INSTRUCTION MANUAL

SIRRAH Sensor

DTNO075-1.2

Revision

Revision Number	Date	Description	§ Modified
1.0	01/07/2008	Creation	All
1.1	05/01/2009	Profibus mapping modification	§10.1.3, §10.2.4
1.2	02/07/2009	Update for Sirrah TS11 (working with passive beacon) New command to get system identification in serial mode only	§1.1, §1.2.1, §5.3.1, §9.1, §9.4, §11

Table of Contents

List of illustrations

List of tables

1 OVERVIEW

1.1 PRODUCT PRESENTATION

SIRRAH LS / TS is a contactless instrument for angular positions, for one or several integrated beacons located in its sighting field. It is especially intended for use on stacking crane in harbour.

LS08 a well suited sensor for a full automated stacking crane as well as for bridge cranes. Its working range, its angle of view and its price make it suitable for such a crane.

TS19 / TS20 is dedicated to quay cranes with a working range up to 60 meters with high accuracy.

TS11 is dedicated for inside cranes and can work with active or passive beacon.

The Sirrah is a smart sensor. It collects the information on the position sensor and calculates the angular speed depending on the angles theta and phi.

Using coded BEACONS, that insures the reliability of the position information of up to three beacons in the field of the sensor.

- Speed: ***Up to 200 measures/second***
- Resolution: ***1/1000 of degree***

The angular position information and the angular speed are available with a RS232 or RS422 serial link or on Profibus network.

SIRRAH can be connected to a PC with specific software for testing or to a PLC with a protocol defined in chapter **9** & **10** depending on the communication type.

It is possible to change the parameters of the operating system in order to make it fit to the measuring conditions.

This documentation has to be entirely read before any using of the material.

1.1.1 Beacon description

Our Sirrah product family can work with two king of beacons:

- 1 Sirrah sensor in relation with up to three active beacons in its visual field.
- 1 Sirrah sensor in relation with only one passive beacon.

An active beacon is composed with IR led facet and an electronic board wich send infrared pulse towards the sirrah sensor. Thanks to this configuration, the sirrah sensor works with a high working distance and with a high accuracy.

A passive beacon is composed with one or more optical reflector. The infrared pulse is send directly by the sirrah sensor. The IR light is reflected on the beacon and sends back to the sirrah sensor. This working principle gives to our customers a lower price. Passive beacon are dedicated to work with TS11 Sirrah sensor.

1.2 MATERIAL DESCRIPTION

1.2.1 Furniture's details

- ✓ 1 sensor SIRRAH reference **LSxx**, **TSxx** (See Products references).
- ✓ 1 power supply cable: **220VAC** or **120VAC** or **24VDC** (See Products references).
- ✓ 1 communication cable for the calculator: **RS422** or **RS232** or **Profibus** (See Products references).
- ✓ 1 optical reflector 10 x 10cm for TS11 reference

When SI sensor equipment is ordered, all the furniture above are integrated in the BO25 housing.

1.2.2 Description of the sensor

Sensor is presented in a waterproof enclosure which enables the outside and inside use. The sighting axis is perpendicular to the front window, the fixation is insured by three feet under the case; these three points enable to define the reference plan of the sensor.

Connectors on the rear side of the sensor allow transmitting the information by the serial link, to plug in the electrical supply. The sensor is constituted of an optical part: cell, lens, filter, and of an electrical part: filtering, amplification, conversion, computing.

2 WARNING

2.1 SAFETY USE

The product is delivered with waterproof connectors. In order to guarantee the sensor tightness, the male connector MUST be placed if the sensor is disconnected in order to protect against the rain and storm..

The violation of this rule can induce irreversible damages for the sensor (mist on the internal side of the protection window) or electrical short circuit.

2.2 CARES OF INSTALLATION

2.2.1 Protection of the equipment outside

For outside uses the TS or LS cannot be used. Only the SI version, including the protective housing BO25 reference, is recommended.

This protection has three reasons:

- ✓ Protect the equipment from the pelting rain,
- ✓ Protect the equipment from the direct sun in strong sunny period,
- ✓ Avoid the water projection on the sensor window.

3 FIRST STARTUP

After having unpacked the material and verified, that there are no visible damages due to the transport, the unit can be started up.

The links between the different elements of the system are described in chapter “**Physical dimensions**”.

3.1 CONNECTORS

There are two connectors on the rear side of the SIRRAH, one for the electrical supply, the other for serial link.

3.2 STARTUP

- ✓ Connect the sensor to the computer (see chapter “**Visualizing LEDs in front of BO25**”)
- ✓ Connect the sector cable and verify the associated voltage.
- ✓ Place the beacon in the sensor field.
- ✓ Execute the SIRRAH piloting commands (see “**Testing software quick start**”)

3.3 STABILISATION TIME

A temperature stabilisation time of about 5 minutes is necessary to obtain high quality measurements. This is almost sensitive on position ‘zero’ of the sensor.

4 GEOMETRY OF THE MEASURING SYSTEM AND CALCULATION METHOD

4.1 ANGLES MEASURED BY THE SIRRAH

SIRRAH sensor enables to sight both angles on one or several infrared beacons.

The appendix III shows the measured angles in relation to the sensor box. With the sensor is associated an orthogonal reference mark (O, x, y, z) which centre (O) is called optic centre of the objective.

The axis (O,x) is the optical axis of the sensor . A beacon, which transmitting centre is located on this axis will be sighted at the following angular positions (theta = 0 and phi = 0).

The plan (x,O,y) is parallel to the fixation plan of the sensor.

The angle theta is measured in the plan (x,O,y), it is the angle obtained between the orthogonal projection on (x,O,y) of OE and the axis (O,x), E represents the beacon transmitting centre.

The angle Phi is measured in the plan (x,O,z), it is the angle obtained between the orthogonal projection on (x,O,z) of OE and the axis (O,x), E represents the beacon transmitting centre.

The angles Theta and Phi are signed and measured positively, as shown on drawing below.

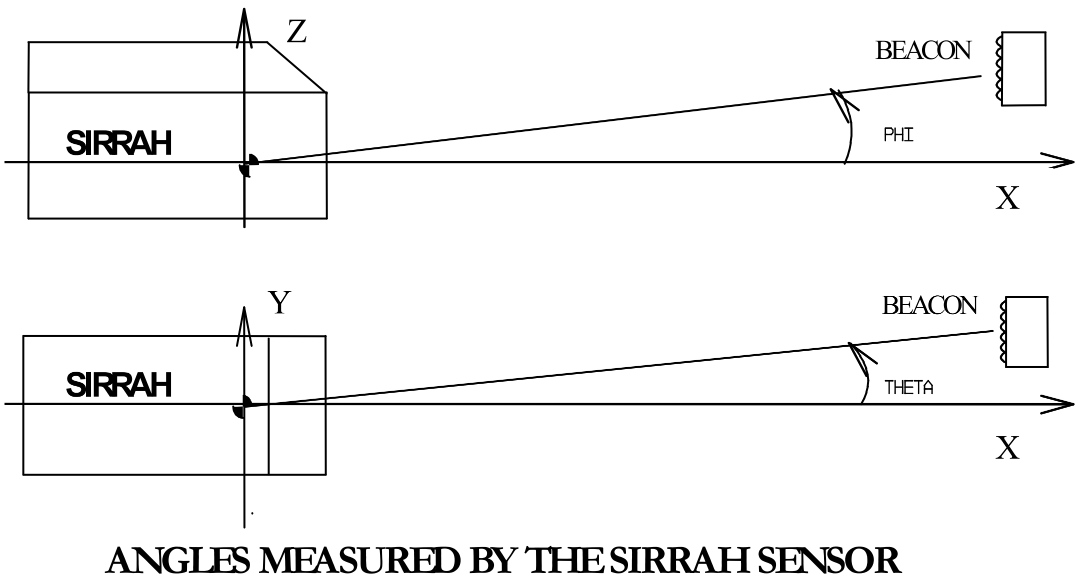


Figure 1: Angles measured by SIRRAH Sensor

4.2 AVERAGE MEASUREMENT AND TIME TRANSMISSION

SIRRAH averages the measurements on a number which is defined by the user (MM order).
(Example : MM4 gives a result which is an average of 4 basic measurements).
SIRRAH gives the results accordingly to a timing defined by the user (EC order).

This timing is given in a multiple of the basic time and is independent of the averaging.
(Example : EC10 gives a result to the computer every 10 measurements).

Note : Value of basic time gap : 5ms in mode 1 (one beacon), 15ms in mode 6 (2 beacons), 20ms in mode 7 (3 beacons).

Examples of standard working orders with one beacon :
PC1A and MM8 and EC4; the cycle time is 20 msec
PC1A and MM4 and EC2; the cycle time is 10 msec

Examples of standard working orders with two beacons :
PC6A and MM6 and EC3; the cycle time is 45 msec
PC6A and MM2 and EC1; the cycle time is 15 msec

Examples of standard working orders with three beacons :
PC7A and MM4 and EC2; the cycle time is 40 msec
PC7A and MM2 and EC1; the cycle time is 20 msec

4.3 ANGULAR SPEED CALCULATED BY SIRRAH

SIRRAH sensor calculates the speed accordingly to Theta and Phi angles.

$$THETA' = \frac{\text{delta (THETA)}}{\text{delta (TIME)}} \quad \text{and} \quad PHI' = \frac{\text{delta (PHI)}}{\text{delta (TIME)}}$$

The time base used for the delta (TIME) measure is the internal clock of the sensor realised by a hardware dating (1 microsecond of resolution).

Speeds are calculated as follow : the delta (ANGLE) is the difference between two angle's measures (optionally averaged) and the delta (TIME) is the date difference between those two measures.

The delta (TIME) depends on the beacon time base; it can be modified by the command "EV" which defines the time gap between two measures for calculation.

Example: the beacon recurrence is 5 ms, EV = 10, the delta (TIME) is about 50 ms.

Principle :
The measures (averaged or not) are stored in a table, the first and last measures is EV times the beacon recurrence, so the speed can be calculated when the number of registered values reaches EV and both measures are valid. So the speeds calculation is made at each measures transmission.

$$Speed = \frac{\text{final angle - initial angle}}{\text{finale date - initial date}}$$

Speed is not valid when the table is not initialised or when one of both measures is incorrect.

