BiSS Interface

Electronic Datasheet: Absolute Encoder

preliminary

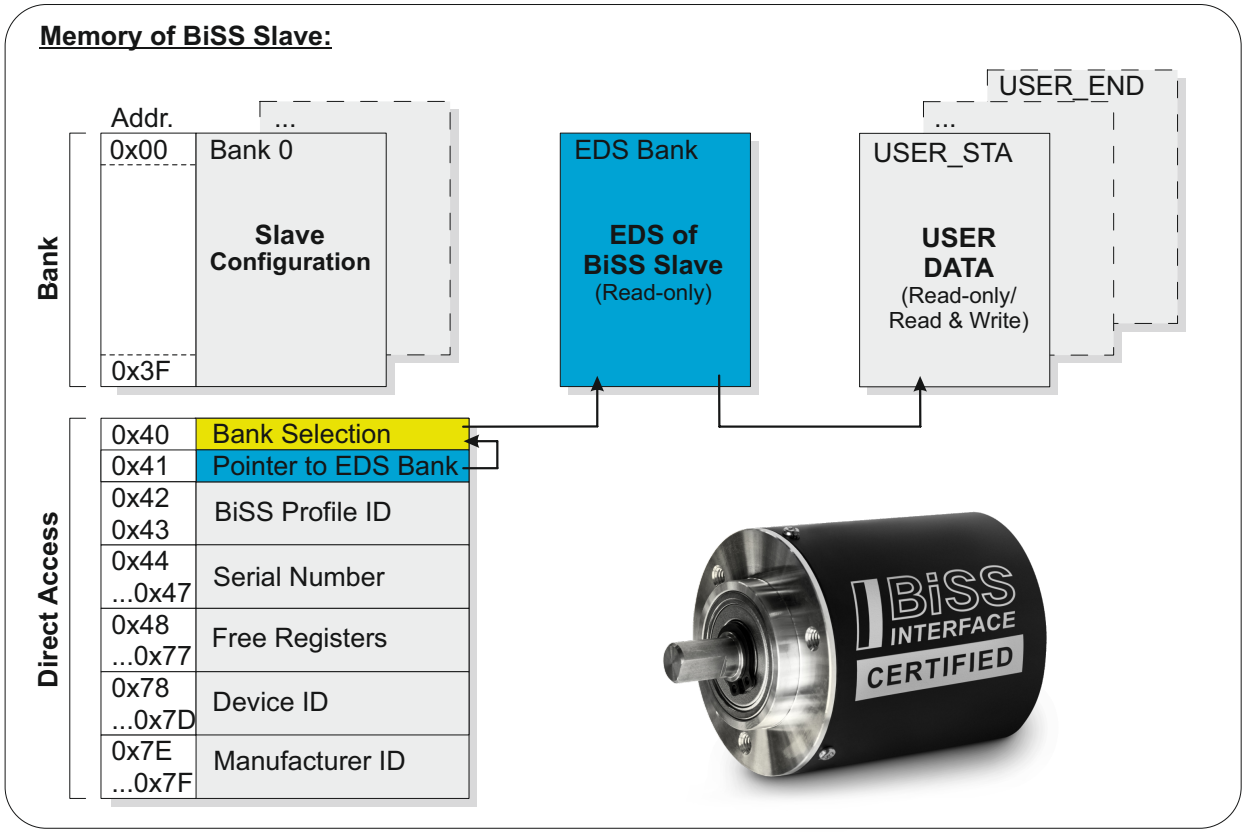
FEATURES

- Standardized Electronic Datasheet (EDS) for absolute encoders
- BiSS slave identification
- BiSS slave characteristics
- Automatic BiSS master configuration
- Plug & Play operation

APPLICATIONS

- Motion controller
- Absolute rotary encoder
- Absolute linear encoder

DIAGRAM



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DESCRIPTION

Electronic Datasheet
The Electronic Datasheet (EDS) is a standardized description of a BiSS device suitable for identification of the BiSS slave(s), their characteristics and application parameters. The EDS enables plug and play operation of BiSS devices.

According to the BiSS C Protocol Description, a BiSS device may contain several daisy-chained BiSS slaves (e.g. several sensors). For each slave an application specific EDS content is stored in one register bank which describes BiSS characteristics including data channel, timings and application details.

The slave device manufacturer stores the EDS in the slave's memory during production and protects the EDS bank with a read-only access before delivery. The bank with EDS content of the addressed BiSS slave is defined in register address 0x41 (Pointer to EDS Bank). By reading the value of register 0x41 (Pointer to EDS Bank) and writing it into register 0x40 (Bank Selection), the BiSS master can read the EDS in registers 0x00 ... 0x3F.

At www.biss-interface.com standardized descriptions are available.

> The EDS versions EDS_VER = 1 ... 31 are obsolete and not recommended for new designs. EDS_VER = 0 indicates a custom EDS. Please refer to the BiSS device manufacturer for details.

Absolute Encoders
This EDS version is suitable for an **absolute encoder**. Absolute encoders provide an absolute position information after power-on without referencing.

Three groups of absolute encoders are available:

- **Multiturn rotary encoder:**
  Capable to capture angle position and complete revolutions.
- **Singleturn rotary encoder:**
  Capable to capture angle, not capable to capture complete revolutions.
- **Linear encoder:**
  Capable to capture linear position.

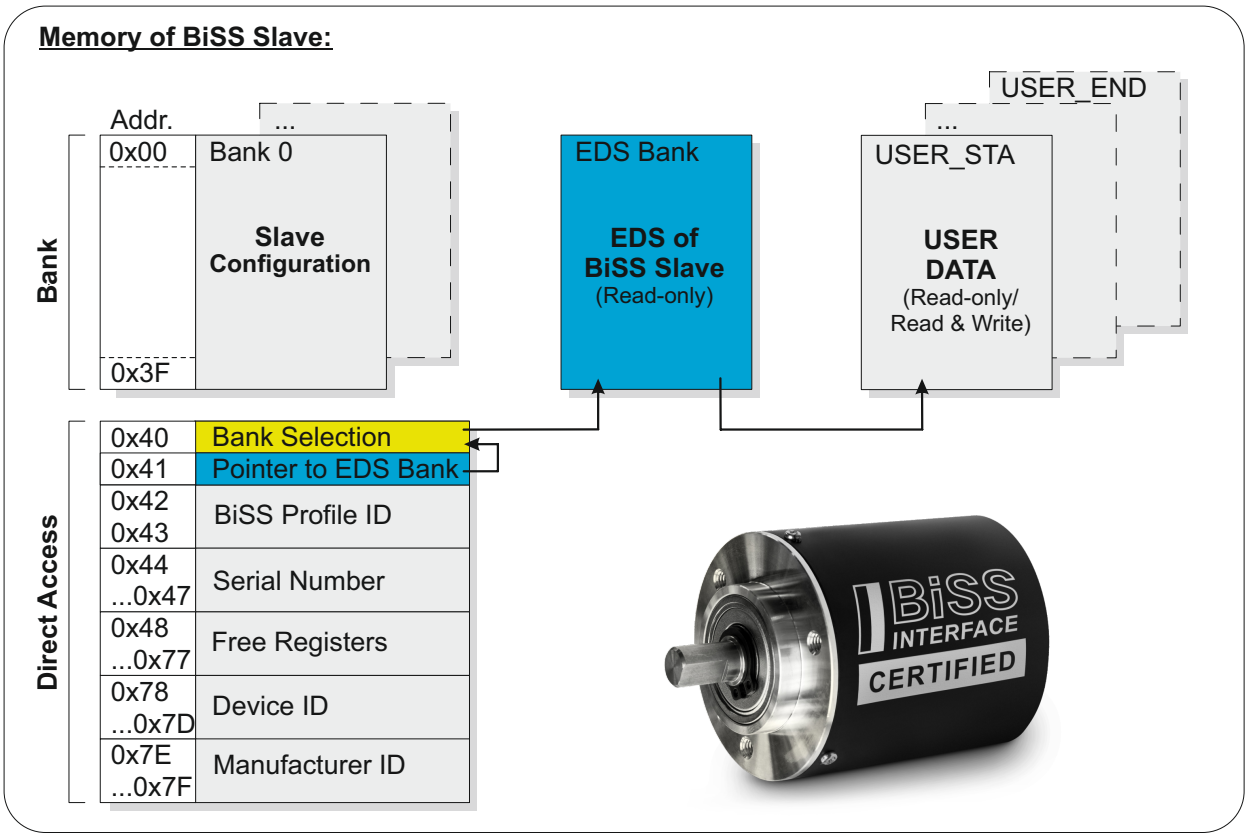
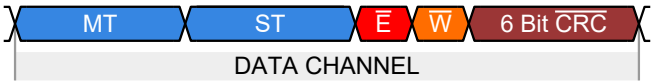


