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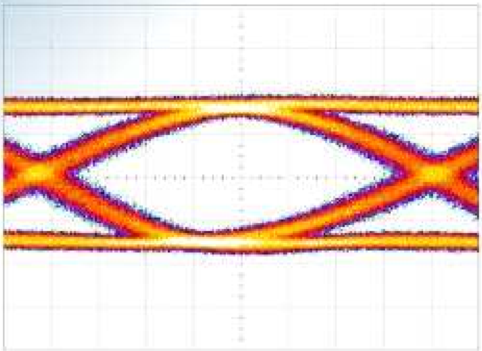


Datasheet

EC-SSI2

SHF Communication Technologies AG

the bandwidth company

Datasheet EC-SSI2

Contents

1. Application range

The module EC-SSI2 was developed for the acquisition of signals of absolute encoders. The determined results are transmitted by the EtherCAT®[1] fieldbus. The module is designed for DIN rail assembly.

The module has two channels for connecting SSI[2]-encoders. It is possible to connect encoders with a data word length between 1 and 32bit. Binary or gray coded data can be read. The inputs and outputs are galvanic isolated to each other, to digital electronic and to Ethernet. The clock outputs are short circuit protected. The power supply for the clock outputs is generated from the 24V-power supply internally.

The acquisition of the SSI-data can be made free-wheeling or synchronized to the EtherCAT®-frames.

The clock frequency can be programmed in steps between 62,5kHz and 1MHz adapted to the cable length.

Certain errors like broken cable and polarity failure can be detected automatically.

If there are used encoders with power fail bit, it is possible to separate it from the data flow and store it in the status byte.

The connection of the peripheral signals is made by two 6-pole connectors.

The power supply is carried out by a 2-pole threaded connector.

[1] EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany

[2] SSI: synchronous serial interface; The SSI interface is a common interface for absolute single- and multiturn encoders.

2. Connectable encoders

Encoders can be connected with the following parameters:

- encoders with data length between 1..32bit
- binary or gray coded values
- encoders with or without power fail bit

Differential (bipolar) or ground based (unipolar) signals can be connected to the SSI inputs. **It is recommended to use encoders with bipolar signals.** These encoders enable a better noise rejection.

The position information is read out by the help of a serial clock, i.e. synchronously. The clock rate possible depends on the cable length connected. The clock rate can be programmed in steps. Possible are 1 MHz, 500 kHz, 250 kHz, 125 kHz and 62.5 kHz (see chapter 4.2.1). The noise immunity is increased by lowering the clock rate. But the speed of data exchange is also decreasing. The relation of the clock rate and cable length is shown in the table following:

cable length	clock rate	read time for single turn encoders	read time for multi turn encoders
< 50 m	1 MHz	< 20µs	< 30µs
< 100 m	500 kHz	< 40µs	< 60µs
< 200 m	250 kHz	< 75µs	< 120µs
< 400 m	125 kHz	< 120µs	< 240µs
< 1000 m	62,5 kHz	< 250µs	< 500µs

The table gives only a rough recommendation. The clock rate possible depends on several influences. An important factor is the cable capacity. The pulse forms of clock and data should be checked always. If the edges are accurate higher clock rates can be chosen. But attention must be paid to the signal delay time also because of being a synchronous interface.

If there is used an encoder with power fail option the power fail information is transferred in the last bit, e.g. bit13 (single turn) or bit25 (multi turn) respectively. Then programming of the PFB-option is recommended (bit6 of the channel control byte). If this bit is set:

1. The PFB-Bit is separated from the data stream and stored in the status byte.
2. The LSB in the SSI-data word used for the PFB-information is reset to 0.

3. Hardware description

3.1. SSI input/output circuit

The peripheral signals for the connection of the encoder are galvanic isolated from the remaining logic. A galvanic isolation exists also between both channels. The clock outputs are powered internally and short circuit protected.
There are also to pins for the encoder supply at every peripheral connector. These pins are fed from the module power supply including a reverse battery diode. The current maximal allowed is 500mA per channel. But it is possible to supply the encoders separately.

3.2. Programmable Logic

The module is assembled with a programmable logic IC. It serves as a link between EtherCAT® slave controller and the input/output circuit.

3.3. EtherCAT®-connection

The module has two Ethernet interfaces each with one yellow and one green LED. The yellow LED signalizes an Ethernet connection with 100MB, the green data transfer.
One interface serves as an input, the other as output to the next EtherCAT® slave or is unconnected if the module is the last inside the chain. Both interfaces support auto crossover (MDI/MDIX).
Furthermore there is a green LED at the front side displaying the EtherCAT® state with different blink sequences.

3.4. Power supply

The module is supplied with 24V±30%. All necessary supply voltages for the different functional blocks are generated internally. The power needed is about 3W plus transducer supply.

