

## SDI-12 GPS SENSOR

TBSGPS2 is a GPS sensor with SDI-12 interface. It measures latitude, longitude, altitude and velocity.

The sensor is used in agricultural yield applications to monitor the operation of center pivot irrigation systems or the location of remote telemetry units.



*TBSGPS2 SDI-12 GPS*

### Features

- GPS sensor
- Latitude, longitude, altitude and velocity.
- Cold start: 29s
- Hot start: 1s
- SDI-12 Standard V1.4
- Plug and Play
- 6 - 16V supply voltage
- Less than 65 $\mu$ A idle current
- Operating Temperature Range: - 40°C ... + 80°C
- Dimensions: 16.5x12.5x10 cm
- Weight: 450 g
- Excellent price-performance ratio

### Target Applications

- RTU localization
- Monitoring of center pivot irrigators

# SDI-12 GPS SENSOR

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# SDI-12 GPS SENSOR

## 1 Introduction

The TBSGPS2 is a rugged GPS sensor with SDI-12 interface. It is mounted inside an IP67 housing from Fibox.

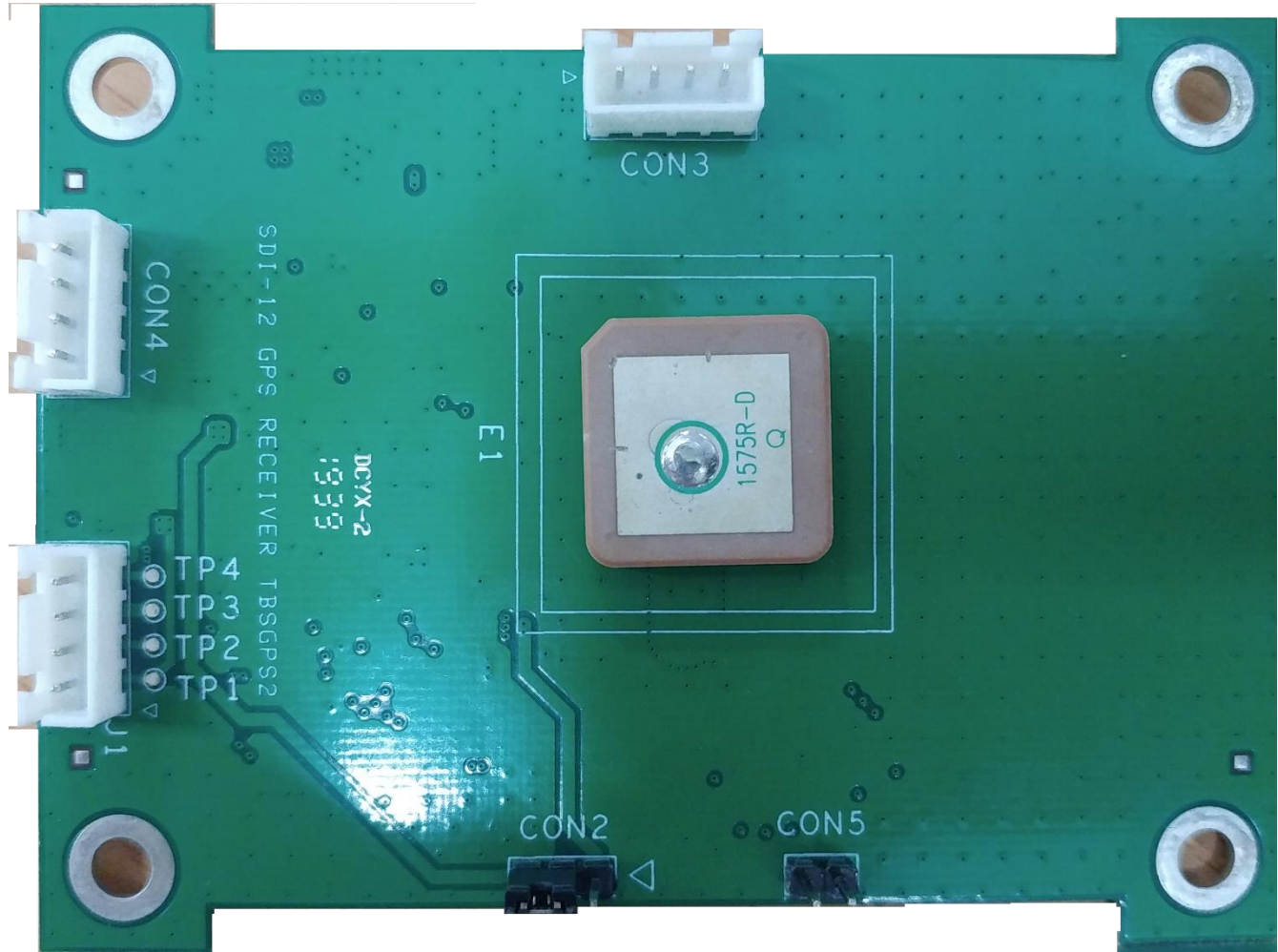


Figure 1 – TBSGPS2 board

## 2 Measurement

The TBSGPS2 outputs the latitude, longitude, elevation and velocity.

## SDI-12 GPS SENSOR

### Supported measurement commands:

**aM! aMC! aC! aCC!** Latitude, Longitude, Elevation, Velocity

### Supported SDI-12 v1.4 commands: metadata commands

<b>aIM! aIMC! aIC! aICC!</b>	<b>Identify Measurement Commands</b>
<b>aIM_001! aIMC_001! aIC_001! aICC_001!</b>	<b>Identify Measurement Parameter (1<sup>st</sup>)</b>
<b>aIM_002! aIMC_002! aIC_002! aICC_002!</b>	<b>Identify Measurement Parameter (2<sup>nd</sup>)</b>
