Bliss

SSI sensor interface board

Revision 1.0a (preliminary)

1. Features

- **SSI front-end: bridges carrier SPI to the field bus**
- **Differential RS-422 signalling for long cable runs**
- **Powers the SSI device over the same field cable**
- **Sensor supply current-limited and monitored**
- **Protected field lines: $> \pm$15 kV ESD and TVS clamps**
- **Open or shorted line reads as a fail-safe state**
- **Full -40 to +125 °C operating range**
- **Auto-identified; supplied mounted on the carrier**

2. Applications

- SSI absolute encoders, rotary and linear
- Position, angle and displacement sensing in motion systems
- SSI-output transducers (inclinometers, draw-wire, magnetostrictive)
- Remote sensors powered and read over a single cable
- Field-identified SSI endpoints on a CAN / CAN FD backbone

3. Description

Bliss is an SSI (Synchronous Serial Interface) front-end daughterboard for the Nexilica *Nexor* carrier. It gives the carrier a robust differential interface to an external SSI absolute encoder or SSI-output sensor, and can power that device from the carrier over the same cable. Bliss is soldered onto one face of the carrier through its castellated pads: the carrier drives the SSI clock and reads the data over its SPI bus, then publishes the value on the CAN bus. Bliss performs no SSI-to-CAN conversion itself; it is the physical-layer and power interface between the SSI cable and the carrier SPI, while the carrier handles the protocol and CAN.

It translates the carrier 3.3 V single-ended SPI into the RS-422 differential signalling that SSI devices use, and a supply passthrough with an integrated e-Fuse feeds the device, with adjustable current limit, overvoltage clamp, reverse-polarity protection and fault reporting. All components are rated from -40 °C to +125 °C.

Image to be added

`bliss_render.png`

Figure 1: Bliss interface board

4. Technical Characteristics

Absolute maximum ratings

Stresses beyond those listed in Table 1 may cause permanent damage to the device. These are stress ratings only; functional operation at or beyond the values listed under *Electrical and environmental characteristics* is not implied.

PARAMETER	MIN	MAX	UNIT
SSI field-line voltage (to GND) [(1)]	-7	+12	V
ESD on SSI field lines (HBM) [(2)]	—	±15	kV
Storage temperature	-40	+150	°C

Table 1: Absolute maximum ratings

[(1)] Continuous voltage on the differential clock / data pins with respect to ground, set by the on-board transient suppressors: they conduct beyond this window, so field surges are clamped but a sustained voltage outside it damages the board. It matches the RS-422 / RS-485 common-mode range, so correct wiring never approaches it. [(2)] Human-body model on the field lines. The same pins withstand ±12 kV IEC 61000-4-2 contact discharge and ±4 kV IEC 61000-4-4 fast transient bursts.

SSI interface

Table 2 summarises the electrical interface to the SSI device. The usable clock rate and cable length are set together by the carrier and the installation, not by the transceivers, which are rated well above typical SSI operation.

PARAMETER	VALUE
Signalling	RS-422 differential, as used for SSI
SSI clock	Differential output, generated by the carrier (SPI clock)
SSI data	Differential input, returned by the device (to SPI data)
Clock output level	$\geq$2 V differential into 100 Ω; $\geq$1.5 V into 54 Ω
Data input sensitivity	$\pm$200 mV differential, 80 mV hysteresis
Common-mode range [1]	-7 V to +12 V
Open, shorted or idle line [2]	Data reads as a steady logic high (fail-safe)
Line termination [3]	120 Ω fitted across the clock pair; unfitted provision across the data pair
Transceiver signalling rate [4]	up to 50 Mbit/s
Typical SSI clock rate [5]	100 kHz – 2 MHz
Cable length [5]	up to $\sim$100 m at $\leq$1 MHz (installation-dependent)

Table 2: SSI interface

[1] Ground-potential difference the board tolerates between itself and the connected device, on top of the signal itself. [2] The data receiver is internally biased, so a disconnected cable, a shorted pair or an unpowered device gives a defined reading instead of noise; no external bias resistors are required. [3] As delivered. The clock pair is terminated on the board; the data pair is supplied unterminated. [4] Line-transceiver capability; the practical rate is limited by the carrier SPI and the cable. [5] Indicative values for SSI encoders. Higher clock rates require shorter cables; refer to the connected device datasheet.

