Bit	-
Description				
Delivers the upper 16Bit of the 32Bit serial number of the deflection unit. Together with Serial Number Low (0x1E) the 32Bit serial number comes into existence. Calculation of the serial number is 65536 * Serial Number High (0x1F) + Serial Number Low (0x1E)				

4.3.1.18 Article Number Low (0x20)

Identification			SetMode Parameter	
Article Number Low			0x20	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Unsigned 16Bit	-
Description				
Delivers the lower 16Bit of the 32Bit article number of the deflection unit. Together with Article Number High (0x21) the 32Bit article number comes into existence. Calculation of the article number is 65536 * Article Number High (0x21) + Article Number Low (0x20)				

4.3.1.19 Article Number High (0x21)

Identification			SetMode Parameter	
Article Number High			0x21	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Unsigned 16Bit	-
Description				
Delivers the upper 16Bit of the 32Bit article number of the deflection unit. Together with Article Number Low (0x20) the 32Bit article number comes into existence. Calculation of the article number is 65536 * Article Number High (0x21) + Article Number Low (0x20)				

4.3.1.20 Firmware Version Number (0x22)

Identification			SetMode Parameter	
Firmware Version Number			0x22	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Unsigned 16Bit	-
Description				
Delivers the version of the firmware of the axis.				

4.3.1.21 Calibration (0x23)

4.3.1.22 Aperture (0x24)

Identification			SetMode Parameter	
Aperture			0x24	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Signed 16Bit	Millimeter
Description				
Delivers the aperture of the beam of the axis as mm.				

4.3.1.23 Wavelength (0x25)

Identification			SetMode Parameter	
Wavelength			0x25	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Signed 16Bit	nm
Description				
Delivers the wave length of the laser in nm which the coating of the mirror dimensioned for. Following laser types offer accordingly : CO2-Laser: 10600nm YAG-Laser: 1064nm D-YAG-Laser: 532nm T-YAG-Lser: 355nm				

4.3.1.24 Tuning Number (0x26)

Identification		SetMode Parameter		
Tuning Number		0x26		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	2x Unsigned 8Bit	-
Description				
Within the upper 8Bit (D15 downto D8) the number of the actual adjusted tuning of the axis is delivered. (The tuning can be selected by the command SelectControlDefinition (0x11), described in the chapter 4.3.3 on page 39) Within the lower 8Bit (D7 downto D0) the number of the tuning is shown which is loaded automatically after switching on the supply voltage of the axis. With the command UpdatePermanentMemory (0x0A), described in the chapter 4.3.2 on page 39, the actual adjusted tuning can be activated to be loaded automatically after booting.				

4.3.1.25 Data Type Selected (0x27)

Identification		SetMode Parameter		
Data Type Selected		0x27		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	2x Unsigned 8Bit	-
Description				
Within the upper 8Bit (D15 downto D8) the number of the actual adjusted feed-back channel signal of the axis is delivered. Therefore the upper 8Bit are always 0x27. (The feed-back channel signal is selected by the command SetMode (0x05), i.e. by the command whose parameters are described here). Within the lower 8Bit (D7 downto D0) the number of the tuning is shown which is loaded automatically after switching on the supply voltage of the axis. With the command UpdatePermanentMemory (0x0A), described in the chapter 4.3.2 on page 39, the actual adjusted tuning can be activated to be loaded automatically after booting.				

4.3.1.26 Current Operational State Low (0x28)

Identification			SetMode Parameter	
Current Operational State Low			0x28	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Flags 16Bit	-
Description				
Bit 15 (MSB) = 1: output stage active Bit 14 = 0: galvo heating inactive (SS-III has no galvo heating) Bit 13 = 1: all of voltages (internal generated ones too) within allowed range Bit 12 = 1: tracking error of the tracking error window (adjustable with the command SetPo-sAcknowledgeLevel (0x15) described in the chapter 4.3.5 on page 40) Bit 11 = 1: Servo board temperature normal (i.e. under 80°C) Bit 10 = 1: Boot process finished Bit 9 = 1: no permanent error case Bit 8 = 1: External supply voltages are okay Bit 7 = 1: Servo board temperature normal (d.h. unter 80°C) Bit 6 = 1: ADC initialized Bit 5 = 1: Axis is not within a critical position Bit 4 = 1: Controller parameters are okay Bit 3 = 1: unused Bit 2 = 1: unused Bit 1 = 1: unused Bit 0 = 0: Position controlling of the axis is active				