<b>aIM_003! aIMC_003! aIC_003! aICC_003!</b>	<b>Identify Measurement Parameter (3<sup>rd</sup>)</b>
<b>aIM_004! aIMC_004! aIC_004! aICC_004!</b>	<b>Identify Measurement Parameter (4<sup>th</sup>)</b>

### Extended SDI-12 commands:

<b>aXSDM,nn!</b> where nn: dynamic model index	<b>Set dynamic model</b>
<b>aXGDM!</b>	<b>Get dynamic model</b>
<b>aXSPF,n!</b> where n: positioning format	<b>Set positioning format</b>
<b>aXGPF</b>	<b>Get positioning format</b>

## 3 Product Specification

- Velocity accuracy: 0.05 m/s (50% @ 30 m/s)
- Horizontal position accuracy: 2.5m (CEP, 50%, 24 hours static, -130dBm, > 6 SVs)
- Max navigation update rate: 18 Hz
- Time-To-First-Fix (all satellites at -130dBm):
  - Cold start: 29s
  - Hot start: 1s
- Sensitivity:
  - Tracking & navigation: -166 dBm
  - Reacquisition: -160 dBm
  - Cold start: -148 dBm
  - Hot start: -157 dBm
- Operational limits:
  - Dynamics: 4 g or below
  - Altitude: 50km
  - Velocity: 500 m/s
- SDI-12 Standard V1.4
- 6 - 16V supply voltage

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- Operating Temperature Range: - 40°C ... + 80°C
- Dimensions: 16.5x12.5x10 cm
- Weight: 450 g
- Current consumption: active 45mA (up to 180 seconds); idle 65µA
- Standard cable length: 3m; any other length upon requirement

### 4 Calibration

TBSGPS2 is factory calibrated and does not require further calibration.

Default dynamic model is set to stationary.

### 5 Installation

TBSGPS2 is compatible with any data logger or remote telemetry unit with SDI-12 interface (v1.3 or v1.4).

Refer to the data logger or RTU manual for further information.

