

## 3D MOBILE MAPPING SYSTEM



### Positioning and data collection solution

- 3D Scanning of Roadside Features
- 360° Camera for Spherical Image Capture
- Dual Frequency GNSS Tracking
- High Accuracy 6-Axis IMU Integration
- External Wheel Encoders for Odometry and Tracking
- Quick and Easy Setup

## Turn-key Mobile Mapping solution

Topcon's IP-S2 Mobile Mapping System overcomes the challenges of mapping 3D features at a high level of accuracy. Accurate vehicle positions are obtained using three technologies:

- a dual frequency GNSS receiver establishes a geospatial position
- an Inertial Measurement Unit (IMU) provides vehicle attitude
- a connection to external wheel encoders obtains odometry information



These three technologies work together to sustain a highly accurate 3D position for the vehicle even in locations where satellite signals can be blocked by obstructions such as buildings, bridges, or tree lines.

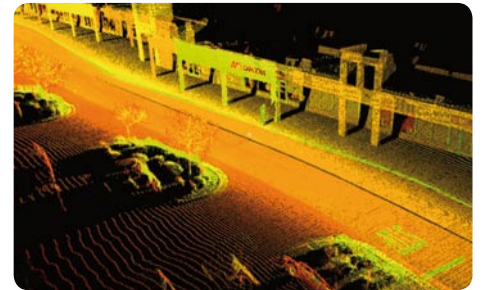
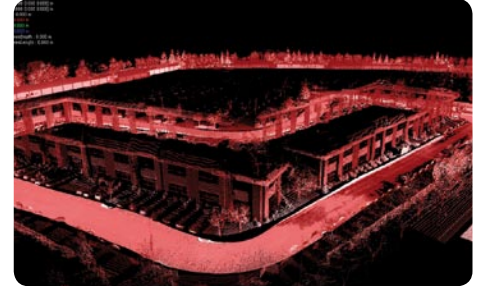
The IP-S2 is modular and can be configured with multiple sensors. The standard system includes three high-resolution LiDAR scanners oriented to cover the road surface and adjacent buildings up to 30 meters away.

A high-resolution digital camera can be added providing 360 degree spherical images at fixed distance intervals. Other sensors can be integrated for total flexibility of system configuration, additional range or scan density, and support for a wide variety of applications. All sensor inputs are recorded and time stamped to a common clock driven by the IP-S2.

Spatial Clean, Topcon's powerful software, will post-process the geo-referenced LiDAR and/or digital imaging data into a viewable 3D image representation which can then be exported to industry standard formats. GNSS data can be post-processed against a reference station for higher accuracy.

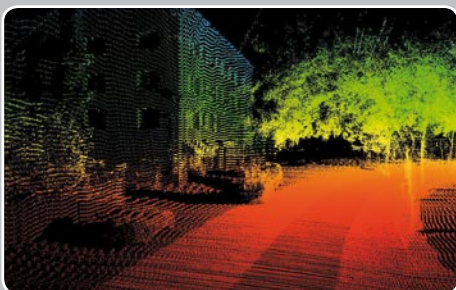
Optional desktop software includes a viewer enabling the user to review georeferenced point cloud and camera information, label features and assets, make measurements and export data into GIS programs.

The IP-S2 quickly provides high accuracy data and dynamic imaging for any mapping project. The vehicle-mounted system can map data at normal travel speeds for roadway surface condition assessments and roadside feature inventories. Safety is increased by removing pedestrians from the travelled lanes. Other applications include pipelines, railways, utility corridors, and waterways.



Homeland security and disaster management can benefit from the IP-S2's ability to collect high accuracy GIS information simply and quickly. The IP-S2 is perfect for 3D street-level city mapping and provides essential information for these applications.