Figure 1: Concept of EDS

DATA CHANNEL FORMAT

a) Absolute Rotary Encoder



b) Absolute Linear Encoder



Figure 2: Data channel of absolute rotary and linear encoder

Absolute encoders transmit position data, diagnosis information and a CRC. For rotary encoders the position data contains singleturn information and optionally multiturn information. For linear encoders the position data contains the linear position.

Multiturn (MT)
The multiturn information (MT) is transmitted with the most significant bit first. The multiturn data length is in the range of 0 to 55 bit (0 bit for singleturn encoder). If the encoder uses a different bit count than the resolution, the measurement value is placed right-aligned and filled with leading "0".

Singleturn (ST)
The singleturn information (ST) is transmitted with the most significant bit first. The singleturn data length is in the range of 0 to 55 bit. If the encoder uses a different bit count than the resolution, the measurement value is placed left-aligned and filled with trailing "0".

Linear Position (POS)
The linear position information is transmitted with the most significant bit first. The position data length is in the range of 0 to 55 bit. If the encoder uses a different bit count than the resolution, the measurement value is placed right-aligned and filled with leading "0".

Diagnosis: Error and Warning ($\overline{E}$, $\overline{W}$)
Modern encoders monitor the environmental conditions. Typical examples are monitoring of LED aging attributes or monitoring of angular values to plausibility. Both bits are inverted before transmission (indicated with overline: $\overline{E}$, $\overline{W}$). Thus, an error or a warning is indicated, if $\overline{E}$ = 0 or $\overline{W}$ = 0 respectively. The position is considered valid with a warning and may be invalid with an error.

Cyclic Redundancy Check ($\overline{CRC}$)
To increase the transmission safety, the process data is protected with a CRC. The CRC value is generated with the generator polynomial $x^6 + x^1 + x^0$ (0x43) and a start value. The default start value is "0". However, in systems with more than one sensor, the start value can be used to distinguish the data channels. The CRC bits are inverted before transmission (indicated with overline: $\overline{CRC}$). All data bits (position data and diagnosis bits) are considered for the CRC calculation. The data length (position data and diagnosis bits) must not exceed a maximum length of 57 bit. The data channel carries a hamming distance of 3 and permits a 2-bit-error detection and a 1-bit-error correction.

The sequence of the data is multiturn data, singleturn data/position data, error, warning and CRC. The data is transferred completely within a single cycle. Further measurement values e.g. revolution speed or acceleration are not covered with this EDS version.

MASTER CONFIGURATION

Absolute Rotary Encoder

The following configuration is set in the BiSS master configuration after reading the EDS of the absolute rotary encoder.

Timings	
Cycle time	$\geq \max\{t_{Cycle_min}, t_{CYC}\} + t_{LineDelay}$, with t_{Cycle_min} as specified in CYCLE TIME CALCULATION. The line delay is typically measured by the BiSS master during initialization.
Clock period at MA	$\geq T_{MA_min}$
Data channel configuration	
Transmission type	Sensor data
Data length	DLEN = mt_len + st_len + $\overline{E}$ + $\overline{W}$ = mt_len + st_len + 2 Bit
Data alignment	Multiturn data is right-aligned with leading zero bits. Singleturn data is left-aligned with trailing zero bits.
CRC length	CRCLEN = 6 Bit
CRC polynomial	0x43 = $x^6 + x^1 + x^0$
CRC start value	As defined by CRCS

Absolute Linear Encoder

The following configuration is set in the BiSS master configuration after reading the EDS of the absolute linear encoder.

Timings	
Cycle time	$\geq \max\{t_{Cycle_min}, t_{CYC}\} + t_{LineDelay}$, with t_{Cycle_min} as specified in CYCLE TIME CALCULATION. The line delay is typically measured by the BiSS master during initialization.
Clock period at MA	$\geq T_{MA_min}$
Data channel configuration	
Transmission type	Sensor data
Data length	DLEN = pos_len + $\overline{E}$ + $\overline{W}$ = pos_len + 2 Bit
Data alignment	Position data is right-aligned with leading zero bits.
CRC length	CRCLEN = 6 Bit
CRC polynomial	0x43 = $x^6 + x^1 + x^0$
CRC start value	As defined by CRCS

CYCLE TIME CALCULATION

Definition

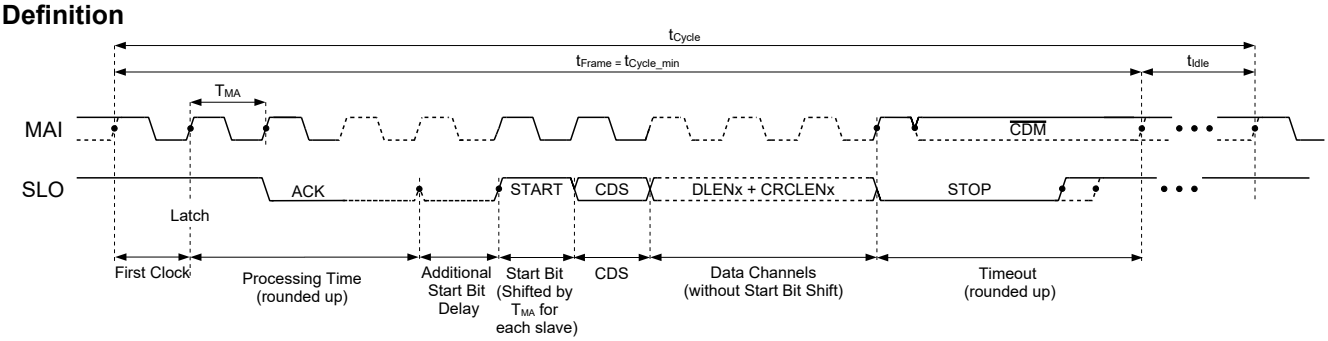


Figure 3: BiSS frame composition for calculation of minimum cycle time (line delay excluded)

General Calculation for n Slaves (line delay excluded):

$$t_{Cycle_min} = \underbrace{T_{MA}}_{\text{First Clock}} + \underbrace{\max_{x \epsilon n}[\max[t_{busy,\,x}, 2T_{MA}] + T_{MA}}_{\text{Processing Time}} + \underbrace{busy_s_x * T_{MA}]}_{\text{Additional Start Bit Delay}} + \underbrace{T_{MA}}_{\text{CDS}} + \underbrace{T_{MA} * \sum_{x=1}^{n}[1 + DLENx + CRCLENx]}_{\text{Data Channels (incl. Start Bit Shift)}} + \underbrace{\max_{x \epsilon n}[t_{TO,\,x} + T_{MA}]}_{\text{Timeout (Static or Adaptive)}}$$

$$= 4T_{MA} + \max_{x \epsilon n}[\max[t_{busy,\,x}, 2T_{MA}] + busy_s_x * T_{MA}] + T_{MA} * \sum_{x=1}^{n}[1 + DLEN_x + CRCLEN_x] + \max_{x \epsilon n}[t_{TO,\,x}]$$

