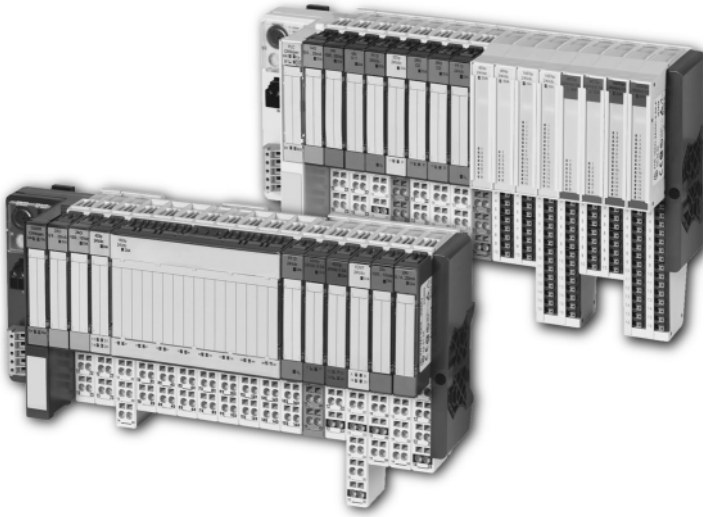
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XN-1SSI
Technology Module



Powering Business Worldwide

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Original manual
The German version of this document is the original manual.

Translations of the original manual
All non-German editions of this document are translations of the original manual.

Editorial department
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Subject to modifications.



Warning!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that the device cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (DIN VDE 0105 Part 100) may work on this device.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or tothe potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC/HD 60364-4-41 (DIN VDE 0100 Part 410).
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause uncontrolled operation or restart.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).

- The electrical installation must be carried out in accordance with the relevant regulations (e.g. with regard to cable cross sections, fuses, PE).
- All work relating to transport, installation, commissioning and maintenance must only be carried out by qualified personnel. (IEC/HD 60364 (DIN VDE 0100) and national work safety regulations).

Table of contents

Table of contents 5

About This Manual 9
Writing conventions. 9

1 Product Description 11
General product description 11
– Power supply 11
– Transmission procedure. 12
– Data exchange 12
– Internal registers - read and write operations 13
– Register access and meaning 15
– Comparison value 1, Comparison value 2 19
– Lower limit, upper limit 21
– Offset function / load value 23
– Status messages of the SSI encoder 23
– Resetting the register bank 25
Technical features 26
– Block diagram of the XN-1SSI 26
– Technical data of the XN-1SSI 27
– Indication elements 29
Base modules. 30
– Technical data of the base modules 31
– Connection diagram for the SSI encoder. 32

2 Integrating the Module in PROFIBUS-DP 33
PROFIBUS-DP data image 33
– Process input 33
– Process output 39
– Diagnostics 42
– Parameters. 44
– Error detection / messages 47
Function block for SIMATIC S7 49

3 Integrating the Module in DeviceNet 57
Process image 57
SSI Module Class (VSC116) 59

4 Integrating the Module in CANopen 77
Introduction 77
– General 77
– Encoder-specific default PDOs 78
Encoders Device Profile Implementation 79
– Overview of Encoders Device Profile Range 79
– Object 5800hex – Encoder Basic Mode 81
– Object 5801hex – Encoder Config 81
– Object 5802hex – Encoder Status 84
– Object 5803hex – Encoder Flags 85
– Object 5804hex – Encoder Diag 87
– Object 5805hex – SSI Native Status 89
– Object 5806hex – SSI Optional Encoder Status . . . 93
– Object 5808hex – Encoder Control 94
– Object 5810hex – Counter Load Prepare Value . . . 94
– Object 5811hex – Counter Pulse Width 94
– Object 5820hex – Measuring Integration Time . . . 94
– Object 5821hex – Measuring Low Limit 94
– Object 5822hex – Measuring High Limit 94
– Object 5823hex – Measuring Units per Revolution 94
– Object 5840hex – SSI Diag Mapping 94
– Object 6800hex – Operating Parameters 97
– Object 6810hex – Preset Values for Multi-Sensor Devices 97
– Object 6820hex – Position Value 98
– Object 6B00hex – CAM State Register 99
– Object 6B01hex – CAM Enable Register 100
– Object 6B02hex – CAM Polarity Register 101
– Object 6B10hex – CAM1 Low Limit 101
– Object 6B20hex – CAM1 High Limit 102
– Object 6B30hex - CAM1 Hysteresis 103
– Object 6D00hex – Operating Status 103
– Object 6D01hex - SingleTurn Resolution (rotary), Measuring Step (linear) 103

– Object 6D02hex - Number of distinguishable revolutions 103
– Object 6FFFhex - Device Type 103
– Additional emergencies 104

Index 105

Table of contents

About This Manual

Writing conventions

Symbols used in this manual have the following meanings:



Note!
Warns of a hazardous situation that could result in slight damage to the product or components.



Caution!
Warns of the possibility of a hazardous situation that could result in major damage and minor injury.



Warning!
Warns of the possibility of a hazardous situation that could result in major damage and serious or fatal injury or even death.



Indicates interesting tips and additional information.

1 Product Description

General product description

The XN-1SSI technology module is an addition to the XI/ON range of components in slice design. It is used for connecting SSI encoders with a maximum word length of 32 bits and a maximum bit transmission rate of 1Mbit/s. The module provides a 24 V DC (500 mA) power supply. In order to read SSI encoder data, the XN-1SSI module outputs a clock signal with which the encoder value can be read via the signal input. The clock signal and the signal input are based on the RS422 protocol.

The module can be fitted or removed during operation without damaging the module electronics. Once the module is removed or fitted, this is detected with the next telegram, the module list is updated and communication with all modules of the station is restored. Communication is maintained for as long as no more than two adjacent modules have been removed. Removing the electronics module will cause the power supply of the SSI encoder to be disconnected from the field voltage.

Power supply

The connected SSI encoder is fed with power via the output terminals of the SSI module. The power supplied to the XN-PF-24VDC-D power feeding module and XN-BR-24VDC-D bus refreshing module is distributed via the bus system and connected directly to the output terminals. The module bus electronics unit is fed by the module bus.

Transmission procedure

The XN-1SSI module enables the SSI data to be transferred according to the requirements of the application. The parameters of the XN-1SSI module can be configured by the user to set up a functional transmission procedure as required.

Gray code or binary code data transmission is possible.

Bit transmission rates from 62.5 Kbit/s to 1 Mbit/s are possible.

The SSI encoder value can be represented in a data frame with between 1 to 32 bits. Bits can be deactivated at both the LSB and MSB side of the frame. At the MSB side this is done by a masking operation, which causes invalid bits to be set to 0. At the LSB side, the invalid bits are removed by shifting the entire data frame to the right. The missing bits on the MSB side are filled with zeros.

Data exchange

The process output data is transmitted from the PLC to the XN-1SSI module, whilst the process input data is transferred from the XN-1SSI module to the PLC.

The process output data is used for writing the registers and requesting data from them. It is possible to stop the communication with the SSI encoder and activate or deactivate comparison operations.

The process input data is used for reading the contents of the registers inside the modules. In this case, the SSI encoder value is part of the register. The writing of these registers can be controlled. The results of different comparison operations can be supplied, and the communication status with the SSI encoder can also be

displayed. Status messages that were generated by the connected SSI encoder can be passed to the PLC as process input data.

The diagnostics messages are also embedded in the process input data.

The parameter and diagnostics interface allows acyclic data to be transferred in addition to this cyclic data. The parameters for the data transmission on the SSI module, such as bit transmission rate, telegram length etc. are set via the parameter interface. The diagnostics interface supplies the higher-level system with error messages, such as parameter errors.

Internal registers - read and write operations

The SSI module is provided with a universal register interface that enables access to up to 64 registers. These are accessed via the process data.

For write access, it must be ensured beforehand that the register write interface is in the default status and that a write access operation is therefore not currently active. This is ensured if REG_WR = 0 in the process output data, and is confirmed in the process input data with REG_WR_AKN = 0. Write access is then possible. The following values must be transferred with the process output data for this:

REG_WR_ADR = Register address,
REG_WR_DATA = Value to be written (32 bit)
REG_WR = 1 (write command)

The SSI module acknowledges the processing of the write command via the process input data by signalling REG_WR_AKN = 1.
REG_WR_ACEPT = 1 in the process input data confirms whether the write operation to the

register was successfully completed. If the register could not be written (no access authorisation, out of value range, ...), this is indicated by REG_WR_ACEPT = 0. The write operation must then be terminated by REG_WR = 0 in order to resume the default state.

The address specified at REG_RD_ADR of the process output data is used for read access. The read register content is entered in REG_RD_DATA (bytes 4-7) if the address at REG_RD_ADR was accepted in the process input data and if REG_RD_ABORT = 0 confirms that the register was read error-free. REG_RD_ABORT = 1 indicates that the register could not be read. REG_RD_ADR in the process input data then contains the address that could not be accessed successfully. The user data is then set to ZERO.

Register access and meaning

Designation		Description	Default (HEX)
REG_SSI_POS	0	Actual binary SSI encoder value	
REG_MAGIC_NO	1	Magic number (0xaa55cc33)	
REG_HW_VER	2	Hardware version	
REG_SW_VER	3	Software version	
REG_SF	4	Special Function register	
REG	5	Reserve	
	.		
REG	13	Reserve	
REG_WR_ADR	14	Pointer register OUT	
REG_RD_ADR	15	Pointer register IN	
REG_DIAG1	16	Diagnostics data	
REG	17	Reserve	
	.		
REG	19	Reserve	
REG_PARA1	20	Parameter data	0 x19 01 00 00
REG	21	Reserve	
	.		
REG	31	Reserve	
REG_GRAY_POS	32	Actual Gray-coded SSI encoder value.	
REG_SSI_FRAME	33	Complete frame read from SSI encoder.	
REG_CMP1	34	Comparison value 1	0 x 00 00 00 00
REG_CMP2	35	Comparison value 2	0 x 00 00 00 00
REG	36	Reserve	
	.		
REG	47	Reserve	

Designation		Description	Default (HEX)
REG_LOWER_LIMIT	48	Lower limit	0 x 00 00 00 00
REG_UPPER_LIMIT	49	Upper limit	0 x FF FF FF FF
REG_OFFSET	50	Offset value	0 x 00 00 00 00
REG_SSI_MASK	51	Selection of the SSI encoder diagnostics transferred to the diagnostics interfaces	0 x 00 00 00 00
REG	52	Reserve	
	.		
REG	63	Reserve	

Designation		Process output interface	Storage in module	Process input interface	Parameter interface	Diagnostics interface
REG_SSI_POS	0			RD		
REG_MAGIC_NO	1			RD		
REG_HW_VER	2			RD		
REG_SW_VER	3			RD		
REG_SF	4	WR	Non-retentive	RD		
REG	5					
	.					
REG	13					
REG_WR_ADR	14			RD		
REG_RD_ADR	15			RD		
REG_DIAG1	16			RD		RD

Designation		Process output interface	Storage in module	Process input interface	Parameter interface	Diagnostics interface
REG	17					
	.					
REG	19					
REG_PARA1	20	WR	Retentive	RD	WR	
REG	21					
	.					
REG	31					
REG_GRAY_POS	32			RD		
REG_SSI_FRAME	33			RD		
REG_CMP1	34	WR	Non-retentive	RD		
REG_CMP2	35	WR	Non-retentive	RD		
REG	36					
	.					
REG	47					
REG_LOWER_LIMIT	48	WR	Retentive	RD		
REG_UPPER_LIMIT	49	WR	Retentive	RD		
REG_OFFSET	50	WR	Retentive	RD		
REG_SSI_MASK	51	WR	Retentive	RD		
REG	52					

Designation	Process output interface	Storage in module	Process input interface	Parameter interface	Diagnostics interface
	.				
REG	63				



Retentive registers can be written up to 100,000 times.