Note : To have a good stable and predict speed, the angle measures have to be stable (average on 10 measures for example) and the delta (TIME) relatively long.

The angular speeds are given in 1/1000e of degrees per second and the value is signed.

4.4 DISTANCE MEASURED BY SIRRAH

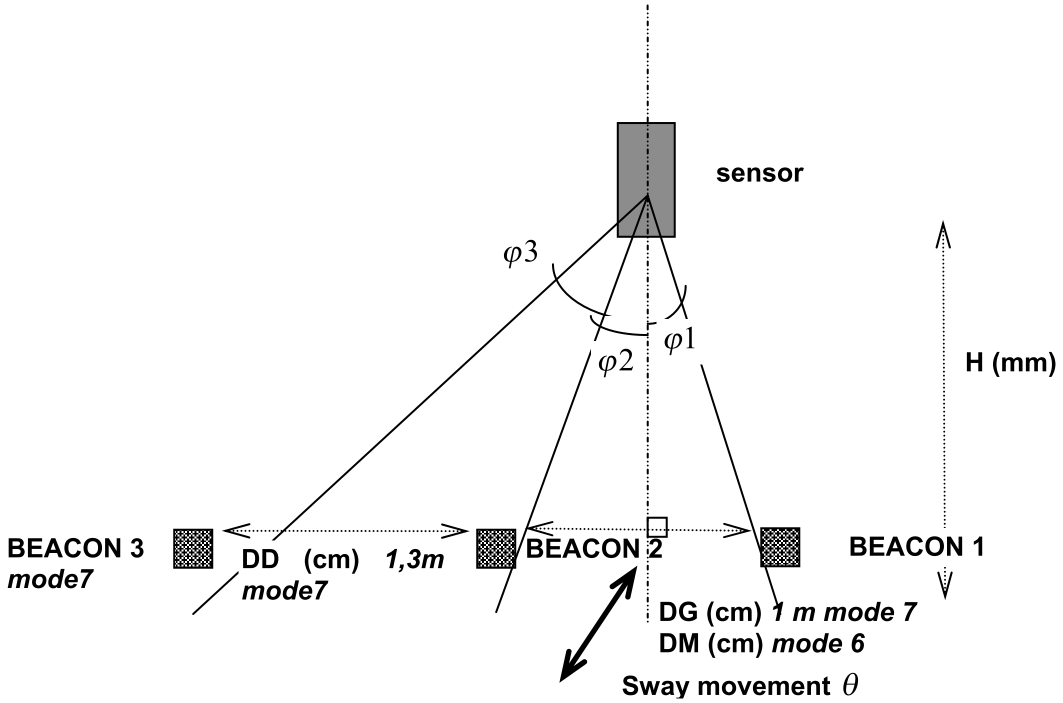
SIRRAH sensor includes the distance computing function between the sensor and two beacons in mode 6, or between the sensor and three beacons in mode 7.

The gap between the beacons is given to the software (command DM mode 6; command DG for beacon gap between 1 and 2 in mode 7, command DD for beacon gap between 2 et 3 in mode 7).
The distance computed is based upon the PHI angles of each beacon, and the result is expressed in millimeters.

Distance : Value of distance measurement from sensor to beacons expressed in millimetres, according to the value of distance separating the beacons B1 B2 (Dmxxx in cm, in mode 6); or between B1 B2 (DGxxx in cm) and B2 B3 (DDxxx in cm) in mode 7.
The distance calculation is only be done by using one direction angle : the angle in the opposite side of the sway movement.The distance is measured from the optical centre of the sensor to the front face of the beacons.

- Notes for distance calculation

SIRRAH is set perpendicular between Beacon1 and Beacon 2 (in their middle in mode 6).
Beacon B2 is the centre beacon in mode7.



4.5 MEASURING FIELD OF THE SENSOR

The beacon is visible inside a cone which revolution axis is the optical axis, and the top is the optical centre. Refer to chapter "**Characteristics**" for angle visual field.

5 USING CONDITIONS

5.1 RELATIVE POSITION OF THE ELEMENTS

- Distance between sensor and beacon :

It depends on the types of beacons used. Refer to chapter “**Characteristics**” for maximum distance depending on sensor reference. This maximum range includes a guaranty against beacon power decrease due to rain, fog or after a long life use of beacon.

Minimum distance: under a minimum distance between beacon and sensor, the sensor will deliver “saturation” message witch means it is receiving too much light from the beacon.

- Distance between sensor and computer :

It is possible to connect a PLC or an external computer on the serial link. The maximum distance between sensor and computer depends on the used cable specifications and environment.

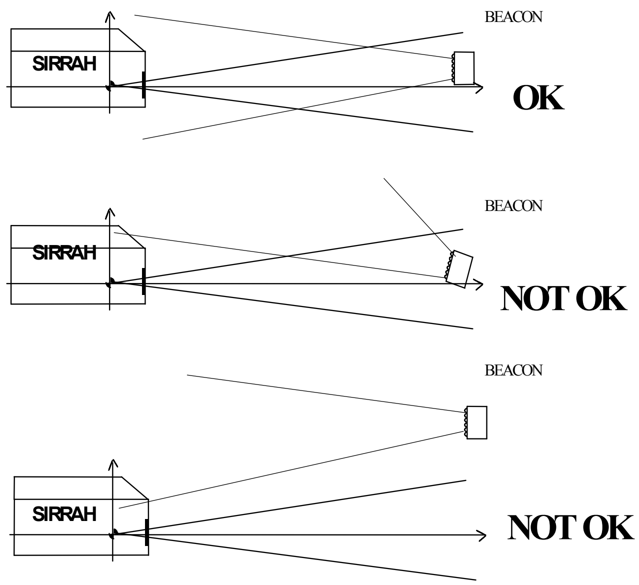
For long distances or if the cable goes near powerful electrical engines, it is better to use shielded cables with low line resistance. The maximum allowable distance at 9 600 bauds RS422 is a few hundred meters.

- Relative position of the sensor and beacon :

The beacon has to be placed in the reception cone of the sensor, as above described. The beacon has also to be oriented to the sensor actually; the beacon transmits an infrared signal in a directional way.

According to the used type of beacon, the emitting cone can have the following values: (+/-3°, +/-10°, +/-25°). The type beacon has to be chosen to transmit infrared always in the sensor direction for all the positions the beacon can take.

The following drawing explains the good orientation of the beacon.



BEACON POSITION TOWARDS THE SENSOR

Figure 2: Beacon position

5.2 DISTURBANCES DUE TO ENVIRONMENT

- Weather influence

The sensor operates without damages outside. Except if the rain is particularly heavy (storm), it doesn't affect the SIRRAH operating, it can however decrease the measures stability.
The snow can create some occultation of the beacon, and induce the invisibility code emission in an intermittent way. The few heat of the beacon will however dissolve the snow slowly.
The sun, or any other very intense infrared heat source, if it is directly in the measurement field of SIRRAH, can saturate the sensor, which causes an impossibility of measurement and a saturation code transmission by the SIRRAH. Used on container crane, with the sensor oriented to the ground, there is no risk of troubles with the sun.

- Obstacles

Generally speaking, obstacles have not to be located in the sensor field, it means in an angle equal to the double of the measuring cone.
In extreme situations, it can give wrong measures by the SIRRAH.

5.3 DESCRIPTION OF THE OPERATING MODES

5.3.1 Mode 1 Monobeacon

An external beacon transmits pulses with a time base of constant period of 5ms; when a pulse happens, it has to be checked that it is included in a temporal window.

Due to the power modulated beacon, the beacon transmits different energies and the sensor chooses the best energy.

Once the sensor has received a valid pulse, it calculates the position and the sensor's non linearity correction. This compensation is done by reading bi-dimensional tables giving the gauging coefficients of the concerned sensor and by an area type interpolation of these values.

Once the measure made, a new message is sent on the serial link with the measure result.

The same working mode is obtained with passive or active beacon.

5.3.2 Mode 6 multibeacon 1/2

An external beacon transmits temporally coded pulses. When a pulse is arriving, the time window has to be controlled and the code is determined. Two beacons can be seen in the sensor field.

The temporal repartition of the pulses enables the code identification of each beacon, 3 base periods are needed to enable the reading of codes, it means: 15 msec.

A message with the measuring result and the beacon identification is sent.

5.3.3 Mode 7 multibeacon 1/3

An external beacon transmits temporally coded pulses. When a pulse is arriving, the time window has to be controlled and the code is determined. Three beacons can be seen in the sensor field.

The temporal repartition of the pulses enables the code identification of each beacon, 4 base periods are needed to enable the reading of codes, it means: 20 msec.

A message with the measuring result and the beacon identification is sent.

6 VISUALIZING LEDS IN FRONT OF BO25

When using SIRRAH sensor with a BO25, two LEDs indicate the sensor status:

<table>
<tr><th></th><th>SIRRAH with BO25</th><th>Status of the RED led</th><th>Status of the GREEN led</th><th>notes</th><th>sequences of flickering</th></tr>
<tr><td rowspan="4">SIRRAH and BO25, without computer, serial connector physically disconnected</td><td>Power off</td><td>off</td><td>off</td><td></td><td>1</td></tr>
<tr><td rowspan="3">Power on</td><td>Red led flickers 2 times</td><td></td><td></td><td>2</td></tr>
<tr><td></td><td>After, green led flickers 2 times</td><td></td><td>3</td></tr>
<tr><td>on</td><td></td><td></td><td>4</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td rowspan="4">SIRRAH and BO25, with equipment connected (RS232 or RS422), with no communication</td><td>Power off</td><td>off</td><td>off</td><td></td><td>5</td></tr>
<tr><td rowspan="3">Power on</td><td>Red led flickers 2 times</td><td></td><td></td><td>6</td></tr>
<tr><td></td><td>After green led flickers 2 times</td><td></td><td>7</td></tr>
<tr><td>Red led remain on</td><td></td><td></td><td>8</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td rowspan="2">SIRRAH and BO25, with equipment connected (RS232 or RS422) and communication, mode1, mode6, mode7</td><td>When SIRRAH is receiving</td><td>Red led flickers</td><td></td><td>Computer transmits</td><td>9</td></tr>
<tr><td>When SIRRAH is emitting</td><td></td><td>green led flickers</td><td>Computer receives</td><td>10</td></tr>
</table>