4.3.1.27 Current Operational State High (0x29)

Identification		SetMode Parameter		
Current Operational State High		0x29		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Flags 16Bit	-
Description				
Bit 31 (MSB) = 1: AGC of the position detector is within the allowed range Bit 30 = 1: Analogue supply voltages are okay Bit 29 = 1: ADC supply voltage okay (2.5V) Bit 28 = 1: DSP supply voltage okay (3.3V) Bit 27 = 1: DSP core voltage okay (1.9V) Bit 26 = 1: Servo board temperature okay Bit 25 = 1: Galvo temperature okay Bit 24 = 1: Current measurement of the output stage okay Bit 23 = 1: Commanded current value for the output stage okay Bit 22 = 1: unused Bit 21 = 1: unused Bit 20 = 1: unused Bit 19 = 1: unused Bit 18 = 1: unused Bit 17 = 1: unused Bit 16 = 0: unused				

4.3.1.28 Stop Event Code (0x2A)

Identification		SetMode Parameter		
Stop Event Code		0x2A		
Range				
Minimal	Nominal	Maximal	Data type	Unit
-	0	-	Unsigned 16Bit	-
Description				
Delivers the reason of the last occured error 0x0000: no error 0x0001: Galvanometer reached a critical edge position (unused) 0x0002: ADC error (unused) 0x0003: Temperature to high 0x0004: External supply voltage outside of allowed range 0x0005: Invalid flags (unused) 0x0006 – 0x000C: reserved (unused) 0x000D: Watchdog (unused) 0x000E: Position error too high for too long time (unused) 0x000F: Reserved (unused) 0x0010: Error within the current controlling of the output stroge (too high impulse load) 0x0011 – 0xFFFF: unused				

4.3.1.29 Flags on Stop Low (0x2B)

Identification		SetMode Parameter		
Flags on Stop Low		0x2B		
Range				
Minimal	Nominal	Maximal	Data type	Unit
-	-	-	Flags 16Bit	-
Description				
Delivers the state of the flags (Current Operational State Low (0x28)) within the moment of the last triggered error state.				

4.3.1.30 <u>Flags on Stop High (0x2C)</u>

Identification			SetMode Parameter	
Flags on Stop Low			0x2C	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	Flags 16Bit	-
Description				
Delivers the state of flags (Current Operational State High (0x29)) within the moment of the last caused error state.				

4.3.1.31 <u>Running Time Seconds (0x2F)</u>

Identification			SetMode Parameter	
Running Time Seconds			0x2F	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
0	-	59	Signed 16Bit	Sekunden
Description				
Delivers the second part of the total running time of the axis. After every second this value is incremented. After reaching the maximum value (59) a carry is generated into Running Time Minutes (0x30) and this value is reset to 0. The total running time of the axis is not lost after switching of the power supply.				

4.3.1.32 Running Time Minutes (0x30)

Identification		**SetMode Parameter**		
Running Time Minutes		0x30		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
0	-	59	Signed 16Bit	Minuten
Description				
Delivers the minute part of the total running time of the axis. After every second this value is incremented. After reaching the maximum value (59) a carry is generated into Running Time Hours (0x31) and this value is reset to 0. The total running time of the axis is not lost after switching of the power supply.				

4.3.1.33 Running Time Hours (0x31)

Identification		**SetMode Parameter**		
Running Time Hours		0x31		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
0	-	23	Signed 16Bit	Stunden
Description				
Delivers the hour part of the total running time of the axis. After every second this value is incremented. After reaching the maximum value (59) a carry is generated into Running Time Days (0x32) and this value is reset to 0. The total running time of the axis is not lost after switching of the power supply.				

4.3.1.34 Running Time Days (0x32)

Identification		SetMode Parameter		
Running Time Days		0x32		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
0	-	32767	Signed 16Bit	Tage
Description				
Delivers the day part of the total running time of the axis. After each day this value is incremented. The total running time of the axis is not lost after switching of the power supply.				