Comparison value 1, Comparison value 2

The recorded encoder position can be compared with two loadable values. The character "x" below stands for "1" or "2". The register contents are loaded into the register REG_CMPx using in a write operation. The comparison functions are activated by setting bit EN_CMPx = 1 in the process output data. The results of the continuous comparison operations are displayed in the process input data via STS_CMPx, REL_CMPx and FLAG_CMPx. Bit REL_CMPx indicates as the actual status message the relation of the actual value (register content of REG_SSI_POS) to the comparison value (register content of REG_CMPx). Bit STS_CMPx is non-retentive and indicates whether the current actual value (REG_SSI_POS) and the comparison value (REG_CMPx) match. FLAG_CMPx is also used as a marker to indicate that the status (REG_SSI_POS = REG_CMPx) is present or lost. This bit must be reset by the application via the process output data using CLR_CMPx = 1. If the comparator is inactive (EN_CMPx = 0), the signals from STS_CMPx, REL_CMPx and FLAG_CMPx are always zero.

Comparator enable	Process input data		Process output data
EN_CMPx = 0	REL_CMPx = 0 STS_CMPx = 0 FLAG_CMPx = 0		
EN_CMPx = 1	(REG_SSI_POS) < (REG_CMPx)	REL_CMPx = 0 STS_CMPx = 0 FLAG_CMPx = Z_0*	Reset the FLAG_CMPx flag with CLR_CMPx = 1
	(REG_SSI_POS) > (REG_CMPx)	REL_CMPx = 1 STS_CMPx = 0 FLAG_CMPx = Z_0*	Reset the FLAG_CMPx flag with CLR_CMPx = 1
	(REG_SSI_POS) = (REG_CMPx)	REL_CMPx = 1 STS_CMPx = 1 FLAG_CMPx = 1	Reset of FLAG_CMPx not possible when values match

*The value Z_0 of this flag is 1 as soon as the comparison values match. The value stays 1 until it is reset.

Lower limit, upper limit

The recorded encoder position can be compared with up to two loadable limit values. The upper limit value must be entered in the REG_UPPER_LIMIT register and the lower limit value in REG_LOWER_LIMIT. Writing these registers with values that are different to the default values will activate the monitoring of the limits, and bits STS_OFLW and STS_UFLW will be enabled in the process input data. The diagnostics function will indicate the presence of values above or below the default values.

"Encoder value overflow" and "Encoder value underflow" signals will also indicate this via the acyclic diagnostics interface.

The limit values are set by default to the maximum and minimum value.

Table 1: Overflow of the encoder values

Register access	Process input data		Diagnostics
REG_UPPER_LIMIT at default value $FFFFFFFF_{hex}$	STS_OFLW = 0		Value: 0
Register content of REG_UPPER_LIMIT less than $FFFFFFFF_{hex}$	(REG_SSI_POS) <= (REG_UPPER_LIMIT)	STS_OFLW = 0	Value: 0
	(REG_SSI_POS) > (REG_UPPER_LIMIT)	STS_OFLW = 1	Value: 1 Text: Encoder value overflow

Table 2: Underflow of the encoder values

Register access	Process input data		Diagnostics
REG_LOWER_LIMIT at default value 00000000_{hex}	STS_UFLW = 0		Value: 0
Register content of REG_LOWER_LIMIT greater than 0	(REG_SSI_POS) >= (REG_LOWER_LIMIT)	STS_UFLW = 0	Value: 0
	(REG_SSI_POS) < (REG_LOWER_LIMIT)	STS_UFLW = 1	Value: 1 Text: Encoder value underflow

Offset function / load value

This function is activated by writing the REG_OFFSET register with a value <> 0. The content of the register is then subtracted from the SSI encoder value and stored in REG_SSI_POS. All limit values, such as lower limit, upper limit, comparison value 1, comparison value 2 then refer to the newly calculated value (REG_SSI_POS).

The calculation is thus:

(REG_SSI_POS) = SSI encoder - (REG_OFFSET)

This function can be deactivated by writing the REG_OFFSET with zero.

Status messages of the SSI encoder

Some SSI encoders not only transfer the position value in the data frame that they transfer to the module but also supply additional status messages. It is useful to include these status messages in the application in order to analyse the measured value.

Writing the REG_SSI_MASK register allows up to four individual bits to be taken from the data frame of the SSI encoder and transferred to the SSI_STSx bits of the process input data. It is also possible to output the "SSI encoder group diagnostics message" with an acyclic diagnostics operation when a status message is initiated.

Table 3: Masking with REG_SSI_MASK

Process input data	**REG_SSI_MASK**								
	Byte	B7	B6	B5	B4	B3	B2	B1	B0
SSI_STS0	0	EN_ D0_ RMS0	EN_D0_ DS	X	SSI_FRAME_BIT_SEL0				
SSI_STS1	1	EN_ D1_ RMS1	EN_D1_ DS	X	SSI_FRAME_BIT_SEL1				
SSI_STS2	2	EN_ D2_ RMS2	EN_D2_ DS	X	SSI_FRAME_BIT_SEL2				
SSI_STS3	3	EN_ D3_ RMS3	EN_D3_ DS	X	SSI_FRAME_BIT_SEL3				

Designation	**Value**	**Description**
EN_Dx_RMSx	0[1)]	The transfer of the SSI status messages to the process input data is not activated
	1	The transfer of the SSI status messages to the process input data is activated
EN_ Dx_DS	0[1)]	The evaluation of the SSI status messages for bit 0 of the diagnostics is not activated
	1	The evaluation of the SSI status messages for bit 0 of the diagnostics is activated.
SSI_FRAME_BIT_ SEL	0-31	Definition of the selected bits in the frame of the SSI encoder to be evaluated or copied. Default:0

1) Default

The following applies to bit 0 (SSI group diagnostics) of the diagnostics interface and SSI_DIAG of the process input data:

(SSI_STS0 & EN_D0_DS) || (SSI_STS1 & EN_D1_DS) || (SSI_STS2 & EN_D2_DS) || (SSI_STS3 & EN_D3_DS)

Resetting the register bank

If register REG_SF is written with the signature:

"LD20" = $6C643230_{hex}$,

all default values of the retentive registers (incl. parameter registers) are reset.

If register REG_SF is written with the signature:

"LD48" = $6C643438_{hex}$

all default values of the retentive registers except the parameter registers are reset.



Overwritten values are lost.

Technical features

Block diagram of the XN-1SSI



Figure 1: XN-1SSI electronics module

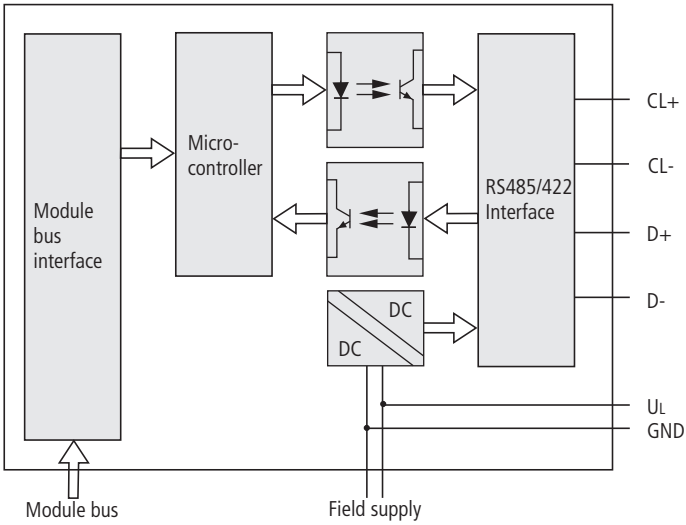


Figure 2: XN-1SSI block diagram

Technical data of the XN-1SSI

The module is provided with two RS422 interfaces that form one SSI interface. One RS422 interface works as the clock generator for reading the data, which is then received on the other RS422 interface.

Table 4: Technical data of the XN-1SSI

Designation	XN-1SSI
Number of SSI interfaces	1
Transmission channels	CL, D
Encoder voltage	24 V DC (-15% / +20%)
Encoder current	≦ 500 mA
Clock output type	RS422
Signal input type	RS422
RS422 connection type	Four wire full-duplex (clock output/signal input)
Bit transmission rate	≦ 1 MHz (configurable), default settings: 500 kBit/s
Cable impedance	120 Ω
Bus terminating resistors	internal
RS422 cable length	≦ 30 m
Nominal supply from supply terminal U_L (range)	24 V DC (18 to 30 V DC)
Nominal current consumption from supply terminal I_L	≦ 25 mA (without encoder current)
Nominal current consumption from module bus I_{MB}	≦ 50 mA
Power loss of the module	normally 1 W
Insulation voltage between interface and module bus/system voltage	500 V_{rms}
Insulation voltage between interface and field voltage	500 V_{rms}

Designation	XN-1SSI
Electromagnetic compatibility (EMC) according to IEC/EN 61000-6-2 (industrial)	
ESD	IEC/EN 61000-4-2
Electromagnetic fields	IEC/EN 61000-4-3
Burst	IEC/EN 61000-4-4
Surge	IEC/EN 61000-4-5
HF asymmetrical	IEC/EN 61000-4-6
Damped oscillation	IEC/EN 61000-4-12
Line-conducted emission/interference voltage	IEC/EN 61000-6-4
Radiated high frequency emission	IEC/EN 61000-6-4: IEC/CISPR 11 / EN 55011, Class A
Degree of protection	IP 20
Environment	
Operating temperature	0 to +55 °C
Storage temperature	-25 to +85 °C
Relative humidity	15 to 95 % without condensation

Indication elements

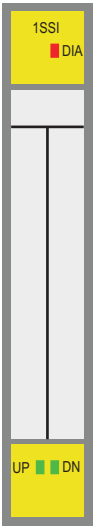


Table 5: Meaning of the LEDs

LED	Display	Meaning	Solution
DIA	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been pulled out. This applies to modules that are located between the gateway and this module. Check the power supply of the module bus. Also check whether the SSI encoder is fully functional and the data cable check has been supported in the required manner.
	OFF	No error message or diagnostics	–
UP	Green	Direction of movement upwards	–
	OFF	No upwards direction of movement	–
DN	Green	Direction of movement downwards	–
	OFF	No downwards direction of movement	–