Table 1: SIRRAH SI status

7 CONNECTING SIRRAH TS / LS

7.1 220VAC / 110VAC POWER SUPPLY

For SIRRAH standard power supply (220VAC or 110VAC), connect the cable (SCB4 or SCB5) to the power source as indicate in the table below:

Cable colour	Description
Brown	Phase of power source
Blue	Neutral of power source
Green/Yellow	Earth

Table 2: 220VAC / 110VAC power supply connection

7.2 24VDC POWER SUPPLY

For SIRRAH 24VDC, connect the cable (SCB6) to the power source as indicate in the table below:

Cable colour	Description
Brown	+24V
Blue	Neutral (0V)
Green/Yellow	GND (Earth)

Table 3: 24VDC power supply connection

7.3 RS232 SERIAL LINK

When using SIRRAH with a RS232 serial link, connect the RS232 cable (SCB14) to the sensor and connect your equipment as indicated in the table below:

Signal name	Description
RX	SIRRAH receive line
TX	SIRRAH transmit line
Ground	SIRRAH circuit ground

Table 4: RS232 communication cable

7.4 RS422 SERIAL LINK

When using SIRRAH with a RS422 serial link, connect the RS422 cable (SCB13) to the sensor and connect your equipment as indicated in the table below:

Signal name	Description
RX1	SIRRAH negative receive line
RX2	SIRRAH positive receive line
TX1	SIRRAH negative transmit line
TX2	SIRRAH positive transmit line
Ground	SIRRAH circuit ground

Table 5: RS422 communication cable

7.5 PROFIBUS NETWORK

When using SIRRAH on a profibus network, connect the profibus cable (SCB15) to the sensor and connect your equipment as indicated in the table below:

Signal name	Description
+5V	+5V Bus (Output, Isolated, 100mA max)
A	Profibus A line
B	Profibus B line
GND	GND Bus (Isolated)
Shield	Shield

Table 6: Profibus communication cable

8 CONNECTING SIRRAH WITH BO25

8.1 RS232 SERIAL LINK

- ✓ Open the connection box (5) with the four-quarter turn screws.
- ✓ Put the cables into the rubber rings.
- ✓ Connect the 3 wires for power supply (Phase, neutral and ground)
- ✓ Connect the 2 wires (RX and TX) to your equipment.
- ✓ Close the connection box (5) with the four-quarter turn screws.
- ✓ Link a ground terminal to the screw of the hook (113)

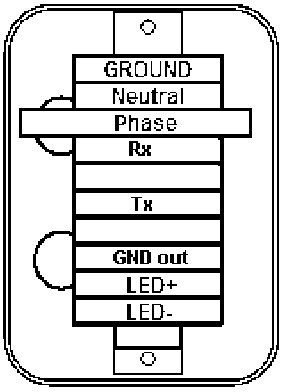


Figure 3: SIRRAH RS232 connection with BO25

8.2 RS422 SERIAL LINK

- ✓ Open the connection box (5) with the four-quarter turn screws.
- ✓ Put the cables into the rubber rings.
- ✓ Connect the 3 wires for power supply (Phase, neutral and ground)
- ✓ Connect the 4 wires (RX1, RX2, TX1 and TX2) to your equipment.
  - RX1: Sirrah RX-
  - RX2: Sirrah RX+
  - TX1: Sirrah TX-
  - TX2: Sirrah TX+
- ✓ Close the connection box (5) with the four-quarter turn screws.
- ✓ Link a ground terminal to the screw of the hook (113)

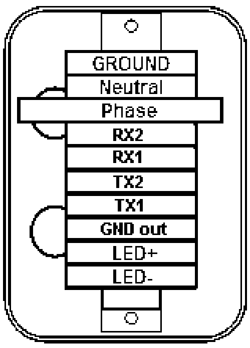


Figure 4: SIRRAH RS422 connection with BO25

8.3 PROFIBUS NETWORK

Sensor is not at the end of the bus

- ✓ Open the connection box (5) with the four-quarter turn screws.
- ✓ Put the cables into the rubber rings.
- ✓ Connect the 3 wires for power supply (Phase, neutral and ground)
- ✓ Connect the 2 wires of your twisted pair to A and B. Connect the shield of the profibus cable to the SHIELD terminal
- ✓ The connections +5V OUT and GND OUT are outputs of the sensor. When the Sirrah is not the end node, these outputs should be left unused.
- ✓ Wire the relay support as indicated.
- ✓ Close the connection box (5) with the four-quarter turn screws.
- ✓ Link a ground terminal to the screw of the hook (113)

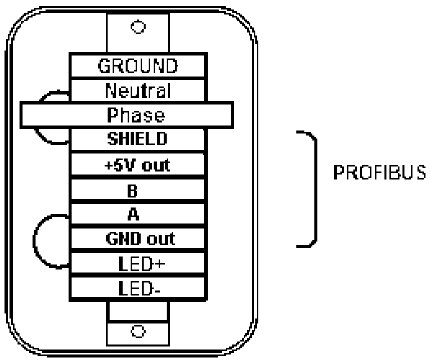


Figure 5: SIRRAH not at the end of the profibus

Sensor at the end of the bus

When Sirrah is the END NODE of the bus, the +5V OUT and GND OUT outputs should be connected to A and B with termination resistors. The schematic of these connections is just below:

- ✓ R1 = 220 Ohms
- ✓ R2 = 390 Ohms

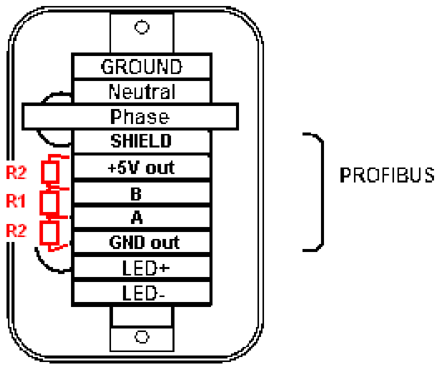


Figure 6: SIRRAH at the end of the profibus

9 SIRRAH OPERATING ON RS232/RS422 SERIAL LINK

9.1 AVAILABLE COMMANDS

- ✓ PCxy define the operating mode of the sensor.
- ✓ EVxxx gap for the speed calculation
- ✓ ECxxx gap between sending of xxx measures
- ✓ MMxxx average on xxx measures
- ✓ ST measure stop
- ✓ RT reset
- ✓ ID Identification of the Sirrah sensor

Operating:

PCxy: defines the operating mode with the external computer and start the measure sequence.
x = 1 defines the mode 1 (1 beacon)
x = 6 defines the mode 6 (2 beacons)
x = 7 defines the mode 7 (3 beacons)
The others values of x are forbidden.

The following y values are dedicated to sirrah application with active beacons:
y = V indicates a functioning with a speed calculation,
y = A indicates a functioning with angular measurement only,
y = C indicates a functioning with angle + speed + distance (reserved mode 6 or 7),
y = D indicates a functioning with angle + distance (reserved mode 6 or 7);

The following y values are dedicated to sirrah application with passive beacons:
y = P indicates a functioning with a speed calculation,
y = B indicates a functioning with angular measurement only,
The other values of y are forbidden.

X means allowed

Mode / Option	1	6	7
A	X	X	X
C		X	X
D		X	X
V	X	X	X
B	X		
P	X		

Table 7: Operating mode

This command will be taken into account after a Power Off / Power On of the sensor.

EVxxx: Defines the number of elementary periods for the angular speed calculation. In mode 1, the elementary period is 5 ms, for example: EV = 10 integrate the speed on 50 ms.
(1 ≤ xxx ≤ 50). After power up or RT command, the sensor value is set to EV1.

ECxxx: Defines the number of elementary periods between data are refreshed in the Write Process Data zone of the Profibus device computer. In mode 1, one measure corresponds to the 5 ms period, for example EC=10 send results every 50 ms.
(1 ≤ xxx ≤ 255). After power up or RT command the sensor value is set to EC1.

MMxxx: Defines the number of measures used to calculate average value, and so the elementary period on which it is averaged.

(1 ≤ xxx ≤ 255, idem Ecxxx). After power up or RT command the sensor value is set to MM4.

DMxxx : Define the distance (in cm) between two beacons in mode 6, in distance meter mode. (10 ≤ xxx ≤ 999), Default is DM10.

DGxxx : Define the distance (in cm) between the two beacons 1 and 2 in mode 7, in distance meter mode.(10 ≤ xxx ≤ 999), Default is DG10.

DDxxx : Define the distance (in cm) between the two beacons 2 and 3 in mode 7, in distance meter mode.(10 ≤ xxx ≤ 999), Default is DD10.

ST: Measures stop. The rerun happens with the command ECxxx.

RT: Resets the software. The parameters above have to be programmed again.

ID: Ask for Sirrah sensor identification. This command is only available when the sensor is not measuring (after the RT command). The returned frame is detailed in the chapter §9.4.

9.2 USE RESTRAINTS

If the SIRRAH unit is used with a lab top, it's better to use special software which could be asked to ARCK Sensor for the display of values sent by Sirrah in a numerical way as well as in a graphical way.

9.3 USE PROTOCOL

<u>All the commands are in ASCII coded and have to be followed by a carriage return (ASCII OD hex code).</u>

- With an external computer, especially a PLC

For communication with a PLC, the command **PCxy** has to be sent first to SIRRAH. Then, the commands can be sent to SIRRAH, no command's echo is. The measures will only begin to be displayed after having typed the command **ECxxx**.

- Connection specification

- ✓ Baud rate available : 9600 bds, 19200 bds, 38400 bds, 57600 bds, 115200 bds.
- ✓ No parity
- ✓ 8 data bits
- ✓ 1 stop bit

9.4 RESULT FRAMES

After receiving the command PC and the command ECxxx, SIRRAH starts transmission on the serial link of the measure information.
The frame, sent on the serial link has a constant length for a determined operating mode.

Notation:	[ ]	:	brackets content = 1 byte
	< >	:	2 bytes
	LF	:	Line Feed (OA hex)
	CR	:	Carriage Return (OD hex)
	Bx	:	beacon x

Observation: Data are in binary pure, the most significant byte is the first received byte
ex: <THETA> <=> [THETA MSB] [THETA LSB].