4. Programming and memory mapping of the EtherCAT®-slave controller

4.1. Summary

4.1.1. Programming of SyncManagers

The integrated circuit ET1100 of Beckhoff Automation GmbH is used as EtherCAT® –slave controller. It is responsible for the data exchange between application layer and logic of the SSI module. There for two SyncManagers (SM) of the ET1100 are used. One serves for the output of data (channel control bytes, data word length), the other is used for reading SSI values and state register. Both SMs operate in 3 buffer mode ensuring data consistency. The SM for data output activates the interrupt line of the process data interface if there new output data were transmitted with the last frame. The logic will serve the interrupt by reading the new output data. The SSI values and state registers are written to the slave controller by the logic after finishing reading of SSI encoders

SM	Address	value	Explanation
SM0	0x800	0x2000	Start address of input data
	0x802	0x000A	Length of input data in byte
	0x804	0x0010	Read, 3buffer, ECAT IRQ
	0x806	0x0001	Enable (set after 0x800..804 are programmed)
SM1	0x808	0x2100	Start address of output data
	0x80A	0x0004	Length of output data in byte
	0x80C	0x0024	Write, 3buffer, PDI IRQ
	0x80E	0x0001	Enable (set after 0x808..80C are programmed)

4.1.2. Data fields

Input data:

Address	Content
0x2000	SSI-Byte0 Channel0
0x2001	SSI-Byte1 Channel0
0x2002	SSI-Byte2 Channel0
0x2003	SSI-Byte3 Channel0
0x2004	SSI-Byte0 Channel1
0x2005	SSI-Byte1 Channel1
0x2006	SSI-Byte2 Channel1
0x2007	SSI-Byte3 Channel1
0x2008	Status Channel0
0x2009	Status Channel1

Output data:

Address	Content
0x2100	Channel control byte Channel0
0x2101	Channel control byte Channel1
0x2102	Data word length Channel0
0x2103	Data word length Channel1

4.2. Channel registers

Every channel has four registers. These are:
- Channel control byte
- Data word length
- SSI-data
- Channel status byte

4.2.1. Channel control byte

The operation mode of a SSI-channel is determined by the channel control byte. They are composed identically for every channel.

Channel control byte:

D7	D6	D5	D4	D3	D2	D1	D0
PL	PFB	SYNC	MULTI	GRAY	CR2	CR1	CR0

CR(2..0) clock rate
- 000: 62,5kHz
- 001: 125kHz
- 010: 250kHz
- 011: 500kHz
- 100: 1MHz
- 101: do not use
- 110: do not use
- 111: do not use

GRAY type of coding
- 0: encoder transmits binary coded data
- 1: encoder transmits gray coded data

MULTI type of encoder
- 0: Single turn encoder (13Bit)
- 1: Multi turn encoder (25Bit)

SYNC Triggering of read command
- 0: reading is free-wheeling
- 1: reading is started with transmission of channel control bytes

PFB power fail bit
- 0: encoder sends no power fail bit
- 1: encoder sends power fail bit

PL programmable length
- 0: the data length is determined by MULTI
- 1: the data length is determined by the register data word length

Remarks:
- If the encoder is sending gray coded data and the bit GRAY is set in the channel control byte the data will be transformed to binary automatically and stored in this form in the SSI-data register.
- If the SSI-channel is used in synchronous mode the reading of encoder is started with the transmission of the channel control byte(s) including a SYNC bit set. If the reading of new data over EtherCAT is delayed sufficiently according to the type of encoder and clock rate chosen the currently read position is transferred. By testing the READY bit it is possible to detect if the reading of SSI-data was finished at this time.

4.2.2. Data word length

The length of the data word of the encoder connected is determined by the register data word length if the bit PL in the channel control byte is set.

D7	D6	D5	D4	D3	D2	D1	D0
X	X	L5	L4	L3	L3	L1	L0

L(5..0) data word length of the encoder connected

Remarks:

- One start clock is added automatically to the data word length programmed, e.g. if there is written 17 into the register, 18 (=17+1) clocks are generated. The start clock is used by the SSI encoder to latch the actual position into the output shift register.
- It is possible to program a data word length between 1 and 32bit. If there is written a 0 into the register a data word length of 1 is generated. If there is written a number greater than 32 the data word length is limited to 32bit automatically.

4.2.3. SSI-Data

The register for the SSI data has a length of 32bit. It is written right aligned. The unused upper bits are filled with 0.

