1 INTRODUCTION

This specification covers the requirements for digital communication with inclination sensor modules from the AXISENSE-Series equipped with an USB interface. This series is mainly developed with focus on platform leveling, dynamic engine management, tip-over protection and tilt alarm.

When corresponding with personnel, use the terminology provided in this specification to facilitate inquiries for information.

2 REFERENCE MATERIAL

2.1 Revision Summary

Revisions to this application specification include:

- Remove obsolete sections
- Format updates

2.2 Customer Assistance

Reference Product Type can be found on the label of the sensor starting with "*AXISENSE*" (resp. "*G-NSDOG*" for backward compatibility).
Use of this name will identify the product type and help you to obtain product information.
Such information can be obtained through a local Representative, by visiting our Website at www.te.com, or by calling PRODUCT INFORMATION at the numbers at the bottom of page 1.

2.3 Drawings

Customer Drawings for product part numbers are available from the service network. If there is a conflict between the information contained in the Customer Drawings and this specification or with any other technical documentation supplied, the information contained in the Customer Drawings takes priority.

2.4 Specifications

Reference documents which pertain to the products are available via www.te.com or your personal point of contact at TE Connectivity.

3 REQUIREMENTS

As configured as "listener", the sensor is waiting for requests/commands (see below) from the host. Each command (10 Bytes) is replied to by the sensor. A checksum is included to detect communication errors and make the communication safe. It is up to the customer to decide whether the checksum is interpreted or not. For requests sent to the sensor, the checksum must always be included as it is checked by the inclinometer.

3.1 Interface Parameter

Baud rates:	57.6 kBaud, 256 kBaud (baud rate is depending on the sensor type)
Settings:	8 data bits, 1 stop bit, no parity

3.2 The Protocol

The protocol uses a fix number of 10 bytes for both, read and write options. In the following the hexadecimal data format is used to describe the commands and sensor data. For example, a 0x01 is equivalent to send a decimal 1 to the sensor and a 0x40 is equivalent to the decimal 64 (=ASCII code for '@').
To summarize the previous section, a binary transfer is used for high efficiency and reduction of communication traffic. Each data block transferred has 10 bytes.

Additionally, a synchronization of the sensor is possible. If, for example, the sensor receives less than 10 bytes, no reply will be sent. In this case, the master should send single (arbitrary) bytes until the inclinometer replies with a 10-byte error frame. However, if there is no error in terms of missing or additional bytes, there is no need to synchronize the sensor. Anyway, we strongly suggest including a simple timeout feature for the host application that starts synchronization if the sensor does not respond for some 10 ms after a command/request has been sent. This gives additional safety and ensures immediate re-connection in case of an accidental power down or short-term connection interrupts (defective cable/connector).

This is an overview of available commands, with byte value in hexadecimal notation:

Sensor connection:

Write:

0x01	0x40	0x00	0x10	0x00	0x00	0x00	0x00	0x00	0xAF

Read:

0x01	0x43	0x00	0x10	0x00	0x9A	0x01	0x2A	0x23	0xC4

Can be used to test the connection. The replied frame contains the device identifier.

Serial number readout:

Write:

0x01	0x40	0x18	0x10	0x04	0x00	0x00	0x00	0x00	0x93

Read:

0x01	0x43	0x18	0x10	0x04	Byte0	Byte1	Byte2	Byte3	CHK

Serial number (Byte3 Byte2 Byte1 Byte0) is presented in hexadecimal notation.

X-tilt readout:

Write:

0x01	0x40	0x10	0x60	0x00	0x00	0x00	0x00	0x00	0x4F

Read:

0x01	0x43	0x10	0x60	0x00	LSB			MSB	CHK

Y-tilt readout:

Write:

0x01	0x40	0x20	0x60	0x00	0x00	0x00	0x00	0x00	0x3F

Read:

0x01	0x43	0x20	0x60	0x00	LSB			MSB	CHK

X-Offset readout:

Write:

0x01	0x40	0x14	0x60	0x00	0x00	0x00	0x00	0x00	0x4B

Read:

0x01	0x43	0x14	0x60	0x00	LSB			MSB	CHK

X-Offset setting to currently value -> the current X-Angle will become 0°:

Write:

0x01	0x23	0x14	0x60	0x00	0x10	0x60	0x00	0x00	0xF8

Read:

0x01	0x60	0x14	0x60	0x00	0x10	0x60	0x00	0x00	0xBB

X-Offset re-setting to manufacture value (use the factory 0° setting):

Write:

0x01	0x23	0x14	0x60	0x00	0x00	0x00	0x00	0x00	0x68

Read:

0x01	0x60	0x14	0x60	0x00	0x00	0x00	0x00	0x00	0x2B

Y-Offset readout:

Write:

0x01	0x40	0x24	0x60	0x00	0x00	0x00	0x00	0x00	0x3B

Read:

0x01	0x43	0x24	0x60	0x00	LSB			MSB	CHK

Y-Offset setting to currently value -> the current Y-Angle will become 0°:

Write:

0x01	0x23	0x24	0x60	0x00	0x20	0x60	0x00	0x00	0xD8

Read:

0x01	0x60	0x24	0x60	0x00	0x20	0x60	0x00	0x00	0x9B

Y-Offset re-setting to manufacture value (use the factory 0° setting):

Write:

0x01	0x23	0x24	0x60	0x00	0x00	0x00	0x00	0x00	0x58

Read:

0x01	0x60	0x24	0x60	0x00	0x00	0x00	0x00	0x00	0x1B

Microcontroller temperature (for surveillance only):

Write:

0x01	0x40	0x06	0x20	0x00	0x00	0x00	0x00	0x00	0x99

Read:

0x01	0x43	0x06	0x20	0x00	LSB			MSB	CHK

Any angle is given in millidegree (m° = 1/1000 degree) and the temperature is given in millidegree Celsius (m°C = 1/1000 °C). For the communication frame, a “signed long” data type in so called “little endian” format is used. This means, any angle or temperature value is splitted into 4 bytes, starting with the least significant byte and ending with the most significant byte.

Typically, the signed long numbers are represented by a two’s complement. In case the received bytes are just copied to the corresponding positions of a variable in the host memory (LSB to LSB ... MSB to MSB), the user does not need to care about representation of numbers. After copying the 4 bytes, the variable holds the current value including the sign.