Calculation for one Slave with EDS_VER=0x20 (line delay excluded):

Rotary:

$t_{Cycle_min} = T_{MA} * [13 + busy_s + st_len + mt_len] + \max[\, t_{busy}, 2T_{MA}\,] + t_{TO}$

Linear:

$t_{Cycle_min} = T_{MA} * [13 + busy_s + pos_len] + \max[\, t_{busy}, 2T_{MA}\,] + t_{TO}$

ELECTRONIC DATASHEET: ABSOLUTE ROTARY ENCODER

Address	Symbol	Description	Format	Unit	Value
Organization					
0x00	EDS_VER	EDS version (32 = absolute encoder)	U8	-	32
0x01	EDS_REV	EDS revision	U8	-	0
0x02	USER_STA	First bank of USER DATA banks (0 = no USER DATA)	U8	-	0 ... 255
0x03	USER_END	Last bank of USER DATA banks (0 = no USER DATA)	U8	-	0 ... 255
Timings					
0x04	TMA_MIN	Minimum possible clock period at MA	U8	10 ns	10 ... 100
0x05	TO_MAX	Maximum BiSS timeout	U8	-	0 ... 160
0x06	TBUSY	Maximum processing time for process data (0 = no constant delay) [1]	U8	250 ns	0 ... 160
0x07	BUSY_S	Additional start bit delay in clocks (0 = no additional delay)	U8	- [2]	0 ... 8
0x08	TCYC	Absolute minimum cycle time (0 = no limitation)	U8	µs	0 ... 250
0x09	PON_DLY	Maximum power-on delay until process data is available (0 = undefined)	U8	100 ms	0 ... 255
BiSS Commands [3]					
0x0A	CMD00	BiSS command CMD="00" (0 = not implemented, 1 = implemented)	U8	-	0, 1
0x0B	CMD01	BiSS command CMD="01" (0 = not implemented, 1 = implemented)	U8	-	0, 1
0x0C	CMD10	Procedure BiSS command CMD="10" (0 = not implemented)	U8	-	0 ... 5
0x0D	CMD11	Procedure BiSS command CMD="11" (0 = not implemented)	U8	-	0, 2 ... 5
Application					
0x0E	APP	Application (0 = rotary position, 1 = linear position, 2 = rotary position (CPW) for safety, 3 = linear position (CPW) for safety)	U8	-	0, 2
Data Channel					
0x0F	MT_LEN	Data length of multiturn information	U8	bit	0 ... 55
0x10	ST_LEN	Data length of singleturn information	U8	bit	0 ... 55
0x11	-	Reserved	U8	-	0
0x12	CRCS	Start value for CRC calculation (0 = default)	U8	-	0 ... 255
Rotary Encoder Data					
0x13	MT_ZEROS	Number of leading zeros in MT_LEN (0 = default)	U8	bit	0 ... 55
0x14	ST_ZEROS	Number of trailing zeros in ST_LEN (0 = default)	U8	bit	0 ... 55
0x15	DIR	Standard direction of rotation (0 = increasing clockwise, 1 = increasing counterclockwise)	U8	-	0, 1
0x16 ... 0x17	SIP_CNT	Number of signal periods per revolution (0 = undefined)	U16 [4]	CPR	0 ... 2^{16}-1
0x18 ... 0x1F	-	Reserved	-	-	0
0x20 ... 0x23	SPEED_MAX	Maximum revolution speed (0 = undefined)	U32 [4]	RPM	0 ... 2^{32}-1
0x24 ... 0x27	ACC_MAX	Maximum angular acceleration (0 = undefined)	U32 [4]	RPM / s	0 ... 2^{32}-1
0x28 ... 0x29	LATENCY	Latency of position sensing (0 = undefined)	U16 [4]	10 ns	0 ... 2^{16}-1
0x2A	HYSTERESIS	Hysteresis (0 = undefined)	U8	0.25 bit	0 ... 221
0x2B	RESONANCE	Resonance frequency of mechanical coupling (0 = undefined)	U8	50 Hz	0 ... 255
0x2C	NF_RES	Noise-free (= +/- 3 σ) resolution (0 = undefined)	U8	0.25 bit	0 ... 221
0x2D	-	Reserved	-	-	0
Temperature Data					
0x2E	TEMP_INT	Pointer to and format of temperature data from internal sensor (0 = Temperature data not available)	U8	- [5]	0, 72 ... 119, 200 ... 247
0x2F	TEMP_EXT	Pointer to and format of temperature data from external sensor (0 = Temperature data not available)	U8	- [5]	0, 72 ... 119, 200 ... 247
0x30	TEMP_MIN	Min. operating temperature, offset: -64°C (0 = undefined)	U8	°C [6]	0 ... 255
0x31	TEMP_MAX	Max. operating temperature, offset: -64°C (0 = undefined)	U8	°C [6]	0 ... 255
Status Information					
0x32	STAT_E1	Pointer to error byte 1 (0 = not available)	U7	- [7]	0, 72 ... 119
0x33	STAT_E2	Pointer to error byte 2 (0 = not available)	U7	- [7]	0, 72 ... 119
0x34	STAT_E3	Pointer to error byte 3 (0 = not available)	U7	- [7]	0, 72 ... 119
0x35	STAT_E4	Pointer to error byte 4 (0 = not available)	U7	- [7]	0, 72 ... 119
0x36	STAT_W1	Pointer to warning byte 1 (0 = not available)	U7	- [7]	0, 72 ... 119
0x37	STAT_W2	Pointer to warning byte 2 (0 = not available)	U7	- [7]	0, 72 ... 119
0x38	STAT_W3	Pointer to warning byte 3 (0 = not available)	U7	- [7]	0, 72 ... 119
0x39	STAT_W4	Pointer to warning byte 4 (0 = not available)	U7	- [7]	0, 72 ... 119
Register Based Commands [8]					
0x3A	CMD_ADR	Pointer to command register (0 = not available)	U7	- [7]	0, 72 ... 119
0x3B	REBOOT	Opcode to reboot sensor (255 = not available)	U8	- [9]	0 ... 255
0x3C	RESET	Opcode to initialize sensor (255 = not available)	U8	- [9]	0 ... 255
0x3D	PRESET	Opcode to execute preset (255 = not available)	U8	- [9]	0 ... 255
0x3E	SCLEAR	Opcode to clear status of sensor (255 = not available)	U8	- [9]	0 ... 255
Checksum					
0x3F	CHKSUM	Checksum	U8	-	0 ... 255

Notes
[1] The processing time is measured from first rising edge at MAI to the rising edge of the start bit at SLO. As specified by the BiSS C Protocol Description, the processing time is at least 2 T_{MA}.
[2] T_{MA} is the clock period at MA.
[3] BiSS Commands are defined in the BiSS C Protocol Description.
[4] U16 and U32 values are saved as a Big Endian, i.e. with the highest-value byte at the lowest-value address.
[5] Bit 7 indicates the format: U8 or I16. Bit 6:0 point to the (first) register. Only the I16 values are saved as Little Endian, i.e. with the lowest-value byte at the lowest-value address.
[6] An offset of -64 °C is applied to describe a range of -63 °C ... +191 °C. A value of 0x00 indicates that the limit is undefined.
[7] The address is expected in the range of 0x48 to 0x77. A value of 0x00 indicates the unavailability of status, temperature sensors or commands.
[8] Register based commands use register accesses to send sensor specific commands to the slave.
[9] The opcode is expected in the range of 0x00 to 0xFE. A value of 0xFF indicates the command is not available.

