MANUFACTURER DOCUMENT PACKAGE

# Manufacturer's Manual

Selected official pages for procurement and maintenance review

PRODUCT BRAND

## Siemens

PRODUCT MODEL

## 6ES7138-4DB03-0AB0

ET 200S SSI Interface. Relevant section pages: 231, 232, 233, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263. Adjacent model text on shared pages is outside this product reference.

OFFICIAL SOURCE

SIMATIC ET 200S Technological Functions; 06/2010, A5E00124867-07

Source: Siemens 06/2010, A5E00124867-07. Original manufacturer pages follow this cover.

Siemens 06/2010 exact-4DB03 chapter; original p238 retains a compatible 4DB02 diagram label. Read with p231 applicability and complete ET 200S station instructions.

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Amikon Limited prepared this independent reference package. Selected manufacturer pages follow with their original content and pagination visible.

SIEMENS


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# SIMATIC

# ET 200S
# Technological Functions

Operating Instructions


06/2010
A5E00124867-07

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|---|
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|---|
| indicates that death or severe personal injury **may** result if proper precautions are not taken. |

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|---|
| with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken. |

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|---|
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| NOTICE |
|---|
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# Preface

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## How this Manual Is Structured...

This manual is supplementary to the *ET 200S Distributed I/O System* operating instructions.

The ET 200S Distributed I/O System (http://support.automation.siemens.com/WW/view/en/1144348) operating instructions provide comprehensive information pertaining to the hardware configuration, installation, wiring, commissioning, diagnostics and technical specifications of the ET 200S distributed I/O system.

This manual provides a description of functions and the technical specifications of the ET 200S modules for technological functions: 1Count24V, 1Count5V, 1SSI and 2PULSE.

## How to Find Your Way Around

At the beginning of each section you will find a **Product Overview**, which lists the features and applications of the module described. You will also find the order number of the module and the name and release of the software required. For the current GSD file, go to:

- http://www.automation.siemens.com/csi/gsd

In each section you will then find a section with the heading **Brief Instructions on Commissioning**. These brief instructions tell you in a series of short steps how to install and configure the module, how to integrate it in your use program, and how to test it in your user program.

## Index

The index contains keywords that come up in the manual.

## Standards and approvals

For information about standards and approvals, refer to the section "General technical specifications" in the ET 200S Distributed I/O System (http://support.automation.siemens.com/WW/view/en/1144348) operating instructions.

## Recycling and disposal

The ET 200S 1Count24V, ET 200S 1Count5V, ET 200S 1SSI and ET 200S 2PULSE modules can be recycled due to the non-toxic materials from which they are assembled. For environmentally sustainable recycling and disposal of your old device, contact a certified disposal service for electronic scrap.

# 1SSI 4

## 4.1 Product Overview

### Order Number

6ES7 138-4DB03-0AB0

### Compatibility

The 1SSI with order number 6ES7 138-DB03-0AB0 replaces the 1SSI with the following order numbers:

- 6ES7 138-4DB02-0AB0
- 6ES7 138-4DB01-0AB0
- 6ES7 138-4DB00-0AB0

and is fully compatible.

### Features

- The 1SSI is an interface between an absolute encoder (SSI) and the higher-level controller. You edit the cyclically recorded encoder value in your controller program.
- Can be operated using terminal modules TM-E15S24-01 and TM-E15S26-A1
- Isochronous mode
- Normalization of the encoder value (that is, discounting of adjusted, irrelevant bits in the encoder value).
- Reversal of the direction of rotation to adjust the direction of movement of the absolute encoder to the axis.
- Latch function for freezing the current encoder value (only possible in standard mode).
- Comparison function between the current encoder value and loadable comparison values (only possible in standard mode).
- Type of encoder value recording can be selected:
  - Free-wheeling
  - Synchronous to the update rate
  - Isochronously
- Fast mode can be selected; with rapid encoder value detection and compressed functionality (cannot be used with the IM 151 with the order number 6ES7 151-1AA00-0AB0).
- Maximum encoder sampling rate (e.g., for ultrasonic encoders) is taken into account in isochronous mode
- Sign of life in isochronous mode
- Parity check of encoder value can be performed
- Gray/dual converter

## Supported Encoder Types

The following encoder types are supported:

- Absolute encoder (SSI) with 13 bits

  To

- Absolute encoder (SSI) with 25 bits

**Note**

The predecessor modules only support absolute encoders (SSI) that have widths of 13 bits, 21 bits and 25 bits.

## Firmware update [1]

To add functions and for troubleshooting, you can load firmware updates to the operating system memory of the 1SSI using STEP 7 HW Config.

**Note**

When you start the firmware update, the old firmware is deleted. If the firmware update is interrupted or canceled for any reason, the 1SSI will no longer function correctly as a result. Restart the firmware update and wait until it has completed successfully.

## Identification Data [1]

- Hardware release status
- Serial number

See also ET 200S Distributed I/O operating instructions (http://support.automation.siemens.com/WW/view/en/1144348), "Identification data" section.

[1] The function is only available if the used interface module supports the required system services.

## Configuration

You can use either of the following to configure the 1SSI:

- STEP 7 V5.4 SP2 and later, or with the HSP (hardware support package, available online) STEP 7 V5.3 SP2 and later.
- A GSD file (http://www.automation.siemens.com/csi/gsd)

## 4.2 Isochronous Mode

**Note**

For basic information on isochronous mode, refer to the Isochronous mode (http://support.automation.siemens.com/WW/view/en/15218045) function manual.

### Hardware Requirements

You will require the following for the 1SS in isochronous mode:

- A CPU that supports isochronous mode
- PROFIBUS master or PROFINET controller that supports the constant bus cycle time
- An IM 151 that supports isochronous mode

### Features

Depending on the system parameter assignment, the 1SSI works in either non-isochronous or isochronous mode.

In isochronous mode, the data communication between the master and 1SSI is isochronous to the bus cycle.

In isochronous mode, all bytes of the feedback interface are consistent.

If isochronous mode fails, the feedback interface is not updated. In the user program, this can be detected with the sign of life in the feedback interface.

