The open-source BiSS Interface (Bi
directional/Serial/Synchronous) protocol implements a realtime interface. BiSS enables a digital, serial and secure communication between controller, sensor and actuator. The BiSS protocol is used on the lower sensor/actuator communication level in industrial applications (e.g. motor feedback, robotics) which require high-speed data transfer rates, safety, flexibility and a minimized implementation effort. In addition to its technical advantages, two conditions have established the current global standard: free BiSS license for applications and the stability and continuity of the protocol since its introduction.

BiSS follows the industrial trend of fully digital communication and increasing functional capabilities. It enables point-to-point topologies that are hardware compatible to the industrial standard SSI (Serial Synchronous Interface) and offers advanced features:

Minimum two unidirectional lines (clock and data) enable:

- Cyclic high-speed data transmission (up to 10 MHz with RS422)
- Line delay compensation for high-speed data transfer on long transmission lines
- Consideration of sensor processing times for data generation
- Safety capability: CRC, Errors, Warnings
- Daisy-chaining of multiple sensors within one slave device
- Register communication with slave, e.g. for sensor configuration and calibration

Actuator data transmission and bus compatibility (daisy-chaining of several BiSS slave devices) can be enabled with an additional data line MO (master to slave).

**BiSS SYSTEM STRUCTURE**

A typical setup of a BiSS system with a BiSS master (e.g. drive/PLC) and BiSS slave (e.g. encoder/sensor) is shown in Figure 1. The position data is sent over a single cable from BiSS slave on the right to the BiSS master on the left. Besides power supply lines, two lines for differential clock signal transmission from BiSS master to slave and two lines for differential data transmission from BiSS slave to master are used to enable a robust and safe communication with RS422.
Latch Point
Sensor data is simultaneously captured for all slaves in the daisy chain.

Line Delay Compensation
The BiSS master measures and compensates the total line delay in every frame. The line delay is measured from 2nd rising clock edge (MA) to falling data line edge (SL) and takes aging and temperature effects into account.

Slave Processing Time
In a point-to-point topology the slave delays the Start bit, if it requires time to prepare and provide its sensor data.

Data Channel
Sensor and actuator data are transmitted as part of a data channel. Each data channel is defined by its communication parameters, e.g. transmission direction (sensor or actuator data), data length (0...64 bit), CRC polynomial. The BiSS master is configured accordingly to ensure proper communication.

Control Communication
BiSS enables a bidirectional control communication via its unidirectional clock (MA) and data line (SL). In each frame the master sends one control data bit to the slave (CDM) and the slave responds accordingly (CDS). This in-band protocol can be used to perform register accesses to the slave without interrupting sensor data transfer. For example, it enables reading a sensor’s electronic datasheet, its temperature register or sensor calibration.

Timeout
Each BiSS frame is terminated by the slave's timeout (stretching 0 at the end of the frame). The timeout is either a constant period (typically about 20µs) or depends on the clock frequency applied to MA (adaptive timeout). With the adaptive timeout, the timeout period is reduced at high frequencies.

BiSS COMMUNICATION PROFILES

Standardized communication profiles are defined for different applications, e.g. rotary encoders transmit angle position words as shown in Figure 3. The position word may contain the number of full mechanical revolutions (MT: multturn information) and angle information within one mechanical revolution (ST: singleturn information). Validity of the position word can be indicated to the BiSS master with an error (nE) and warning bit (nW). Position, error and warning bit are protected against transmission errors with a standard 6-bit CRC.
BiSS DEVICE IDENTIFICATION

Control communication enables a BiSS master to access the slave’s memory. Typically, the sensor/actuator manufacturer stores product specific data, e.g. a manufacturer ID, device ID, serial number and a standardized electronic datasheet (EDS) in the slave’s non-volatile memory (e.g. EEPROM). The EDS contains all required parameters to successfully establish BiSS communication between master and slave and additionally provides application specific parameters. On power-up the BiSS master can then automatically read the EDS and configure itself accordingly.

BISS CERTIFIED

In order to verify interoperability of BiSS products, the user organization BiSS Association e.V. has introduced a certification service. The service includes thorough verification of BiSS features and precise documentation of measurements and results in a report. Compliant BiSS devices are labeled as BiSS Certified.

BISS SAFETY

Safety-critical applications can now be fully covered by BiSS Safety. BiSS Safety is a profile definition for BiSS Interface that has been certified by TÜV Rheinland. It follows in extracts the requirements stated in DIN EN 61784-3:2011 and can be used in safety applications up to SIL3 according to IEC61508:2010.

BISS LINE

BiSS Line is a one-cable technology based on BiSS Interface and enables a robust power and data transmission over just two or four wires. BiSS Line is fully compatible to BiSS Interface and all of its features but maps the communication on a multi-slave capable RS485 half duplex line. BiSS Line uses a forward error correction (FEC). Sensor data that has been corrupted during transmission is corrected to increase availability.

BISS ASSOCIATION e.V.

The BiSS Association e.V. operates as an exchange platform concerning BiSS Interface, products and solutions. Members have access to the community, share their industrial knowledge and experiences and corporately develop protocol features. At www.biss-interface.com BiSS Interface products and services including ICs, encoders, drives, modules and tools are presented by members and licensees.