- MODE 1 with speed option (12 bytes)

[State] <THETA> <PHI> <THETA'> <PHI'> [checksum] LF CR

- MODE 1 without speed option (8 bytes)

[state] <THETA> <PHI> [checksum] LF CR

- MODE 3 (43 bytes)

[state Bl] <THETA Bl> <PHI Bl>
[state B2] <THETA B2> <PHI B2>
[state B3] <THETA B3> <PHI B3>
[state B4] <THETA B4> <PHI B4>
[state B5] <THETA B5> <PHI B5>
[state B6] <THETA B6> <PHI B6>
[state B7] <THETA B7> <PHI B7>
[state B8] <THETA B8> <PHI B8>
[checksum] LF CR

- MODE 6 with speed option and distance (24 bytes)

[state Bl] <THETA Bl> <PHI Bl> <THETA' Bl> <PHI' Bl>
[state B2] <THETA B2> <PHI B2> <THETA' B2> <PHI' B2>
[state D] <DISTANCE> [checksum] LF CR

- MODE 6 with speed option without distance (21 bytes)

[state Bl] <THETA Bl> <PHI Bl> <THETA' Bl> <PHI' Bl>
[state B2] <THETA B2> <PHI B2> <THETA' B2> <PHI' B2>
[checksum] LF CR

- MODE 6 with distance option without speed option (16 bytes)

[state Bl] <THETA Bl> <PHI Bl>
[state B2] <THETA B2> <PHI B2>
[state D] <DISTANCE> [checksum] LF CR

- MODE 6 without speed option and without distance option (13 bytes)

[state Bl] <THETA Bl> <PHI Bl>
[state B2] <THETA B2> <PHI B2>
[checksum] LF CR

- MODE 7 with speed option and distance (33 bytes)

[state Bl] <THETA Bl> <PHI Bl> <THETA' Bl> <PHI' Bl>
[state B2] <THETA B2> <PHI B2> <THETA' B2> <PHI' B2>
[state B3] <THETA B3> <PHI B3> <THETA' B3> <PHI' B3>
[state D] <DISTANCE> [checksum] LF CR

- MODE 7 with speed option without distance (30 bytes)

[state Bl] <THETA Bl> <PHI Bl> <THETA' Bl> <PHI' Bl>
[state B2] <THETA B2> <PHI B2> <THETA' B2> <PHI' B2>
[state B3] <THETA B3> <PHI B3> <THETA' B3> <PHI' B3>
[checksum] LF CR

- MODE 7 with distance option without speed option (21 bytes)

[state Bl] <THETA Bl> <PHI Bl>
[state B2] <THETA B2> <PHI B2>
[state B3] <THETA B3> <PHI B3>
[state D] <DISTANCE> [checksum] LF CR

- MODE 7 without speed option and without distance option (18 bytes)

[state Bl] <THETA Bl> <PHI Bl>
[state B2] <THETA B2> <PHI B2>
[state B3] <THETA B3> <PHI B3>
[checksum] LF CR

The word state Bx is defined by putting at "level 1" one or several bits like following :

- ✓ Bit 7 : invisible beacon
- ✓ Bit 6: saturation
- ✓ Bit 5: measure non valid
- ✓ Bit 4: incoherence
- ✓ Bit 3: average in run
- ✓ Bit 2: speed non valid
- ✓ Bit 1 & 0:
  - in mode 1, bit1 = 0 and bit0 = 0.
  - in mode 6 or 7 :
    - 01 : beacon code 1
    - 10 : beacon code 2
    - in mode 7 11 : beacon code 3

The status D is defined by setting (to high level), one of four bit as follows:

- ✓ Bit 7: no distance calculation ($\Delta\varphi < 2°$).
- ✓ Bit 6: distance invalid ($\Delta\varphi > 12°$).
- ✓ Bit 5: distance in low resolution ($2° \leq \Delta\varphi < 8°$).
- ✓ Bit 4: distance in high resolution ($8° \leq \Delta\varphi < 12°$).
- ✓ Bit 3 to 0: Reserved 0 , don't care

The angles theta and phi are in thousandth of degrees, and angular speeds theta' and phi' are in thousandth of degrees per second. Distance is expressed in millimetres module 65536.

The checksum is defined by the counts of bits in state "1" in the complete frame (Checksum, LF, CR excepted), state words, theta, phi, theta' and phi' and distance values included: this number is calculated in module 256.

After receiving the ID command, the sensor send back the following frame:

<000E> <PARAM 1> <PARAM 2> … <PARAM 14> LF CR

Parameter	Identification	Detail	Format
1	SIRRAH SN	Sirrah sensor without BO25 serial number	HEXA
2	CSM SN	Numeric electronic board serial number	HEXA
3	MSA SN	Analog electronic board serial number	HEXA
4	CUSTOMER ID	Customer identification	ASCII
5	SIRRAH REFERENCE	Sirrah sensor reference • 08 -> LS08 • 10 -> TS10 • 11 -> TS11 • 19 -> TS19 • 20 -> TS20	HEXA

6	COM_PROFIBUS	Sirrah sensor operating communication - 255 : Profibus communication - 0 : Serial communication	HEXA
7	CSM_CPU_VERSION	CPU Software version • MSB -> Version • LSB -> Revision	ASCII
8	CSM_FPGA_VERSION	FPGA Software version • MSB -> Version • LSB -> Revision	ASCII
9	MSP SN	Power electronic board serial number	HEXA
10	SSC SN	SSC serial number for TS11	HEXA
11	PSD SN	PSD serial number	HEXA
12	Reserved	-	-
13	Reserved	-	-
14	Reserved	-	-

10 SIRRAH OPERATING ON PROFIBUS NETWORK

10.1 AVAILABLE COMMANDS

10.1.1 Introduction

The Profibus implemented in the SIRRAH PROFIBUS sensor is conformed to the DPV0 norm. This involves that all the data from MASTER to the sensor are send using CYCLICAL EXCHANGES. All the measurements produced by the sensor are read by the Master during cyclical accesses. The Acyclic Exchanges (Diagnosis, Alarms…) are not supported by the sensor. Acyclic requests to the sensor will be ignored.

10.1.2 Data sent to the sensor

The data sent by the master to the sensor are ASCII commands. These commands are transmitted to the sensor using the "Read Process Data zone" of the Profibus interface of the sensor. These commands are transmitted using the cyclical write accesses. These commands are listed just below.

- ✓ PCxy_ define the operating mode of the sensor.
- ✓ EVxxx gap for the speed calculation
- ✓ ECxxx gap between sending of xxx measures
- ✓ MMxxx average on xxx measures
- ✓ ST___ measure stop
- ✓ RT___ reset
- ✓ NNx_y set node number
- ✓ DN___ No command to be performed

Operating:

PCxy_: defines the operating mode with the external computer and start the measure sequence.
x = 1 defines the mode 1 (1 beacon)
x = 6 defines the mode 6 (2 beacons)
x = 7 defines the mode 7 (3 beacons)
The others values of x are forbidden.
y = V indicates a functioning with a speed calculation,
y = A indicates a functioning with angular measurement only,
y = C indicates a functioning with angle + speed + distance (reserved mode 6 or 7),
y = D indicates a functioning with angle + distance (reserved mode 6 or 7);
The other values of y are forbidden.

X means allowed

Option \ Mode	1	6	7
A	X	X	X
C		X	X
D		X	X
V	X	X	X

Table 8: Operating mode

This command will be taken into account after a Power Off / Power On of the sensor.

EVxxx: Defines the number of elementary periods for the angular speed calculation. In mode 1, the elementary period is 5 ms, for example: EV = 10 integrate the speed on 50 ms.
(1 ≤ xxx ≤ 50). After power up or RT command, the sensor value is set to EV1.

ECxxx: Defines the number of elementary periods between data are refreshed in the Write Process Data zone of the Profibus device computer. In mode 1, one measure corresponds to the 5 ms period, for example EC=10 send results every 50 ms.
(1 ≤ xxx ≤ 255). After power up or RT command the sensor value is set to EC1.

MMxxx: Defines the number of measures used to calculate average value, and so the elementary period on which it is averaged.
(1 ≤ xxx ≤ 255, idem Ecxxx). After power up or RT command the sensor value is set to MM4.

DMxxx : Define the distance (in cm) between two beacons in mode 6, in distance meter mode.
(10 ≤ xxx ≤ 999), Default is DM10.

DGxxx : Define the distance (in cm) between the two beacons 1 and 2 in mode 7, in distance meter mode.(10 ≤ xxx ≤ 999), Default is DG10.

DDxxx : Define the distance (in cm) between the two beacons 2 and 3 in mode 7, in distance meter mode.(10 ≤ xxx ≤ 999), Default is DD10.

ST___: Measures stop. After this command the measurements are no more refreshed in the Write Process Data zone of the Profibus device. The rerun happens with the command ECxxx.

RT___: Resets the software. The parameters above have to be programmed again.

DN___: "Do Nothing": this command is useful due to the cyclical communications. The master should send this command each cycle there is nothing to do. In practice, after the power-up and the configuration sequence, the master will always sent this DN___ command, once per cycle.

NNx_y: "set Node Number": this command is used during commissioning in order to modify the network Node number of the sensor. X is the current node address, and y is the new node address. X and Y are binary coded. If the current address (X) is wrong, the instruction is ignored. If the X value is correct, the Y value is stored in a non volatile memory and the new node address will be taken in account after the following RT instruction or after the following power-up. This instruction must be used instead of the Set Slave Address Service.
Default node number is '15'.

10.1.3 Data mapping output (from Master to Sensor)

The data sent to the sensor, are written in the 5 bytes "Read Process Data" zone of the sensor. The mapping of these data is:

Output of the Master: **5 bytes of command frames.**	1 byte: ASCII Value of the first character of the command 1 byte: ASCII Value of the 2nd character of the command 1 byte: ASCII Value of the third character of the command 1 byte: ASCII Value of the fourth character of the command 1 byte: ASCII Value of the firth character of the command

Table 9: Data mapping OUTPUT

Ex: for the EC025 command:

byte 1: <45> -> 'E' character
byte 2: <43> -> 'C' character
byte 3: <30> -> '0' character
byte 4: <32> -> '2' character
byte 5: <35> -> '5' character

10.2 MEASUREMENTS READINGS

10.2.1 Introduction

After configuration and initialization of the sensor, the measurements are stored in a memory zone that has to be accessed by the Bus Master. This zone is called the Write Process Data zone. The measurements are tied in a single ADI instance. That makes the measurements upload by the BusMaster very simple. The Data are mapped in the “Write Process Data” zone of the sensor.