#### Connectors:

- CON3: external SDI-12 power supply (optional)
- CON4: SDI-12 connector
- J1: programming connector

## SDI-12 GPS SENSOR

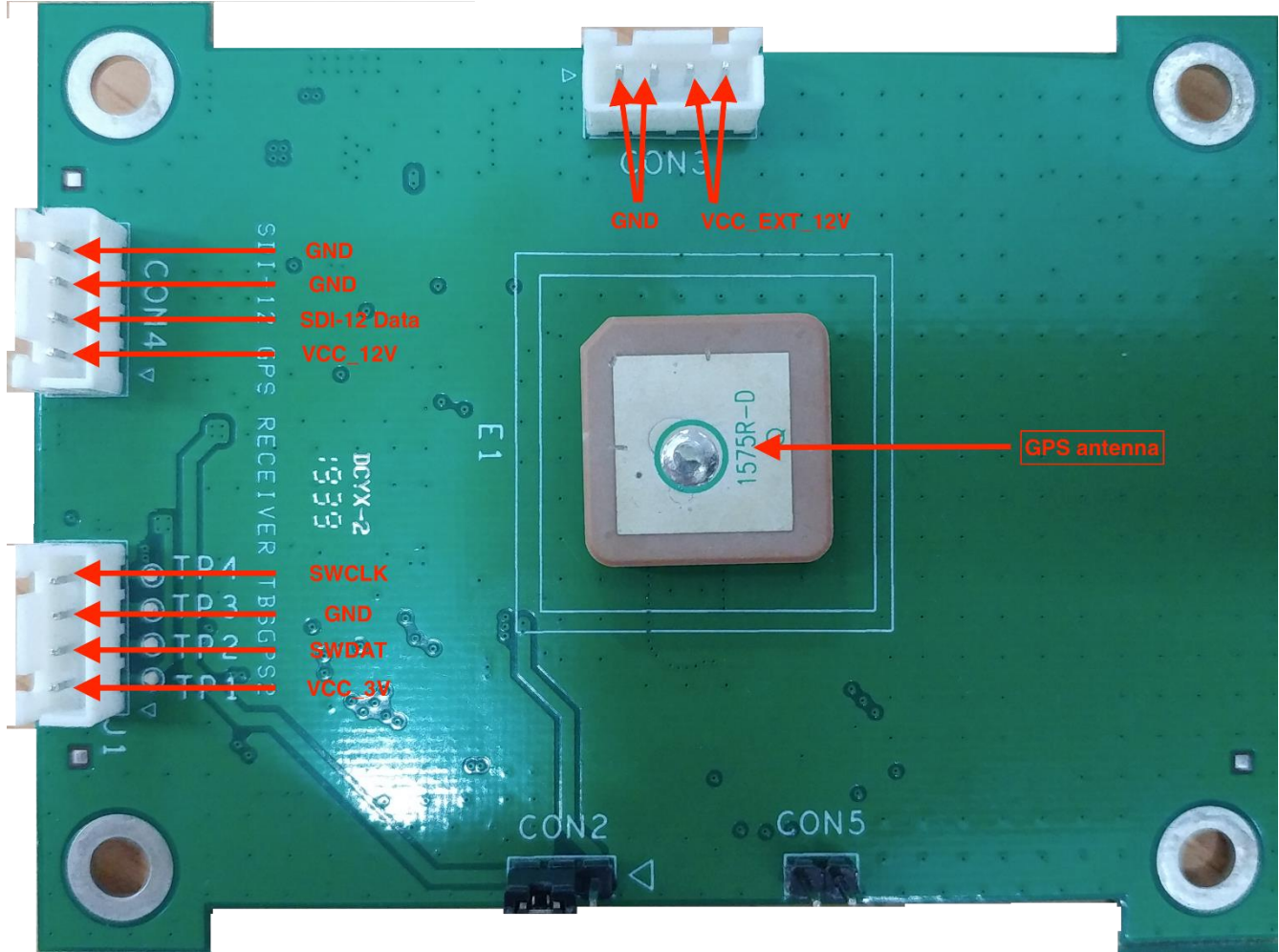


Figure 2 – terminal block pin assignment

### 6 SDI-12

SDI-12 is a standard for interfacing data recorders with microprocessor-based sensors. SDI-12 stands for serial/digital interface at 1200 baud. It can connect multiple sensors with a single data recorder on one cable. It supports up to 60 meter cable between a sensor and a data logger.