Base modules

The following base modules can be used as terminals for connecting the XN-1SSI:

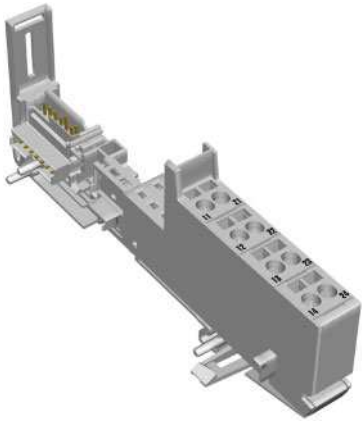


Figure 3: XN-S4x-SBBS base module

Designation	
With tension clamp connectors	XN-S4T-SBBS
With screw terminal	XN-S4S-SBBS

Technical data of the base modules

Table 6: Technical data of the base modules

Designation	Value
Measurement data	according to VDE 0611 Part 1/8.92 / IEC/EN 60947-7-1
Rated voltage	250 V
Rated current	17.5 A
Rated cross section	1.5 mm^2
Rated surge voltage	4 kV
Pollution degree	2
TOP connection technology	Tension clamp or screw connection
Protection class	IP20
Insulation stripping length	8.0 to 9.0 mm / 0.32 to 0.36 inch
Max. wire range	0.5 to 2.5 mm^2 / 0.0008 to 0.0039 $inch^2$ / AWG 24 to AWG 14
Crimpable wire	
"e" solid core H 07V-U	0.5 to 2.5 mm^2 / 0.0008 to 0.0039 $inch^2$
"f" flexible core H 07V-K	0.5 to 1.5 mm^2 / 0.0008 to 0.0023 $inch^2$
"f" with ferrules according to DIN 46228-1 (ferrules crimped gas-tight)	0.5 to 1.5 mm^2 / 0.0008 to 0.0023 $inch^2$
Test finger according to IEC/EN 60947-1	A1

Connection diagram for the SSI encoder

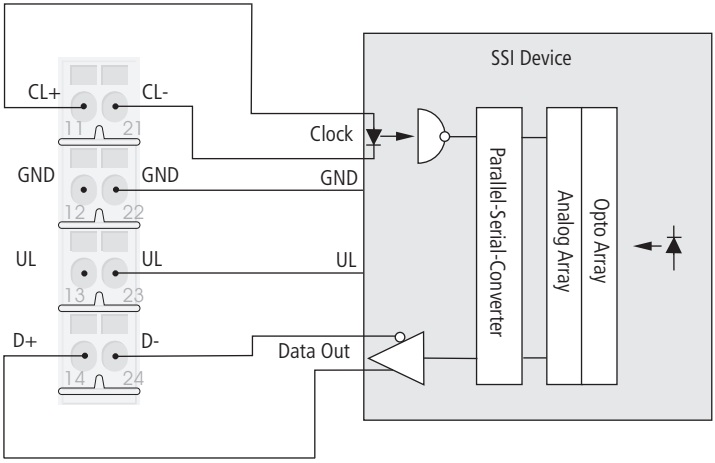


Figure 4: Connection diagram of XN-S4x-SBBS to an SSI encoder

Table 7: Signal types

Signal designation	
CL	Clock
D	Data
GND	Signal ground
U_L	Voltage

2 Integrating the Module in PROFIBUS-DP

PROFIBUS-DP data image

Process input

The field input data is transferred from the connected field device to the XN-1SSI module.

The process input data is the data that is transferred to the PLC from the XN-1SS1 via a gateway.

This is transferred in an 8 byte format as follows:

- 4 bytes are used for representing the data that was read from the register with the address stated at REG_RD_ADR.
- When necessary, 1 byte represents the register address of the read data and an acknowledgement that the read operation was successful.
- 1 byte can be used to transfer status messages of the SSI encoder. This byte also contains an acknowledgement that the write operation to the register was successful and indication of an active write operation.
- 1 byte contains the results of comparison operations with the SSI encoder value.
- 1 byte contains messages concerning the communication status between the XN-1SSI module and the SSI encoder, as well as other results of comparison operations.

The following table describes the structure of the 8 x 8 bits of the process input data.

STS (or ERR) contains non-retentive status information, i.e. the bit concerned indicates the actual status.

FLAG describes a retentive flag that is set in the event of a particular event. The bit concerned retains the value until it is reset.

Structure of the data bytes in the PROFIBUS-DP fieldbus:

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 0	REG_RD_DATA, Byte 3							
…	…							
Byte 3	REG_RD_DATA, Byte 0							
Byte 4	REG_ RD_ ABORT	X	REG_RD_ADR (MSB to LSB)					
Byte 5	REG_ WR_ ACEPT	REG_ WR_ AKN	X	X	SSI_ STS3	SSI_ STS2	SSI_ STS1	SSI_ STS0
Byte 6	STS_ UP	STS_ DN	REL_ CMP2	FLAG_ CMP2	STS_ CMP2	REL_ CMP1	FLAG_ CMP1	STS_ CMP1
Byte 7	STS_ STOP	X	X	ERR_ PARA	STS_ UFLW	STS_ OFLW	ERR_ SSI	SSI_ DIAG

X = reserved

Meaning of the data bits (process input data):

Designation	Value	Description
REG_RD_DATA	0... 2^{32}-1	Content of the register to be read if REG_RD_ABORT = 0. If REG_RD_ABORT = 1, REG_RD_DATA = 0.
REG_RD_ABORT	0	The reading of the register stated at REG_RD_ADR was accepted and executed. The content of the register is located in the user data range (REG_RD_DATA Bytes 0-3).
	1	The reading of the register stated at REG_RD_ADR was not accepted.The user data range (REG_RD_DATA Bytes 0-3) is zero.
REG_RD_ADR	0...63	Address of the register containing the data shown in the user data range (REG_RD_DATA Bytes 0-3) of the process input data when REG_RD_ABORT = 0.
REG_WR_ACEPT	0	The writing of user data for process output to the register with the address stated at REG_WR_ADR in the process output data could not be executed.
	1	The writing of user process output data to the register with the address stated at REG_WR_ADR in the process output data was successfully completed.
REG_WR_AKN	0	No modification of the data in the register bank by process output, i.e. REG_WR = 0 → Chapter "Process output". A write job would be accepted with the next telegram of process output data. (handshake for data transmission to the register.)
	1	A modification of the register contents by a process output was initiated, i.e. REG_WR = 1 → Chapter "Process output". A write job would not be accepted with the next telegram of process output data.

Designation	Value	Description
SSI_STS3	0	These four bits transfer the status bits of the SSI encoder with the status messages of the SSI module. With some SSI encoders, the status bits are transferred together with the position value.
	1	
SSI_STS2	0	
	1	
SSI_STS1	0	
	1	
SSI_STS0	0	
	1	
STS_UP (LED UP)	0	The SSI encoder values are decremented or the values are constant.
	1	The SSI encoder values are incremented.
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.
	1	The SSI encoder values are decremented.
REL_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP2)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≧ (REG_CMP2)
FLAG_CMP2	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP2) since the last reset.
	1	The contents of the registers match (REG_SSI_POS) = (REG_CMP2). This marker must be reset with CLR_CMP2 = 1 in the process output data.
STS_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) k (REG_CMP2)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP2)

Designation	Value	Description
REL_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) ≧ (REG_CMP1)
FLAG_CMP1	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP1) since the last reset.
	1	The contents of the registers match: (REG_SSI_POS) = (REG_CMP1). This marker must be reset when CLR_CMP1 = 1 in the process output data.
STS_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) k (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP1)
STS_STOP	0	The SSI encoder is read cyclically.
	1	Communication with the SSI encoder is stopped as STOP = 1 (process output) or ERR_PARA = 1.
ERR_PARA	0	The parameter set of the module has been accepted.
	1	Operation of the module is not possible with the present parameter set.
STS_UFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≧ (REG_LOWER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_LOWER_LIMIT)

Designation	Value	Description
STS_OFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≦ (REG_UPPER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) > (REG_UPPER_LIMIT)
ERR_SSI	0	SSI encoder signal present.
	1	SSI encoder signal faulty. (e.g. due to a cable break).
SSI_DIAG	0	No enabled status signal is active (SSI_STSx = 0).
	1	At least one enabled status signal is active (SSI_STSx = 1).

Process output

The field output data is transferred from the XN-1SSI module to the connected field device.

The process output data is the data that is output from the PLC to the XN-1SSI module via a gateway.

This is transferred in an 8 byte format as follows:

- 4 bytes are used for representing the data that is to be written to the register with the address specified at REG_WR_DATA.
- 1 byte contains the register address for the data that is to be read with the next response telegram.
- 1 byte contains the register address of the data to be written to bytes 0 to 3 of this telegram and a write request.
- 1 byte is used for controlling the comparison operations.
- 1 byte contains a Stop bit for interrupting communication with the encoder.

Structure of the data bytes (process output data):

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	REG_WR_DATA, Byte 3							
...	...							
Byte 3	REG_WR_DATA, Byte 0							
Byte 4	X	X	REG_RD_ADR					
Byte 5	REG_ WR	X	REG_WR_ADR					
Byte 6	X	X	X	CLR_ CMP2	EN_ CMP2	X	CLR_ CMP1	EN_ CMP1
Byte 7	STOP	X	X	X	X	X	X	X

X = reserved

Meaning of the data bits (process output data):

Designation	Value	Description
REG_WR_DATA	0... 2^{32}-1	Value to be written to the register with the address stated at REG_WR_ADR.
REG_RD_ADR	0...63	Address of the register to be read. If the read operation is successful (REG_RD_ABORT = 0), the user data is located in REG_RD_DATA of the process input data (bytes 4 – 7).
REG_WR	0	Default status, i.e. there is no request to overwrite the content of the register with the address stated at REG_WR_ADR with REG_WR_DATA. Bit REG_WR_AKN (→ Chapter "Process input") is reset (0) if necessary.
	1	Request to overwrite the content of the register with the address stated at REG_WR_ADR with REG_WR_DATA.
REG_WR_ADR	0...63	Address of the register to be written with REG_WR_DATA.
CLR_CMP2	0	Default status, i.e. no reset of FLAG_CMP2 active.
	1	Reset of FLAG_CMP2 active

Designation	Value	Description
EN_CMP2	0	Default status, i.e. the data bits REL_CMP2, STS_CMP2 and FLAG_CMP2 always have the value 0, irrespective of the actual SSI encoder value.
	1	Comparison active, i.e. the data bits REL_CMP2, STS_CMP2 and FLAG_CMP2 have a value based on the result of the comparison with the SSI encoder value.
CLR_CMP1	0	Default status, i.e. reset of FLAG_CMP1 not active.
	1	Reset of FLAG_CMP1 active
EN_CMP1	0	Default status, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 always have the value 0, irrespective of the actual SSI encoder value.
	1	Comparison active, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 have a value based on the result of the comparison with the SSI encoder value.
STOP	0	Request to read the SSI encoder cyclically
	1	Request to interrupt communication with the encoder

Diagnostics

The parameter setting for the PROFIBUS-DP gateway provides the Gateway Diagnostics parameter for selecting between two different diagnostics displays. Choose "Devices, ID, Channel Diagnostics" to select more detailed diagnostics indication. The diagnostics message will then consist of the following elements:

- 2 bytes of gateway diagnostics (device-related diagnostics)
- 64 bits of ID-specific diagnostics
- n x 3 bytes of channel-specific diagnostics (n: number of channels with active diagnostics)

With channel-specific diagnostics the use of an error number enables the type of error to be indicated as text (e.g. Parameter error).