4.2.4. Channel status byte

D7	D6	D5	D4	D3	D2	D1	D0
SSIF	SPFB	X	x	PED	BCC	BCD	READY

READY SSI-reading is finished
0: data reading not ready
1: data were read completely since the last transmission of channel control byte
is static 1, if the SYNC-bit in the channel control byte = 0 (free-wheeling mode)

BCD broken cable data
0: data connection is okay
1: data connection is broken

BCC broken cable clock
0: clock connection is okay
1: clock connection is broken

PED polarity error data
0: no polarity error at data line
1: polarity error at data line

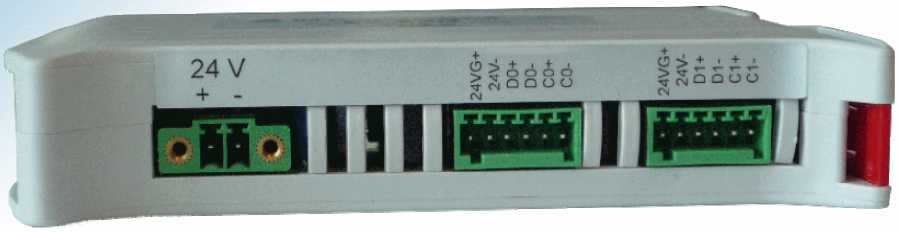
SPFB state of power fail bit
0: power supply of the encoder is okay
1: power supply of the encoder is not okay
is static 0, if the PFB-bit in the channel control byte = 0 (no power fail bit)

SSIF SSI failure
0: SSI-encoder responds (start bit is high)
1: SSI-encoder does not respond (start bit is low)

4.3. Version

The version of logic implemented can be determined by reading the memory cell 0xFE0 of the EtherCAT® slave controller. The cell is written by the slave logic while the slave is in the Init state.

5. Connector pin assignment



24V+	Power supply +
24V-	Power supply ground
24VG+	Encoder supply + Channel 0
24V-	Encoder supply – Channel 0
D0+	Data input P Channel 0
D0-	Data input N Channel 0
C0+	Clock output P Channel 0
C0-	Clock output N Channel 0
24VG+	Encoder supply + Channel 1
24V-	Encoder supply – Channel 1
D1+	Data input P Channel 1
D1-	Data input N Channel 1
C1+	Clock output P Channel 1
C1-	Clock output N Channel 1

The supply voltage is directed to a diode used as reverse voltage protection. The resulting voltage behind the diode is named 24VG+. It is used for powering the internal logic as well as for the encoder supply. The current maximal allowed is 0.5A per channel. The “24V-“-pins are connected directly. But the encoders can be supplied separately also.

6. Technical data

EtherCAT®-connection:

2 x RJ45 with LED yellow and green
Every connection with MDI/MDIX (auto crossover)
1 x state-LED, green

SSI-inputs/outputs:

Number of channels:	2
Type:	programmable data word length between 1 and32bit
Coding:	binary or gray coded
Power fail bit:	is supplied
Frequency:	62.5/125/250/500kHz, 1MHz
Input voltage:	>=3V
Input current:	2 - 3mA
Galvanic isolation:	to each other, to digital electronic and to Ethernet
Isolation voltage:	250Vrms (channel to channel)
	500Vrms (inputs to digital electronic)
	1500Vrms (digital electronic to Ethernet)

Power supply:

Input voltage	24V±30%
Power consumption:	<3W

Encoder supply:

Output voltage:	input voltage 24V+ minus 0,5V
Output current:	<=0.5A per encoder

Housing:

Dimensions:	120 x 101 x 22.5 mm
Material:	Blend PC/ABS self-extinguishing
Color:	grey (other on request)
Assembly:	DIN rail
Weight:	135 g incl. connectors

Connector power supply:

Type:	Phoenix FK-MC 1,5/2-STF-3,5
Type of connection:	screw connection
Color:	green
No. of positions:	2
Conductor cross-section:	0.14 - 1.5mm^2
Stripped insulation length:	7mm

Connector peripheral signals:

Type:	Phoenix FK-MC 0,5/6-ST-2,5
Type of connection:	spring-cage
Color:	green
No. of positions:	6
Pieces:	2
Conductor cross-section:	0.14 - 0.5mm^2
Stripped insulation length:	8mm

There must be used twisted pair conductors for every track. Using a cable from the encoder to the connector with 2 or 3 twisted pairs with an overall shielding is recommended. The type of cable „UNITRONIC® BUS LD FD P, ordering number 2170215“ of the company “LAPP Kabel” ($3 \times 2 \times 0{,}25$ mm^2) is recommended. The overall shielding should be connected all around to PE/ground.
Depending on the special conditions a different grounding method can be usefully, especially if the potential difference between transducer and the EtherCAT®-module is very high.

The cable resistance and capacity between transducer and EtherCAT®-module should be considered.

Ambient conditions

Humidity:	5% until 95% without condensation
Operating temperature:	0°C to + 55° C
Storage temperature:	-40°C to +85° C

Electromagnetic compatibility

Emissions:	EN61000-6-2:2001
Immunity:	EN61000-6-4:2001

7. Ordering information

EC-SSI2: **100 43 08**

All necessary connectors are included.