The SDI-12 standard is prepared by

#### SDI-12 Support Group

## SDI-12 GPS SENSOR

**(Technical Committee)**  
**165 East 500 South**  
**River Heights, Utah**  
**435-752-4200**  
**435-752-1691 (FAX)**  
**<http://www.sdi-12.org>**

The latest standard is version V1.4 which dates from December 1<sup>st</sup>, 2017. The standard is available on the website of the SDI-12 Support Group.

# SDI-12 GPS SENSOR

## 7 Application Examples

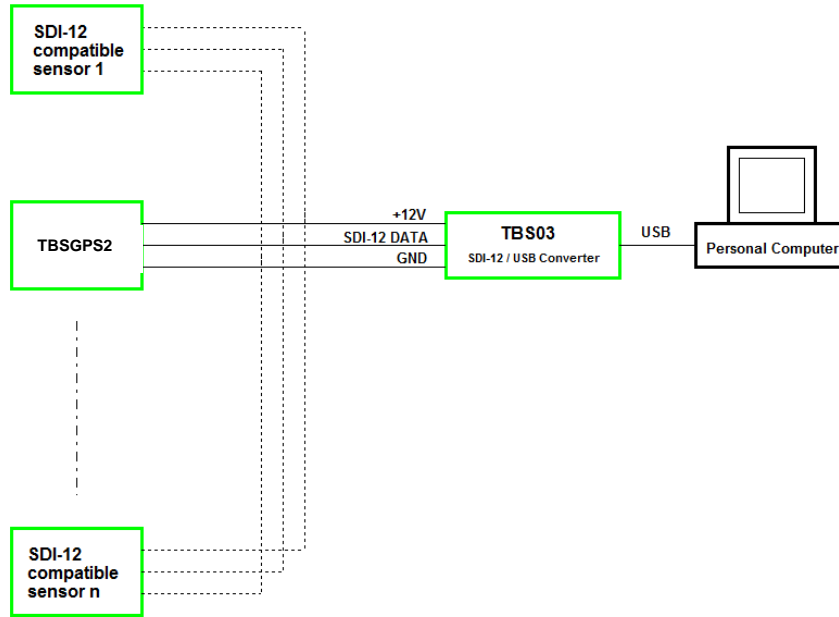


Figure 3 – TBSGPS2 and other sensors with SDI-12 interface connected to TBS03 SDI-12 to USB converter; setup for controlling / testing sensors and for PC based data recording

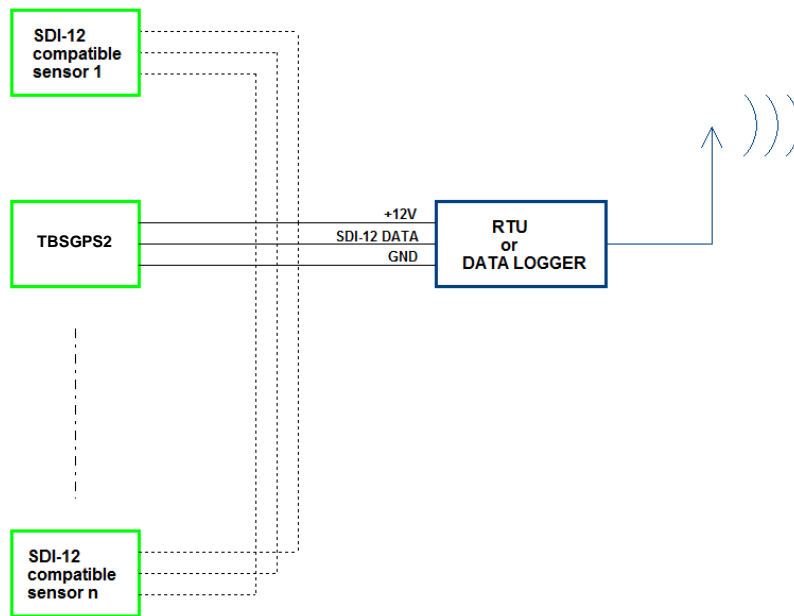


Figure 4 – TBSGPS2 and other sensors with SDI-12 interface connected to Remote Telemetry Unit or Data Recorder