## 4.4 Terminal Assignment Diagram

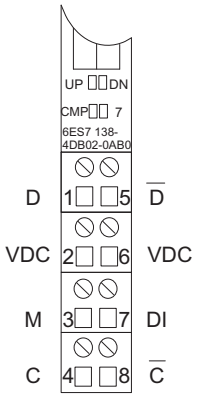
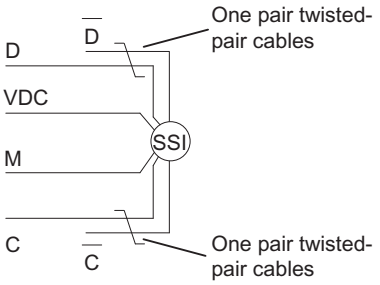
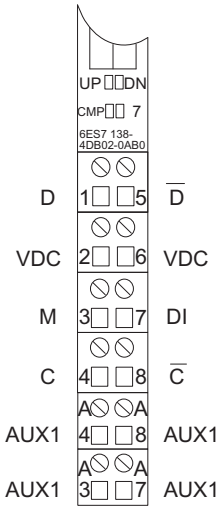
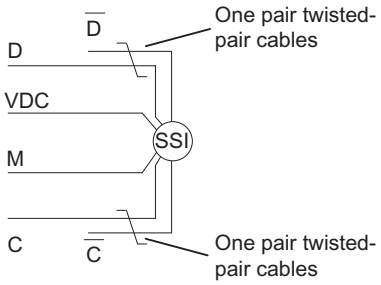
### Wiring Rules

The cables (terminals 1 and 5 and terminals 4 and 8) must be shielded, twisted-pair cables. The shield must be supported at both ends. To do this, use the shield contact (see the ET 200S Distributed I/O System (http://support.automation.siemens.com/WW/view/en/1144348) operating instructions).

## Terminal Assignment

You will find the terminal assignment for the 1SSI in the table below.

Table 4- 1 Terminal Assignment of the 1SSI

| View | Terminal Assignment | Remarks |
|---|---|---|
|  | TM-E15S24-01 and EM 1SSI<br>  | Terminals 1 to 8:<br>1/5: Data from the SSI encoder [1]<br>2/6: Power supply for absolute encoder and switch [2]<br>3: Chassis ground<br>7: Digital input latch function<br>4/8: SSI clock (clock wire) [1] |
|  | TM-E15S26-A1 and EM 1SSI<br>  | |

[1] It is essential that you maintain the correct polarity when wiring the encoder. If you do not, an absolute encoder error is reported. Signals according to RS422

[2] Short circuit-proof, maximum 0.5 A.

# 4.5 Configuring standard mode and fast mode

## Introduction

In order to take full advantage of the functionality of the 1SSI for the application in question, choose between fast mode and standard mode, depending on your automation task.

| Areas of Application | Mode |
|---|---|
| • Closed-loop control applications such as position controls with path position as actual value<br>• Fast encoder value detection | Fast |
| • Monitoring or detecting of position points<br>• Length measurement, edge detection, synchronization with workpieces | Standard |

## Configuring Standard Mode and Fast Mode

| Standard Mode | Fast Mode |
|---|---|
| Parameters are assigned to the various modes. You will find the parameter lists in the descriptions of the modes.<br>You can integrate the 1SSI in your project in two different ways. Decide whether you want to work with the GSD file or with STEP 7 using HW Config . | |

| Configuring 1SSI with STEP 7 using HW Config (in isochronous and non-isochronous mode) | |
|---|---|
| Select an entry from the hardware catalog that corresponds to the functionality you want. | |
| For standard mode, select the 1SSI entry with the number 6ES7 138-4DB03-0AB0 in the infotext. | For fast mode, select the 1SSI fast mode entry with the number 6ES7 138-4DB03-0AB0 Fast in the infotext. |
| Drag the entry to the slot at which you have installed your 1SSI. | |
| Select the parameters. | |

| Configuring 1SSI with the GSD file (only in non-isochronous mode) | |
|---|---|
| Select an entry in the GSD file that corresponds to the functionality you want. | |
| Select 6ES7 138-4DB03-0AB0 1SSI for standard mode. | Select 6ES7 138-4DB03-0AB0 1SSI Fast for fast mode. |
| Select the parameters. | |

# 4.6 Functions of the 1SSI

## 4.6.1 Overview of 1SSI functions

### Operating Principle

The 1SSI records the signals of the connected position encoder cyclically and forwards them, depending on the parameter assignment, to the feedback interface by means of the following functions:

- Encoder value detection
- Gray/binary converter
- Normalization
- Direction reversal
- Comparator (only in standard mode)
- Latch function (only in standard mode)
- Error detection
- Sign of life

The 1SSI uses the "ready for operation" feedback bit to indicate that the functions are executable and the displayed encoder value is valid.

## 4.6.2 Encoder Value Detection

### Description

The absolute encoder transfers its encoder values in message frames to the 1SSI. The transmission of message frames is initiated by the 1SSI. The following alternatives are available for encoder value detection:

- Free-wheeling encoder value detection
- Synchronous encoder value detection
- Isochronous encoder value detection

You can set free-wheeling or synchronous encoder value detection in HW Config with the "Detection" parameter. This parameter only works in non-isochronous mode.

The detection of the encoder value will be isochronous when the 1SSI is in isochronous mode. In this case, the "Detection" parameter is not evaluated.

The following table shows these connections:

Table 4- 2 Encoder Value Detection

| Mode | "Detection" Parameter | Encoder value detection |
|---|---|---|
| Non-isochronous mode | Free-wheeling | Free-wheeling encoder value detection |
| | Synchronous | Synchronous encoder value detection |
| Isochronous mode | - (irrelevant) | Isochronous encoder value detection |

### Free-Wheeling Encoder Value Detection

With free-wheeling encoder value detection, you obtain maximum accuracy with the latch function.

The 1SSI initiates the transmission of a message frame each time the assigned monoflop time elapses.

The 1SSI processes the detected encoder value asynchronously to these free-wheeling message frames in the cycle of the update rate.

This results in encoder values of various ages with the free-wheeling detection of encoder values. The difference between maximum and minimum age is the jitter.

