# SSI TO USB CONVERTER
# SSI2USB


Adapter box that can be used to capture or read SSI data and display it on a PC using a Graphical User Interface via a USB port.

**Main Features**

- SSI master device for USB connection
- Alternatively SPI master device via TTL level
- Three independent tri-state push-pull outputs
- Compact and robust aluminium housing
- Built in gray code to binary code conversion
- Power supply of SSI device from USB port (12 Volts up to 90 mA or 5 V up to 270 mA)
- External power supply can be connected
- Graphical user interface provided with device

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## Technical Data

### Electrical data

| | | |
|---|---|---|
| Device Power Supply | via USB Full Speed 2.0 | DO NOT CONNECT DEVICE TO A USB HUB! |
| Sensor Power Supply (CAUTION: use of internal power mode may depend on computer!) | Internal 5 V mode | typ. > 4,5 V @ 200 mA sourced by USB (SSI2USB issues reset below 4,5 V)<br>CAUTION: internal 5 V mode is not possible with RS422 levels, use external supply for this case) |
| | Internal 12 V mode | typ. > 10 V @ 90 mA sourced by USB |
| | External supply | 0 – 36 V up to 1 A |
| Output ports | Tristate push-pull | max +/- 3 mA<br>HI-level equal to sensor supply voltage – 1 V<br>LO-level < 800 mV<br>+/- 1 mA<br>HI-level Ub_Ext – 700 mV<br>LO-level < 600 mV |
| SSI mode (CAUTION: parameters may exceed SSI protocol specification) | Clock rate | 62.5 kHz – 2 MHz |
| | Word length | 1 – 32 bit |
| | Sample rate | 12 µs – 4 ms (Jitter 0,5 µs max) |
| | No. of contiguous samples | 1 – 2E24 |
| | Mask mode | 32 bit AND mask |
| | Gray mask mode | 32 bit AND mask |
| | Clock input | Via opto-coupler |
| | Data output | Line-driver according to RS 422 or TTL |
| SPI mode | According to SSI, additional MOSI provided | |
| | Clock rate | 62.5 kHz – 8 MHz |
| | MOSI word | 32 bit |
| Sensor connector | Sub-D 15 pin female | |

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**Synchronous Serial Interface (SSI)**

| | |
|---|---|
| Driver | Driver meets EIA standard RS 422; alternatively TTL transmission |
| Transfer | Transfer distance up to 1200 m |
| Transmission | Balanced transmission provides high noise immunity |
| Pair lines | Shielded and twisted pair lines are essential to attain extremely high noise immunity |
| Interface | For a detailed description of the synchronous-serial-interface (SSI) refer to SSI description of this document. |
| SPI mode | Device can be used as SPI master |

**General Purpose Outputs**

| | |
|---|---|
| Driver | Tri-state push pull drivers |
| No. of outputs | 3 |

**Mechanical data**


| Dimensions in mm ( inch) | |
|---|---|
| X | 114 (4.5 “) |
| Y | 64 (2.52”) |
| Z | 33 (1.30”) |

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## Synchronous Serial Interface (SSI)

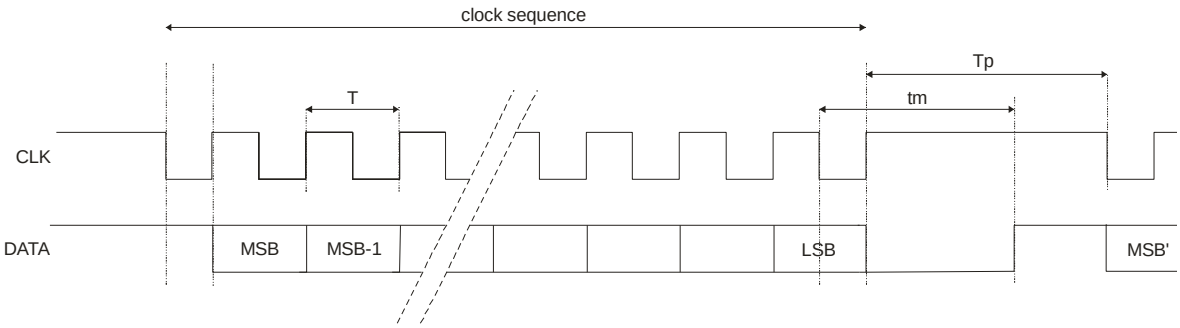
The SSI transmits data synchronously to the clock signal of the master device starting with the most significant bit (MSB). When non-operational, clock and data line levels are high. As soon as the clock signal of a sequence changes for the first time from high (H) to low (L), data is latched for transmission.Data bits are shifted on rising clock edges starting with the most significant bit (MSB). Transmission ends on the last rising clock edge and is terminated after expiration of the SSI delay time (latch is cleared after at least 20 µs).

The maximum data word length with SSI2USB is 32 bits. The device is capable of gray to binary code conversion during process of sampling. For this purpose, the data word may be masked by a 32 bit word (AND mask) to cut status bits that are not object of conversion.
Additionally, the overall data may be masked by another 32 bit word (AND mask) to cut out data that is of no interest.

Especially the sample time (time interval between two consecutive transmissions of a single data batch) can be selected to be shorter than the actual SSI pause time for development purposes. This setting may cause the device under test to send the same data over and over again, since the latch may not be released between succeeding transmissions. Please be aware that SSI2USB's capabilities go beyond the SSI protocol specification

### Signal diagram

T > 12 µs; tm > 20 µs; Tp>tm



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## Serial Peripheral Interface (SPI)

SSI2USB can be used to interface a SPI via TTL levels, providing the additional data master output (MOSI) and framing signals (NSL (Shift-NotLoad), SNL (NotShift-Load)). MOSI allows the transmission of a single 32 bit word towards the slave; this word will be sent with EVERY transmission of a contiguous batch (array of data acquired by SSI2USB with single operation).