Table 1: Electronic Datasheet for absolute rotary encoder

ELECTRONIC DATASHEET: ABSOLUTE LINEAR ENCODER

Address	Symbol	Description	Format	Unit	Value
Organization					
0x00	EDS_VER	EDS version (32 = absolute encoder)	U8	-	32
0x01	EDS_REV	EDS revision	U8	-	0
0x02	USER_STA	First bank of USER DATA banks (0 = no USER DATA)	U8	-	0 ... 255
0x03	USER_END	Last bank of USER DATA banks (0 = no USER DATA)	U8	-	0 ... 255
Timings					
0x04	TMA_MIN	Minimum possible clock period at MA	U8	10 ns	10 ... 100
0x05	TO_MAX	Maximum BiSS timeout	U8	-	0 ... 160
0x06	TBUSY	Maximum processing time for process data (0 = no constant delay) [1]	U8	250 ns	0 ... 160
0x07	BUSY_S	Additional start bit delay in clocks (0 = no additional delay)	U8	- [2]	0 ... 8
0x08	TCYC	Absolute minimum cycle time (0 = no limitation)	U8	µs	0 ... 250
0x09	PON_DLY	Maximum power-on delay until process data is available (0 = undefined)	U8	100 ms	0 ... 255
BiSS Commands [3]					
0x0A	CMD00	BiSS command CMD="00" (0 = not implemented, 1 = implemented)	U8	-	0, 1
0x0B	CMD01	BiSS command CMD="01" (0 = not implemented, 1 = implemented)	U8	-	0, 1
0x0C	CMD10	Procedure BiSS command CMD="10" (0 = not implemented)	U8	-	0 ... 5
0x0D	CMD11	Procedure BiSS command CMD="11" (0 = not implemented)	U8	-	0, 2 ... 5
Application					
0x0E	APP	Application (0 = rotary position, 1 = linear position, 2 = rotary position (CPW) for safety, 3 = linear position (CPW) for safety)	U8	-	1, 3
Data Channel					
0x0F	POS_LEN	Data length of linear position information	U8	bit	0 ... 55
0x10	-	Reserved	U8	-	0
0x11	-	Reserved	U8	-	0
0x12	CRCS	Start value for CRC calculation (0 = default)	U8	-	0 ... 255
Linear Encoder Data					
0x13	POS_ZEROS	Number of leading zeros in POS_LEN (0 = default)	U8	bit	0 ... 55
0x14	-	Reserved	-	-	0
0x15	SC_EXP	Scaling exponent for linear position	I8	-	-128 ...127
0x16 ... 0x17	SIP_LEN	Signal period length (0 = undefined)	U16 [4]	100 nm	0 ... 2^{16}-1
0x18 ... 0x19	SC_NUM	Scaling numerator for linear position (0 = undefined)	U16 [4]	-	0 ... 2^{16}-1
0x1A ... 0x1B	SC_DEN	Scaling denominator for linear position (0 = undefined)	U16 [4]	-	0 ... 2^{16}-1
0x1C ... 0x1F	RANGE	Measurement range of linear position (0 = undefined)	U32 [4]	$\frac{sc_num}{sc_den} * 10^{sc_exp}$ m	0 ... 2^{32}-1
0x20 ... 0x23	SPEED_MAX	Maximum speed (0 = undefined)	U32 [4]	mm/s	0 ... 2^{32}-1
0x24 ... 0x27	ACC_MAX	Maximum acceleration (0 = undefined)	U32 [4]	mm/s^2	0 ... 2^{32}-1
0x28 ... 0x29	LATENCY	Latency of position sensing (0 = undefined)	U16 [4]	10 ns	0 ... 2^{16}-1
0x2A	HYSTERESIS	Hysteresis (0 = undefined)	U8	0.25 bit	0 ... 221
0x2B	RESONANCE	Resonance frequency of mechanical coupling (0 = undefined)	U8	50 Hz	0 ... 255
0x2C	NF_RES	Noise-free (= +/- 3 σ) resolution (0 = undefined)	U8	0.25 bit	0 ... 221
0x2D	-	Reserved	-	-	0
Temperature Data					
0x2E	TEMP_INT	Pointer to and format of temperature data from internal sensor (0 = Temperature data not available)	U8	- [5]	0, 72 ... 119, 200 ... 247
0x2F	TEMP_EXT	Pointer to and format of temperature data from external sensor (0 = Temperature data not available)	U8	- [5]	0, 72 ... 119, 200 ... 247
0x30	TEMP_MIN	Min. operating temperature, offset: -64°C (0 = undefined)	U8	°C [6]	0 ... 255
0x31	TEMP_MAX	Max. operating temperature, offset: -64°C (0 = undefined)	U8	°C [6]	0 ... 255
Status Information					
0x32	STAT_E1	Pointer to error byte 1 (0 = not available)	U7	- [7]	0, 72 ... 119
0x33	STAT_E2	Pointer to error byte 2 (0 = not available)	U7	- [7]	0, 72 ... 119
0x34	STAT_E3	Pointer to error byte 3 (0 = not available)	U7	- [7]	0, 72 ... 119
0x35	STAT_E4	Pointer to error byte 4 (0 = not available)	U7	- [7]	0, 72 ... 119
0x36	STAT_W1	Pointer to warning byte 1 (0 = not available)	U7	- [7]	0, 72 ... 119
0x37	STAT_W2	Pointer to warning byte 2 (0 = not available)	U7	- [7]	0, 72 ... 119
0x38	STAT_W3	Pointer to warning byte 3 (0 = not available)	U7	- [7]	0, 72 ... 119
0x39	STAT_W4	Pointer to warning byte 4 (0 = not available)	U7	- [7]	0, 72 ... 119
Register Based Commands [8]					
0x3A	CMD_ADR	Pointer to command register (0 = not available)	U7	- [7]	0, 72 ... 119
0x3B	REBOOT	Opcode to reboot sensor (255 = not available)	U8	- [9]	0 ... 255
0x3C	RESET	Opcode to initialize sensor (255 = not available)	U8	- [9]	0 ... 255
0x3D	PRESET	Opcode to execute preset (255 = not available)	U8	- [9]	0 ... 255
0x3E	SCLEAR	Opcode to clear status of sensor (255 = not available)	U8	- [9]	0 ... 255
Checksum					
0x3F	CHKSUM	Checksum	U8	-	0 ... 255

Notes

[1] The processing time is measured from first rising edge at MAI to the rising edge of the start bit at SLO. As specified by the BiSS C Protocol Description, the processing time is at least 2 T_{MA}.
[2] T_{MA} is the clock period at MA.
[3] BiSS Commands are defined in the BiSS C Protocol Description.
[4] U16 and U32 values are saved as a Big Endian, i.e. with the highest-value byte at the lowest-value address.
[5] Bit 7 indicates the format: U8 or I16. Bit 6:0 point to the (first) register. Only the I16 values are saved as Little Endian, i.e. with the lowest-value byte at the lowest-value address.
[6] An offset of -64 °C is applied to describe a range of -63 °C ... +191 °C. A value of 0x00 indicates that the limit is undefined.
[7] The address is expected in the range of 0x48 to 0x77. A value of 0x00 indicates the unavailability of status, temperature sensors or commands.
[8] Register based commands use register accesses to send sensor specific commands to the slave.
[9] The opcode is expected in the range of 0x00 to 0xFE. A value of 0xFF indicates the command is not available.

Table 2: Electronic Datasheet for absolute linear encoder

DATA FORMAT

- U7 = unsigned 7, value range 0 . . . 127.
- U8 = unsigned 8, value range 0 . . . 255.
- I8 = signed 8, value range -128 . . . 127.
- U16 = unsigned 16, value range 0 . . . 65535.
- I16 = signed 16, value range -32768 . . . 32767.
- U32 = unsigned 32, value range 0 . . . 2^{32}-1.

PARAMETER DESCRIPTION: ORGANIZATION

EDS_VER (U8)
Parameter EDS_VER contains the EDS version. It defines the application of the slave, its data channel content and structure of the EDS.

EDS_VER	Addr. 0x00;	Bit 7:0	R
Code	Function		
0x00	Custom EDS definition		
0x20	Absolute Encoder		
Other	Reserved		
Notes	For other EDS definitions and applications refer to the corresponding datasheet at www.biss-interface.com		

Table 3: EDS version (U8)

EDS_REV (U8)
Parameter EDS_REV contains the revision of the EDS.