IP-S2



#### IP-S2 Features

- Generates Geo-referenced spherical imagery
- Sensor fusion software provides colorized 3D models of the environment
- Viewer software to identify and label assets and features
- Easily export to industry-standard formats
- Accurate vehicle position and attitude
- Flexible, custom sensor integration
- Factory calibrated, integrated system
- Cost effective, turnkey solution

**The IP-S2 is a modular system – sensors can be added as required**



**Laser Scanners**

Laser scanners capture high resolution 3D point clouds of roadside features regardless of lighting conditions. Included PC software projects sensor data into 3D global coordinates with accurate time-stamps. Georeferenced panoramas can be produced for visual inspection and detailed analysis such as time-dependent changes in profile, geometry and location.



**IP-S2 Box**

The IP-S2 Box determines precise vehicle position and attitude on a real-time basis using multiple sensors. An integrated dual frequency GNSS receiver tracks both GPS and GLONASS signals expanding the operation area. An inertial measurement unit (IMU) constantly monitors vehicle motion and attitude, allowing the IP-S2 system to track the vehicle position even when driving near obstructions or through tunnels where satellite signals can be blocked.



**Wheel Encoders**

Wheel encoders further enhance positioning accuracy and reliability. Retrofitted to rear wheel axles, the encoder detects rotation of each wheel. Vehicle attitude can be computed even more accurately by comparing difference in rotation speeds between two wheels.



**360° Digital Camera**

The 360° digital camera continuously captures spherical video imagery. Combination with point cloud data significantly enhances the quality of the 3D data and the resulting data analysis.