4.3.1.35 Position Value Scale Setting (0x3F)

Identification		SetMode Parameter		
Position Value Scale Setting		0x3F		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	0	-	Signed 16Bit	-
Description				
Not supported				

4.3.1.36 <u>Compatible Statusword (0x80)</u>

Identification			**SetMode Parameter**	
Compatible Statusword			0x80	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	2x Unsigned 8Bit, SS-II kompatibles Frameformat	-
Description				

Conforms to the status word of the standard XY2-100 (without -E).
The only difference to Status word 0x00 ist, that the 16Bit Downward Compatible Feed-Back Channel Frame is used instead of 16Bit Feed-Back Channel Frame. The meaning and the function of the bits are identical to Status word 0x00. This feed-back channel signal conforms to the ones of the SS-II.

The status word consists of 8 bits which are repeated within the higher and lower byte.

Bit 15 and 7: 1 = Axis is running; 0 = error

Bit 14 and 6: 1 = Galvo temperature normal; 0 = Galvo temperature error (In SS-III always OK, as this temperature is not captured)

Bit 13 and 5: 1 = Position of the Z-Axis inside tracking error window (currently not implemented and always 1)

Bit 12 and 4: 1 = Position of the X-axis (small mirror) inside tracking error window. (the tracking error window can be configured by the command SetPosAcknowledgeLevel (0x15), as described in chapter 4.3.5 on page 35.)

Bit 11 and 3: 1 = Position of the Y-Axis (tall mirror) inside tracking error window

Bit 10 and 2: 1 = auto calibration sensor inactiv (or always 1, when no auto calibration exists)

Bit 9 and 1: always 0

Bit 8 and 0: always 1

4.3.1.37 Actual Angular Position 18Bit (0x81)

Identification			SetMode Parameter	
Actual Angular Position 18Bit			0x81	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-131072	-	131071	Signed 18Bit	-
Description				
Measured actual position of the mirror as 18Bit signed integer A 0 means that the axis stays in the mittle of the field. Since this measured value is noisy it can be that the available range at the edge of the field is exceeded. In this case the issued value is saturated to the possible minimum or maximum value. Is the value -131072 or +131071 so the real measured value is exceeded probably. This feed-back channel signal doesn't differ from Actual Angular Position 0x01 (chapter 4.3.1.2 on page 21) except for higher resolution.				

4.3.1.38 Set Angular Position 18Bit (0x82)

Identification			SetMode Parameter	
Set Angular Position 18Bit			0x82	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-131072	-	131071	Signed 18Bit	-
Description				
Internal command position of the mirror as 18Bit signed integer A 0 means that the axis has to stay in the middle of the field. This value cannot under- or overflow as the range equals the (unsigned) command position of the appropriate command channel exactly. Under certain circumtances (in error case or short after activation of the supply voltage) the command position is unequal to the position commanded via XY2-100. This feed-back channel signal doesn't differ from Set Angular Position 0x02 (chapter 4.3.1.3 on page 21) except for higher resolution.				

4.3.1.39 Position Error 18Bit (0x83)

Identification			SetMode Parameter	
Position Error 18Bit			0x83	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-131072	-	131071	Signed 18Bit	-
Description				
Delivers a signed integer which is calculated from Set Angular Position – Actual Angular Positi-on. This value can overflow (e.g. if a commanded step is executed from one to the other end of the field). In case of under- or overflow the value is saturated to -131072 or +131071. Even if this value is almost 0 it is not a credible indicator that the particular mirror stays on the expected position as the internal command position (requestable over Set Angular Position 18Bit (0x82)) must not equate to the commanded position. This can occure when the axis hasn't been booted yet or an error appears. Also in case of a transmission error of the command position the axis doesn't stay on the target position. This feed-back channel signal doesn't differ from Position Error 0x03 (chapter 4.3.1.4 on page 22) except for higher resolution.				

4.3.1.40 Interpolation Configuration (0x90)

Identification			SetMode Parameter	
Interpolation Configuration			0x90	
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	2x Unsigned 8Bit	
Description				
Within the upper 8Bits (D15 downto D8) the actual adjusted interpolation time is delivered back. Within the lower 8Bits (D7 downto D0) the interpolation time is delivered back which is loaded automatically after switching on the supply voltage. With the command UpdatePermanentMemory (0x0A), described in chapter 4.3.2 on page 39, the actual adjusted interpolation time can be activated to be loaded automatically after Booting. With the command SetInterpolation (0x90) (described in chapter 4.3.8 on page 41) the interpo-lation time can be adjusted. Also die meaning of the bits of the both delivered bytes is descri-bed there.				