EDS_REV	Addr. 0x01;	Bit 7:0	R
Code	Function		
0x00	First revision of the EDS definition		
Other	Reserved for future use		

Table 4: EDS revision (U8)

USER_STA (U8)
USER_STA specifies the first bank of the USER DATA. The permitted value range is 0 . . . 255. However, the maximum possible value might be limited by the memory size (e.g. EEPROM).

USER_STA	Addr. 0x02;	Bit 7:0	R
Code	Function		
0x00	USER DATA not available		
0x01 . . . 0xFF	First bank of USER DATA		

Table 5: First Bank of USER DATA

USER_END (U8)
USER_END specifies the last bank of the USER DATA. The permitted value range is 0 . . . 255. However, USER_END must be greater or equal to USER_STA. Note, the maximum possible value might be limited by the memory size (e.g. EEPROM).

USER_END	Addr. 0x03;	Bit 7:0	R
Code	Function		
0x00	USER DATA not available		
0x01 . . . 0xFF	Last bank of USER DATA		
Notes	USER_END≥USER_STA		

Table 6: Last Bank of USER DATA

PARAMETER DESCRIPTION: TIMINGS

TMA_MIN (U8)

TMA_MIN specifies the minimum possible clock period at MA that the BiSS Slave can handle for proper function.

TMA_MIN	Addr. 0x04;	Bit 7:0	R
Code	Minimum possible clock period (T_{MA_min})	Maximum possible clock frequency ($f_{MA_max} = 1 / T_{MA_min}$)	
0x0A ...0x64	Code * 10 ns	10 MHz ...1 MHz	
Other	Reserved		

Table 7: Minimum possible clock period at MA

TO_MAX (U8)

With TO_MAX = 0x00 ... 0x31 it is indicated that the BiSS device adapts the timeout according to the applied clock frequency at MA. The maximum adaptive BiSS timeout t_{TOA_max} is calculated as specified in the BiSS C Protocol Description considering the first 1.5 clock periods at MA (t_{TOA_ref}).

With TO_MAX = 0x32 ... 0xA0 the BiSS device uses a static (constant) timeout.

TO_MAX	Addr. 0x05;	Bit 7:0	R
Code	Maximum timeout t_{TO}	Value Range of t_{TO}	
Adaptive Timeout			
0x00 ...0x31	t_{TOA_ref} + Code * 250 ns	t_{TOA_ref} ... t_{TOA_ref} + 12.25 µs	
Static Timeout			
0x32 ...0xA0	Code * 250 ns	12.5 µs ...40 µs	
Other	Reserved		
Notes	t_{TOA_ref} is measured from first falling to second rising edge at MAI. Typically, t_{TOA_ref}=1.5*T_{MA}. The constant Code*250 ns depends on the sensor's clock sampling frequency and is calculated by the sensor manufacturer. Refer to BiSS C Protocol Description for further details.		

Table 8: Maximum BiSS Timeout

TBUSY (U8)

The BiSS slave may require processing time in order to prepare sensor data before transmission. According to the BiSS C Protocol Description, the processing time is measured from first rising clock edge at MA to the start bit and must be between 2*T_{MA} and 40 µs. In the EDS, the maximum processing time is described by a time constant TBUSY and a number of clock periods BUSY_S as follows:

$$\max[\, t_{busy}, 2T_{MA} \,] + busy_s * T_{MA} \leq 40\ \mu s$$

TBUSY	Addr. 0x06;	Bit 7:0	R
Code	Maximum processing time (t_{busy})		
0x00 ...0xA0	Code * 250 ns		
Other	Reserved		
Notes	$\max[\, t_{busy}, 2T_{MA} \,] + busy_s * T_{MA} \leq 40\ \mu s$		

Table 9: Maximum processing time for sensor data transmission

BUSY_S (U8)

BUSY_S describes processing time by an additional start bit delay in clock periods. Refer to TBUSY for further details.

BUSY_S	Addr. 0x07;	Bit 7:0	R
Code	Additional start bit delay (busy_s)		
0x00	No additional delay		
0x01 ...0x08	Code		
Other	Reserved		
Notes	1.) $\max[\, t_{busy}, 2T_{MA} \,] + busy_s * T_{MA} \leq 40\ \mu s$ 2.) T_{MA} is the currently applied clock signal period at MA.		

Table 10: Additional start bit delay in clocks

TCYC (U8)

The cycle time that can be applied by the master depends on several characteristics of the slave(s), e.g. the line delay, the processing time, the data length, the timeout and the applied clock frequency at MA. In chapter CYCLE TIME CALCULATION a formula for calculation of the minimum possible cycle time T_{Cycle_min} is provided. However, the parameter TCYC states the absolute minimum cycle time that must not be underrun.



The line delay depends on the cable length and the slaves propagation delay. It is not considered in TCYC and can typically be measured by the BiSS master.

TCYC	Addr. 0x08;	Bit 7:0	R
Code	Absolute minimum cycle time (t_{CYC})		
0x00	No limitation		
0x01 ...0xFA	Code * 1 µs		
0xFB ...0xFF	Reserved		

Table 11: Absolute minimum cycle time

PON_DLY (U8)
The parameter PON_DLY describes the power-on delay that the BiSS slave requires in order to provide process data via BiSS after start-up.

PON_DLY	Addr. 0x09;	Bit 7:0	R
Code	Function		
0x00	Undefined		
0x01 ... 0xFF	Delay ≤ Code * 100 ms		

Table 12: Power on delay

PARAMETER DESCRIPTION: BiSS COMMANDS

This chapter describes the function of the BiSS commands as described in the BiSS C Protocol Description. For functionality of register based commands, refer to chapter PARAMETER DESCRIPTION: REGISTER BASED COMMANDS.

CMD00 (U8)
CMD00 describes the function of the BiSS slave when an addressed or broadcasted BiSS command with CMD="00" is transmitted. The typical behavior is described in the BiSS C Protocol Description.

CMD00	Addr. 0x0A;	Bit 7:0	R
Code	Function		
0x00	BiSS command not available		
0x01	As predefined in the BiSS C Protocol Description		
Other	Reserved		

Table 13: Procedure for BiSS command CMD="00" (U8)

CMD01 (U8)
CMD01 describes the function of the BiSS slave when an addressed or broadcasted BiSS command with CMD="01" is transmitted. The typical behavior is described in the BiSS C Protocol Description.

CMD01	Addr. 0x0B;	Bit 7:0	R
Code	Function		
0x00	BiSS command not available		
0x01	As predefined in the BiSS C Protocol Description		
Other	Reserved		

Table 14: Procedure for BiSS command CMD="01" (U8)

CMD10 (U8)
CMD10 describes the function of the BiSS slave when a BiSS command with CMD="10" is transmitted. The function is defined by the manufacturer according to the BiSS C Protocol Description.



If CMD10 = 0x02 ... 0x05, only the addressed BiSS command is executed by the BiSS slave. The broadcasted BiSS command has no effect.

CMD10	Addr. 0x0C;	Bit 7:0	R
Code	Function		
0x00	BiSS command not available		
0x01	As predefined for bus coupler in the BiSS C Protocol Description		
0x02	REBOOT (addressed BiSS command)		
0x03	RESET (addressed BiSS command)		
0x04	PRESET (addressed BiSS command)		
0x05	SCLEAR (addressed BiSS command)		
Other	Reserved		

Table 15: Procedure for BiSS command CMD="10" (U8)

CMD11 (U8)
CMD11 describes the function of the BiSS slave when a BiSS command with CMD="11" is transmitted. The function is defined by the manufacturer according to the BiSS C Protocol Description.



If CMD11 = 0x02 ... 0x05, only the addressed BiSS command is executed by the BiSS slave. The broadcasted BiSS command has no effect.