### Synchronous Encoder Value Detection

With synchronous encoder value detection, you obtain maximum accuracy with encoder value detection.

The 1SSI initiates the transmission of a message frame in the cycle of its update rate.

The 1SSI processes the transmitted encoder value synchronously to its update rate.

### Isochronous Encoder Value Detection

Isochronous encoder value detection is carried out automatically when the equidistant bus cycle is activated in the DP master system and the DP slave is synchronized to the bus cycle.

The 1SSI initiates the transmission of a message frame in every bus cycle at time $T_i$, as long as the configured maximum encoder sampling rate does not result in a reduction.

The 1SSI processes the transmitted encoder value isochronously to the bus cycle.

### 4.6.3 Gray/Binary Converter

#### Description

When Gray is set, the encoder value supplied by the absolute encoder in gray code is converted to binary code. When Binary is set, the supplied encoder value is not converted.

| NOTICE |
| --- |
| If you selected the Gray setting, the 1SSI always converts the total encoder value (13 to 25 bits). Preceding special bits thus influence the encoder value and trailing bits can under some circumstances be corrupted. |

### 4.6.4 Transmitted Encoder Value and Standardization

#### Description

The transmitted encoder value contains the encoder position of the absolute value encoder. Depending on the encoder that is used, other bits that are located before and after the encoder position are transmitted in addition to the encoder position.

So that the 1SSI can determine the encoder position, specify the following:

- Encoder type
- Number of trailing bits
- Total steps of the absolute encoder

With normalization, you specify the representation of the encoder value in the feedback interface.

- With "Normalization On", you specify that trailing, irrelevant bits in the encoder value are to be discounted (see the following example).
- With "Normalization Off", you specify that trailing bits are retained and are available for evaluation.

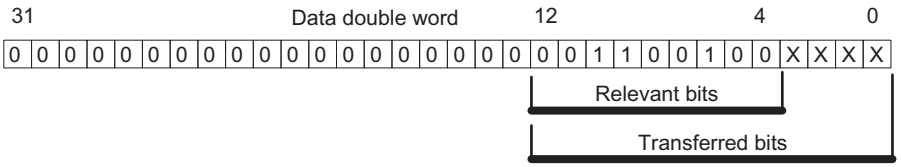
## Normalization Example

Presettings:

You use a single-turn encoder with $2^9$ (corresponds to 9 bits) = 512 steps/revolution (resolution/360°) with the following parameter assignment:

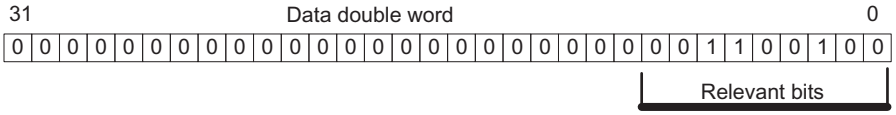
- Encoder type: SSI-13 bit
- Number of trailing bits: 4 places
- Total steps of the absolute encoder: 512

Without normalization: Cyclically recorded encoder position 100




Of the 13 bits transferred, bits 4 to 12 are required for evaluation.

After normalization: encoder position 100




Bits 0 to 3 (indicated above by "x") are discounted

## 4.6.5 Detection of Direction and Reversal of the Direction of Rotation

### Direction Detection

The 1SSI needs the following information to detect the direction of movement of the encoder correctly:

- Encoder type
- Total steps of the absolute encoder
- Number of trailing bits

The information is used as explained in the normalization example.

The direction of movement that is determined is displayed in the feedback interface and at the LEDs.

UP LED: encoder position change from lower to higher value

DN LED: encoder position change from higher to lower value

### Direction Reversal

The direction reversal adjusts the direction of movement of the encoder to that of the axis.

Two settings are possible:

- Off

  The direction of the transmitted encoder position is maintained.

- On

  The direction of the transmitted encoder position is reversed. This means that although the encoder sends ascending values, descending values are displayed.

  This reversal applies to the total steps of the absolute encoder, as indicated in the parameter assignment.

### Example of Direction Reversal

Presettings:

You use a single-turn encoder with $2^{10}$ (corresponds to 10 bits) = 1024 steps/revolution (resolution/360°) with the following parameter assignment:

- Encoder type: SSI-13 bit
- Number of trailing bits: 3 places
- Direction reversal: On
- Total steps of the absolute encoder: 1024

Encoder value before direction reversal: cyclically recorded encoder position 1023

Encoder value after direction reversal: displayed encoder position 0

### 4.6.6 Comparator (Only in Standard Mode)

#### Description

The encoder position that is detected can be compared with up to two loadable values (without hysteresis). Both comparison results are stored in the feedback interface. The appropriate comparator becomes active only after the comparison value is loaded.

You set the two comparators in the Comparator 1 and Comparator 2 parameters:

| Setting | Effect on the Result of Comparison (CMPx) |
|---|---|
| Not active | The encoder value is not compared.<br>The feedback bit CMPx = 0. |
| In the up direction | The encoder value is compared in the up direction (UP).<br>• If the encoder value ≥ the comparison value, the feedback bit CMPx = 1.<br>• If the encoder value < the comparison value, the feedback bit CMPx = 0.<br>• If the direction is down, the feedback bit CMPx remains unchanged.<br>• If no change is detected in the encoder value, the feedback bit CMPx remains unchanged. |
| In the down direction | The encoder value is compared in the down direction (DN).<br>• If the encoder value ≤ the comparison value, the feedback bit CMPx = 1.<br>• If the encoder value > the comparison value, the feedback bit CMPx = 0.<br>• If the direction is up, the feedback bit CMPx remains unchanged.<br>• If no change is detected in the encoder value, the feedback bit CMPx remains unchanged. |
| In both directions | The encoder value is compared in both directions.<br>If the direction is up, the following conditions apply:<br>• If the encoder value ≥ the comparison value, the feedback bit CMPx = 1.<br>• If the encoder value < the comparison value, the feedback bit CMPx = 0.<br>If the direction is down, the following conditions apply:<br>• If the encoder value ≤ the comparison value, the feedback bit CMPx = 1.<br>• If the encoder value > the comparison value, the feedback bit CMPx = 0.<br>• If no change is detected in the encoder value, the feedback bit CMPx remains unchanged. |

As soon as you load a comparison value, the comparison result is deleted and is then entered in accordance with the directional setting.