## SDI-12 GPS SENSOR

### 8 Functional description

Once powered TBSGPS2 goes to idle mode waiting to be waken up by a SDI-12 command.

The embedded GPS relies on NMEA v4.10 protocol for satellite communication.

Upon reception of a measurement command, TBSGPS2 will look for a fix with at least 4 satellites to determine the position.

With a clear line of sight, a cold start should take around 30s.

However depending where TBSGPS2 is installed it may take much more time (ex. Under trees).

This is why the measurement commands operate with 180s timeout.

When using:

- aC!/aCC!: the position will be returned after 180s
- aM!/aMC!: the position will be returned after 180s or if it's available earlier the sensor will issue a Service Request to the SDI-12 controller.

#### Latitude and longitude format:

Latitude and longitude are returned in degrees and minutes or degrees only according to following format: <sign><value>.

The values format is chosen by extended SDI-12 command aXSPF,n! where:

- n=0 for degrees and minutes format
- n=1 for decimal degrees only format

The value indicates the angle:

*In degrees and minutes:*

- Latitude:
  - ddmm.mmm where dd is in degrees and mm.mmm in minutes
  - Ex: 1051.025 => 10 degrees and 51.025 minutes
- Longitude
  - dddmm.mm where ddd is in degrees and mm.mm in minutes
  - Ex: 10648.37 => 106 degrees 48.37 minutes

*In decimal degrees:*

- Latitude:
  - mm.mmmm
  - Ex: 10.85042 degrees
- Longitude
  - mmm.mmmm
  - Ex: 106.8062 degrees

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The sign indicates the direction:

- Latitude:
  - +: North
  - -: South
- Longitude
  - +: East
  - -: West

Example: Tekbox Digital Solution location in Ho Chi Minh City, Vietnam

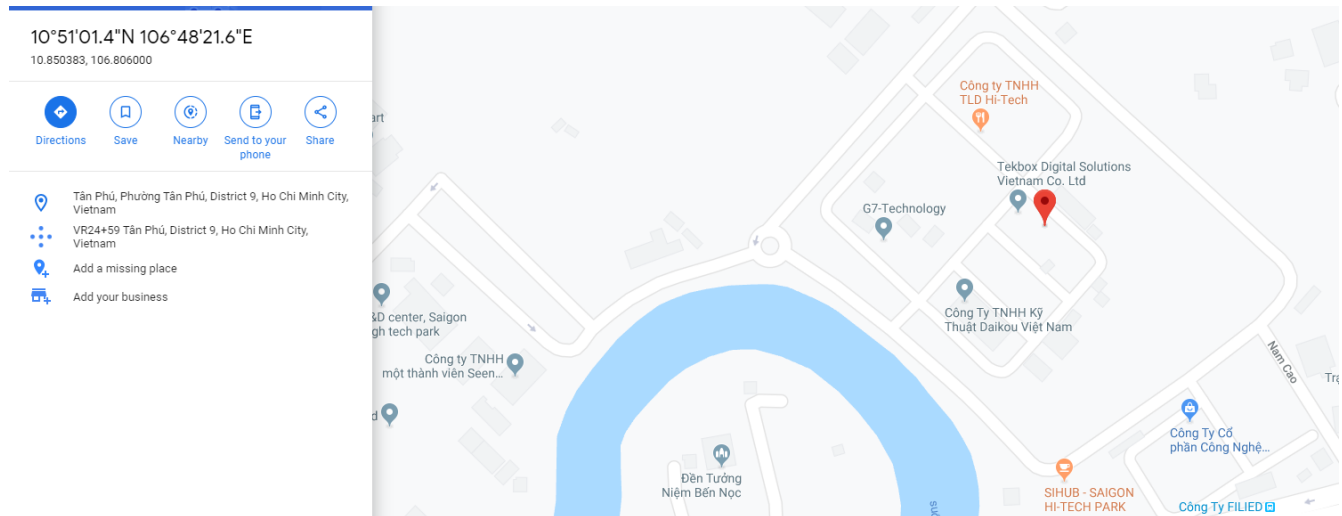
TBSGPS2 returns following coordinates:

Latitude: +1051.023 => 10 degrees 51.023 minutes North

Longitude: +10648.36 => 106 degrees 48.36 minutes East

If converted to degrees to match with Google Maps format:

- Latitude: 10.850383 degrees
- Longitude: 106.806 degrees



## 9 Mechanical Dimensions

Refer to [http://www.fibox.com/catalog/1995/product/609/7032520\\_ENG3.html](http://www.fibox.com/catalog/1995/product/609/7032520_ENG3.html) with respect to the mounting holes of the housing.

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## 10 Cable Connection

Cable Color	Signal Assignment
Red	SDI-12 Power
White	SDI-12 Data
Blue	GND
Black	Shield

Table 1 – Cable Connection

## 11 Supported SDI-12 v1.3 Commands

Following commands are supported by the TBSGPS2:

Command	Description	Response
<b>a!</b>	Acknowledge Active	a<CR><LF>
<b>al!</b>	Send Identification	014TEKBOXDSTBSPGPS2.0ssssffffff<CR><LF> With ssss representing the serial number and ffffff representing the firmware version
<b>aAb!</b>	Change Address	b<CR><LF> Changing the sensor address from a to b
<b>?!</b>	Address Query	a<CR><LF>
<b>aM!</b>	Start Measurement Measures latitude, longitude, elevation and velocity	a1804<CR><LF> Delay: (180) seconds and number of values (4)
<b>aMC!</b>	Start Measurement and request CRC Measures latitude, longitude, elevation, velocity and calculate CRC	a1804ccc<CR><LF> Delay: (180) seconds, number of values (4) and CRC (ccc)
<b>aC!</b>	Start Concurrent Measurement Measures latitude, longitude, elevation and velocity	a18004<CR><LF> Delay: (180) seconds and number of values (04)
<b>aCC!</b>	Start Concurrent Measurement and request CRC Measures latitude, longitude, elevation, velocity and calculate CRC	a18004ccc<CR><LF> Delay: (180) seconds, number of values (04) and CRC (ccc)
<b>aD0!</b>	Get Measurement Result(s)	Upon issuing the aD0! Command, TBSGPS2 will send the measurement results.
<b>aV!</b>	Start Verification	a0000<CR><LF> Not supported

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<b>aRn!</b>	Continuous Measurement	a<CR><LF>
<b>aRCn!</b>	Continuous Measurement + CRC	Not supported