CMD11	Addr. 0x0D;	Bit 7:0	R
Code	Function		
0x00	BiSS command not available		
0x01	Reserved		
0x02	REBOOT (addressed BiSS command)		
0x03	RESET (addressed BiSS command)		
0x04	PRESET (addressed BiSS command)		
0x05	SCLEAR (addressed BiSS command)		
Other	Reserved		

Table 16: Procedure for BiSS command CMD="11" (U8)

PARAMETER DESCRIPTION: APPLICATION

APP (U8)
The parameter APP indicates the mechanical type of encoder.

APP	Addr. 0x0E;	Bit 7:0	R
Code	Function		
0x00	Absolute rotary encoder		
0x01	Absolute linear encoder		
0x02	Control Position Word (CPW) for absolute rotary encoder in safety applications		
0x03	Control Position Word (CPW) for absolute linear encoder in safety applications		
Other	Reserved		

Table 17: Encoder type (U8)

PARAMETER DESCRIPTION: DATA CHANNEL

MT_LEN (U8) / POS_LEN (U8)
The parameter MT_LEN indicates the total data length of the multiturn information of a rotary encoder including leading zero bits (refer to MT_ZEROS).

The permitted value range is:
0 bit $\leq$ mt_len + st_len $\leq$ 55 bit

MT_LEN	Addr. 0x0F;	Bit 7:0	R
Code	Multiturn data length (mt_len)		
0x00 ... 0x37	Total data length of multiturn information (incl. leading zeros) in bit		
Other	Reserved		
Notes	For rotary encoders (APP = 0 or APP = 2): 0 bit $\leq$ mt_len + st_len $\leq$ 55 bit.		

Table 18: Total data length of multiturn information (U8)

The parameter POS_LEN indicates the total data length of the position of a linear encoder including leading zero bits (refer to POS_ZEROS).

The permitted value range is 0 ... 55 bit.

POS_LEN	Addr. 0x0F;	Bit 7:0	R
Code	Linear position data length (pos_len)		
0x00 ... 0x37	Total data length of linear position (incl. leading zeros) in bit		
Other	Reserved		

Table 19: Total data length of linear position information (U8)

ST_LEN (U8)
The parameter ST_LEN indicates the total data length of the singleturn information of a rotary encoder including trailing zero bits (refer to ST_ZEROS).

The permitted value range is:
0 bit $\leq$ mt_len + st_len $\leq$ 55 bit

For linear encoders (APP = 1 or APP = 3), st_len = 0.

ST_LEN	Addr. 0x10;	Bit 7:0	R
Code	Function		
0x00 ... 0x37	Total data length of singleturn information (incl. trailing zeros) in bit		
Other	Reserved		
Notes	1.) For rotary encoders (APP = 0 or APP = 2): 0 bit $\leq$ mt_len + st_len $\leq$ 55 bit. 2.) For linear encoders (APP = 1 or APP = 3): st_len = 0.		

Table 20: Singleturn length (U8)

CRCS (U8)
The parameter CRCS indicates the start value used for CRC calculation. The CRC start value is typically "0x00". Systems with more than one slave may implement a different start value to identify the data channels.

CRCS	Addr. 0x12;	Bit 7:0	R
Code	Function		
0x00 ... 0xFF	CRC start value		

Table 21: CRC start value (U8)

PARAMETER DESCRIPTION: ENCODER DATA

MT_ZEROS (U8) / POS_ZEROS (U8)

The multiturn information MT_LEN or linear position information POS_LEN may contain leading zero bits. The parameter MT_ZEROS indicates the number of leading zeros ahead of multiturn position bits as shown in Figure 4.

The permitted value range is mt_zeros ≤ mt_len.

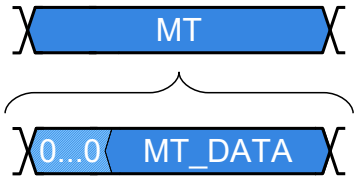


Figure 4: Multiturn information

MT_ZEROS	Addr. 0x13; Bit 7:0 R
Code	Number of leading zeros ahead of multiturn position bits (APP = 0 or APP = 2)
0x00 ...0x37	Number of leading zeros (mt_zeros)
Other	Reserved
Notes	mt_zeros ≤ mt_len.

Table 22: Number of leading zeros ahead of multiturn position bits (U8)

The linear position information POS_LEN may contain leading zero bits. The parameter POS_ZEROS indicates the number of leading zeros ahead of linear position bits as shown in Figure 5.

The permitted value range is pos_zeros ≤ pos_len.

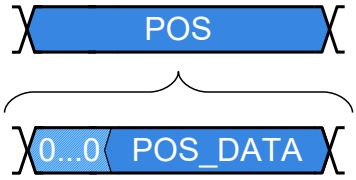


Figure 5: Linear position information

POS_ZEROS	Addr. 0x13; Bit 7:0 R
Code	Number of leading zeros ahead of linear position bits (APP = 1 or APP = 3)
0x00 ...0x37	Number of leading zeros (pos_zeros)
Other	Reserved
Notes	pos_zeros ≤ pos_len.

Table 23: Number of leading zeros ahead of linear position bits (U8)

ST_ZEROS (U8)

The singleturn information ST_LEN may contain trailing zero bits. The parameter ST_ZEROS indicates the number of trailing zeros following the singleturn position bits as shown in Figure 6.

The permitted value range is st_zeros ≤ st_len.

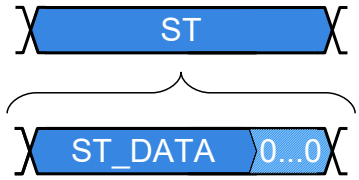


Figure 6: Singleturn information

ST_ZEROS	Addr. 0x14; Bit 7:0 R
Code	Number of trailing zeros following the singleturn position bits (APP = 0 or APP = 2)
0x00 ...0x37	Number of trailing zeros (st_zeros)
Other	Reserved
Notes	st_zeros ≤ st_len.

Table 24: Number of trailing zeros following the singleturn position bits (U8)

DIR (U8) / SC_EXP (I8)

The parameter DIR indicates the standard direction of rotation of the rotary encoder. With DIR = 0 the position value increases for clockwise rotation of the encoder shaft (looking at the shaft or the flange for hollow shaft encoders). With DIR = 1 the position value increases for counterclockwise rotation of the encoder shaft (looking at the shaft or respectively the flange for hollow shaft encoders).

DIR	Addr. 0x15; Bit 7:0 R
Code	Standard direction of rotation
0x00	Increasing position values for clockwise (CW) rotation of the shaft
0x01	Increasing position values for counterclockwise (CCW) rotation of the shaft
Other	Reserved

Table 25: Standard direction of rotation (U8)

For a linear encoder (APP = 1 or APP = 3), the scaling exponent SC_EXP enables a precise specification of the resolution of the position, i.e. the physical size of one LSB.
1 LSB = $\frac{sc_num}{sc_den} * 10^{sc_exp}$ m.

SC_EXP	Addr. 0x15;	Bit 7:0	R
Code	Scaling exponent for linear position (sc_exp)		
0x80 ...0xFF	-128 ...-1		
0x00 ...0x7F	0 ...127		

Table 26: Scaling exponent for linear position (I8)

SIP_CNT (U16) / SIP_LEN (U16)
This parameter describes a systemic periodicity and serves as a hint for further signal processing.

For a rotary encoder (APP = 0 or APP = 2), the parameter SIP_CNT indicates the number of underlying physical signal periods per revolution. This count of periods is identical to possible sine/cosine analog output signals. Example: An optical rotary encoder with 1024 CPR generates 1024 signal periods per revolution. Thus, SIP_CNT = 0x0400.

SIP_CNT(15:8)	Addr. 0x16;	Bit 7:0	R
SIP_CNT(7:0)	Addr. 0x17;	Bit 7:0	R
Code	Number of signal periods per revolution of rotary encoder (APP = 0 or APP = 2)		
0x0000	Undefined		
0x0001 ...0xFFFF	Number of signal periods per revolution (CPR)		

Table 27: Number of signal periods per revolution (U16)

For a linear encoder (APP = 1 or APP = 3), the parameter SIP_LEN indicates the length of the underlying physical signal period.