The word transmitted towards the slave is sent MSB first from a 32 bit shift register; in case the transmission does not comprise 32 bits, the word has to be aligned in the register.
Of course, as a special case a SSI communication with TTL level rather than RS422 may be a special case of SPI mode.

| **SPI mode signals** | **Description** |
|---|---|
| OUT 3 | Push pull output |
| OUT 1 | Push pull output |
| UB_EXT | Sensor power supply |
| MISO | Master In Slave Out path |
| SPI NSL | SPI frame signal: Not-Shift Load (high on idle SPI) |
| MOSI | Master Out Slave In (single 32 bit word for ALL transmissions of a contiguous data batch) |
| OUT 2 | Push pull output |
| GND_ISO | Gnd level of supply |
| GND | Internal device gnd level<br>DO NOT CONNECT |
| SPI CLK | SPI clock signal |
| SPI SNL | SPI frame signal (Shift Not-Load signal, high on active SPI) |
| GND_ISO | Cable shield |

Please note that in case of using SPI mode rather than SSI mode different pins for clock and data transmission have to be connected to the sensor (see pin assignment for details).Moreover, please connect GND and GND_ISO to avoid floating potentials. All specifications for the SSI mode are valid in SPI mode as well.

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## SSI2USB: Principle of Operation

The main unit for data transfer within the SSI2USB device is a 32 bit shift register.

The register's content is shifted with every clock cycle, which explains the necessity of defining a binary mask: all bits occupying storage places higher than the MSB of the actual data transfer belong to the previous communication or the SSI leading high level. Since this data is of no interest the binary mask simply cancels these bits.

In all cases, specify one clock cycle more than the actual desired word length indicates to accommodate for the leading high level of the SSI transmission (refer to SSI specification for this issue).

Additionally, the data word may be patched by extra bits (alarm bits) that have to be cut out before doing a gray to binary code conversion; the gray code mask cancels these bits before the process of conversion and the cut bits are attached afterwards again.

SSI2USB is capable of issuing 63 clock cycles, enabling the device of shifting through a longer data word than 32 bits (of course only 32 bits of the data word are caught and transferred to the USB interface).

Longer data words than 32 bits may be read out by using a batch trick: define a batch of two 32 bit samples and a sample rate resulting in a delay between the two samples not exceeding the SSI pause time. This allows splitting a long data word into two smaller 32 bit sections.

Using SPI mode, the line drivers for communication with the target device are bypassed. With this mode, the target is directly connected to the internal FPGA of SSI2USB; please be aware that this might harm the device.

With SPI mode, the 32 bit shift register is filled with a word before transmission which will be sent to the slave (within one batch, the same word is sent with every transmission). When using shorter transmissions than 32 bits, the word sent to the slave has to be MSB aligned in the register, because the transmission works MSB first.

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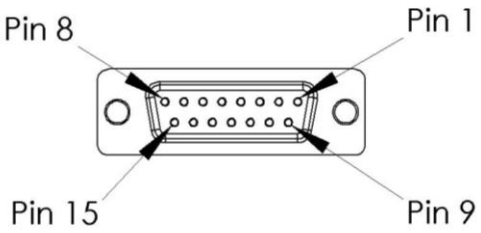
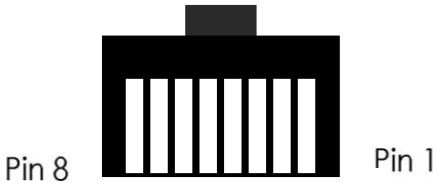
## Pin Assignment

| Signal Name | DB-15 Pin No. | RJ-45 Pin No. | Comment |
|---|---|---|---|
| SSI DAT- | 1 | 6 | RS422 data negative path |
| SSI CLK- | 2 | 4 | RS422 clock negative path |
| OUT 3 | 3 | | Push pull output |
| OUT 1 | 4 | 8 | Push pull output |
| UB_EXT | 5 | 2 | Sensor power supply |
| MISO | 6 | | TTL data line |
| SPI NSL | 7 | | SPI frame signal |
| MOSI | 8 | | SPI output data word |
| SSI DAT+ | 9 | 5 | RS422 data positive path |
| SSI CLK+ | 10 | 3 | RS422 clock positive path |
| OUT 2 | 11 | 7 | Push pull output |
| GND_ISO | 12 | 1 | Gnd level of external supply |
| GND | 13 | | Internal device gnd level |
| SPI CLK | 14 | | SPI clock signal |
| SPI SNL | 15 | | SPI frame signal |
| GND_ISO | Shield | Shield | Cable shield |




**DB-15 Connector on Box**




**RJ-45 Connector on Box**

For single-ended (TTL) transmission:

- connect GND and GND_ISO
- use transmission lines for SPI mode

## Status LEDs

Four status LEDs indicate different modes:

| Name | Colour | Description |
|---|---|---|
| OK | green | Device ready for operation |
| Busy | yellow | Device busy, user has to wait |
| PWR INT | red | Indicates usage of internal (USB) power |
| PWR ISO | red | Indicates usage of high power voltage (either 11V internal or external supply) |

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## Accessories and Documentation

| Description | Article number |
|---|---|
| External power supply | |
| USB 2.0 cable ( 2x AWG 24 / 2x AWG 28) | included |
| SSI2USB graphical user interface (*) | - |
| SSI2USB graphical user interface Visual Studio MFC sources | contact POSITAL |

(*) Visit our homepage www.posital.com. All files can be downloaded free of charge from our homepage.

**Disclaimer**