When "Device-related Diagnostics" is selected, an abbreviated diagnostics message is generated that simply shows the gateway diagnostics (device-related diagnostics). The diagnostics bytes of all station modules are attached that support diagnostics.

Meaning of the data bits (diagnostics):

Name of error type	Position (Type 2)	Value	Description
SSI group diagnostics	Bit 0	0	No enabled status signal active: SSI_STSx = 0 or no status messages of the SSI encoder present.
		1	At least one enabled status signal is active: SSI_STSx = 1.
Wire-break	Bit 1	0	SSI encoder signal present.
		1	SSI encoder signal faulty (e.g. due to a cable break).
Encoder values overflow	Bit 2	0	SSI encoder value below / equal to upper limit.
		1	SSI encoder value above upper limit. Overflow occurred.
Encoder values underflow	Bit 3	0	SSI encoder value above / equal to lower limit.
		1	SSI encoder value below lower limit. Underflow occurred.
Parameter error	Bit 4	0	The parameter set of the module has been accepted.
		1	Operation of the module is not possible with the present parameter set.

Parameters

Parameters consist of data that has to be sent to the module so that it can operate correctly in the application concerned.

Meaning of the data bits (parameters):

Designation	Value	Name of the values	Description
Encoder data cable test	0[1)]	Activate	ZERO test of data cable.
	1	Deactivate	After the last valid bit, a ZERO test of the data cable is not carried out.
Number of invalid bits (LSB)	0 to 15	0 to 15	Number of invalid bits on the LSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows:[2)] SSI_FRAME_LEN - INVALID_BITS_MSB- INVALID_BITS_LSB. The invalid bits on the LSB side are removed by shifting the position value to the right, starting with the LSB. (Default 0 Bit = 0x 0). INVALID_BITS_MSB + INVALID_BITS_LSB must always be less than SSI_FRAME_LEN.

Designation	Value	Name of the values	Description
Number of invalid bits (MSB)	0 to 7	0 to 7	Number of invalid bits on the MSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows:[2] SSI_FRAME_LEN - INVALID_BITS_MSB - INVALID_BITS_LSB. The invalid bits on the MSB side are zeroed by masking the position value. INVALID_BITS_MSB + INVALID_BITS_LSB must always be less than SSI_FRAME_LEN. Default: 0 = 0_{hex}
Bit transmission rate	0	1000000 Bit/s	
	1[1]	500000 Bit/s	
	2	250000 Bit/s	
	3	125000 Bit/s	
	4	100000 Bit/s	
	5	83000 Bit/s	
	6	71000 Bit/s	
	7	62500 Bit/s	
	8 to 15		Reserve
Number of data frame bits	1 to 32	1 to 32	Number of bits of the SSI data frame. [2] SSI_FRAME_LEN must always be greater than INVALID_BITS. Default: 25 = 19_{hex}

Designation	Value	Name of the values	Description
Data format	0[1)]	Binary coded	SSI encoder sends data in binary code
	1	GRAY-coded	SSI encoder sends data in Gray code

1) Default

2) SSI_FRAME_LEN: Number of data frame bits
INVALID_BITS_MSB: Number of invalid bits (MSB)
INVALID_BITS_LSB: Number of invalid bits (LSB)
INVALID_BITS: INVALID_BITS_MSB + INVALID_BITS_LSB

Error detection / messages

The following errors and diagnostics are reported by the module:

Diagnostics	Process input data	Description
SSI group diagnostics	SSI_DIAG	At least one enabled status message is active.
Wire-break	ERR_SSI	Non-retentive error message. Error detected in the interface (e.g. wire-break).
Encoder values overflow	STS_OFLW	Non-retentive error message. Upper limit exceeded (overflow).
Encoder values underflow	STS_UFLW	Non-retentive error message. Gone below lower limit.
Parameter error	ERR_PARA	Non-retentive error message, and rejected parameter set with it.
	STS_STOP	Non-retentive status message indicating Stop / Go operating mode of the SSI module.
	STS_CMP1	Non-retentive status message indicating the relationship (k or =) of the SSI encoder value to the comparison value 1.
	FLAG_CMP1	Retentive marker for SSI encoder value = Comparison value 1.
	REL_CMP1	Non-retentive status message indicating the relationship (f or <) of the SSI encoder value to the comparison value 1.
	STS_CMP2	Non-retentive status message indicating the relationship (k or =) of the SSI encoder value to the comparison value 2.
	FLAG_CMP2	Retentive marker for SSI encoder value = Comparison value 2.

Diagnostics	Process input data	Description
	REL_CMP2	Non-retentive status message indicating the relationship (f or <) of the SSI encoder value to the comparison value 2.
	STS_DN	Non-retentive status message indicating the direction of the SSI encoder.
	STS_UP	Non-retentive status message indicating the direction of the SSI encoder.

Function block for SIMATIC S7

The function block that was created for the SIMATIC S7 PLC system (Siemens) enables the data bytes to be exchanged between the PLC and the XN-1SSI module, and provides in particular access to the register interface.

The system function blocks SFC14 and SFC15 from Siemens are used in order to ensure consistent data exchange. The return values are transferred transparently, and the meaning of the error numbers can be obtained from the manual "System software for S7-300/400".

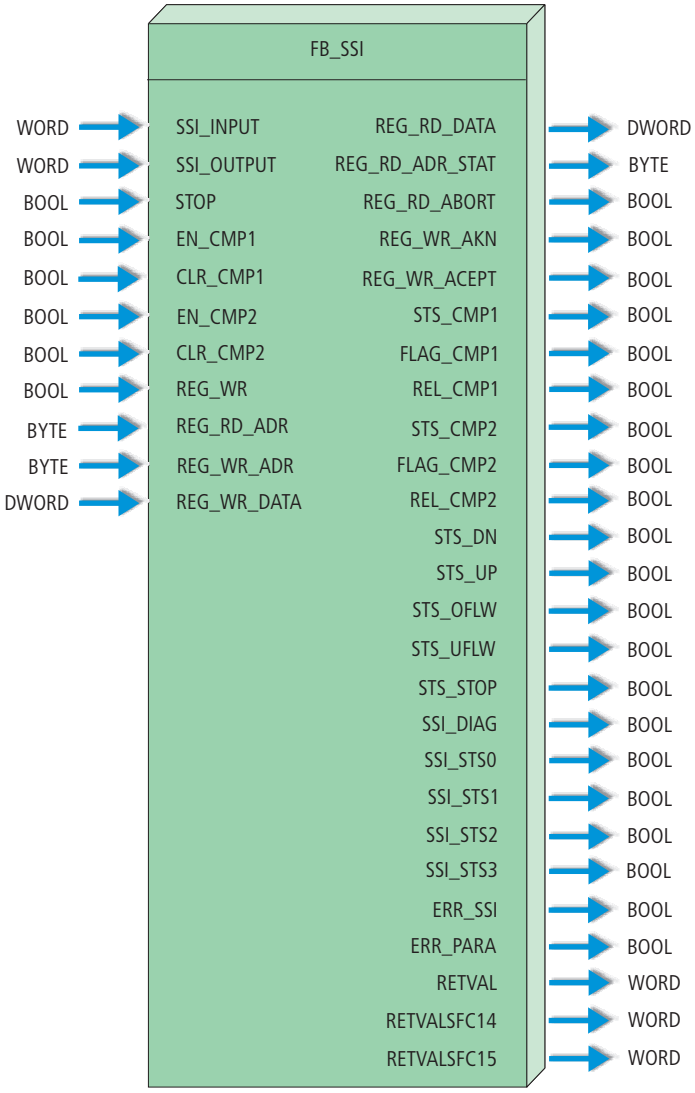


Figure 5: Function block for data exchange with the SIMATIC S7 software

Table 8: Input variables of FB_SSI

Variable	Meaning
SSI_INPUT	Start address for the 8-byte input address range of the XN-1SSI module. The SIMATIC STEP 7 software assigns the address ranges to the appropriate modules. The address ranges are selected and displayed in the hardware configurator of the software. WORD format is used for the addresses and therefore consists of 2 bytes. Example: The decimal value 258 must be transferred in hexadecimal code as W#16#102.
SSI_OUTPUT	Start address for the 8-byte output address range of the XN-1SSI module. The SIMATIC STEP 7 software assigns the address ranges to the appropriate modules. The address ranges are selected and displayed in the hardware configurator of the software. WORD format is used for the addresses and therefore consists of 2 bytes. Example: The decimal value 258 must be transferred in hexadecimal code as W#16#102.
STOP	0: Request to read the SSI encoder cyclically 1: Request to interrupt communication with the encoder.
EN_CMP1	0: Default status, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 always have the value 0, irrespective of the actual SSI encoder value. 1: Comparison active, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 have a value based on the result of the comparison with the SSI encoder value.
CLR_CMP1	0: Default status, i.e. reset of FLAG_CMP1 not active. 1: Reset of FLAG_CMP1 active.

Variable	Meaning
EN_CMP2	0: Default status, i.e. the data bits REL_CMP2, STS_CMP2 and FLAG_CMP2 always have the value 0, irrespective of the actual SSI encoder value. 1: Comparison active, i.e. the data bits REL_CMP2, STS_CMP2 and FLAG_CMP2 have a value based on the result of the comparison with the SSI encoder value.
CLR_CMP2	0: Default status, i.e. reset of FLAG_CMP2 not active. 1: Reset of FLAG_CMP2 active.
REG_WR	0: Default status, i.e. there is no request to overwrite the content of the register with the address stated at REG_WR_ADR with REG_WR_DATA. Bit REG_WR_AKN (output variable) is reset from 1 to 0 if necessary. 1: Request to overwrite the content of the register with the address stated at REG_WR_ADR with REG_WR_DATA.
REG_RD_ADR	Address of the register to be read.
REG_WR_ADR	Address of the register to be written with REG_WR_DATA.
REG_WR_DATA	Value to be written to the register with the address stated at REG_WR_ADR.