Table 2 – Standard SDI-12 commands

### 12 Supported SDI-12 v1.4 commands

Command	Description	Response
<b>aIM!</b>	aM! Identify Measurement Returns delay and number of parameters	a1804<CR><LF> Delay: (180) seconds and number of values (4)
<b>aIMC!</b>	aMC! Identify Measurement Returns delay and number of parameters	a1804<CR><LF> Delay: (180) seconds and number of values (4)
<b>aIC!</b>	aC! Identify Measurement Returns delay and number of parameters	a18004<CR><LF> Delay: (180) seconds and number of values (04)
<b>aICC!</b>	aCC! Identify Measurement Returns delay and number of parameters	a18004<CR><LF> Delay: (180) seconds and number of values (04)
<b>aIM_001!</b>	aM! Identify Measurement Parameters (1rst) Returns parameter's identification and unit	a,Latitude,degree;<CR><LF>
<b>aIM_002!</b>	aM! Identify Measurement Parameters (2ndt) Returns parameter's identification and unit	a,Longitude,degree;<CR><LF>
<b>aIM_003!</b>	aM! Identify Measurement Parameters (3rd) Returns parameter's identification and unit	a,Altitude,m;<CR><LF>
<b>aIM_004!</b>	aM! Identify Measurement Parameters (4th) Returns parameter's identification and unit	a,Speed,km/h;<CR><LF>
<b>aIMC_001!</b>	aMC! Identify Measurement Parameters (1rst) Returns parameter's identification and unit	a,Latitude,degree;ccc<CR><LF> Where ccc is the CRC
<b>aIMC_002!</b>	aMC! Identify Measurement Parameters (2nd) Returns parameter's identification and unit	a,Longitude,degree;ccc<CR><LF> Where ccc is the CRC
<b>aIMC_003!</b>	aMC! Identify Measurement Parameters (3rd) Returns parameter's identification and unit	a,Altitude,m;ccc<CR><LF> Where ccc is the CRC
<b>aIMC_004!</b>	aMC! Identify Measurement Parameters (4th) Returns parameter's identification and unit	a,Speed,km/h;ccc<CR><LF> Where ccc is the CRC
<b>aIC_001!</b>	aC! Identify Measurement Parameters (1rst) Returns parameter's identification and unit	a,Latitude,degree;<CR><LF>
<b>aIC_002!</b>	aC! Identify Measurement	a,Longitude,degree;<CR><LF>

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	Parameters (2nd) Returns parameter's identification and unit	
<b>aIC_003!</b>	aC! Identify Measurement Parameters (3rd) Returns parameter's identification and unit	a,Altitude,m;<CR><LF>
<b>aIC_004!</b>	aC! Identify Measurement Parameters (4th) Returns parameter's identification and unit	a,Speed,km/h;<CR><LF>
<b>aICC_001!</b>	aCC! Identify Measurement Parameters (1rst) Returns parameter's identification and unit	a,Latitude,degree;ccc<CR><LF> Where ccc is the CRC
<b>aICC_002!</b>	aCC! Identify Measurement Parameters (2nd) Returns parameter's identification and unit	a,Longitude,degree;ccc<CR><LF> Where ccc is the CRC
<b>aICC_003!</b>	aCC! Identify Measurement Parameters (3rd) Returns parameter's identification and unit	a,Altitude,m;ccc<CR><LF> Where ccc is the CRC
<b>aICC_004!</b>	aCC! Identify Measurement Parameters (4th) Returns parameter's identification and unit	a,Speed,km/h;ccc<CR><LF> Where ccc is the CRC

Table 3 – Standard SDI-12 commands

### 13 Supported Extended Commands

Command	Description	Response
<b>aXSDM,mm!</b>	Set Dynamic Model mm: 02: stationary 03: pedestrian	aX_OK<CR><LF>
<b>aXGDM!</b>	Get Dynamic Model	amm<CR><LF> where mm: 02: stationary 03: pedestrian
<b>aXSPF,n!</b>	Set Positioning format 0: degrees and minutes 1: degrees	aX_OK<CR><LF>
<b>aXGPF!</b>	Get Positioning format	an<CR><LF> where n: 0: degrees and minutes 1: degrees

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Table 4 – Extended SDI-12 Commands

## 14 Ordering Information

Part Number	Description
TBSGPS2	TBSGPS2, SDI-12 GPS sensor with 3m cable

Please mention in your order, if you require a different cable length

Table 4 – Ordering Information

## 15 History

Version	Date	Author	Changes
V1.0	29.11.2019	Philippe Hervieu	Creation of the document
V1.1	03.12.2019	Philippe Hervieu	Select latitude/longitude format
V1.2	03.02.2020	Philippe Hervieu	Photos added
V1.3	17.02.2020	Philippe Hervieu	Remove watermark
V1.4	17.02.2020	Philippe Hervieu	Update dimensions and weight

Table 5 – History