4.3.1.41 Setpos Acknowledge Level (0x40)

Identification		SetMode Parameter		
SetposAcknowledgeLevel		0x40		
Range				
Minimal	**Nominal**	**Maximal**	**Data type**	**Unit**
-	-	-	2x Unsigned 8Bit	-
Description				
Within the upper 8Bits (D15 downto D8) the actual adjusted SetPosAcknowledgeLevel of the axis is delivered back. (The tuning can be selected by the command SetPosAcknowledgeLevel (0x15), described in chapter 4.3.5 on page 40.) Within the lower 8Bits (D7 downto D0) the SetPosAcknowledgeLevel is shown which is automatically loaded after switching on the supply voltage of the axis. With the command UpdatePermanentMemory (0x0A), described in chapter 4.3.2 on page 39 the actual adjusted SetPosAcknowledgeLevel can be activated to be loaded automatically after Booting.				

4.3.2 UpdatePermanentMemory (0x0A)

Saves the current adjustments to make them available after re-boot of the deflection unit.

Following adjustments are saved:

1. selected signal for the feed-back channel (4.3.1 SetMode (0x05), page 18)
2. set of controller parameters (4.3.3 SelectControlDefinition (0x11), page 39)
3. field scaling (SetPositionScale (4.3.4 SetPositionScale (0x12), page 40)
4. limit of the tracking error (4.3.5 SetPosAcknowledgeLevel (0x15), page 40)
5. Interpolation time (4.3.8 SetInterpolation (0x90), page 41)

to execute this command 0x00 must be sent as command. Therefore the intire 16Bit use data of the command frame must be 0x0A00.

This command can be executed during the normal operating mode whithout braking the axis movement.

4.3.3 SelectControlDefinition (0x11)

With this command different tuning sets can be activated. The tuning sets are preprogrammed by RAYLASE.

The goal of different tuning sets is to adjust the dynamic behaviour of the deflection unit during the operating mode. In the SS-III there are three different tuning sets which are described in the table 1.

Switching tunings during operation is possible. However, the switching requires some ms during which the axes are in undefined state. It is therefore recommended to introduce a sufficient switching delay between the corresponding markings.

Switching of the tuning set occurs by the command code 0x11 and the number of the tuning set within the command parameter. Allowed command parameters are 0, 1 and 2. All the other parameters are ignored. If a tuning set which has been already loaded is selected again, the disturbance described above doesn't appear.

With the command SetMode (0x05) with parameter Tuning Number (0x26) (chapter 4.3.1.24 on page 29) a feed-back channel signal can be adjusted which delivers the current adjusted Tuning and the tuning which has been loaded automatically after switching on.

With command UpdatePermanentMemory (0x0A) (described in chapter 4.3.2 on page 39) the tuning can be changed which is loaded automatically after switching on.

Tuing set 0	Tuning set 1	Tuning set 2
Low Noise	Rapid	Step
This is the default tuning. It is optimized on minimum noise, ideal for bitmap applications or for marking of lines with minimum dither.	Especially ideal for fast inscribing This tuning type contains a minimized acceleration time which makes fast scribing possible. Edge radiuses are particularly small.	Especially ideal for applications with long steps. With this tuning the axes reach a particularly high end speed and minimized step time with large steps.

Table 1: available Tunings within SS-III

4.3.4 SetPositionScale (0x12)

This command is not supported within SS-III.

4.3.5 SetPosAcknowledgeLevel (0x15)

With the parameter byte of this command the tracking error window is defined. The default value ist 183 (this equates 0.28% of the service field).

If the position error is greater than tracking error window, PosAck bits are reset to 0 in the feed-back channel signals Status word 0x00 (page 20), Current Operational State Low (0x28) (page 30) and Compatible Statusword (0x80) (page 36).

The current position error can be requested over the feed-back channel signal Position Error 0x03 (page 22).

4.3.6 StoreRestoreTransmissionMode (0x17)

This command saves the actual feed-back channel signal temporally or regenerates a feed-back channel signal temporally saved earlier.