Table 9: Output variables of FB_SSI

Variable	Meaning
REG_RD_DATA	Read data at the register with the address stated at REG_RD_ADR if access is successful (REG_RD_ABORT = 0).
REG_RD_ADR_STAT	Return the register address for the read data REG_RD_DATA.
REG_RD_ABORT	1: Reading of register with the address stated at REG_RD_ADR could not be executed successfully. The operation was aborted. 0: Reading of register with the address stated at REG_RD_ADR was executed successfully. The read data is shown at REG_RD_DATA.
REG_WR_AKN	1: Writing of the register was requested with REG_WR = 1 in the previous cycle. Another write request with REG_WR = 1 is not accepted. This value returns to 0 when REG_WR = 0. 0: A write request with REG_WR = 1 is accepted. This value then changes to 1. A further write request is ignored.
REG_WR_ACEPT	1: Writing of register with the address stated at REG_WR_ADR was executed successfully. 0: Writing of register with the address stated at REG_WR_ADR was not executed successfully.
STS_CMP1	0: A comparison of the register contents has produced the following result: (REG_SSI_POS) k (REG_CMP1) 1: A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP1)
FLAG_CMP1	0: Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP1) since the last reset. 1: The contents of the registers match: (REG_SSI_POS) = (REG_CMP1). This marker must be reset with bit CLR_CMP1 = 1.

Variable	Meaning
REL_CMP1	0: A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP1) 1: A comparison of the register contents has produced the following result: (REG_ SSI_POS) ≧ (REG_CMP1)
STS_CMP2	0: A comparison of the register contents has produced the following result: (REG_SSI_POS) k (REG_CMP2) 1: A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP2)
FLAG_CMP2	0: Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP2) since the last reset. 1: The contents of the registers match: (REG_SSI_POS) = (REG_CMP2). This marker must be reset with bit CLR_CMP2 = 1.
REL_CMP2	0: A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP2) 1: A comparison of the register contents has produced the following result: (REG_ SSI_POS) ≧ (REG_CMP2)
STS_DN	0: The SSI encoder values are incremented or the SSI encoder values are constant. 1: The SSI encoder values are decremented.
STS_UP	0: The SSI encoder values are decremented or the SSI encoder values are constant. If STS_DN = 0 at the same time, this means that the SSI encoder has stopped. 1: The SSI encoder values are incremented.
STS_OFLW	0: A comparison of the register contents has produced the following result: (REG_SSI_POS) ≦ (REG_UPPER_LIMIT) 1: A comparison of the register contents has produced the following result: (REG_SSI_POS) > (REG_UPPER_LIMIT)

Variable	Meaning
STS_UFLW	0: A comparison of the register contents has produced the following result: (REG_SSI_POS) ≧ (REG_LOWER_LIMIT) 1: A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_LOWER_LIMIT)
STS_STOP	0: The SSI encoder is read cyclically. 1: Communication with the SSI encoder is stopped as STOP = 1.
SSI_DIAG	0: No enabled status signal active: SSI_STSx = 0 or no status messages of the SSI encoder present. 1: At least one enabled status signal is active: SSI_STSx = 1
SSI_STS0	These four bits transfer the status bits of the SSI encoder with the status messages of the SSI module. With some SSI encoders, the status bits are transferred together with the position value.
SSI_STS1	
SSI_STS2	
SSI_STS3	
ERR_SSI	0: SSI encoder signal present. 1: SSI encoder signal faulty. (e.g. due to a cable break).
ERR_PARA	0: The parameter set of the module has been accepted. 1: Operation of the module is not possible with the present parameter set.
RETVAL	Return value of the function (status or error code) 0: Everything OK. No error 8xxxh:Error Formal operands
RETVALSFC14	See manual "System software for S7-300/400, SFC14"
RETVALSFC15	See manual "System software for S7-300/400, SFC15"

3 Integrating the Module in DeviceNet

Process image

The structure of the process image is represented with symbolic names. These correspond to the attribute names which also correspond to the relevant functions.

The bits and bit groups assigned to the names indicate numerical values.

The meaning of the numerical values is explained in the description of the attributes.

Table 10: Process input

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	DIAGNOSTICS AND STATUS							
Byte 1								
Byte 2	RESULT WRITE OPERATION		X	X	SSI_ STS3 1)	SSI_ STS2 1)	SSI_ STS1 1)	SSI_ STS0 1)
Byte 3	RESULT READ OPERA-TION	X	ADDRESS READ REGISTER					
Byte 4	VALUE READ REGISTER Byte 0							
...	...							
Byte 7	VALUE READ REGISTER Byte 3							

X = reserved

1) Status bits of the SSI encoder

Table 11: Meaning of the data bits 0 to 3 (byte 2):

SSI_STS3	0	These four bits transfer the status bits of the SSI encoder with the status messages of the SSI module. With some SSI encoders, the status bits are transferred together with the position value.
	1	
SSI_STS2	0	
	1	
SSI_STS1	0	
	1	
SSI_STS0	0	
	1	

Table 12: Process output

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 0	CONTROL							
Byte 1								
Byte 2	X	X	ADDRESS READ REGISTER					
Byte 3	WRITE OPERA-TION	X	ADDRESS WRITE REGISTER					
Byte 4	VALUE WRITE REGISTER, Byte 0							
...	...							
Byte 7	VALUE WRITE REGISTER, Byte 3							

X = reserved

SSI Module Class (VSC116) This class contains all the parameters and information relating to the XN-1SSI module.

Table 13: Class Instance

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
100 (64h)	CLASS REVISION	G	UINT	Contains the revision number of this class (Maj. Rel. x 1000 + Min. Rel.).
101 (65h)	MAX INSTANCE	G	USINT	Contains the number of the highest instance of an object created on this level in the class hierarchy.
102 (66h)	# OF INSTANCES	G	USINT	Contains the number of object instances created on this class level.
103 (67h)	MAX CLASS ATTR	G	USINT	Contains the number of the last class attribute implemented.

Table 14: Object instances

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
100 (64_{hex})	MAX OBJECT ATTRIBUTE	G	USINT	Contains the number of the last object attribute implemented.
101 (65_{hex})	MODULE PRESENT	G	BOOL	0: XI/ON module is not plugged in, empty base module. 1: XI/ON module is plugged in
102 (66_{hex})	TERMINAL SLOT NUMBER	G	USINT	The slot number of the base module (base module to the right of the gateway = No. 1) belonging to the module. Corresponds to the instance number within the TERMINAL SLOT CLASS.
103 (67_{hex})	MODULE ID	G	DWORD	Contains the module ID.
104 (68_{hex})	MODULE ORDER NUMBER	G	UDINT	Contains the order number of the module.
105 (69_{hex})	MODULE ORDER NAME	G	SHORT_ STRING	Contains the module name, e.g. XN-1RS485/422.
106 ($6A_{hex}$)	MODULE REVISION NUMBER	G	USINT	Contains the revision number of the module firmware.

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
107 ($6B_{hex}$)	MODULE TYPE ID	G	ENUM USINT	Gives information about the module type: 0 (00_{hex}) unknown module type 1 (01_{hex}) digital I/O module 17 (11_{hex}) analog module I/O voltage 18 (12_{hex}) analog module I/O current 19 (13_{hex}) analog module PT temperature 20 (14_{hex}) analog module Thermo temperature 33 (21_{hex}) 16-bit counter module 34 (22_{hex}) 32-bit counter module 40 (28_{hex}) SSI module 49 (31_{hex}) motor starter module as DOL or reversing starter 50 (32_{hex}) electronic motor starter 65 (41_{hex}) RS232 module 66 (42_{hex}) RS485/422 module 67 (43_{hex}) TTY module
108 ($6C_{hex}$)	MODULE COMMAND INTERFACE	G/S	ARRAY	Command interface of the XI/ON module. ARRAY OF: BYTE: Command byte sequence
109 ($6D_{hex}$)	MODULE RESPONSE INTERFACE	G	ARRAY	Signal interface of the XI/ON module. ARRAY OF: BYTE: Response byte sequence
110 ($6E_{hex}$)	MODULE REGIS-TERED INDEX	G	ENUM USINT	Contains the index number registered in all module lists.

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
111 ($6F_{hex}$)	NUMBER OF SUP-PORTED CHANNELS	G	USINT	Indicates the number of channels supported by this module instance.
112 (70_{hex})	DIAGNOS-TICS AND STATUS	G	WORD	Bit 0: 0 No enabled status signal is active (SSI_STSx = 0). 1 = **"group diagnostics"** At least one enabled status signal is active (SSI_STSx = 1).
				Bit 1: 0 SSI encoder signal present. 1 = **"SSI error/open circuit"** SSI encoder signal faulty. (e.g. due to a cable break).
				Bit 2: 0 A comparison of the register contents has produced the following result: (REG_SSI_POS) ≦ (REG_UPPER_LIMIT) 1 = **"error POS > UPPER LIMIT"** A comparison of the register contents has produced the following result: (REG_SSI_POS) > (REG_UPPER_LIMIT)

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
	DIAGNOS-TICS AND STATUS	G	WORD	Bit 3: 0 A comparison of the register contents has produced the following result: (REG_SSI_POS) ≧ (REG_LOWER_LIMIT) 1 = **"error POS < LOWER LIMIT"** A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_LOWER_LIMIT)
				Bit 4 0 The parameter set of the module has been accepted. 1 = **"parameterization error"** Operation of the module is not possible with the present parameter set.
				Bit 5 to 6 "<reserved>"
				Bit 7 0 The SSI encoder is read cyclically. 1 = **"SSI communication suspended"** Communication with the SSI encoder is stopped as STOP = 1 (process output) or ERR_PARA = 1.

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
	DIAGNOS-TICS AND STATUS	G	WORD	Bit 8 0 A comparison of the register contents has produced the following result: (REG_SSI_POS) k (REG_CMP1) 1 = **"CMP1 register value matches POS"** A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP1)
				Bit 9 0 Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP1) since the last reset. 1= **"CMP1 flag set"** The contents of the registers match: (REG_SSI_POS) = (REG_CMP1). This marker must be reset with bit 9 of the CONTROL attribute.
				Bit 10 0 A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP1) 1 = **"POS >= CMP1 register value"** A comparison of the register contents has produced the following result: (REG_ SSI_POS) ≧ (REG_CMP1)

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
	DIAGNOS-TICS AND STATUS	G	WORD	Bit 11 0 A comparison of the register contents has produced the following result: (REG_SSI_POS) k (REG_CMP2) 1 = **"CMP2 register value matches POS"** A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP2)
				Bit 12 0 Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP2) since the last reset. 1 = **"CMP2 flag set"** The contents of the registers match: (REG_SSI_POS) = (REG_CMP2). This marker must be reset with bit 12 of the CONTROL attribute.
				Bit 13 0 A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP2) 1 = **"POS >= CMP2 register value"** A comparison of the register contents has produced the following result: (REG_SSI_POS) ≧ (REG_CMP2)

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
	DIAGNOS-TICS AND STATUS	G	WORD	Bit 14 0 The SSI encoder values are incremented or the values are constant. 1 = **"counting downwards"** The SSI encoder values are decremented.
				Bit 15 0 The SSI encoder values are decremented or the values are constant. 1 = **"counting upwards"** The SSI encoder values are incremented.