The ADI containing all the data is described just below:

[STATUS] <THETA> <PHI> <SPEED THETA> <SPEED PHI>

Notation:	[ ]	:	1 byte
	< >	:	2 bytes

10.2.2 Beacon status word in detail

- ✓ Bit 7: invisible beacon
- ✓ Bit 6: saturation
- ✓ Bit 5: measure non valid
- ✓ Bit 4: incoherence
- ✓ Bit 3: average in run
- ✓ Bit 2: invalid speed calculation
- ✓ Bit 1 and 0: beacon number depending on the configuration mode

When the sensor is properly working, the status word value should be 0. Possible causes of the bad status:

- ✓ Bit 7: no beacon, beacon not properly working, beacon hidden by something.
- ✓ Bit 6: beacon – sensor distance too short
- ✓ Bit 5: beacon near to the end of the field of the sensor.
- ✓ Bit 4: beacon not configured to work with this sensor, or several beacons in the field of the sensor.
- ✓ Bit 3: there are not enough successive valid values available for average calculation, occurs just after average calculation starts or when invalid measurements occur.
- ✓ Bit 2: same as bit 3 but for speed calculation
- ✓ Bit 1 & 0:
  - in mode 1, bit1 = 0 and bit0 = 0.
  - in mode 6 or 7 :
    - 01 : beacon code 1
    - 10 : beacon code 2
    - in mode 7 11 : beacon code 3

10.2.3 Distance status word in detail

The status D is defined by setting (to high level), one of four bit as follows:

- ✓ Bit 7: no distance calculation ($\Delta\varphi < 2°$).
- ✓ Bit 6: distance invalid ($\Delta\varphi > 12°$).
- ✓ Bit 5: distance in low resolution ($2° \leq \Delta\varphi < 8°$).
- ✓ Bit 4: distance in high resolution ($8° \leq \Delta\varphi < 12°$).
- ✓ Bit 3 to 0: Reserved 0 , don’t care

Distance is expressed in millimetres module 65536.

10.2.4 Data mapping input (from Sensor to Master)

The data sent to the Master, are written in the Write Process Data zone of the sensor. Depending on the operating mode, the mapping of these data is:

Input of the Master in mode 1:	1 byte, Status of beacon 1 1 word: Theta angle value 1 word: Phi angle value 1 word: Theta speed value 1 word: Phi speed value
Input of the Master in mode 6:	1 byte: Status of beacon 1 1 byte: Status of beacon 2 1 word: Theta angle value beacon 1 1 word: Phi angle value beacon 1 1 word: Theta speed value beacon 1 1 word: Phi speed value beacon 1 1 word: Theta angle value beacon 2 1 word: Phi angle value beacon 2 1 word: Theta speed value beacon 2 1 word: Phi speed value beacon 2 1 byte: Status of distance 1 word: Distance value
Input of the Master in mode 7:	1 byte: Status of beacon 1 1 byte: Status of beacon 2 1 byte: Status of beacon 3 1 word: Theta angle value beacon 1 1 word: Phi angle value beacon 1 1 word: Theta speed value beacon 1 1 word: Phi speed value beacon 1 1 word: Theta angle value beacon 2 1 word: Phi angle value beacon 2 1 word: Theta speed value beacon 2 1 word: Phi speed value beacon 2 1 word: Theta angle value beacon 3 1 word: Phi angle value beacon 3 1 word: Theta speed value beacon 3 1 word: Phi speed value beacon 3 1 byte: Status of distance 1 word: Distance value

Table 10: Data mapping INPUT

10.2.5 Measurements words in detail

The angles theta and phi are in thousandth of degrees, and angular speeds theta' and phi' are in thousandth of degrees per second. Distance is expressed in millimetres.

10.2.6 GSD File

The GSD file to be used for the Profibus Master configuration is the Generic GSD file of the Profibus interface. This file is provided by the manufacturer of this interface. This GSD file has been fully tested and certified by the Profibus Authorities.
Some services described in the GSD file are not supported by the sensor:

- ✓ FREEZE MODE is not supported
- ✓ SYNC MODE is not supported
- ✓ SET SLAVE ADRESS should not be used (use the Nnx_y instruction to change the node address.

10.3 USE RESTRAINTS

If the SIRRAH unit is used with a lab top, it’s better to use special software which could be asked to ARCK Sensor for the display of values sent by Sirrah in a numerical way.

11 CHARACTERISTICS

	TS10	TS11	TS19	TS20	LS08
Electrical specifications					
Power supply	220 VAC or 120 VAC				
Consumption	17 W				
Mechanical specifications					
Sensor dimensions	about 255 x 120 x 125 mm				
Weight	about 2.6 Kg				
Sensor tightness	IP54 sensor alone				
	IP65 with BO25 housing				
Temperature					
- Storage	- 20° up to 70° degrees Celsius				
- Operating	- 20° up to 50° degrees Celsius				
- On special request	- 40° up to 50° degrees Celsius				
Performances					
Visual field	+/- 6.5°	+/-6°	+/- 9°	+/- 8.8°	+/- 7°
Max working distance with active beacon (3)	35m	25m	45 m	60 m	25m
Operating mode with active beacon	Multi Beacon	Mono beacon	Mono Beacon	Multi Beacon	Multi Beacon
Max working distance with passive beacon	-	12 / 18m	-	-	-
Operating mode with passive beacon	-	Mono beacon	-	-	-
Measure frequency	up to 200 Hz				
Numerical resolution (°)	0,001°				
Non linearity (2)	See specific datasheets				
Stability	See specific datasheets				

Table 11: Sensor characteristics

Note: (1) smaller moving observable averaging the measures
(2) Non linearity guaranty in free field without obstacles.
(3) Working distance can be adjusted. The minimum working distance is one thence of the maximum working distance. Standard factory set for minimum distance is four meters for all sensors except the LS08 adjusted at two meters.

Max working distance:

	TS10	TS11	TS19	TS20	LS08
BMU01					
BMU02			60m		
BMU04					
BMU12			50m		

Max working distance evaluated with an energy of 50/600 in the middle of the field and 20/30 on the side of the sensor with the beacon oriented in the direction of the sensor.

12 PRODUCTS REFERENCES

12.1 General references

Standard sensor reference

- ✓ **TS10**: SIRRAH sensor multi beacon.
- ✓ **TS19**: SIRRAH sensor mono beacon.
- ✓ **TS20**: SIRRAH sensor multi beacon with high visual field and high working distance range.
- ✓ **LS08**: SIRRAH sensor low cost.
- ✓ **TS11**: SIRRAH sensor mono beacon with active or passive beacon

Reference for power cable

- ✓ **SCB4**: 220VAC power supply cable
- ✓ **SCB5**: 110VAC power supply cable
- ✓ **SCB6**: 24VDC power supply cable

Reference for serial link cable:

- ✓ **SCB13**: RS422 serial link cable
- ✓ **SCB14**: RS232 serial link cable
- ✓ **SCB15**: Profibus network cable

Reference with BO25 for improved tightness

- ✓ **SI10**: TS10 + BO25
- ✓ **SI19**: TS19 + BO25
- ✓ **SI20**: TS20 + BO25
- ✓ **SI08**: LS08 + BO25

12.2 Optional references

- ✓ **-P**: Interface on profibus network
- ✓ **-D**: 24Vdc power source
- ✓ **-HT**: High operating temperature