**Note**

Only one control bit can be set at a particular time:

CMP_VAL1 or CMP_VAL2.

Otherwise, the ERR_LOAD error is reported until both control bits are deleted.

## Loading the Comparison Value

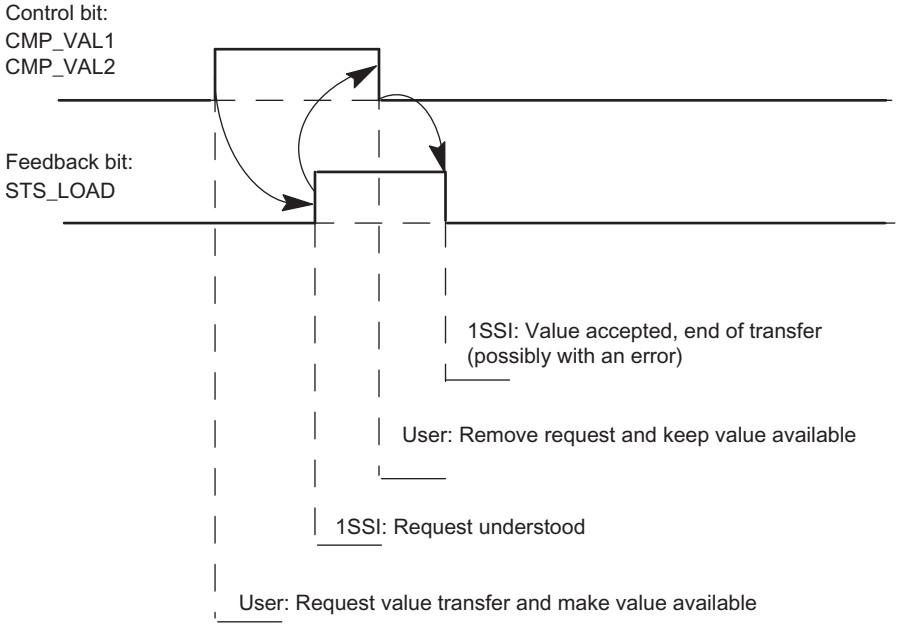



Figure 4-2 Value Transfer

## Comparator in Isochronous Mode

In isochronous mode, the comparison values are loaded at time $T_o$ and are effective as of time $T_i$ in the same bus cycle.

## 4.6.7 Latch Function (Only in Standard Mode)

### Description

You use the latch function to freeze the current encoder value of the 1SSI at an edge at the digital input (DI).

The encoder value can thus be evaluated on an event-dependent basis.

A frozen encoder value is identified by the set bit 31 and is preserved until the termination of the latch function.

The frozen encoder value is entered at the feedback interface at the position of the cyclically recorded value and assigned the identifier "Bit 31 set."

---

**Note**

Direction determination, comparison, and error monitoring also take place when the encoder value is frozen.

---

### Prerequisites for Using the Latch Function

- You must have specified which edge (rising and/or falling) at the digital input freezes the encoder value.
- You specify that the latch function that is coupled to the digital input is switched on.

## Terminating the Latch Function

The latch function must be acknowledged. When the controller program acknowledges the acceptance of the encoder value, bit 31 is deleted and the encoder value is updated again. Freezing is then possible again.

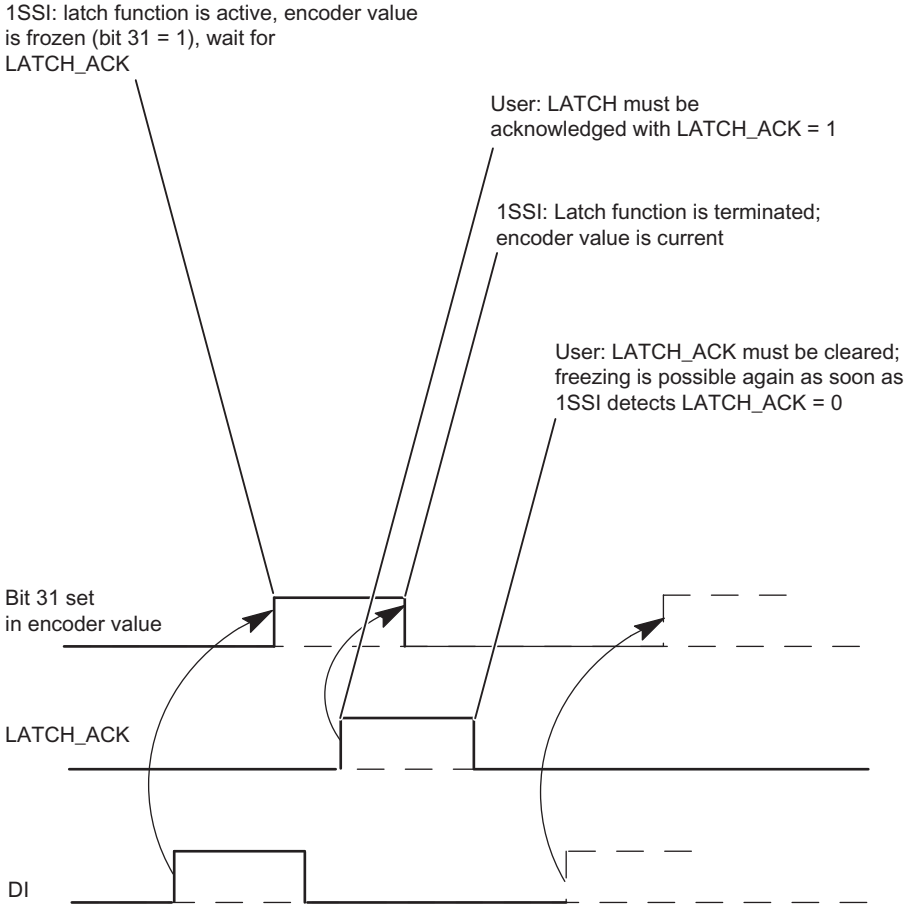



Figure 4-3 Latch Function

## 4.6.8 Error Detection in Standard Mode

### Description

The absolute value encoder and sensor supply short circuit errors must be acknowledged. They have been detected by the 1SSI and are indicated at the feedback interface. Channel-specific diagnostics are performed if you have enabled group diagnostics in your configuration (see device manual of the interface module used).