SIP_LEN(15:8)	Addr. 0x16;	Bit 7:0	R
SIP_LEN(7:0)	Addr. 0x17;	Bit 7:0	R
Code	Formula	Length of signal period of linear encoder (APP = 1 or APP = 3)	
0x0000	-	Undefined	
0x0001 ...0xFFFF	Code * 100 nm	100 nm ... 6.5536 mm	

Table 28: Length of signal period (U16)

SC_NUM (U16)
For a linear encoder (APP = 1 or APP = 3), the scaling numerator SC_NUM enables a precise specification of the resolution of the position, i.e. the physical size of one LSB.
1 LSB = $\frac{sc_num}{sc_den} * 10^{sc_exp}$ m.

SC_NUM(15:8)	Addr. 0x18;	Bit 7:0	R
SC_NUM(7:0)	Addr. 0x19;	Bit 7:0	R
Code	Scaling numerator for linear position (APP = 1 or APP = 3)		
0x0000	Undefined		
0x0001 ...0xFFFF	Scaling numerator (sc_num)		
Notes	For rotary encoders (APP = 0 or APP = 2), SC_NUM = 0.		

Table 29: Scaling numerator for linear position (U16)

SC_DEN (U16)
For a linear encoder (APP = 1 or APP = 3), the scaling denominator SC_DEN enables a precise specification of the resolution of the position, i.e. the physical size of one LSB.
1 LSB = $\frac{sc_num}{sc_den} * 10^{sc_exp}$ m.

SC_DEN(15:8)	Addr. 0x1A;	Bit 7:0	R
SC_DEN(7:0)	Addr. 0x1B;	Bit 7:0	R
Code	Scaling denominator for linear position (APP = 1 or APP = 3)		
0x0000	Undefined		
0x0001 ...0xFFFF	Scaling denominator (sc_den)		
Notes	For rotary encoders (APP = 0 or APP = 2), SC_DEN = 0.		

Table 30: Scaling denominator for linear position (U16)

RANGE (U32)
The parameter RANGE indicates the measurement range of the linear position in multiples of the resolution as defined by $\frac{sc_num}{sc_den} * 10^{sc_exp}$ m.

RANGE(31:24)	Addr. 0x1C;	Bit 7:0	R
RANGE(23:16)	Addr. 0x1D;	Bit 7:0	R
RANGE(15:8)	Addr. 0x1E;	Bit 7:0	R
RANGE(7:0)	Addr. 0x1F;	Bit 7:0	R
Code	Measurement range (APP = 1 or APP = 3)		
0x00000000	Undefined		
0x00000001 ...0xFFFFFFFF	Code * $\frac{sc_num}{sc_den} * 10^{sc_exp}$ m.		

Table 31: Measurement range (U32)

SPEED_MAX (U32)
The parameter SPEED_MAX indicates the maximum revolution speed of the rotary encoder or the maximum speed of the linear encoder.

SPEED_MAX(31:24)	Addr. 0x20;	Bit 7:0	R
SPEED_MAX(23:16)	Addr. 0x21;	Bit 7:0	R
SPEED_MAX(15:8)	Addr. 0x22;	Bit 7:0	R
SPEED_MAX(7:0)	Addr. 0x23;	Bit 7:0	R
Code	Maximum revolution speed of rotary encoder (APP = 0 or APP = 2)	Maximum speed of linear encoder (APP = 1 or APP = 3)	
0x00000000 0x00000001 ...0xFFFFFFFF	Undefined Code * 1 min^{-1}	Undefined Code * 1 mm/s	

Table 32: Maximum revolution/linear speed (U32)

ACC_MAX (U32)

The parameter ACC_MAX indicates the maximum revolution acceleration of the rotary encoder or maximum linear acceleration of the linear encoder.

ACC_MAX(31:24)	Addr. 0x24;	Bit 7:0	R
ACC_MAX(23:16)	Addr. 0x25;	Bit 7:0	R
ACC_MAX(15:8)	Addr. 0x26;	Bit 7:0	R
ACC_MAX(7:0)	Addr. 0x27;	Bit 7:0	R
Code	Maximum acceleration of rotary encoder (APP = 0 or APP = 2)	Maximum acceleration of linear encoder (APP = 1 or APP = 3)	
0x00000000 0x00000001 ...0xFFFFFFFF	Undefined Code * 1 U/min/s	Undefined Code * 1 mm/s^2	

Table 33: Maximum revolution/linear acceleration (U32)

LATENCY (U16)

The value of the parameter LATENCY is the maximum latency of the sensor position as shown on Figure 7.

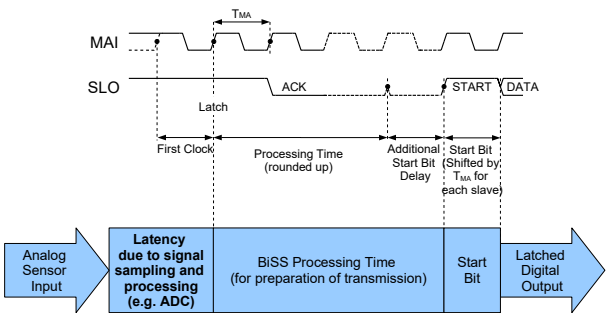


Figure 7: Definition of Latency

LATENCY(15:8)	Addr. 0x28;	Bit 7:0	R
LATENCY(7:0)	Addr. 0x29;	Bit 7:0	R
Code	Typical latency of position sensing		
0x0000 0x0001 ...0xFFFF	Undefined Latency $\leq$ Code * 10 ns		

Table 34: Latency of position sensing (U16)

HYSTERESIS (U8)

The value of the parameter HYSTERESIS is the hysteresis. HYSTERESIS quantifies the hysteresis in the singleturn position data ST_DATA (refer to Figure 6) or linear position data POS_DATA (refer to Figure 5).

HYSTERESIS	Addr. 0x2A;	Bit 7:0	R
Code	Hysteresis		
0x00 0x01 ...0xDD	Undefined (Code - 1) * 0.25 Bit		

Table 35: Hysteresis (U8)

RESONANCE (U8)

The value of the parameter RESONANCE is the resonance frequency of the mechanical coupling, e.g. the mechanical stator coupling in case of a rotary encoder.

RESONANCE	Addr. 0x2B;	Bit 7:0	R
Code	Resonance frequency of mechanical coupling		
0x00 0x01 ...0xFF	Undefined Code * 50 Hz		

Table 36: Resonance frequency (U8)

NF_RES (U8)

The value of the parameter NF_RES is the sensor's intrinsic noise-free resolution of the single-turn position data ST_DATA (ref. Figure 6) or linear position data POS_DATA (ref. Figure 5). NF_RES represents the resolution for a value being inside a +/- 3-sigma probability range (mean +/- 3*standard deviation). That is, for a given position the same NF_RES leading bits of the digital value are reported in 99.7 % of all cases.

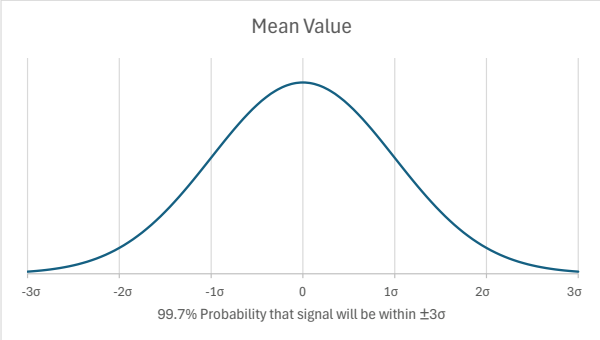


Figure 8: Display of +/- 3-sigma for NF_RES

NF_RES	Addr. 0x2C;	Bit 7:0	R
Code	Noise-free resolution (+/- 3*σ)		
0x00	Undefined		
0x01 ... 0xDD	(Code - 1) * 0.25 Bit		

Table 37: Noise-free resolution (U8)

PARAMETER DESCRIPTION: TEMPERATURE DATA

The following parameters contain addresses that point to temperature data registers.