# IP-S2



Single PC for data collection



Car mount fits standard roof-rack



Ready for future extensions

# IP-S2



## Plug and Play design gives the IP-S2 system full flexibility allowing for your perfect choice of sensors

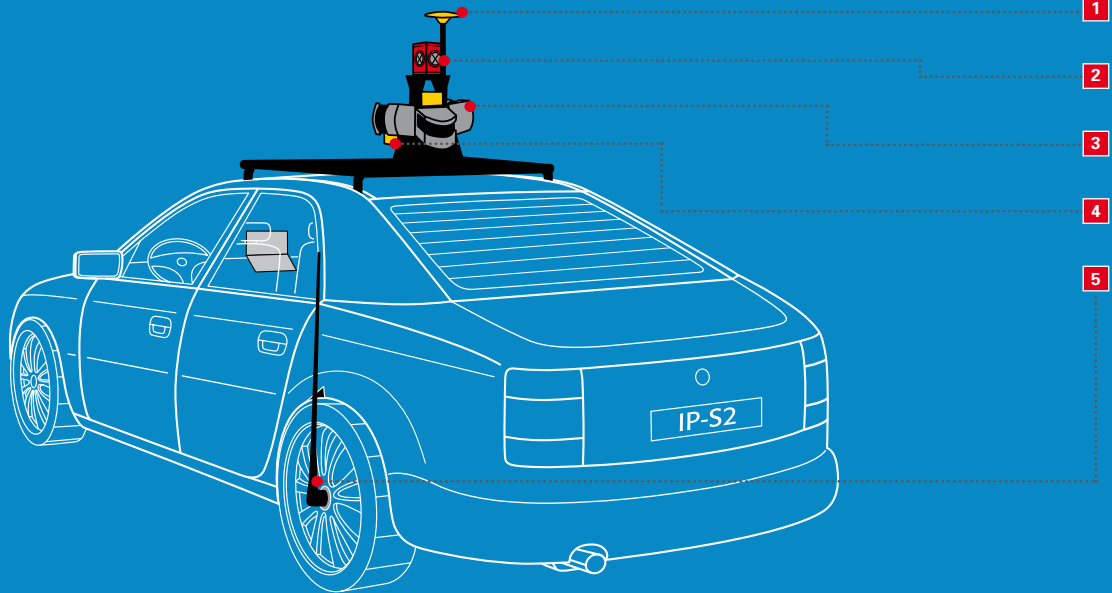
1 GNSS Antenna

2 360° Digital Camera

3 Laser scanners

4 IMU

5 Wheel encoders



### Vehicle Position Metrics\*

Outage Duration	System	Position error (m)		attitude Error (Degrees)		
		2D	H	Roll	Pitch	Heading
0s	IP-S2 (AG58 - 1°/Hr)	0.015	0.025	0.020	0.020	0.040
	IP-S2 (AG60 - 3°/Hr)	0.015	0.025	0.025	0.025	0.050
15s	IP-S2 (AG58 - 1°/Hr)	0.020	0.025	0.020	0.020	0.045
	IP-S2 (AG60 - 3°/Hr)	0.025	0.025	0.025	0.025	0.060
30s	IP-S2 (AG58 - 1°/Hr)	0.040	0.030	0.025	0.025	0.050
	IP-S2 (AG60 - 3°/Hr)	0.055	0.030	0.030	0.030	0.075

Outage results are determined by calculating the RMS of the maximum errors for a minimum of 30 outages. Each outage was selected such that at least 100-second high-accuracy GNSS outputs (fixed ambiguities) were available before and after the outage. All results are based on a forward-and-backward smoothed solution with inertial and wheel sensor data input. Metrics were obtained using PPK (Post Processing Kinematic) solution.

\* Under optimal conditions

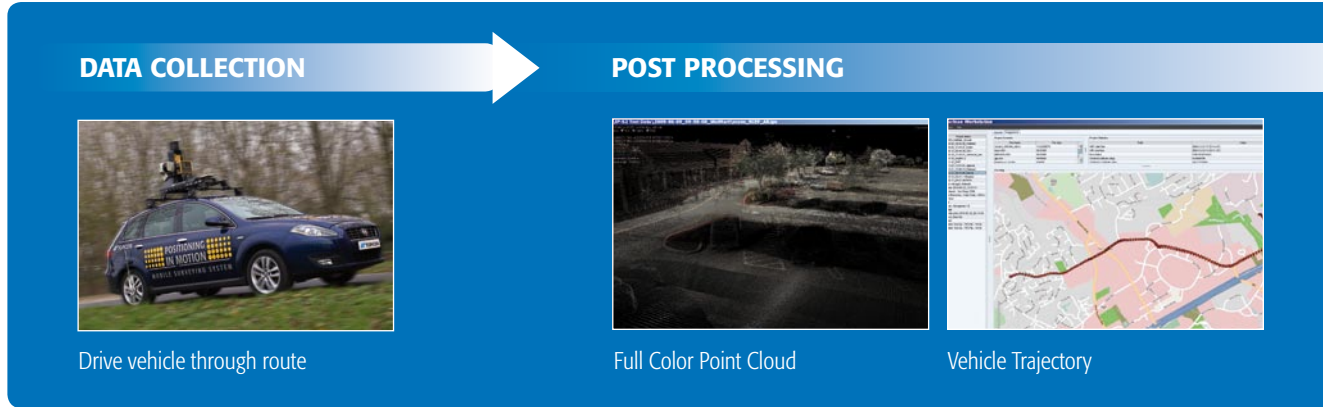
### Supports Multiple Laser Scanners and Other Sensor Integration

With flexible sensor and interface options, powerful automated calibration and high performance filtering the IP-S2 enables applications which demand high precision positioning in diverse and demanding environments. Multiple LiDAR and camera options are supported and additional ports allow for synchronization of custom sensors.

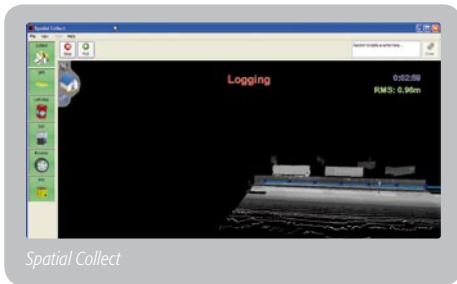
### Integrated, Calibrated Mounting Solution

Turn-key solution delivered fully calibrated and ready to deploy by end-user. Factory calibration using advanced machine learning algorithms enables the system to automatically extract system parameters and tunes the filter for optimal performance.





