Topic:

- What maxon controllers can process SSI absolute encoder data?
- What specific details have to be taken into account concerning the compatibility of a SSI encoder protocol and the controller.

Situation:

SSI is an industry-proven and well established protocol standard in use by absolute encoders and linear scales since years. SSI single- and multi-turn encoders use a serial protocol to transmit the absolute position data to the motor controller.

At the early days of the SSI standard there was just position data transmitted by most SSI encoders. Many manufacturers of SSI encoders implement additional enhanced SSI protocols nowadays transmitting status bits of the encoder too. In principle this is helpful to get some information if the encoder had been referenced during initial commissioning or if there is an error state present (e.g. low battery in case of a battery back-up multi-turn encoder). There is still a SSI serial communication in use but the number of additional bits, the meaning of the bits and the alignment of these bits in front or behind the position data can vary by each encoder manufacturer. Not all of these manufacturer specific SSI protocols and features might be compatible with any controller. It is even possible that the controller cannot properly process the position information mixed with status bits anymore.

In general most SSI encoders work with controllers supporting the SSI standard without any problems or special investigation based on a correct configuration of the controller.

If the SSI encoder not just transmits position data but also additional information, there can be a compatibility issue sometimes. It is strongly recommended to investigate in the data sheet and details about the bit stream of the SSI encoder and compare this specification with the configuration features of the motor controller if there is a SSI encoder with additional or so-called "special" bits in use.
Solution 1: maxon controllers offering a SSI Interface

- **SSI encoders** can be in use with all EPOS4 controllers and the MAXPOS controller. Anyway it has to be checked that the number of position data bits and the presence of additional "special" bits of the encoder match with the configuration features and limits of the EPOS4 or MAXPOS controller. The information about the maximum number of Single-turn, Multi-Turn, and special bits can be found in the "EPOS4 Firmware Specification.pdf" resp. "MAXPOS Firmware Specification.pdf".

- Most of the EPOS2 controllers are designed for incremental encoder feedback only. Just the product types "EPOS2 50/5" (#347717) and "EPOS2 70/10" (#375711) can be in use with SSI encoders which transmit position data only (without any additional special bits). Please refer to chapter "13.3.1 SSI Absolute Encoder" of the "EPOS2 Application Notes Collection.pdf" for wiring of the SSI encoders in use by the mentioned two EPOS2 product types.

- **SSI encoders** cannot(!) be in use with the ESCON product line. The ESCON is a velocity or current controller only. There is no need for absolute position data by these control modes. Due to this the ESCON does not provide an absolute encoder interface at all and there can just be encoders with incremental signals in use instead.
Solution 2: SSI characteristics to check in advance

Please check the following details by the SSI encoder’s data sheet and compare these with the configuration features of controller. These features can be found in the "Firmware Specification" (-> SSI objects) of the corresponding controller or easily be tested by the “Startup” wizard of maxon's "EPOS Studio" resp. "MAXPOS Studio".

a) **Number of position bits (i.e. maximum resolution)**

The number of multi-turn and single-turn position data bits as well as the total number of bits are limited to a specified minimum and maximum number by the controller. These limitations can be found in the controller's “Firmware Specification”. Please ensure that the encoder's multi-turn and/or single-turn resolution does not exceed these configuration limits. Otherwise the SSI encoder is not compatible with the controller and cannot be in use.

b) **Position transfer with a fixed number of data bits**

Normally a SSI encoder exactly transmits the number of bits corresponding to the encoder's position data resolution which has to be configured by the controller too. There are some manufacturer of SSI encoders which transmit the position data always with a fixed frame length (= fixed number of bits) and fill up the frame with '0' bits if the actual position data resolution is lower. One popular manufacturer using such a position data frame with a fixed length is Renishaw.

The SSI encoders by Renishaw always use a fixed position data frame of 26 bits for some SSI protocols although the actual position data resolution might be lower (e.g. just 23 bit). The "unused" position data bits are filled up with '0' at the end. This means that the controller must process the actual position data only and ignore the '0' bits at the end. The '0' bits have to be processed like special bits, i.e. the position data has to be configured based on the actual resolution (e.g. of 23 bits) and the additional '0' bits have to be configured (as 3) special bits.

c) **Alignment and number of special bits**

Some SSI encoders provide "special" bits in addition to the position data. The EPOS2 cannot handle such additional bits and the processed position data might be wrong due to this.

It is possible to configure the number of special bits by the EPOS4 and MAXPOS within some limits. The bits can be read in a controller object by the master. The master can analyze and react on the special bit information then. Anyway there are some restrictions too:
EPOS4, MAXPOS:
The number of "special" bits can be 8 in maximum.

Remark:
If a SSI encoder is based on fixed position data length (e.g. 26 bit) but not all of these actually correspond to the actual position resolution (e.g. 23 bit), the difference (e.g. 5 bits) count as "special" bits too if the frame was filled up with '0' bits at the end.

EPOS4, MAXPOS:
Position data has to be transmitted first and "special" bits have to be at the end.

IMPORTANT restriction:
If there is a SSI protocol present which transmits the "special" bits in front of the position data, the SSI encoder is not(!) compatible with maxon controllers and cannot be used.

d) Clock frequency & timing

Normally the configuration of the clock frequency and timing does not provide any difficulties due to often wide range of supported clock frequencies by the SSI encoder and wide range of configurable settings by the controller. There will be just a quick look in the SSI encoder's data sheet required to configure the controller properly.

e) Power consumption
Typically the 5V output current of 100 mA (or even 150 mA depending on the concrete controller) is sufficient to supply an encoder. There are just some encoders (e.g. Renishaw) which partly require a higher supply current due to additional features or a powerful internal processor. Please check the power consumption of the encoder and compare it to the 5V output current rating provided by the controller. If the current draw by the encoder would be too high, there is the need for an additional 5V supply. The GND of the external 5V supply and the controller's logic GND has to be connected then.
Further assistance required?

maxon cannot take any responsibility that any SSI encoder type is compatible with maxon controller. There is just a too great variety of different and enhanced SSI protocol types present by the different encoder manufacturers. If you are not sure about the compatibility of a SSI encoder and maxon controller, please "Submit a request" and provide the following information:

- Manufacturer name and full part number of the encoder.
- Data sheet or manual of the encoder holding the technical data and protocol specification.
- Part number or product name of the maxon controller.