13 PHYSICAL DIMENSIONS

13.1 SIRRAH LS / TS

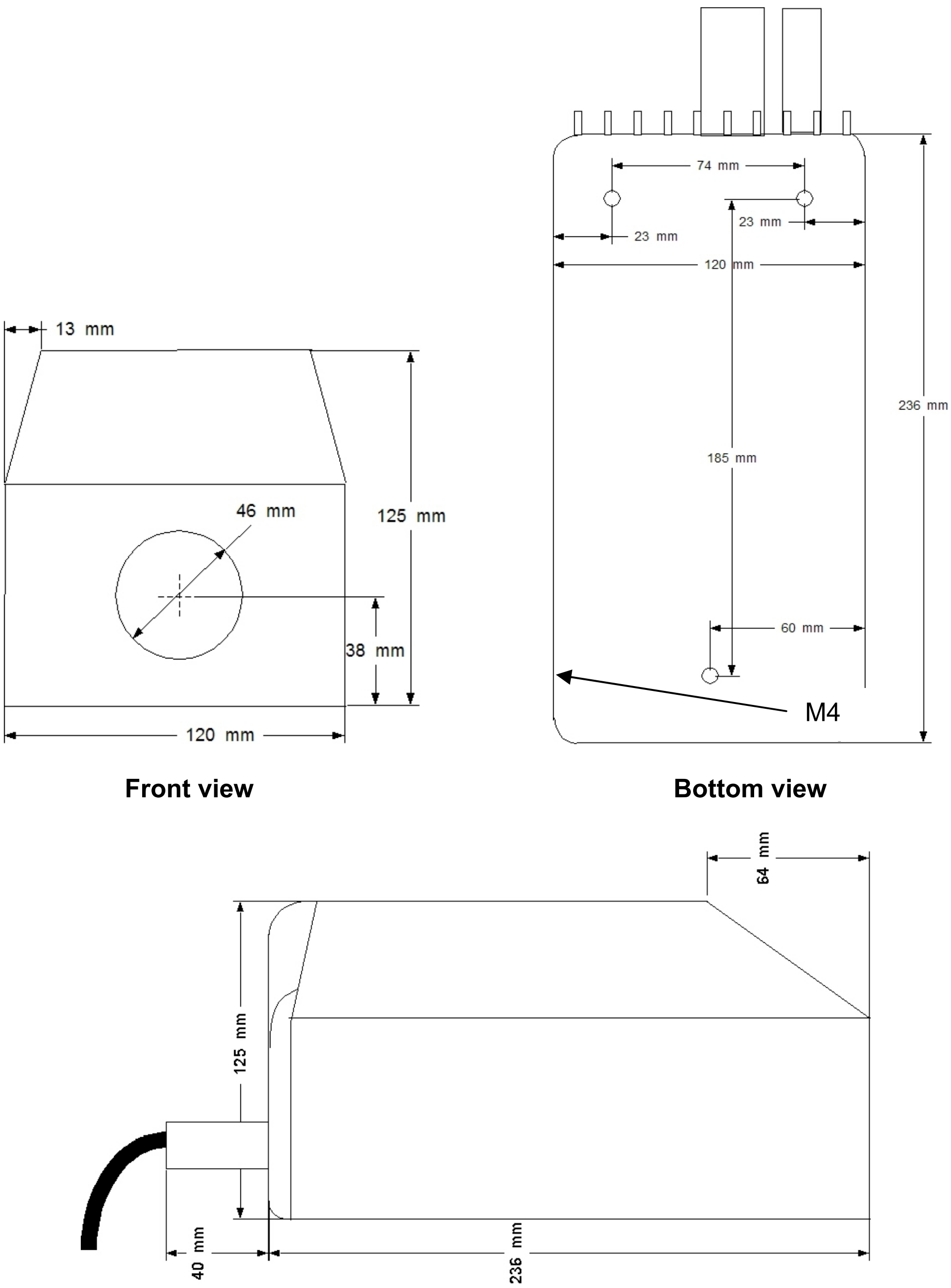


Figure 7: SIRRAH physical dimensions

13.2 BO25 (SIRRAH SI)

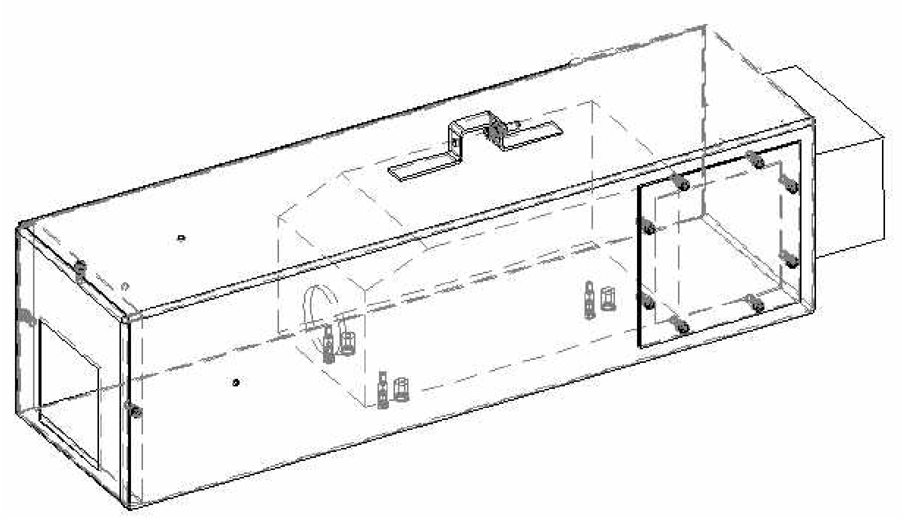


Figure 8: BO25 drawing

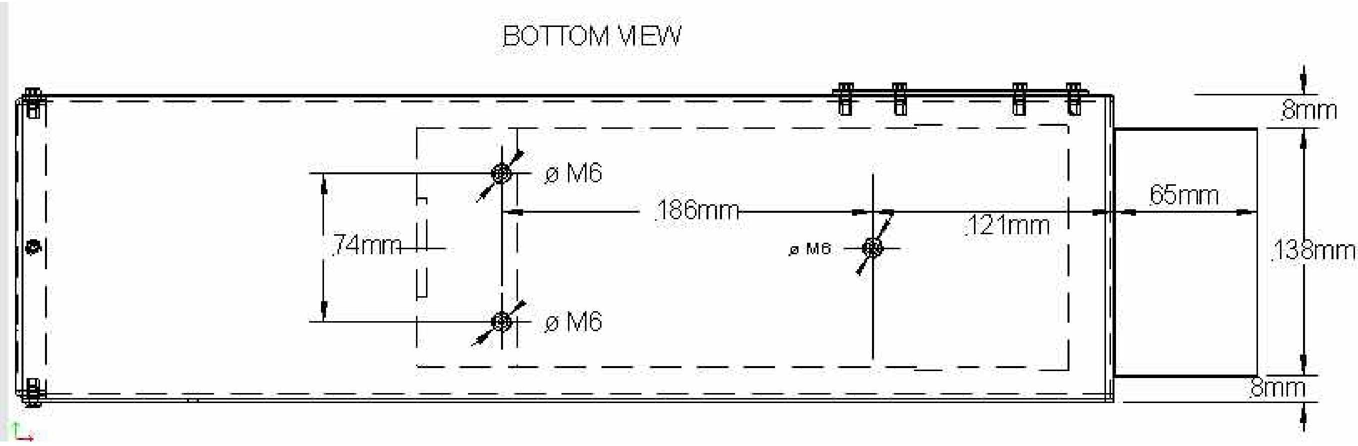


Figure 9: BO25 bottom view

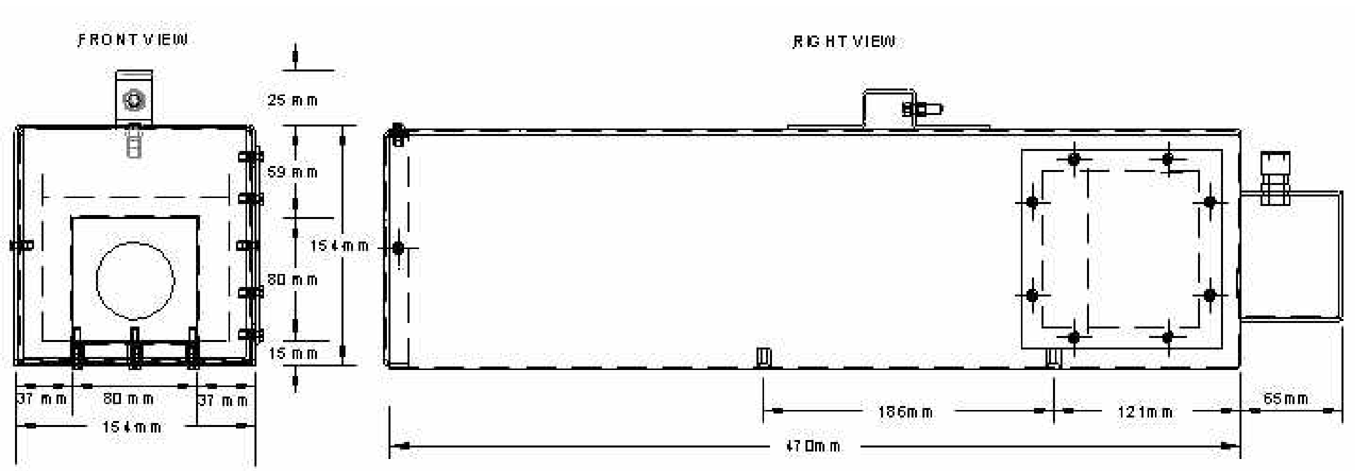


Figure 10: BO25 right & front view

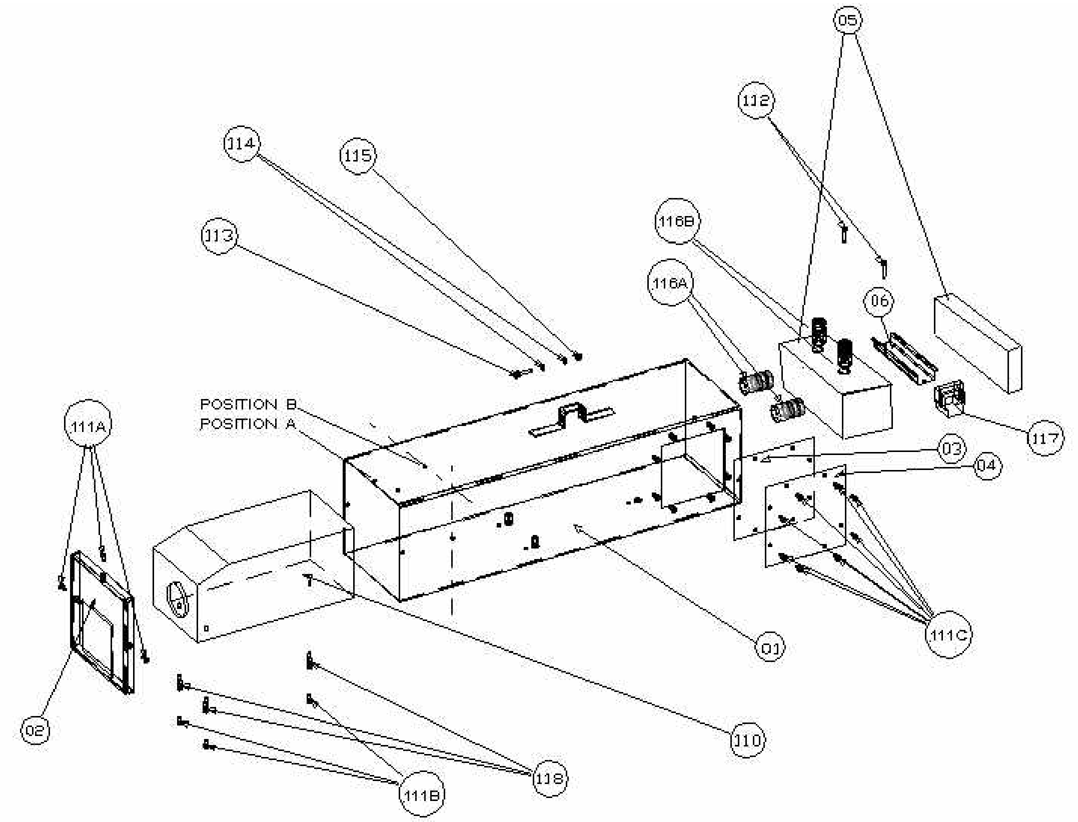


Figure 11: BO25 assembly

No.	Description	Qty	Remarks
01	BO25 protective housing	1 set(s)	
02	Front plate	1 set(s)	
03	Joint	1 set(s)	
04	Trap door	1 set(s)	
05	Connecting box	1 set(s)	
06	Plugs mounting rail	1 set(s)	
110	SIRRAH TS-10 or TS-20	1 set(s)	
111A	Window fixing Screws	3 set(s)	M4 x 8 stainless steel
111B	SIRRAH fixing Screws	3 set(s)	M4 x 8 stainless steel
111C	Trap door fixing Screws	8 set(s)	M4 x 8 stainless steel
112	Connection box fixing Screws	2 set(s)	M4 x 25 stainless steel
113	Earth connection fixing Screw	1 set(s)	M5 x 20 stainless steel
114	Earth connect. fixing Washer	2 set(s)	D5 stainless steel
115	Earth connection fixing Nut	1 set(s)	M5 stainless steel
116A	Water-proof rubber	2 set(s)	
116B	Water-proof rubber	2 set(s)	
117	Terminal plugs with screws	8 set(s)	
117K	SIRRAH fixing Washers	3 set(s)	D4
118	SIRRAH fixing interface	3 set(s)	

Table 12: BO25 assembly list

14 TESTING SOFTWARE QUICK START

Special software is provided to let the user test the Sirrah sensor using a laptop PC with Windows. This software is called “MAINTENANCE SIRRAH”.