The parameter assignment error bit is acknowledged by means of correct parameter assignment.

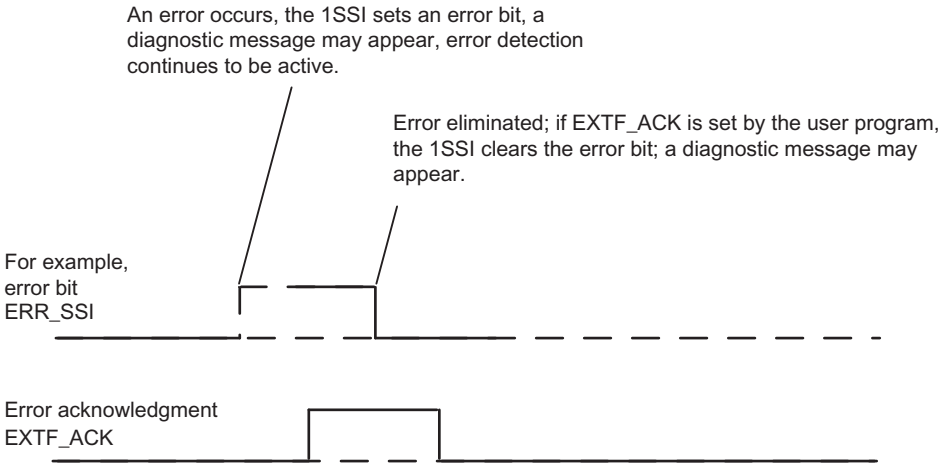



Figure 4-4 Error Acknowledgment

In the case of constant error acknowledgement (EXTF_ACK = 1) or in CPU/master STOP mode, the 1SSI reports the errors as soon as they are detected and clears the errors as soon as they are eliminated.

## 4.6.9 Error Detection in Fast Mode

### Description

The absolute value encoder and sensor supply short circuit errors have been detected by the 1SSI and are indicated at the feedback interface. Channel-specific diagnostics are performed if you have enabled group diagnostics in your configuration (see device manual of the interface module used).

The parameter assignment error bit is acknowledged by means of correct parameter assignment.

As soon as the absolute value encoder and sensor supply short circuit errors are no longer detected by the 1SSI, the error display at the feedback interface is cleared, and in certain cases the channel-specific diagnosis reports an error-free condition.

# 4.7 Behavior at CPU/master STOP

## Description

The 1SSI detects the CPU/master STOP. The reaction to this is to stop the active operation.

## Exiting the CPU/master STOP status

| | |
|---|---|
| Without reassigning the parameters of the ET 200 station | • The feedback interface of the 1SSI remains current. |
| With reassignment of the parameters of the ET 200 station | • You must reload the comparison values.<br>• The latch function has to be triggered with a new edge on the digital input DI. |

## Reassigning Parameters of the ET 200S Station

Reconfiguration of the ET 200S station is carried out by your CPU/master at:

- POWER ON of the CPU/master
- Upon power on of the IM 151
- After failure of the bus transmission
- Upon loading changed parameters or configuration of the ET 200S station to the CPU/master

# 4.8 Setting parameters for the 1SSI

## Overview

You set the parameters for the 1SSI by means of the GSD file for the ET 200S or using the STEP 7 parameter assignment software. It is not possible to reassign the parameters by means of the user program.

Depending on the mode that you selected, either of the following parameter sets from your parameter assignment appear in the parameter assignment software:

- All parameters (standard mode), or
- A portion of the parameters (fast mode)

You can enter the following parameters (the default appears in bold):

| Parameters | Value Range | Note |
|---|---|---|
| Group diagnostics | **Disable**/enable | Enabling parameter |
| Detection | **Free-wheeling**/synchronous | This parameter is irrelevant in isochronous mode and is not evaluated. |
| Encoder type [1] | No encoder/ **SSI 13-bit /** ... / SSI 25-bit | No encoder: The encoder input is switched off. |
| Gray/binary converter [1] | **Gray**/binary | Code supplied by the encoder |
| Transmission rate [1 3] | **125 kHz** / 250 kHz /<br>500 kHz / 1 MHz / 1.5 MHz / 2 MHz | Note that the transmission rate affects the accuracy and up-to-dateness of the encoder values. |
| Monoflop time [1 2 3] | 16 µs / 32 µs / 48 µs / **64 µs** | The specification of the monoflop time is relevant for free-wheeling encoder value detection.<br>See the vendor's technical specifications. |
| Parity | **None**, odd, even | An assigned parity bit is included in the "Encoder Type" parameter. If a 25-bit encoder is assigned parity, then 26 bits are read from the encoder.<br>The bit following the LSB (least significant bit) is evaluated as a parity bit. A parity error is reported by means of the following feedback interfaces:<br>• EXTF in fast mode<br>• ERR_SSI in standard mode |
| Normalization | **Off**/on | – |
| Number of trailing bits [1] | **0** to 15 | The number of trailing bits must be specified. |
| Direction reversal | **Off**/on | – |