Electrical and environmental characteristics

Both the logic supply and the sensor supply are provided by the carrier; Bliss requires no external supply.

PARAMETER	MIN	TYP	MAX	UNIT
Sensor-supply output [1]	9	—	28	V
Sensor-supply current limit [2]	—	200	—	mA
Sensor-supply clamp level [3]	36	37.5	40	V
Operating temperature	-40	—	+125	°C

Table 3: Electrical and environmental characteristics

[1] What the connected device receives. Nothing is regulated on the board: the node supply is passed through, so this range is the supply range of the node itself, less about 0.1 V dropped across the protection stage at 200 mA. [2] The most the connected device may draw. Beyond it the supply is held at the limit and latches off after at most 0.5 s; the carrier restores it by cycling the supply-enable line. [3] The ceiling the connected device can ever see. Should the node supply rise above this level, the board limits its output to the clamp level instead of passing the surge on. Clamping is a transient measure — the excess is dissipated on board — so after at most 0.5 s, or sooner if the protection stage overheats, the sensor supply latches off until the carrier cycles its enable line.

5. System architecture and carrier interface

Bliss has no wired connection to the carrier: it is soldered onto the castellated pad strip of one face of the Nexor carrier (16 pads: two side columns of 6 at 2.27 mm pitch and a bottom row of 4 at 3.30 mm pitch), and all power and signals are exchanged through those pads. The carrier drives the SSI clock out of its SPI clock line; Bliss converts it to a differential pair for the device. The device returns its data as a differential pair, which Bliss converts back to a single-ended line on the carrier SPI data input. A separate supply passthrough, protected by an e-Fuse, powers the device, and a small identification memory sits on the shared ID bus. Table 4 lists the carrier resources the board uses.

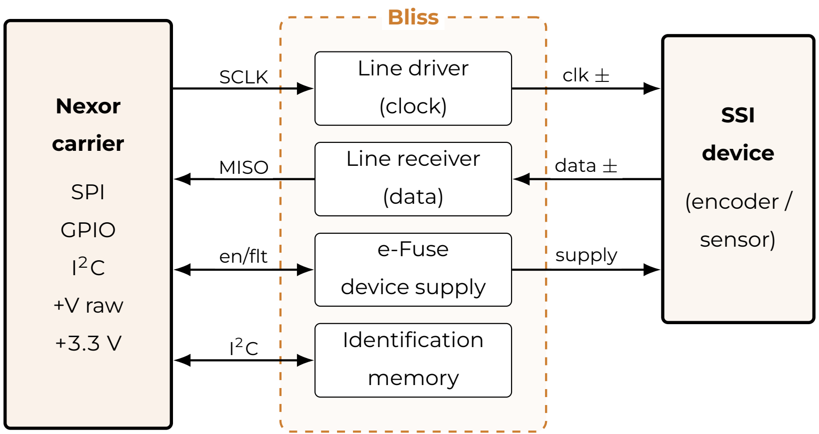

Figure 2: System block diagram. Bliss adapts the carrier SPI to the SSI device and powers it; the carrier reads and publishes the value on CAN.

FUNCTION	CARRIER RESOURCE	DESCRIPTION
SSI clock	SPI clock (SCLK)	Carrier clock, driven to the device as a differential RS-422 clock
SSI data	SPI data (MISO)	Device differential data received on board and returned to the carrier
Interface enables	$2\times$ GPIO	Enable / tri-state the clock driver and the data receiver
Sensor-supply control	GPIO	Turns the sensor supply on and off (e-Fuse enable)
Fault indication	GPIO	e-Fuse fault flag (over-current, over-temperature, reverse)
Board identification	Shared I^2C ID bus + site-select pad	Identification / configuration memory; address set by the mounting face
Power	Raw supply, +3.3 V, GND	Supplied by the carrier; the board does not use the +5 V rail

Table 4: Resources used on the carrier face

6. Communication and output data

Bliss runs no firmware of its own. The Nexor carrier acts as the SSI master: it generates the clock, shifts the SSI frame in over its SPI, applies the device configuration and publishes the result on the CAN bus. From the application side the node therefore appears as a source of the value measured by the connected SSI device, for example:

- **Absolute position or angle** from an SSI encoder
- **Displacement** from a linear SSI transducer
- **Any other quantity** provided by the SSI device

The SSI frame length, clock rate, coding (Gray or binary), the CAN identifiers, the message layout and the update rate are defined by the carrier firmware and its CAN protocol, not by this board; refer to the Nexor carrier and firmware documentation, and to the connected device datasheet, for the exact encoding. The carrier enables the sensor supply and the line interface, waits for the supply to be stable, and only then starts clocking. The supply ramps up in about 5 ms, to which the start-up time of the connected device must be added. The fault flag of the sensor supply is available to the carrier at all times for diagnostics; after an overload the supply stays off until the carrier cycles its enable line.

Because the data receiver is internally biased, a disconnected cable, a shorted pair or an unpowered device does not produce random data: the carrier reads a steady idle state and can report the device as absent rather than publishing a meaningless value.

7. Pin-out / Connections

The interface to the carrier is the castellated pad strip (no connector). The interface to the SSI device is a single 6-way field connector, Table 5: a 3.81 mm screwless terminal block with 45° cable entry, carrying the protected device supply, ground and the two RS-422 differential pairs. The connector is an optional, factory-fit part; on the standard build the field cable is terminated to the board pads. The clock pair is an *output* (carrier to device); the data pair is an *input* (device to carrier).

PIN	SIGNAL	DIRECTION	DESCRIPTION
1	V+ [1]	Power out	Protected device supply, passed through from the carrier
2	CLOCK+	Output	Differential SSI clock to the device (RS-422)
3	CLOCK–	Output	Differential SSI clock to the device (RS-422)
4	DATA+	Input	Differential SSI data from the device (RS-422)
5	DATA–	Input	Differential SSI data from the device (RS-422)
6	GND	Power return	Supply and signal return

Table 5: J1 – SSI field connector (6-way, 3.81 mm; optional / factory-fit)

[1] Passthrough of the carrier supply through the on-board e-Fuse; current-limited and switched on/off by the carrier. Match the clock / data pairs and their polarity to the connected device wiring.

8. Hardware

8.1 SSI line interface

The board carries two RS-422 / RS-485 line transceivers. One is used as a driver that takes the carrier single-ended SPI clock and drives it onto the SSI clock pair, so the carrier generates the SSI clock exactly as it would for an SPI device. The other is used as a receiver that takes the device differential data pair and presents it to the carrier as a single-ended SPI data line. Only the clock and data lines are needed; SSI has no chip-select or return channel. The transceivers run from the carrier 3.3 V rail and tolerate a −7 V to +12 V difference in ground potential between the node and the connected device, which is what makes long cable runs practical. The receiver resolves a ±200 mV differential signal and has 80 mV of hysteresis for noise rejection.

The receiver is internally biased so that its output stays high when the pair is open, shorted or simply not driven. A disconnected cable or an unpowered device therefore reads as a defined idle state rather than as noise, and no external bias resistors are needed on the field wiring.

8.2 Sensor supply and e-Fuse

A supply passthrough lets the device be powered from the carrier over the same field cable, removing the need for a separate supply at the sensor. Nothing is regulated on the board: the device receives the raw supply the node itself is fed with, so the connected device must accept the installation supply voltage.

The passthrough goes through an e-Fuse that provides a current limit set to about 200 mA on this board, protection against reverse polarity down to −60 V, a controlled 5 ms output ramp that limits inrush at turn-on, and surge and fast-transient withstand on the field side (IEC 61000-4-5 and IEC 61000-4-4). It also caps what the connected device can be exposed to: if the node supply rises above about 37.5 V, the stage holds its output at that level rather than passing the surge through to the field cable. On a sustained overload the supply is held at the current limit for up to 0.5 s and then latches off, asserting a fault flag to the carrier; it stays off until the carrier cycles the enable line, so a persistent short cannot be retried indefinitely. The carrier uses the same line to switch the device supply on and off in normal operation.