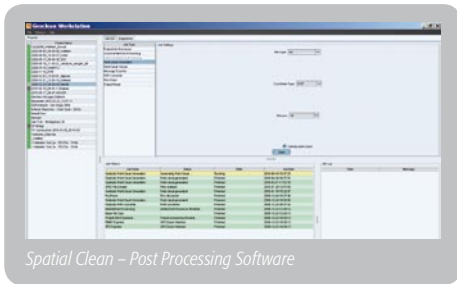
**The IP-S2 Software Provides User-friendly Data Collection and Processing Solutions**



*Spatial Collect*

● **Spatial Collect Software**

This software allows the user to easily control and configure the IP-S2 Box with all connected sensors. It also controls field data capture, storage and display.



*Spatial Clean - Post Processing Software*

● **Spatial Clean - Post Processing Software**

- **GNSS Post Processing**

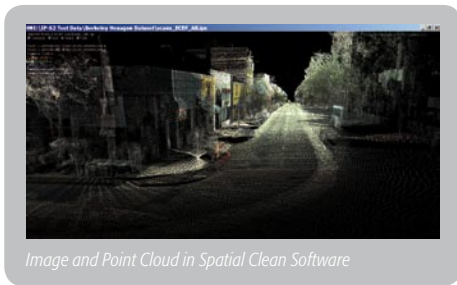
Spatial Clean determines the vehicle positions by mean of continuous kinematic processing using the vehicle mounted GNSS receiver and fixed base station data.

- **Hybrid Analysis for Vehicle Attitude and Location**

By integrating GNSS data with IMU and wheel encoder data, Spatial Clean determines a vehicle attitude correlated to accurate geographical locations.

- **Combining Images and Point Clouds**

Spatial Clean software precisely combines imagery and scanned data to generate insightful full-color point clouds.



*Image and Point Cloud in Spatial Clean Software*

● **Coordinate Conversion Module**

Spatial Clean software converts WGS84 coordinates into local coordinate systems applicable in GIS and CAD projects.

- Projection and datum conversion
- LiDAR point cloud (.las) support
- ESRI ArcGIS .shp, .e00, .gen support
- AutoCAD .dwg and .dxf support
- .kml and .gml support

## WORKFLOW



### Full-color, high-resolution Point Clouds Dramatically Increase Efficiencies in the following areas:

- **Utilities**

Topcon's IP-S2 effectively addresses utility infrastructure needs such as mapping electric and telephone grids in both urban and rural areas. In instances where it has been cost prohibitive to collect location and attribute data due to the time consuming, labor intensive nature of traditional data collection techniques, the IP-S2 now provides a fast and affordable means to create accurate map data. The amount of ground that can be covered in

a day is greatly increased and the number of personnel required to do the job decreases in magnitude. The opportunity for human input error is also greatly decreased. Having expansive and accurate maps and pictures of these utilities benefit the management agencies in many ways such as making quick maintenance decisions right from the office saving field time and costly mistakes.

- **GIS Asset Management**

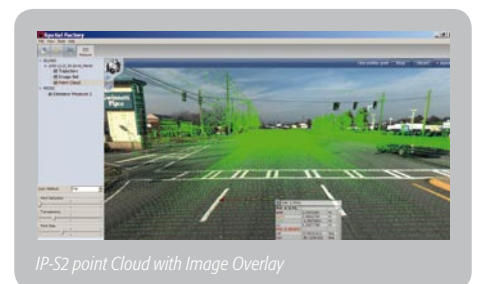
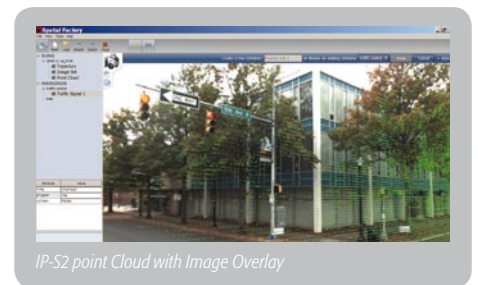
Creating a GIS database of assets can be an overwhelming task as the number of items to map can be immense. Topcon's IP-S2 can simplify the task by obtaining data on all assets in a particular area as the car drives through at normal highway speeds. In addition to location information, asset managers can view descriptive details of the assets using the colorized point cloud image overlay. It is

not necessary to predefine the attribute values needed in the GIS database before fieldwork. All information is in the IP-S2 database and can be extracted at any time after the field work is complete. IP-S2 data can even be exported to a handheld device to navigate to selected locations for update and maintenance