| Parameters | Value Range | Note |
|---|---|---|
| Total steps of the absolute encoder [1] | • Encoder type 13 bits: 16 to 8192<br>• Encoder type 14 bits: 16 to 16384<br>• Encoder type 15 bits: 16 to 32768<br>• Encoder type 16 bits: 16 to 65536<br>• Encoder type 17 bits: 16 to 131072<br>• Encoder type 18 bits: 16 to 262144<br>• Encoder type 19 bits: 16 to 524288<br>• Encoder type 20 bits: 16 to 1048576<br>• Encoder type 21 bits: 16 to 2097152<br>• Encoder type 22 bits: 16 to 4194304<br>• Encoder type 23 bits: 16 to 8388608<br>• Encoder type 24 bits: 16 to 16777216<br>• Encoder type 25 bits: 16 to 33554432 | If you find "Total steps - highword" and "Total steps - lowword" in your parameter assignment software instead of "Total steps", the following definition applies: *Total steps = total steps lowword + total steps highword x* $2^{16}$ |
| Latch: Encoder value | Not active / With rising edge DI / With falling edge DI / With both edges DI | This parameter is available in the parameter assignment software in standard mode only.<br>Not active: The encoder value cannot be frozen. |
| Comparator 1 | Not active / In the up direction / In the down direction / In both directions | This parameter is available in the parameter assignment software in standard mode only.<br>Not active: The comparator is switched off. |
| Comparator 2 | Not active / In the up direction / In the down direction / In both directions | This parameter is available in the parameter assignment software in standard mode only.<br>Not active: The comparator is switched off. |
| Sign of life | Off, On | This parameter is only active in isochronous mode.<br>When sign of life is on, the sign-of-life bit is toggled, i.e., the last sent value is inverted, each time an encoder value is read in in isochronous mode. If a reduction is assigned in the "Encoder Sampling Rate" parameter, the value is toggled only if an encoder value was actually read in.<br>You can find the sign-of-life bit in the feedback interface in:<br>• Byte 4/bit 7 (standard mode)<br>• Byte 0/bit 7 (fast mode) |

| Parameters | Value Range | Note |
|---|---|---|
| Encoder sampling rate | **No limitation**, 0.1 kHz to 6.3 kHz (in 0.1-kHz steps) | Any encoder sampling rate to be taken into account is set here. This parameter is only active in isochronous mode. It enables the use of slower encoders (such as ultrasound encoders) even in a fast processing cycle. An **integer reduction** n is calculated using the set frequency. In this case, the encoder is read in again only every nth clock cycle.<br>Example: Processing cycle 500 µs<br>Encoder sampling rate: 1.2 kHz (approximately every 833 µs)<br>--> reduction n = 2, i.e., the encoder is read in again only every 2nd processing cycle, i.e., every ms. |

[1] See the technical specifications of the absolute encoder.

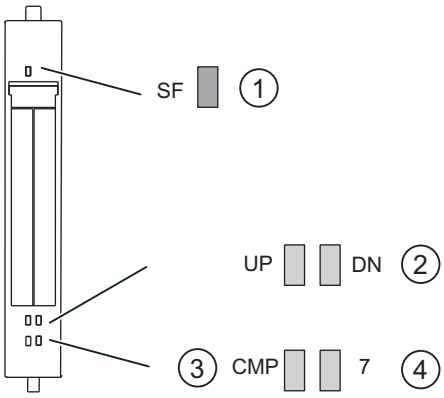
[2] The monoflop time is the time between 2 SSI frames. The assigned monoflop time must be greater than the monoflop time of the absolute encoder (refer to the technical specifications of the manufacturer).

[3] The following limitation applies to the monoflop time of the absolute encoder:
(1/transmission rate) < monoflop time of absolute encoder < 64 µs

# 4.9 Diagnostics

## 4.9.1 Diagnostics using the LED display

### LED display on the 1SSI




① Group error (red)
② Status display for change in sensor value (green)
③ Status display for result of comparison
④ Status display for digital input (green)

### Status and error displays by means of LEDs on the 1SSI

The table below shows the status and error displays on the 1SSI.

| Event (LEDs) | | | | | Cause | Remedy |
|---|---|---|---|---|---|---|
| SF | UP | DN | CMP | 7 | | |
| On | | | | | No parameter assignment. There is a diagnostic message. | Check the parameter assignment. Evaluate the diagnostics data. |
| | On | | | | At value change from smaller to larger sensor values (including zero-crossing) | |
| | | On | | | At value change from larger to smaller sensor values (including zero-crossing) | |
| | | | On | | Set for comparison result CMP 1 | |
| | | | | On | DI (latch) is activated. | |

## 4.9.2 Error types

For information on the structure of the channel-related diagnostics, refer to the manual on the interface module used in your ET 200S station.

### 1SSI error types

The following table shows the error types on the 1SSI.

| Error class | | Meaning | Remedy |
|---|---|---|---|
| $1_D$ | 00001: Short circuit | Short circuit of the supply to the absolute encoder. | Correct the process wiring. |
| $9_D$ | 01001: Error | Internal module error occurred.<br>Load voltage from the power module is too low. | Replace the module.<br>Correct the process wiring. Check the load voltage. |
| $16_D$ | 10000: Parameter assignment error | Parameters have not been assigned to the module. | Correct the parameter assignment. |
| $26_D$ | 11010: External error | Start/Stop bit error (error absolute encoder): Wire break in the sensor cable, or sensor cable is not connected. Sensor type, transmission rate, and monoflop time do not correspond to the sensor connected; programmable sensors do not correspond to the settings on the 1SSI electronic module. Sensor is defective or there are faults. | Replace the sensor; correct the process wiring.<br>Correct the parameter assignment. |

# 4.10 Control and Feedback Interfaces in Standard Mode

**Note**

For the 1SSI, the following data of the control and feedback interface are consistent:

Byte 0 to 3
Byte 4 to 7

Use the access or addressing mode for data consistency over the entire control and feedback interface on your master (only for configuration using the GSD file).

## Description

The two tables show the assignment of the control interface (outputs) and the feedback interface (inputs):

Table 4- 3 Assignment of the Feedback Interface (Inputs)

| Address | Assignment |
|---|---|
| Bytes 0 to 3 | Encoder value double word (bit 31 set, encoder value frozen) |
| Byte 4 | Bit 7: Reserved = 0 or sign of life LZ<br>Bit 6: Ready for operation RDY<br>Bit 5: Parameter assignment error ERR_PARA<br>Bit 4: Absolute encoder error ERR_SSI<br>Bit 3: Encoder supply short circuit ERR_24V<br>Bit 2: Status DI STS_DI<br>Bit 1: Status DN STS_DN<br>Bit 0: Status UP STS_UP |
| Byte 5 | Bit 7: Reserved = 0<br>Bit 6: Reserved = 0<br>Bit 5: Reserved = 0<br>Bit 4: Reserved = 0<br>Bit 3: Comparison value 2 reached, CMP2<br>Bit 2: Comparison value 1 reached, CMP<br>Bit 1: Load function error, ERR_LOAD<br>Bit 0: Load function running, STS_LOAD |
| Bytes 6 to 7 | Reserved = 0 |