The software is only working with a RS232 / RS422 serial link.

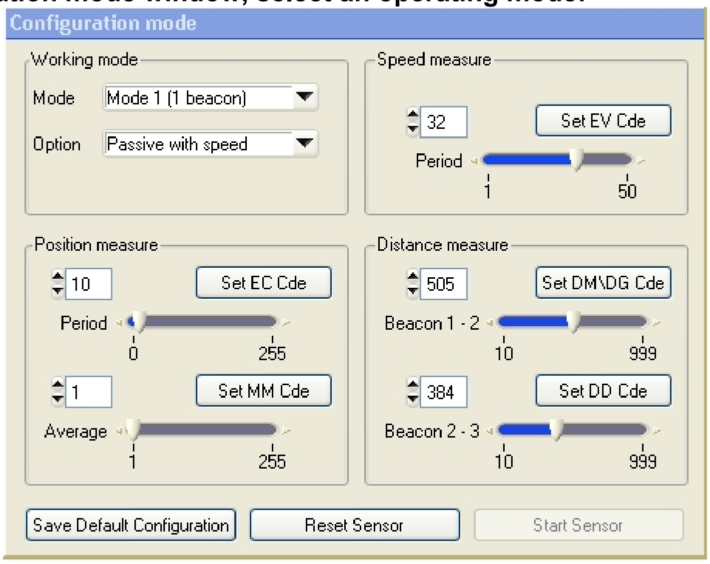
14.1 INSTALL “ MAINTENANCE SIRRAH” SOFTWARE

Install the software by running “**Setup Maintenance Sirrah BELO030.exe**” and follow the instruction. When the software is installed, restart computer.

14.2 USING “MAINTENANCE SIRRAH” SOFTWARE

Connect a sirrah to a Com port with a RS232 serial line. Used a RS422 / RS232 converter if necessary.
Starting: Run “Maintenance Sirrah”:

- ✓ **File menu, Select Open configuration**:
  - **Select the Sirrah configuration file depending on the sirrah version**
- ✓ **Communication menu, select the com port**
  - **Port** : COM1 (or any available port on the PC to be selected)
- ✓ **Communication menu, start serial connexion**
  - **Auto-connect if available**
  - **Connect available baud rate** : 9600, 19200, 38400, 57600 or 115200 Bauds
- ✓ **In the configuration mode window, select an operating mode:**



- ✓ **Reset sensor (Reset button)**
- ✓ **Start sensor in operating mode**

Beacon graphic view (to get a Phi= f(Theta) curve)

Sway graphic view (to get the Theta = f(Time) and Phi = f(Time) curves)

Measurements view (to get the numerical values)

Additional function: not to be used for a simple testing procedure. Refer to Arck Sensor for use in a specific application.

15 SERIAL LINK DESCRIPTION

15.1 RS232 SERIAL LINE

In the industrial sector, the asynchronous serial connection RS232 or RS422 known as standards EIA-232 or EIA-422 kown are very simple of use.
The essential characteristic of the communication consists in a codification of transmitted data, of which the most current parameters are:

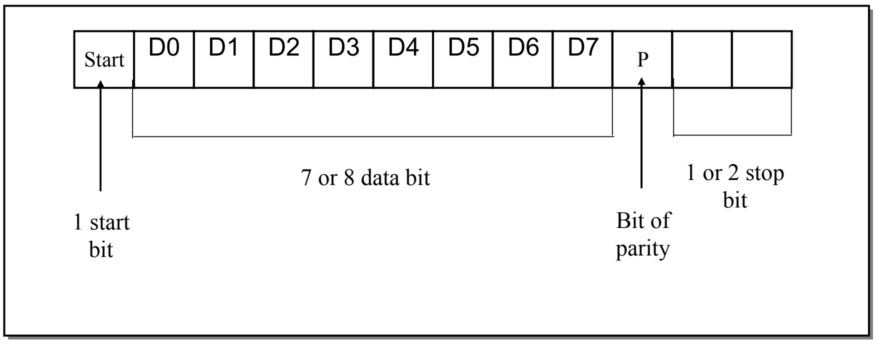


Figure 12: Size of a transmitted character (byte)

Electric signals exchanged in a connection RS232 are bipolar, that is to say that they are sometimes negative with regard to the level zero of the joint wire of return.

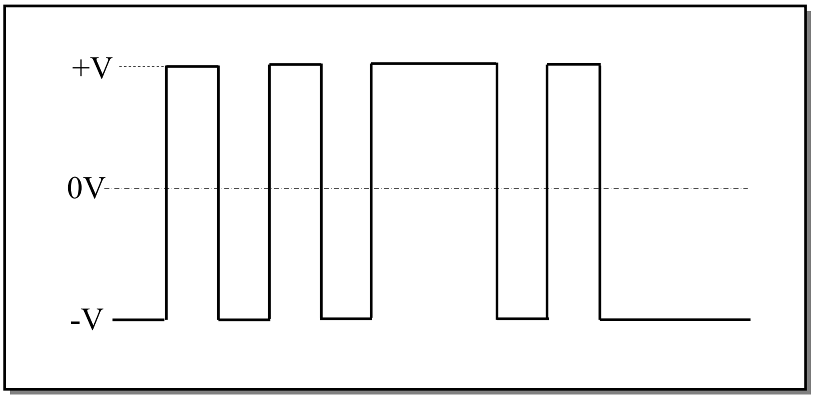


Figure 13: Shape of a RS232 signal

Maximal symmetric tensions defined by the standard EIA-232 are of + /-15 volts.
In practice, we meet more frequently values close to + /-10 volts, or even sometimes unbalanced values such as + /-8 volts, when it is not + /-5 volts with some converters of levels.

In RS232, the length of the line which separate peripherals is conversely proportional to the debit of the communication and in anyway, limited to some dozens of meters for lower or equal connections to 9600 bauds when using it in industrial environment.

15.2 RS422 SERIAL LINK

15.2.1 Theory of operation in RS422 communications

To avoid problems of length and of immunity in front of different parasites, the EIA-422 standard is preferred because signals are emitted in differential mode on symmetric pairs, and not on a wire with return through earth joint wire.

By using reinforced and twisted pairs cable of which the extremities of the reinforcement are connected with the frame of the two peripherals, it is possible to make serial connections being able to reach some hundred meters. (or even 1 000 meters with weak debit).

If the number of wires needed to establish connection is more important in **RS422**, this mode of transmission of signal guarantees however an excellent immunity to noises and to other industrial parasites.

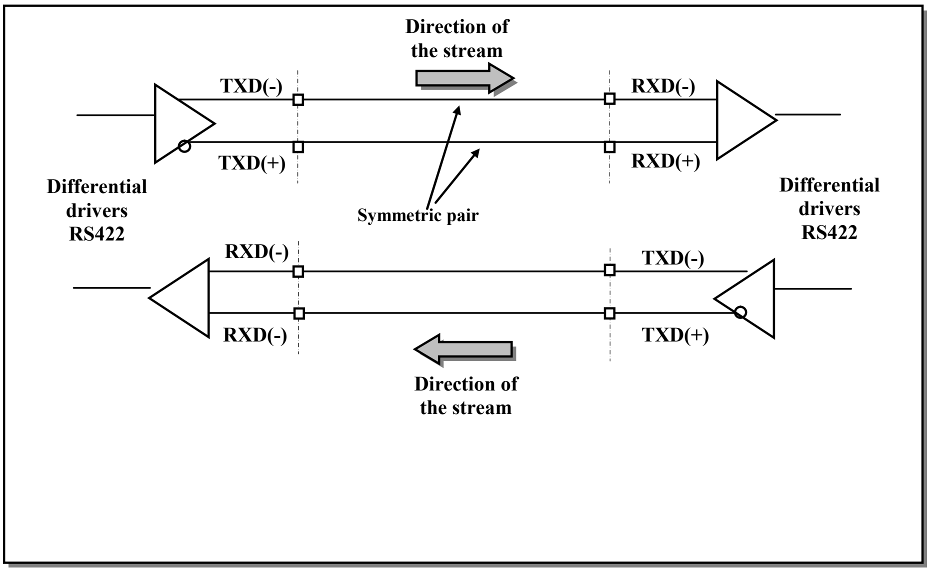


Figure 14: Diagram of a connection (full duplex) in RS 422

If the use of drivers with differential mode minimizes noises (parasites, impulses) which could circulate on the connection, (rejection of the joint mode), it is better to use reinforced and twisted pairs cable to avoid problems of induced and radiated parasites. Indeed, radiated fields and fields received by the line cancel out mutually.

However, in order to minimize all the induced currents (cables of power following the cable of communication) it is advisable to use reinforced cable of which the reinforced screen must be cabled on every side to the frame of peripherals. (See figure below).