8.3 Field-line protection

The SSI clock and data pairs are protected at the connector by transient-voltage (TVS) diode arrays sized for RS-485 / RS-422 field lines, backed by the transceiver own $>$ ±15 kV ESD rating (±12 kV IEC 61000-4-2 contact discharge, ±4 kV IEC 61000-4-4 fast transients). Each line is filtered against common-mode noise and damped with a series resistor. The clock pair carries a fitted 120 Ω differential termination; the data pair has the same provision on the board, supplied unfitted, so termination can be placed at the device end instead. Together these let the board sit at the end of a long field cable in an electrically noisy environment.

8.4 Board identification

A small memory on the shared identification bus holds a board code, serial number and configuration data. Its bus address is set by the mounting face of the carrier, so a board on the TOP face and one on the BOTTOM face are distinguished even when two boards are fitted. At power-up the carrier reads this memory, recognises Bliss and loads the matching configuration for the connected SSI device.

8.5 Mounting

Bliss is soldered onto one face of the carrier through 16 castellated pads: two side columns of 6 at 2.27 mm pitch and a bottom row of 4 at 3.30 mm pitch. The board carries no connector to the carrier and no mounting holes of its own; it is held and supported by the solder joints to the carrier. The SSI field cable is brought out on the board field side.

9. Compliance and qualification

9.1 Component grade

Every component on Bliss is specified over the full -40 to +125 °C range. The identification memory and the field-line transient suppressors are AEC-Q100 qualified; the line transceivers and the sensor-supply protection stage are industrial-grade devices carrying the same extended temperature rating. This is what underpins the wide operating range and the suitability for harsh field environments.

9.2 Environmental compliance

The board is RoHS compliant and of lead-free construction. REACH/SVHC and full material declarations are available on request.

9.3 Assembly and handling

Bliss is soldered onto the Nexor carrier at Nexilica, with a lead-free reflow process (IPC/JEDEC J-STD-020), and is delivered as part of the assembled node: no soldering, mounting or rework is required on the user side.

The field wiring remains the exposed part of the node. The SSI lines carry enhanced ESD and surge protection, but normal ESD precautions still apply when handling the node, and the field cable should be wired with the device unpowered.

10. Use cases

Bliss turns a Nexor node into an SSI reader that also powers the connected device. The families below describe how it is typically used.

Absolute encoder readout. Read position or angle from an SSI rotary or linear absolute encoder and publish it on the CAN bus, with the encoder powered from the same node.

Linear and special transducers. Interface SSI-output transducers such as magnetostrictive linear sensors, draw-wire sensors and inclinometers.

Single-cable remote sensing. Place the sensor at the end of a long field cable and run only that cable back to the node, which supplies power and reads the data differentially.

Harsh environments. Operate where temperatures reach +125 °C and the field lines see electrical noise, ESD and surges.

Dual-function node. Combine Bliss with a second daughterboard on the other carrier face to build a single CAN node that exposes two functions.

11. Mechanical dimensions

Bliss is a 4-layer PCB measuring 26.00 × 28.00 mm, 1.6 mm thick, with castellated pads on three of its edges (two side columns of 6 at 2.27 mm pitch and a bottom row of 4 at 3.30 mm pitch) that are soldered onto one face of the Nexor carrier. The board carries no mounting holes; it is held and supported by the solder joints to the carrier, and the SSI field cable is brought out on the opposite edge. The dimensional drawing below details the overall outline, the castellated pad map and the field-connector location.

Image to be added

`bliss_mechanical.png`

Figure 3: Board outline, pad map and overall dimensions

12. Ordering information

Bliss is supplied already soldered onto a Nexor carrier, as a ready-to-use node; it is not sold as a loose board for customer assembly. The single configuration described in this datasheet is supplied without the field connector fitted; contact Nexilica for the connector-fit option.

PRODUCT	ORDER CODE	DESCRIPTION
Bliss	NXL-BLISS-10A (1)	SSI sensor interface daughterboard, revision 1.0a, factory-mounted on the Nexor carrier

Table 6: Ordering information

(1) Preliminary order code, subject to confirmation. Contact Nexilica for availability and quantities.

Revision history

DATE	REVISION	CHANGES
2026-07	1.0a (preliminary)	First preliminary release. Electrical and interface data verified against the fitted components; mechanical drawings, board images and ordering details to be finalised.

Table 7: Revision history