Table 4- 4 Assignment of the Control Interface (Outputs)

| Address | Assignment |
|---|---|
| Bytes 0 to 3 | Comparison value 1 or 2 (double word) |
| Byte 4 | Bit 7: Error acknowledgment EXTF_ACK<br>Bit 6: Acknowledgment of latch function LATCH_ACK<br>Bit 5: Reserved = 0<br>Bit 4: Reserved = 0<br>Bit 3: Reserved = 0<br>Bit 2: Reserved = 0<br>Bit 1: Load comparison value 2, CMP_VAL2<br>Bit 0: Load comparison value 1, CMP_VAL1 |
| Byte 5 | Reserved = 0 |
| Bytes 6 to 7 | Reserved = 0 |

## Notes on the Control and Feedback Bits

| Bits | Notes |
|---|---|
| CMP | Comparison result of comparator 1 |
| CMP2 | Comparison result of comparator 2 |
| CMP_VAL1 | Load comparison value 1 |
| CMP_VAL2 | Load comparison value 2 |
| ERR_24V | The encoder supply is short circuited. ERR_24V is reset when the short circuit is eliminated and acknowledged with the EXTF_ACK control bit. |
| ERR_LOAD | Error while loading the comparison values because both control bits CMP_VAL1 and CMP_VAL2 are set. |
| ERR_PARA | Incorrect parameter assignment for the ET 200S station.<br>Cause: Total steps of the absolute encoder are not in the range of values for the type of encoder.<br>The parameter bit is cleared when a correct parameter assignment is transmitted. |
| ERR_SSI | The 1SSI detects an absolute encoder error if the message frames at the SSI interface are faulty.<br>Causes: No encoder connected; wire break in the encoder cable; over voltage of encoder supply; type of encoder, transmission rate, parity error, monoflop time do not correspond to the connected encoder; programmable encoders do not correspond to the settings on the 1SSI; encoder is defective or faults exist.<br>ERR_SSI is reset when the cause of the error is eliminated and acknowledged with the EXTF_ACK control bit. |
| EXTF_ACK | Error acknowledgement for the absolute encoder ERR_SSI and encoder supply short circuit ERR_24V errors |
| LATCH_ACK | Acknowledgement for latch function |
| LZ | This parameter is only active in isochronous mode.<br>When sign of life is on, the sign-of-life bit is toggled, i.e., the last sent value is inverted, each time an encoder value is read in in isochronous mode. If a reduction is assigned in the "Encoder Sampling Rate" parameter, the value is toggled only if an encoder value was actually read in. |
| STS_DI | The bit displays the status of the digital input DI. |
| STS_DN | Status direction down; for encoder value change from larger to smaller encoder positions (including zero crossover) |
| STS_LOAD | Feedback bit for CMP_VAL1 and CMP_VAL2. The 1SSI uses this bit to indicate that a comparison value is loaded. |

| Bits | Notes |
|---|---|
| STS_UP | Status direction down; for encoder value change from larger to smaller encoder positions (including zero crossover) |
| RDY | The parameter assignment of the 1SSI is correct, and the module is executing its functions. The displayed feedback is valid. For the absolute value encoder error, ERR_SSI is also set. |

## Access to the Control and Feedback Interface in STEP 7 Programming

| | Configuring with STEP 7 using the GSD file [1]) (Hardware catalog\PROFIBUS-DP\ Additional FIELD DEVICES\ET 200S) | Configuring with STEP 7 using HW Config (Hardware catalog\PROFIBUS-DP\ ET 200S) |
|---|---|---|
| Feedback interface | Read with SFC 14 "DPRD_DAT" | Load command, e.g. L PID |
| Control interface | Write with SFC 15 "DPWR_DAT" | Transfer command, e.g. T PQD |
| [1] Load and transfer commands are also possible with CPU 3xxC, CPU 318-2 (as of V3.0), CPU 4xx (as of V3.0) and WinLC RTX (PC CPU). | | |

# 4.11 Feedback Interface in Fast Mode

## Description

Refer to the table below for the assignment of the feedback interface (inputs):

Table 4- 5 Assignment of the Feedback Interface (Inputs)

| Address | Assignment |
|---|---|
| Bytes 0 to 3 | Bit 31: Reserved = 0 or sign of life LZ<br>Bit 30: Ready for operation (feedback is valid) RDY<br>Bit 29: Parameter assignment error ERR_PARA;<br>Bit 28: Group error absolute encoder or encoder supply short circuit EXTF<br>Bit 27: Status DI STS_DI<br>Bit 26: Status DN STS_DN<br>Bit 25: Status UP STS_UP<br>Bytes 0 to 24: Encoder value |

## Notes on the Feedback Bits

| Bits | Notes |
|---|---|
| ERR_PARA | Incorrect parameter assignment for the ET 200S station.<br>Cause: Total steps of the absolute encoder are not in the range of values for the type of encoder.<br>The parameter bit is cleared when a correct parameter assignment is transmitted. |
| EXTF | Group error absolute encoder or encoder supply short circuit<br>Causes:<br>The encoder supply is short circuited<br>or<br>No encoder connected; wire break in the encoder cable; type of encoder, transmission rate, monoflop time do not correspond to the connected encoder; programmable encoders do not correspond to the settings on the 1SSI; encoder is defective or faults or parity errors exist.<br>EXTF is reset when the causes of the errors are eliminated. |
| LZ | This parameter is only active in isochronous mode.<br>When sign of life is on, the sign-of-life bit is toggled, i.e., the last sent value is inverted, each time an encoder value is read in in isochronous mode. If a reduction is assigned in the "Encoder Sampling Rate" parameter, the value is toggled only if an encoder value was actually read in. |
| STS_DI | The bit displays the status of the digital input DI. |
| STS_DN | Status direction down; for encoder value change from larger to smaller encoder positions (including zero crossover) |
| STS_UP | Status direction down; for encoder value change from larger to smaller encoder positions (including zero crossover) |
| RDY | The parameter assignment of the 1SSI is correct, and the module is executing its functions. The displayed feedback is valid. For the absolute value encoder error, ERR_SSI is also set. |