TEMP_INT (U8)
TEMP_INT specifies the register address and the format under which the value of an an internal temperature sensor can be found. The high bit TEMP_INT(7) selects between U8 and I16 temperature format. TEMP_INT(6:0) points to the start register of the temperature value.

TEMP_INT	Addr. 0x2E;	Bit 7:0	R
Code	Function		
0x00	Internal temperature sensor register not available		
0x48 ... 0x77	TEMP_INT(6:0) = Register address of the temperature data (format U8) of an internal sensor (Table 42)		
0xC8 ... 0xF7	TEMP_INT(6:0) = First register address of two following temperature data registers (format I16) of an internal sensor (Table 43)		
Other	Reserved		
Notes	I16 are saved as Little Endian, i.e. with the lowest-value byte at the lowest-value address.		

Table 38: Pointer to and format of temperature data from internal sensor (U8)

TEMP_EXT (U8)
TEMP_EXT specifies the register address and the format under which the value of an an external temperature sensor can be found. The high bit TEMP_EXT(7) selects between U8 and I16 temperature format. TEMP_EXT(6:0) points to the start register of the temperature value.

TEMP_EXT	Addr. 0x2F;	Bit 7:0	R
Code	Function		
0x00	External temperature sensor register not available		
0x48 ... 0x77	TEMP_EXT(6:0) = Register address of the temperature data (format U8) of an external sensor (Table 42)		
0xC8 ... 0xF7	TEMP_EXT(6:0) = First register address of two following temperature data registers (format I16) of an external sensor (Table 43)		
Other	Reserved		
Notes	I16 are saved as Little Endian, i.e. with the lowest-value byte at the lowest-value address.		

Table 39: Pointer to and format of temperature data from external sensor (U8)

TEMP_MIN (U8)
The parameter TEMP_MIN specifies the minimum operating temperature of the sensor.

TEMP_MIN	Addr. 0x30;	Bit 7:0	R
Code	Function	Min. temperature	
0x00	Minimum operating temperature undefined		
0x01 ... 0xFF	-64 °C + Code * 1 °C	-63 °C ... 191 °C	

Table 40: Minimum operating temperature (U8)

TEMP_MAX (U8)
The parameter TEMP_MAX specifies the maximum operating temperature of the sensor.

TEMP_MAX	Addr. 0x31;	Bit 7:0	R
Code	Function	Max. temperature	
0x00	Maximum operating temperature undefined		
0x01 ... 0xFF	-64 °C + Code * 1 °C	-63 °C ... 191 °C	

Table 41: Maximum operating temperature (U8)

Temperature Data Types

The following temperature ranges are specified.

U8 temperature range
The U8 temperature range describes temperature values with the following mapping:

Temperature Range (U8)		
Code	**Function**	**Temperature (U8)**
0x00	Undefined	-
0x01 ... 0xFF	-64 °C + Code * 1 °C	-63 °C ... 191 °C

Table 42: U8 Temperature Range

I16 temperature range
The I16 temperature range describes temperature values with the following mapping (Two's complement):

Temperature Range (I16)		
Code	**Function**	**Temperature Value**
0x8000 ... 0xFD8A	Undefined	-
0xFD8A ... 0xFFFF	(Code - 65536) * 0.1 °C	-63.0 °C ... -0.1 °C
0x0000 ... 0x0776	Code * 0.1 °C	0.0 °C ... 191 °C
0x0777 ... 0x7FFF	Undefined	-

Table 43: I16 Temperature Range



For I16, temperature data is captured completely when reading the first temperature byte specified by TEMP_INT or TEMP_EXT.

PARAMETER DESCRIPTION: STATUS INFORMATION

The STAT registers contain pointer to related error and warning registers.
Up to 4 status addresses are available for both error and warning.



Typically, these registers are read by the BiSS master, if the corresponding status bits $\overline{E}$ or $\overline{W}$ indicate an error or a warning during a BiSS frame. The meaning of the values in the status registers is specified by the BiSS device manufacturer.



If a warning is indicated with $\overline{W} = 0$, the process data is considered as valid information. If an error is indicated with $\overline{E} = 0$, the process data is considered as invalid.

STAT_Ex (U7)

STAT_E1	Addr. 0x32;	Bit 6:0	R
STAT_E2	Addr. 0x33;	Bit 6:0	R
STAT_E3	Addr. 0x34;	Bit 6:0	R
STAT_E4	Addr. 0x35;	Bit 6:0	R
Code	Function		
0x00	Error register not available		
0x48 ... 0x77	Address of the error register		
Other	Reserved		

Table 44: Pointer to error register 1 ... 4 (U7)

STAT_Wx (U7)

STAT_W1	Addr. 0x36;	Bit 6:0	R
STAT_W2	Addr. 0x37;	Bit 6:0	R
STAT_W3	Addr. 0x38;	Bit 6:0	R
STAT_W4	Addr. 0x39;	Bit 6:0	R
Code	Function		
0x00	Warning register not available		
0x48 ... 0x77	Address of the warning register		

Table 45: Pointer to warning register 1 ... 4 (U7)

PARAMETER DESCRIPTION: REGISTER BASED COMMANDS

Register based commands are executed via register access. Commands execute dedicated procedures in the slave.

CMD_ADR (U7)

CMD_ADD contains the relevant BiSS register address that can be written to execute the register based commands as defined in the following registers.

CMD_ADR	Addr. 0x3A;	Bit 7:0	R
Code	Function		
0x00	Command register not available		
0x48 . . . 0x77	Address of command register		
Other	Reserved		

Table 46: Pointer to command register (U7)

REBOOT (U8)

This command reboots the device.

REBOOT	Addr. 0x3B;	Bit 7:0	R
Code	Function		
0x00 . . . 0xFE	Opcode		
0xFF	Opcode not available		

Table 47: Opcode to reboot sensor (U8)

RESET (U8)

This command initializes the encoder by resetting status messages and calculating position data (without rebooting).

RESET	Addr. 0x3C;	Bit 7:0	R
Code	Function		
0x00 . . . 0xFE	Opcode		
0xFF	Opcode not available		

Table 48: Opcode to initialize sensor (U8)

PRESET (U8)

This command presets the encoder.

PRESET	Addr. 0x3D;	Bit 7:0	R
Code	Function		
0x00 . . . 0xFE	Opcode		
0xFF	Opcode not available		

Table 49: Opcode to preset (U8)

SCLEAR (U8)

The parameter contains the command to clear the status.

SCLEAR	Addr. 0x3E;	Bit 7:0	R
Code	Function		
0x00 . . . 0xFE	Opcode		
0xFF	Opcode not available		

Table 50: Opcode to clear status of sensor (CMD U8)

PARAMETER DESCRIPTION: CHECKSUM

CHKSUM (U8)

The parameter CHKSUM contains the checksum of this EDS bank. The value is the sum of all values of addresses 0x00 . . . 0x3E within this EDS bank. The permitted value range is 0 . . . 255 for the full U8 range. Thus, only the 8 least-significant bits of the checksum are stored in CHKSUM.

$$Checksum = \sum_{i=0x00}^{0x3E} value_of_address(i)$$

CHKSUM	Addr. 0x3F;	Bit 7:0	R
Code	Function		
0x00 . . . 0xFF	Bits 7:0 of the checksum of the EDS content (registers 0x00 . . . 0x3E)		
Example	If the sum of all values equals 0x12E, the 8-bit value 0x2E is stored in CHKSUM.		

Table 51: Check sum (U8)

REVISION HISTORY

Rel.	Rel. Date*	Chapter	Modification	Page
A1	2026-10-22	All	Initial release	All

* Release Date format: *YYYY-MM-DD*