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
113 (71_{hex})	RESULT WRITE OPERATION	G	BYTE	Bit 0 to 5 "<reserved>" Bit 6: 0 No modification of the data in the register bank by process output, i.e. WRITE OPERATION = 0 . A write job would be accepted with the next telegram of process output data. (handshake for data transmission to the register.) 1 = **"control register write acknowledged"** A modification of the register contents by a process output was initiated, i.e. WRITE OPERATION = 1. A write job would not be accepted with the next telegram of process output data. Bit 7: 0 The writing of user data for process output to the register addressed with ADDRESS WRITE REGISTER in the process output data could not be executed. 1 = **"control register write accepted"** The writing of user data for process output to the register addressed with ADDRESS WRITE REGISTER in the process output data could be executed successfully.

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
114 (72_{hex})	RESULT READ OPERATION	G	BYTE	Bit 0 to 6: "<reserved>" Bit 7: 0 The reading of the register stated in ADDRESS READ REGISTER was accepted and executed. The content of the register is located in VALUE READ REGISTER. 1 = **"register read operation aborted"** The reading of the register stated in ADDRESS READ REGISTER was not accepted. VALUE READ REGISTER is zero.
115 (73_{hex})	ADDRESS READ REGISTER	G	UINT	Address of the input register with contents stated in VALUE READ REGISTER when RESULT READ OPERATION = 0.
116 (74_{hex})	VALUE READ REGISTER	G	DWORD	Content of the register to be read if RESULT READ OPERATION = 0. If RESULT READ OPERATION = 1, VALUE READ REGISTER = 0.

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
117 (75_{hex})	CONTROL	G/S	WORD	Bit 0 to 6: "<reserved>" Bit 7: 0 Request to read the SSI encoder cyclically 1 = **"suspend communication requested"** Request to interrupt communication with the encoder
				Bit 8: 0 Default status, i.e. the data bits 8 to 10 of the DIAGNOSTICS AND STATUS attribute always have the value 0, irrespective of the actual SSI encoder value. 1 = **"compare/flag CMP1 active"** Comparison active, i.e. the data bits 8 to 10 of the DIAGNOSTICS AND STATUS attribute always have a value based on the result of the comparison with the actual SSI encoder value.
				Bit 9: 0 Default status, i.e. reset of Bit 9 of the DIAGNOSTICS AND STATUS attribute not active. 1 = **"clear CMP1 flag"** Reset of bit 9 of the DIAGNOSTICS AND STATUS attribute active.
				Bit 10: "<reserved>"

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
	CONTROL	G/S	WORD	Bit 11: 0 Default status, i.e. the data bits 11 to 13 of the DIAGNOSTICS AND STATUS attribute always have the value 0, irrespective of the actual SSI encoder value. 1 = **"compare/flag CMP2 active"** Comparison active, i.e. the data bits 11 to 13 of the DIAGNOSTICS AND STATUS attribute always have a value based on the result of the comparison with the actual SSI encoder value.
				Bit 12: 0 Default status, i.e. no reset of Bit 12 of the DIAGNOSTICS AND STATUS attribute active. 1 = **"clear CMP2 flag"** Reset of bit 12 of the DIAGNOSTICS AND STATUS attribute active.
				Bit 13 to 15: "<reserved>"
118 (76_{hex})	ADDRESS READ REGISTER	G/S	UINT	Address of the register with contents stated in VALUE READ REGISTER when RESULT READ OPERATION 7 = 0.
119 (77_{hex})	ADDRESS WRITE REGISTER	G/S	UINT	Address of the register to be written with VALUE WRITE REGISTER.

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
120 (78_{hex})	VALUE WRITE REGISTER	G/S	DWORD	Value to be written to the register with the address stated at ADDRESS WRITE REGISTER.
121 (79_{hex})	WRITE OPERATION	G/S	BOOL	0: Default status, i.e. there is no request to overwrite the content of the register address stated at ADDRESS WRITE REGISTER with VALUE WRITE REGISTER. Bit 6 of the RESULT WRITE OPERATION attribute is reset (=0) if necessary. 1: Request to overwrite the content of the register at the address ADDRESS WRITE REGISTER with VALUE WRITE REGISTER.
122 ($7A_{hex}$)	WRITE REGISTER AND EXECUTE	S	STRUCT OF UINT DWORD	The structure contains both parts: • Address of the register to be written. • Value to be written. The write operation is executed without checking whether a write job is already present.

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
123 ($7B_{hex}$)	DIAGNOS-TICS	G	WORD	Bit 0: 0 No enabled status signal is active (SSI_STSx = 0). 1 = **"group diagnostics"** At least one enabled status signal is active (SSI_STSx = 1). Bit 1: 0 SSI encoder signal present. 1 = **"SSI error/open circuit"** SSI encoder signal faulty. (e.g. due to a cable break).
				Bit 2: 0 A comparison of the register contents has produced the following result: (REG_SSI_POS) ≦ (REG_LOWER_LIMIT) 1 = **"error POS > LOWER LIMIT"** A comparison of the register contents has produced the following result: (REG_SSI_POS) > (REG_LOWER_LIMIT)

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
	DIAGNOS-TICS	G	WORD	Bit 3: 0 A comparison of the register contents has produced the following result: (REG_SSI_POS) ≧ (REG_LOWER_LIMIT) 1 = **"error POS < LOWER LIMIT"** A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_LOWER_LIMIT)
				Bit 4: 0 The parameter set of the module has been accepted. 1 = **"parameterization error"** Operation of the module is not possible with the present parameter set.
				Bit 5 to 15 "<reserved>"
124 ($7C_{hex}$)	CHECK MODE	G/S	WORD	Bit 0 to 4 "<reserved>" Bit 5: 0 ZERO test of data cable. 1 = **"disable SSI error detection"** After the last valid bit, a ZERO test of the data cable is not carried out. Bit 6 to 15 "<reserved>"

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
125 ($7D_{hex}$)	INVALID BITS LSB	G/S	USINT	Number of invalid bits on the LSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: FRAME LENGTH - INVALID BITS MSB - INVALID BITS LSB. The invalid bits on the LSB side are removed by shifting the position value to the right, starting with the LSB. (Default 0 Bit = 0_{hex}). INVALID BITS MSB + INVALID BITS LSB must always be less than FRAME LENGTH.
126 ($7E_{hex}$)	BITRATE		ENUM USINT	0 = "1 Mbps" 1 = "500 kbps" 2 = "250 kbps" 3 = "100 kbps" 4 = "125 kbps" 5 = "83 kbps" 6 = "71 kbps" 7 = "62.5 kbps" 8 to 15 "<reserved>"
128 (80_{hex})	FRAME LENGTH	G/S	USINT	Number of bits of the SSI data frame. FRAME LENGTH must always be greater than INVALID_BITS[1)]. Default: 25 = 19_{hex}
129 (81_{hex})	KIND OF CODING SSI	G/S	BOOL	0: "Binary code" 1: "GRAY code"

Attr. no. dec. (hex.)	Attribute name	Access	Type	Description
130 (82_{hex})	INVALID BITS MSB	G/S	USINT	Number of invalid bits on the MSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: FRAME LENGTH - INVALID BITS MSB - INVALID BITS LSB. The invalid bits on the MSB side are zeroed by masking the position value. INVALID BITS MSB + INVALID BITS LSB must always be less than FRAME LENGTH. Default: 0 = 0_{hex}

1) INVALID_BITS: INVALID BITS MSB + INVALID BITS LSB

4 Integrating the Module in CANopen

Introduction

The support of XN-1SSI modules has been implemented from firmware version V3.00 of XN-GW-CANOPEN.

General

The XN-1SSI module and also the XN-1CNT-24VDC belong to the device group of encoders (in accordance with CANopen Device Profile DS406). The objects listed comprise all the functions of this device group, but are only partially used for the XN-1SSI module.

Encoder-specific default PDOs

These additional PDOs are always set to Invalid by default.

The relevant parameters must be checked before enabling these PDOs. This particularly applies to the COB IDs as these come from the Default Master-Slave Connection and are assigned to other node IDs. The network should not therefore contain nodes with the corresponding node ID, and these nodes should not use the corresponding COB IDs.

The transmission type of these PDOs is normally 255.

Table 15: Overview of the specific default PDOs for the XN-1SSI and XN-1CNT-24VDC encoder modules

PDO	Meaning	COB ID TPDO[1)]	COB ID TPDO[2)]	COB ID RPDO
PDO9	1st group of encoders (channels 0 + 1)	8000 01E0h + node ID	C000 01E0h + node ID	8000 0260h + node ID
PDO10	2nd group of encoders (channels 2 + 3)	8000 02E0h + node ID	C000 02E0h + node ID	8000 0360h + node ID
PDO11	3rd group of encoders (channels 4 + 5)	8000 03E0h + node ID	C000 03E0h + node ID	8000 0460h + node ID
PDO12	4th group of encoders (channels 6 + 7)	8000 04E0h + node ID	C000 04E0h + node ID	8000 0560h + node ID

1) Applicable from firmware version 2.03

2) Applies to firmware versions before 2.03

Encoders Device Profile Implementation

Overview of Encoders Device Profile Range

The following table provides an overview of the object dictionary entries that are defined by the Device Profile for Encoders CiA/DS406 and are supported by the XI/ON gateway. As this is the 2nd Device Profile of the XI/ON gateway, all entries have an offset of 800h compared to the entries in DS406 (6800_{hex} to $6FFF_{hex}$). This section of the object dictionary contains general information, such as device ID, manufacturer name and communication parameters.

The manufacturer-specific objects are in the range $58xx_{hex}$.

Table 16: Overview of the objects for encoders

Index	Object	Name	Name in the I/O Assistant software	Access
5800_{hex}	ARRAY	Encoder Basic Mode		rw
5801_{hex}	ARRAY	Encoder Config	REG_PARA1	rw
5802_{hex}	ARRAY	Encoder Status		ro
5803_{hex}	ARRAY	Encoder Flags		rw
5804_{hex}	ARRAY	Encoder Diag	REG_DIAG1	ro
5805_{hex}	ARRAY	SSI Native Status		ro
5806_{hex}	ARRAY	SSI Optional Encoder Status		ro
5808_{hex}	ARRAY	Encoder Control		rw
5810_{hex}	ARRAY	Counter Load Prepare Value		rw
5811_{hex}	ARRAY	Counter Pulse Width		rw
5820_{hex}	ARRAY	Measuring Integration Time		rw
5821_{hex}	ARRAY	Measuring Low Limit		rw
5822_{hex}	ARRAY	Measuring High Limit		rw

Index	Object	Name	Name in the I/O Assistant software	Access
5823_{hex}	ARRAY	Measuring Units per Revolution		rw
5840_{hex}	ARRAY	SSI Diag Mapping	REG_SSI_MASK	rw
6800_{hex}	VAR	Operating parameters		rw
6810_{hex}	VAR	Preset value for multi-sensor devices	REG_OFFSET	rw
6820_{hex}	VAR	Position value for multi-sensor devices	REG_SSI_POS	ro
$6B00_{hex}$	ARRAY	Cam state register		ro
$6B01_{hex}$	ARRAY	Cam enable register		rw
$6B02_{hex}$	ARRAY	Cam polarity register		rw
$6B10_{hex}$	ARRAY	Cam 1 low limit	REG_CMP2	rw
$6B20_{hex}$	ARRAY	Cam 1 high limit	REG_CMP1	rw
$6B30_{hex}$	ARRAY	Cam 1 hysteresis		rw
$6C00_{hex}$	ARRAY	Area State Register		ro
$6C01_{hex}$	ARRAY	Work Area Low Limit		rw
$6C02_{hex}$	ARRAY	Work Area High Limit		rw
$6D00_{hex}$	VAR	Operating Status		ro
$6D01_{hex}$	VAR	SingleTurn Resolution (rotary), Measuring Step (linear)		ro
$6D02_{hex}$	VAR	Number of distinguish-able revolutions		ro
$6FFF_{hex}$	VAR	Device Type		ro

Object 5800_{hex} – Encoder Basic Mode

→ This object has no function on the XN-1SSI module.