## Access to the Feedback Interface in STEP 7 Programming

| | Configuring with STEP 7 using the GSD File | Configuring with STEP 7 using HW Config |
|---|---|---|
| Feedback interface | Read with SFC 14 "DPRD_DAT" | Load command (e.g. L PID) |

# 4.12 Technical Specifications

## Overview

| General technical specifications | |
|---|---|
| **Dimensions and Weight** | |
| Dimensions W x H x D (mm) | 15 x 81 x 52 |
| Weight | Approx. 40 g |
| **Voltages, Currents, Potentials** | |
| Rated load voltage L+<br>• Reverse polarity protection | 24 VDC<br>Yes |
| Galvanic isolation<br>• Between backplane bus and SSI function<br>• Between SSI function and load voltage L+ | <br>Yes<br>No |
| Encoder supply<br>• Output voltage<br>• Output current | <br>L+ (-0.8 V)<br>Max. 500 mA (Total current at terminals 2 and 6), short-circuit proof |
| Current consumption<br>• From the backplane bus<br>• From load voltage L+ (no load) | <br>max. 10 mA<br>max. 40 mA |
| Power dissipation of the module | 1.0 W |
| **SSI Module Encoder Input** | |
| Position feedback | Absolute |
| Differential signals for SSI data and SSI clock | According to RS422 |
| Data transmission rate and wire length with absolute encoders (twisted pair and shielded) *) | • 125 kHz max. 320 m<br>• 250 kHz max. 160 m<br>• 500 kHz max. 60 m<br>• 1 MHz max. 20 m<br>• 1.5 MHz max. 10 m<br>• 2 MHz max. 8 m |
| **Digital Input** | |
| Input voltage | 0 signal: -30 ... 5 V<br>1 signal: 11 ... 30 V |
| Input current | 0 signal: ≤2 mA (quiescent current)<br>1 signal: 9 mA (typically) |
| Input delay | 0 > 1: max. 300 µs<br>1 > 0: max. 300 µs |
| Connection of a two-wire BERO type 2 | Possible |
| Shielded cable length | 50 m |
| **Status, Interrupts, Diagnostics** | |

| General technical specifications | | | | | | |
|---|---|---|---|---|---|---|
| Interrupts | | | | | | |
| Status display for digital input DI | LED 7 (green) | | | | | |
| Status display of first comparator CMP | CMP LED (green) | | | | | |
| Encoder value change Up | UP LED (green) | | | | | |
| Encoder value change Down | DN LED (green) | | | | | |
| Group error | SF LED (red) | | | | | |
| **Encoder Value Inaccuracy in Non-Isochronous Mode** | | | | | | |
| Free-wheeling encoder value detection | | | | | | |
| • Maximum age<br>– Standard mode<br>– Fast mode | <br>(2 × frame transfer rate) + monoflop time + 1 µs<br>(2 × frame transfer rate) + monoflop time + 700 µs | | | | | |
| • Jitter<br>– Standard mode<br>– Fast mode | <br>Frame runtime + Monoflop time<br>Frame runtime + Monoflop time | | | | | |
| Synchronous encoder value detection | | | | | | |
| • Age<br>– Standard mode<br>– Fast mode | <br>Frame runtime + 1 ms<br>Frame transfer rate + 700 µs | | | | | |
| Isochronous encoder value detection | | | | | | |
| • Age in standard mode and fast mode | Encoder value at time $T_i$ of the current bus cycle | | | | | |
| **Latch Value Inaccuracy in Non-Isochronous Mode** | | | | | | |
| Free-wheeling encoder value detection | | | | | | |
| • Jitter in standard mode and fast mode | Frame runtime + Monoflop time | | | | | |
| Synchronous encoder value detection | | | | | | |
| • Jitter<br>– Standard mode<br>– Fast mode | <br>1 ms<br>700 µs | | | | | |
| Isochronous encoder value detection | | | | | | |
| • Jitter in standard mode and fast mode | Frame runtime + Monoflop time | | | | | |
| **Frame runtime of the encoders (for selected encoder widths without parity bit)** | | | | | | |
| | 13 bits | 14 bits | 16 bits | 21 bits | 24 bits | 25 bits |
| • 125 kHz | 112 µs | 120 µs | 136 µs | 176 µs | 200 µs | 208 µs |
| • 250 kHz | 56 µs | 60 µs | 68 µs | 88 µs | 100 µs | 104 µs |
| • 500 kHz | 28 µs | 30 µs | 34 µs | 44 µs | 50 µs | 52 µs |
| • 1 MHz | 14 µs | 15 µs | 17 µs | 22 µs | 25 µs | 26 µs |
| • 1.5 MHz | 9 µs | 10 µs | 11 µs | 15 µs | 17 µs | 17 µs |
| • 2 MHz | 7 µs | 8 µs | 9 µs | 11 µs | 13 µs | 13 µs |
| Monoflop time [1] | 16 µs / 32 µs / 48 µs / 64 µs | | | | | |

| General technical specifications | | |
|---|---|---|
| **Response Times in Non-Isochronous Mode** | | |
| Update rate of the 1SSI | | |
| • In standard mode<br>• In fast mode | 1 ms<br>700 µs | |
| **Isochronous Times for the Module** | | |
| • In standard mode | TCI | 125 µs + Frame runtime (in µs) |
| | TCO | 125 µs |
| | $T_{oi}$Min | 0 µs |
| | $T_{DP}$Min | 400 µs + Frame runtime if frame runtime > 100 µs |
| | | 500 µs if frame runtime ≤ 100 µs |
| • In fast mode | TCI | 70 µs + Frame runtime (in µs) |
| | TCO | 0 µs |
| | $T_{oi}$Min | 0 µs |
| | $T_{DP}$Min | 210 µs + Frame runtime if frame runtime > 40 µs |
| | | 250 µs if frame runtime ≤ 40 µs |

[1] The following restriction applies to the monoflop time of the absolute encoder:
(1/transmission rate) < monoflop time of the absolute encoder < 64 µs)

[*)] As long as the encoder in use does not require a shorter line length.