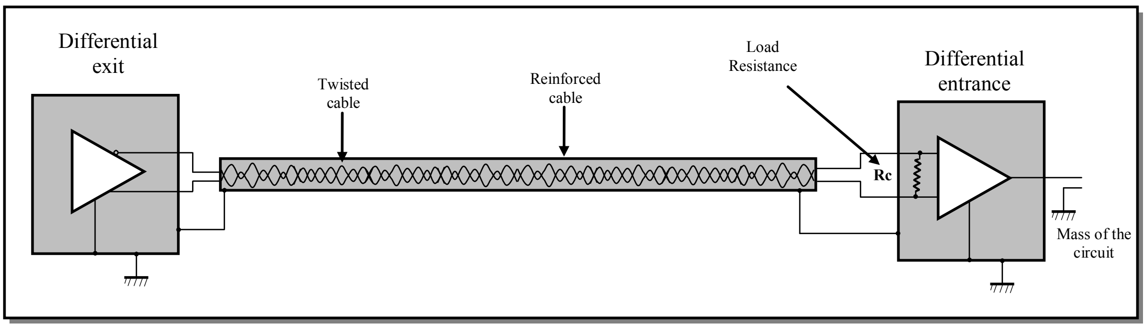


Figure 15: Plan of a RS422 connection

15.2.2 Standard RS485

Standard EIA-485 is a variant of the EIA-422A standard. This standard works in differential mode and was developed to offer the same advantages as the RS422 mode so well that communication can be established in the two directions on the same pair. However this mode of communication requires a rigorous protocol of communication (surveillance of the line before emitting), and the addition of a code of address for "piloting" the concerned peripheral.

The RS-485 connection is a version improved by the RS-422A standard which allows to widen the number of peripherals and terminals (connected in parallel on a single line) and this on a long distance or to increase significantly the debit of communications.

Systems with differential communication mode require two wires for each transmitted signal.
These signals are not referenced in the mass and only the differences of existing potential between the wires are interpreted by the receiver.
Therefore the absolute value of these signals is not important and induced currents in the line made with a twisted pair cancel out mutually.

15.2.3 Characteristics of RS485 signals

The standard specifies only the physical characteristics of signals. The protocol, time of replacement, serial mode, connectors and characteristics can be freely defined by the user.

Description of the parameter	Expected Values
Max voltage in joint mode	-7V to +12V
Resistance of entry (in reception)	12 K Ohm
Resistance of the load of the Driver	60 Ohm
Limitation of the current of short circuit in exit of the driver	150mA to GND 250mA to –7 or +12V
Maximal length of cable	1200m
Tension of exit of the loaded driver	+/-1,5V
Tension of exit of the not loaded driver	+/-5V
Sensibility of the receiver	+/-200mV

Table 13: EIA-485 characteristics

15.2.4 Wiring of the Sirrah sensor RS422 communication's interface

The internal wiring of the communication interface of the SIRRAH sensor is like on figure below. Connection between the levels TTL and RS422 of exit is Opto Isolated.

The type of the cable to be used depends on the used mode of RS232 communication or RS422.

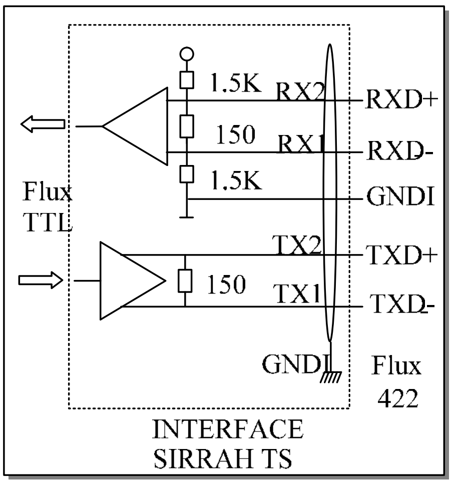


Figure 16: Sirrah RS422 internal wiring

15.2.5 How to resolve the current communications problems

One can resolve communications problems:

- ✓ By reducing the length of the line,
- ✓ By using of cable of twisted pairs
- ✓ By using of reinforced cable,
- ✓ By using of reinforced cable (primary reinforcement connected with the earth, secondary with the mass),
- ✓ By insulating the cables of communication from cables conveying of the power,
- ✓ By insulating the signal of earth coming from cables of power,
- ✓ By connecting the signal of earth with the reinforcement of the cable the most near possible from the source,
- ✓ By using of the cable having the weakest impedance possible,
- ✓ By making the wiring of the communication lines as a star.

15.2.6 Improvement of the signal's communication

A line of transmission must be always ended by a load resistance from approximately 100 to 150 ohms.
To guarantee the commutation's thresholds of circuits drivers of line, some manufacturers recommend and directly integrate resistances of strong value (of the order of some 100 K ohms between the not inverse entrance and +VCC and the inverse entrance and the mass of the circuit).

Given the weak consumption of the modern integrated circuits, and the impedance raised with the circuits of reception, the bridge divisor formed by these resistances can reduce the difference of potential to some mV so much so that the amplifier of entrance is not capable any more to commute the receiver.

To avoid this problem, it is possible to fit definitely the rocking threshold by applying the following formula:

The polarization resistance = 10 x the value of the load resistance

Also 1.5 K ohms to add on the reception side on both sides of the circuit's alimentation.
(See figure 6 below.)

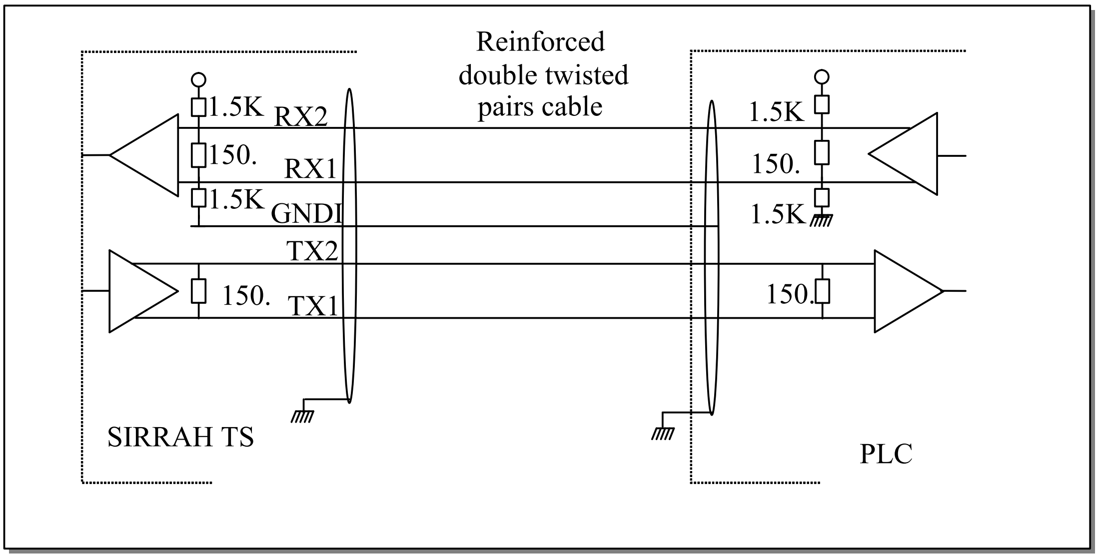


Figure 17: Termination resistor

15.2.7 Galvanic insulation

It is possible to do a galvanic insulation in the transmission systems of data by inserting magnetic or optical transformers into connections connecting emitters and receivers of line.
Such an insulation allows to remove the buckles of mass and eliminate the problems of noise in tension by eliminating them from the signal. The interface of communication of the SIRRAH sensor is opto-isolated between the part TTL and Drivers of line (RS422).

Another method consists in connecting the mass of peripherals with a simple driver on both sides of the line and in connecting the earth on the reinforcement of the cable (Figure 7).
This technique allows freeing itself from the noise of joint mode and can be completely resolved or unimportant.

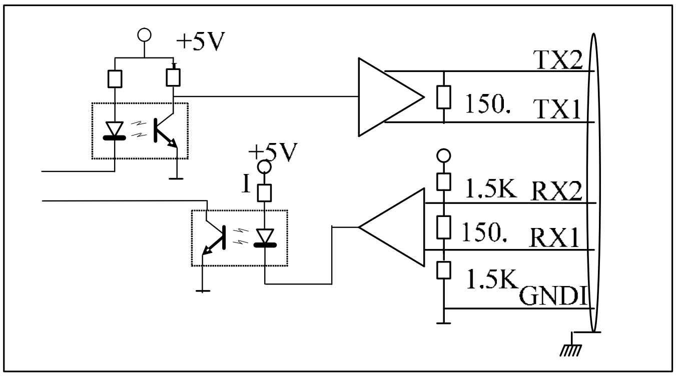


Figure 18: Example of an isolated galvanic interface by the use of photo couplers

15.2.8 Limitation of the commutation's time of the signal

It is possible to improve the quality of the communication by modifying the commutation times of the signal by using a filter RC established by a resistance mass with a condenser. The figure below shows the plan of such a realization.

The value of the capacity is dependent on the debit (in bauds). For example :

- ✓ For a debit of 9600 bauds and a resistance of load of 150 ohms :
- ✓ Γ = R.C = 1/10 bauds What gives us for this example : C = 47 nF

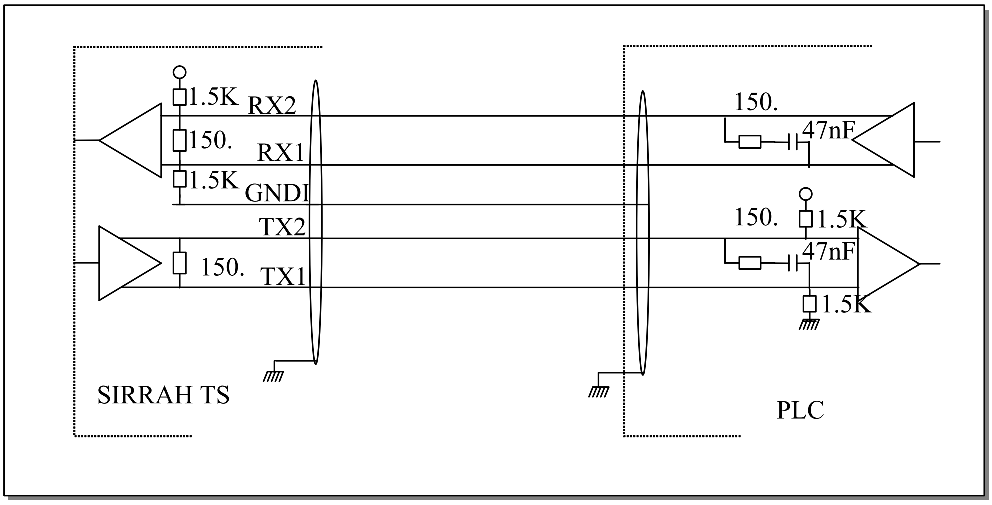


Figure 19: Plan of wiring modified with RC filters