Object 5801_{hex} – Encoder Config

The **Encoder Config** object has an effect on parameter bytes 0 to 3 of the XN-1SSI module and is used for setting the configuration. Write accesses initiate a parameter update on the XI/ON module bus. The parameter is stored retentively in the gateway and is restored with every node reset.

Table 17: Object 5801_{hex} Description

INDEX	**5801_{hex}**
Name	Encoder Config
Object Code	ARRAY
Data type	Unsigned32
Access	rw
Default value	No
PDO Mapping	No

Table 18: Structure of the data bytes

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 0	X	X	DIS_ ERR_ SSI	X	X	X	X	X
Byte 1	X	INVALID_BITS_MSB			INVALID_BITS_LSB			
Byte 2	X	X	X	X	SSI_BIT_RATE			
Byte 3	SSI_ CODE_ G/D	X	SSI_FRAME_LEN					

Table 19: Meaning of the data bits

Designation	Value	Description
DIS_ERR_SSI Encoder data cable test	0[1)]	Activate: ZERO test of data cable.
	1	Deactivate After the last valid bit, a ZERO test of the data cable is not carried out.
INVALID_BITS_LSB Number of invalid bits (LSB)	0 to 15	Number of invalid bits on the LSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN - INVALID_BITS_MSB - INVALID_BITS_LSB. The invalid bits on the LSB side are removed by shifting the position value to the right, starting with the LSB. INVALID_BITS_MSB + INVALID_BITS_LSB must always be less than SSI_FRAME_LEN. Default 0 Bit = 0_{hex}

Designation	Value	Description
INVALID_BITS_MSB Number of invalid bits (MSB)	0 to 7	Number of invalid bits on the MSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN - INVALID_BITS_MSB - INVALID_BITS_LSB. The invalid bits on the MSB side are zeroed by masking the position value. INVALID_BITS_MSB + INVALID_BITS_LSB must always be less than SSI_FRAME_LEN. Default: 0 = 0_{hex}
SSI_BIT_RATE Bit transmission rate	0	1000000 Bit/s
	1 [1)]	500000 Bit/s
	2	250000 Bit/s
	3	125000 Bit/s
	4	100000 Bit/s
	5	83000 Bit/s
	6	71000 Bit/s
	7	62500 Bit/s
	8 to 15	Reserve
SSI_FRAME_LEN Number of data frame bits	1 to 32	Number of bits of the SSI data frame. SSI_FRAME_LEN must always be greater than INVALID_BITS. Default: 25 = 19_{hex}
SSI_CODE_G/D Data format	0 [1)]	SSI encoder sends data in binary code
	1	SSI encoder sends data in Gray code

1) Default (factory setting)

Object 5802_{hex} – Encoder Status

On the XN-1SSI module, bits 6 and 7 of the **Encoder Status** object are emulated for the counter. The bits describe the up/down direction of the current values.

Table 20: Object 5802_{hex} Description

INDEX	**5802_{hex}**
Name	Encoder Status
Object Code	ARRAY
Data type	Unsigned8
Access	ro
Default value	No
PDO Mapping	Yes

Table 21: Structure of data byte 6 of the process input

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 6	STS_ UP	STS_ DN	0	0	0	0	0	0

Table 22: Meaning of the data bits 6 and 7

STS_UP (LED UP)	0	The SSI encoder values are decremented or the values are constant.
	1	The SSI encoder values are incremented.
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.
	1	The SSI encoder values are decremented.

Object 5803_{hex} – Encoder Flags

On the XN-1SSI module, bits 3 to 6 of the **Encoder Flags** object are emulated as much as possible for the counter. The object comprises the bits **FLAG_CMP1**, **FLAG_CMP2**, **STS_OFLW** and **STS_UFLW**. Unlike the counter module, the bits **STS_OFLW** and **STS_UFLW** SSI module are non-retentive status bits. All other bits are 0.

Writing the object with any value will reset the markers **FLAG_CMP1** and **FLAG_CMP2**. Exception: if the relevant condition for setting a marker is still fulfilled, this marker will continue to remain set.

Table 23: Object 5803_{hex} Description

INDEX	**5803_{hex}**
Name	Encoder Flags
Object Code	ARRAY
Data type	Unsigned8
Access	rwr
Default value	No
PDO Mapping	Yes

Table 24: Structure of the data byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	STS_ UFLW	STS_ OFLW	FLAG_ CMP2	FLAG_ CMP1	0	0	0

Table 25: Meaning of the data bits 3 to 6

FLAG_CMP1	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP1) since the last reset.
	1	The contents of the registers match: (REG_SSI_POS) = (REG_CMP1). This marker must be reset when CLR_CMP1 = 1 in the process output data.
FLAG_CMP2	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP2) since the last reset.
	1	The contents of the registers match: (REG_SSI_POS) = (REG_CMP2). This marker must be reset with CLR_CMP2 = 1 in the process output data.
STS_UFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≧ (REG_LOWER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_LOWER_LIMIT)
STS_OFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≦ (REG_UPPER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) > (REG_UPPER_LIMIT)

Object 5804_{hex} – Encoder Diag

The **Encoder Diag** object reads the diagnostics byte of the XN-1SSI module.

Table 26: Object 5804_{hex} Description

INDEX	**5804_{hex}**
Name	Encoder Diag
Object Code	ARRAY
Data type	Unsigned8
Access	ro
Default value	No
PDO Mapping	No

Table 27: Structure of the data byte

Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
X	X	X	ERR_ PARA	STS_ UFLW	STS_ OFLW	ERR_ SSI	SSI_ DIAG

Table 28: Meaning of the data bits

Designation	**Value**	**Description**
SSI_DIAG	0	No enabled status signal active: SSI_STSx = 0 or no status messages of the SSI encoder present.
	1	At least one enabled status signal is active: SSI_STSx = 1.
ERR_SSI	0	SSI encoder signal present.
	1	SSI encoder signal faulty (e.g. due to a cable break).
STS_OFLW	0	SSI encoder value below / equal to upper limit.
	1	SSI encoder value above upper limit. Overflow occurred.

Designation	Value	Description
STS_UFLW	0	SSI encoder value above / equal to lower limit.
	1	SSI encoder value below lower limit. Underflow occurred.
ERR_PARA	0	The parameter set of the module has been accepted.
	1	Operation of the module is not possible with the present parameter set.

Object 5805_{hex} – SSI Native Status

The **SSI Native Status** object reads the bytes 0 to 1 of the process input of the XN-1SSI module.

Writing the object with any value will reset the retentive markers **FLAG_CMP1** and **FLAG_CMP2**. Exception: if the relevant condition for setting a marker is still fulfilled, this marker will continue to remain set.

Table 29: Object 5805_{hex} Description

INDEX	**5805_{hex}**
Name	SSI Native Status
Object Code	ARRAY
Data type	Unsigned16
Access	rwr
Default value	No
PDO Mapping	Yes

Table 30: Structure of the data byte

Byte	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
0	STS_ STOP	X	X	ERR_ PARA	STS_ UFLW	STS_ OFLW	ERR_ SSI	SSI_ DIAG
1	STS_ UP	STS_ DN	REL_ CMP2	FLAG_ CMP2	STS_ CMP2	REL_ CMP1	FLAG_ CMP1	STS_ CMP1

Table 31: Meaning of the data bits

Designation	Value	Description
STS_STOP	0	The SSI encoder is read cyclically.
	1	Communication with the SSI encoder is stopped as STOP = 1 (process output) or ERR_PARA = 1.
ERR_PARA	0	The parameter set of the module has been accepted.
	1	Operation of the module is not possible with the present parameter set.
STS_UFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≧ (REG_LOWER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_LOWER_LIMIT)
STS_OFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≦ (REG_UPPER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) > (REG_UPPER_LIMIT)
ERR_SSI	0	SSI encoder signal present.
	1	SSI encoder signal faulty. (e.g. due to a cable break).
SSI_DIAG	0	No enabled status signal is active (SSI_STSx = 0).
	1	At least one enabled status signal is active (SSI_STSx = 1).
STS_UP (LED UP)	0	The SSI encoder values are decremented or the values are constant.
	1	The SSI encoder values are incremented.
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.
	1	The SSI encoder values are decremented.

Designation	Value	Description
REL_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP2)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≧ (REG_CMP2)
FLAG_CMP2	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP2) since the last reset.
	1	The contents of the registers match: (REG_SSI_POS) = (REG_CMP2). This marker must be reset with CLR_CMP2 = 1 in the process output data.
STS_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) k (REG_CMP2)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP2)
REL_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) ≧ (REG_CMP1)
FLAG_CMP1	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP1) since the last reset.
	1	The contents of the registers match: (REG_SSI_POS) = (REG_CMP1). This marker must be reset when CLR_CMP1 = 1 in the process output data.

Designation	Value	Description
STS_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) k (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP1)

Object 5806_{hex} – SSI Optional Encoder Status

The **SSI Optional Encoder Status** object reads byte 2 of the process input of the XN-1SSI module. Bits 6 and 7 are masked out.

Table 32: Object 5806_{hex} Description

INDEX	**5806_{hex}**
Name	SSI Optional Encoder Status
Object Code	ARRAY
Data type	Unsigned8
Access	ro
Default value	No
PDO Mapping	Yes

Table 33: Structure of the data byte

Byte	**B7**	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
2	masked (0)	masked (0)	X	X	SSI_ STS3	SSI_ STS2	SSI_ STS1	SSI_ STS0

Table 34: Meaning of the data bits

Designation	**Value**	**Description**
SSI_STS3	0	These four bits transfer the status bits of the SSI encoder with the status messages of the SSI module. With some SSI encoders, the status bits are transferred together with the position value.
	1	
SSI_STS2	0	
	1	
SSI_STS1	0	
	1	
SSI_STS0	0	
	1	

Object 5808_{hex} – Encoder Control

Object 5810_{hex} – Counter Load Prepare Value

Object 5811_{hex} – Counter Pulse Width

Object 5820_{hex} – Measuring Integration Time

Object 5821_{hex} – Measuring Low Limit

Object 5822_{hex} – Measuring High Limit

Object 5823_{hex} – Measuring Units per Revolution

→ These objects have no function on the XN-1SSI module.