When the parameter byte 0x00 is transferred, a feed-back channel signal temporally saved earlier is regenerated.

When the parameter byte 0xFF is transferred, the current feed-back channel signal is saved temporally (until the new start of the axis).

4.3.7 SetEchoMode (0x21)

This command sets the feed-back channel signal in such a way that the upper 8 bits of the feed-back channel equate to parameter byte and the lower 8 bits of the feed-back channel to simple complement of the parameter byte.

With this command the XY2-100 interface can be investigated regarding transmission error.

4.3.8 SetInterpolation (0x90)

This command sets the configuration of the interpolation of the command position of the axis. The meaning of the single bits of the parameter byte is described in the table 2.

The actual set configuration of the interpolation can be called up by the feed-back channel signal Interpolation Configuration (0x90) (described in chapter 4.3.1.40 on page 38).

The configuration of the interpolation can be saved permanently by the command UpdatePermanentMemory (0x0A) (described in chapter 4.3.2 on page 39).

Bit 7 downto 1	Maximum interpolation time in 2 micro seconds (0 => 0us, 1 => 2us, … , 127 => 254us) In case that the command position is delivered via XY2-100 in smaller intervals than set here, a linear interpolation between the two neighboring command positions is executed then. But the movement of the axis is delayed by this adjusted interpolation time then. E.g. the entire tracking delay time is enlarged about this time. The main tracking delay of the position control doesn't change (edges of marked objects are not rounded, they only are drawn a short time later. If necessary the laser delay times have to be adjusted). Default: 120us (60)
Bit 0	If this bit is set to '1', the once repeated command position is ignored. This is necessary on the control cards SP-ICE-1 PCI PRO or SP-ICE-2 for the operating of SS-III as these cards transmit each command position twice consecutively. When both identical command positions are considered in the interpolation, a saw tooth like form of the command position exists after the interpolation. For control cards which don't send double position data it is sufficient to let this mode active as the second command position is ignored then if it is similar to the one before. Default: '1' (active)

Table 2: SetInterpolation Parameter

5 Status-LEDs

Similar to the deflection units of the SS-II-generation SS-III-heads dispose of a status lLED window. The meaning of the single LEDs differs from SS-II a little. In the table 3 labeling and color of the 12 status LEDs are shown. In the table 4 the meaning of the-single LEDs is described.

PY Parity Error Y-Axis (red)	DY Data Change Y-Axis (yellow)	P- Power - (green)
EY Error Y-Axis (red)	OY Operational Y-Axis (green)	L- Link Voltage - (green)
EX Error X-Axis (red)	OX Operational X-Axis (green)	L+ Link Voltage + (green)
PX Parity Error X-Axis (red)	DX Data Change X-Axis (yellow)	P+ Power + (green)

Table 3: Array of the LEDs

LED-Imprint	Description
PY	Illuminates red if a parity error occures on the Y-channel of the XY2-100 Interface. Illuminates permanently if clock or sync signal of the XY2-100 interface has an error. The illumination period has been extended to make short failures visible too.
DY	Illuminates yellow if tha data on the Y-channel of the XY2-100 interface changes. The illumination period has been extended to make single data changes visible too.
P-	Illuminates green if negative supply voltage (-15V) has been switched on.
EY	Illuminates red in case of an error on the Y-axis and during the booting of the Y-axis. The booting process lasts a few seconds. If this LED illuminates the output stage of the Y-axis is deactivated.
OY	Illuminates green if the Y-Axis is ready for operation.
L-	lluminates green if internal negative supply voltage exists.
EX	Illuminates red in case of an error on the X-axis and during the booting of the X-axis. The booting process lasts a few seconds. If this LED illuminates the output stage of the X-axis is deactivated.
OX	Illuminates green if the X-Axis is ready for operation.
L+	lluminates green if internal positive supply voltage exists.
PX	Illuminates red if a parity error occures on the X-channel of the XY2-100 Interface. Illuminates permanently if clock or sync signal of the XY2-100 interface has an error. The illumination period has been extended to make short failures visible too.
DX	Illuminates yellow if tha data on the X-channel of the XY2-100 interface changes. The illumination period has been extended to make single data changes visible too.
P+	Illuminates green if positive supply voltage (+15V) has been switched on.

Table 4: Meaning of the LEDs