Object 5840_{hex} – SSI Diag Mapping

The **SSI Diag Mapping** object writes and reads register 51 (REG_SSI_MASK) of the XN-1SSI module.
The REG_SSI_MASK contains the SSI encoder diagnostics transferred.

Some SSI encoders not only transfer the position value in the data frame that they transfer to the module but also supply additional status messages. It is advisable to include these status messages in the application in order to analyse the measured value.

Writing the REG_SSI_MASK register allows up to four individual bits to be taken from the SSI encoder data frame and transferred to the SSI_STSx bits of the process input data. It is also possible to output the "SSI encoder group diagnostics message" with an acyclic diagnostics operation when a status message is initiated.

Table 35: Object 5840_{hex} Description

INDEX	**5840_{hex}**
Name	SSI Diag Mapping
Object Code	ARRAY
Data type	Unsigned32
Access	rw
Default value	No
PDO Mapping	No

Table 36: Masking with REG_SSI_MASK

Process input data	**REG_SSI_MASK**								
	Byte	B7	B6	B5	B4	B3	B2	B1	B0
SSI_STS0	0	EN_D0_RMS0	EN_D0_DS	X	SSI_FRAME_BIT_SEL0				
SSI_STS1	1	EN_D1_RMS1	EN_D1_DS	X	SSI_FRAME_BIT_SEL1				
SSI_STS2	2	EN_D2_RMS2	EN_D2_DS	X	SSI_FRAME_BIT_SEL2				
SSI_STS3	3	EN_D3_RMS3	EN_D3_DS	X	SSI_FRAME_BIT_SEL3				

Table 37: Meaning of the data bits

Designation	Value	Description
EN_Dx_RMSx	0[1)]	The transfer of the SSI status messages to the process input data is not activated
	1	The transfer of the SSI status messages to the process input data is activated
EN_ Dx_DS	0[1)]	The evaluation of the SSI status messages for bit 0 of the diagnostics is not activated
	1	The evaluation of the SSI status messages for bit 0 of the diagnostics is activated.
SSI_FRAME_BIT_SEL	0-31	Definition of the selected bits in the frame of the SSI encoder to be evaluated or copied. Default:0

1) Default

The following applies to bit 0 (SSI group diagnostics) of the diagnostics interface and SSI_DIAG of the process input data:

(SSI_STS0 & EN_D0_DS) || (SSI_STS1 & EN_D1_DS) || (SSI_STS2 & EN_D2_DS) || (SSI_STS3 & EN_D3_DS)

Object 6800_{hex} – Operating Parameters

→ Object 6800_{hex} (corresponds to object 6000_{hex} in accordance with CiA DS406) has no meaning with XI/ON, and only exists because it is a "mandatory" object in accordance with DS406.

Table 38: Object 6800_{hex} Description

INDEX	6800_{hex}
Name	Operating parameters
Object Code	VAR
Data type	Unsigned16
Access	rw
XI/ON default value	00h
PDO Mapping	No

Object 6810_{hex} – Preset Values for Multi-Sensor Devices

Object 6810_{hex} (corresponds to object 6010_{hex} in accordance with CiA DS406) is used for zero point adaption. The content of this object is added to the value of the SSI encoder. The resulting value is stored in object 6820_{hex}.

Table 39: Object 6810_{hex} Description

INDEX	6810_{hex}
Name	Position value for multi-sensor devices
Object Code	ARRAY
Data type	Integer32
Access	rw

INDEX	**6810_{hex}**
Default value	No
PDO Mapping	Yes

Object 6820_{hex} – Position Value

Position value for multi-sensor devices

Object 6820_{hex} (corresponds to object 6020_{hex} as per CiA DS406) contains the SSI encoder value of the XN-1SSI module. The content of the object **Preset Values for Multi-Sensor Devices** contains a value that is added to correct the measured value for a zero point adjustment.

Table 40: Object 6820_{hex} Description

INDEX	6820_{hex}
Name	Position Value for multi-sensor devices
Object Code	ARRAY
Data type	Integer32
Access	ro
Default value	No
PDO Mapping	Yes

Object $6B00_{hex}$ – CAM State Register

The object **CAM State Register** indicates in accordance with DS406 whether the actual counter status is within the range defined by **CAM1 Low Limit** and **CAM1 High Limit** (object $6B10_{hex}$ and $6B20_{hex}$)

Table 41: Object $6B00_{hex}$ Description

INDEX	**$6B00_{hex}$**
Name	CAM State Register
Object Code	ARRAY
Data type	Unsigned8
Access	ro
Default value	No
PDO Mapping	Yes

Table 42: Meaning of the data byte

Value	**Meaning**
00_{hex} (01_{hex})[1)]	The actual SSI encoder value is outside of the range defined by CAM1 Low Limit and CAM1 High Limit or the comparison function is not activated
01_{hex} (00_{hex})[1)]	The actual SSI encoder value is outside of the range defined by CAM1 Low Limit and CAM1 High Limit or the comparison function is not activated

1) If object Cam Polarity register ($6B02_{hex}$) = 01_{hex}, an inversion will be carried out

Object $6B01_{hex}$ – CAM Enable Register

The object **CAM Enable Register** defines if the SSI encoder value is to be compared with the values **CAM1 Low Limit** and **CAM1 High Limit** (object $6B10_{hex}$ and $6B20_{hex}$).

Table 43: Object $6B01_{hex}$ Description

INDEX	**$6B01_{hex}$**
Name	CAM Enable Register
Object Code	ARRAY
Data type	Unsigned8
Access	rw
Default value	No
PDO Mapping	No

Table 44: Meaning of the data byte

Value	**Meaning**
00_{hex}	The SSI encoder value is not compared with the values CAM1 Low Limit and CAM1 High Limit (object 6B10hex and 6B20hex).
01_{hex}	The SSI encoder value is compared with the values CAM1 Low Limit and CAM1 High Limit (object 6B10hex and 6B20hex).

Object $6B02_{hex}$ – CAM Polarity Register

The object **CAM Polarity Register** can cause an inversion of the values represented with object **$6B00_{hex}$**.

Table 45: Object **$6B02_{hex}$** Description

INDEX	**$6B02_{hex}$**
Name	Cam polarity register
Object Code	ARRAY
Data type	Unsigned8
Access	rw
Default value	No
PDO Mapping	No

Table 46: Meaning of the data byte

Value	**Meaning**
00_{hex}	The value represented with object **$6B00_{hex}$** is not inverted.
01_{hex}	The value represented with object **$6B00_{hex}$** is inverted.

Object $6B10_{hex}$ – CAM1 Low Limit

The object CAM1 Low Limit defines in accordance with DS406 a lower limit of the counter range.

Object **CAM1 Low Limit** matches the comparison value 2 of the XN-1SSI module.

Table 47: Object **6B10**$_{hex}$ Description

INDEX	**6B10$_{hex}$**
Name	CAM1 Low Limit
Object Code	ARRAY
Data type	Integer32
Access	rw
Default value	No
PDO Mapping	No

Object 6B20$_{hex}$ – CAM1 High Limit

The object **CAM1 High Limit** defines in accordance with DS406 an upper limit of the counter range.

Object **CAM1 High Limit** matches the comparison value 1 of the XN-1SSI module.

Table 48: Object 6B20$_{hex}$ Description

INDEX	**6B20$_{hex}$**
Name	CAM1 High Limit
Object Code	ARRAY
Data type	Integer32
Access	rw
Default value	No
PDO Mapping	No

Object $6B30_{hex}$ - CAM1 Hysteresis



This object has no function on the XN-1SSI module.

Object $6D00_{hex}$ – Operating Status

Object $6D01_{hex}$ - SingleTurn Resolution (rotary), Measuring Step (linear)

Object $6D02_{hex}$ - Number of distinguishable revolutions



The objects 6D00h to 6D02h (correspond to the objects 6500h to 6502h in compliance with CiA DS406) have no meaning for XI/ON and only exist because they are mandatory objects in accordance with DS406. With XI/ON the objects are always set to 0.

Object $6FFF_{hex}$ - Device Type

Object 6FFFh (corresponds to object 67FFh as per CiA DS406) specifies the type of the second device profile supported. The object is assigned the value 000A 0196_{hex}. The Low word (0196_{hex}) specifies the Device Profile (to CiA DS406: counter module). The High word ($000A_{hex}$) describes the counter type (10_{dec} = Multi-sensor-encoder interface).

Table 49: Object $6FFF_{hex}$ Description

INDEX	**$6FFF_{hex}$**
Name	Device Type
Object Code	VAR
Data type	Unsigned32
Access	ro
Default value	$000A\ 0196_{hex}$
PDO Mapping	No

Additional emergencies

The following CANopen emergencies can be triggered by an SSI module:

Error code	**Name**	**Byte 3**	**Byte 4**	**Byte 5**	**Meaning**
7000_{hex}	Additional modules	Module no.	Channel no. (always 1)	0x01	SSI diag
7000_{hex}	Additional modules	Module no.	1	0x02	SSI error
7000_{hex}	Additional modules	Module no.	1	0x04	Overflow error
7000_{hex}	Additional modules	Module no.	1	0x08	Underflow error
7000_{hex}	Additional modules	Module no.	1	0x10	Parameter error

Index

B
Bit transmission rate ... 27
Block diagram ... 26
Bus terminating resistors ... 27

C
Cable impedance ... 27
Cable length ... 27
CANopen
  Integration ... 77–104
CL ... 32
Clock output ... 27
Connection diagram ... 32
Connection type
  RS422 ... 27

D
D ... 32
Data exchange ... 12
Default PDOs
  Encoder-specific ... 78
Degree of protection ... 28
DeviceNet
  Integration ... 57–75
Diagnostics
  CANopen ... 84
  DeviceNet ... 62, 72
  PROFIBUS-DP ... 42

E
Electromagnetic compatibility ... 28
Emergencies ... 104
Encoder current ... 27
Encoder voltage
  ... 27
Exchanging the module ... 11

G
GND ... 32

I
Indication elements 29
Insulation voltage 27

L
LED 29

N
Nominal current
Module bus 27
Supply terminals 27
Nominal supply
Supply terminals 27

O
Objects
Encoders 79
Offset function 23
Operating temperature 28

P
Parameters
CANopen 81
DeviceNet 73
PROFIBUS-DP 44
Power loss 27
Power supply 11
Process input
CANopen 84
DeviceNet 57, 89, 93
PROFIBUS-DP 33
Process output
CANopen 100, 101
DeviceNet 58
PROFIBUS-DP 39
PROFIBUS-DP
Integration 33–55

R
Register bank
Resetting 25
Registers 13
Relative humidity 28

S
Signal input 27
Status messages
SSI encoder 23, 93, 94
Storage temperature 28

T
Technical data
Base modules 31
XN-1SSI 27–28
Transmission channels 27
Transmission procedure 12