- **Transportation**

Using GNSS alone for data collection of transportation facilities such as roads, highways, tunnels and overpasses can often pose problems as GNSS signals are blocked by nearby buildings and structures. Topcon's IP-S2 becomes a great solution for transportation mapping as the combination of GNSS and IMU sensors allows for continued accurate position updates in GNSS outage areas.

The IP-S2 car can also get data under overpasses and in areas where aerial flyover methods produce no data. A combination of the multiple sensors and the speed and accuracy of the IP-S2 make the system a perfect fit for transportation mapping applications such as highways, railways and roads.



**It's time.**

**The Leader in Positioning Technology...**

Topcon Positioning Systems is the worldwide leading developer and manufacturer of precision positioning equipment and offers the widest selection of innovative precision GPS systems, laser, optical surveying, and machine control products.

From open-field construction projects to isolated surveying sites and from rolling farmland to inner city utility projects, Topcon Positioning Systems creates innovative technology solutions that give a decidedly competitive edge to end-users.

Recognized as the innovative trend-setter in its industry, Topcon has focused on developing an array of integrated positioning and automation technologies to meet the constantly changing demands facing GIS, construction, surveying, agriculture, utilities and law enforcement professionals worldwide. We look forward to building solutions that solve your data collection project challenges today and in the future.



IP-S2



Specifications subject to change without notice.  
©2010 Topcon Corporation. All rights reserved 09/2010

**SPECIFICATIONS**

**IP-S2**

**GNSS COMPONENT<sup>1</sup>**

Channels	Tracking 20 satellites, all-in-view, L1, GPS, L1/L2 GPS, L1/L2 GLONASS, L1/L2 GPS + L1/L2 GLONASS, WAAS, MSAS, EGNOS
Low signal tracking	Down to 30 dBHz
Cold/warm start	< 60 sec / < 10 sec
Reacquisition	< 1 sec
Vibration	Up to 30 g's of dynamic
Advanced firmware function	Multipath Mitigation, Co-Op Tracking
Real time position & raw data	Up to 20Hz update rate
RTCM SC104 v2.1 and 2.2	Input/Output
NMEA 0183 v2.1, 2.2, 2.3 & 3.0	Output

**HIGH-ACCURACY IMU**

Type	Honeywell HG1700
Data rate	100 Hz
Gyro bias/drift rate	1°/hr, 3°/hr

**POWER**

Input supply voltage	10-18V providing 10 amps max current (at 12V)
----------------------	---

**PHYSICAL**

Size	20 x 23 x 10.9 cm (IP-S2 Receiver) / 58.5 x 58 x 67.3 cm (IP-S2 System)
Weight	3.6 kg (IP-S2 receiver) / 22.7 kg (IP-S2 system)

**ENVIRONMENTAL**

Temperature operating storage	-30° to +60°C -40° to +70°C
-------------------------------	-----------------------------

**I/O PORTS**

CAN Bus / Encoder	OBDII - MOLEX-9 Pin / TTL quadrature input
Ethernet / USB 2.0	100 Base-T / Host input/output
RS-232-422	Up to 2Mb/s
High-speed digital I/O (x4)	LVDS 400 Mb/s

**STANDARD LASER SCANNER CONFIGURATION**

Type	Two (2) SICK™ LMS 291-S05, One (1) SICK™ LMS 291-S14
Scanning angle/angular resolution	180°/1° Angular Resolution - LMS 291-S05 90°/0.5° Angular Resolution - LMS 291-S14
Typically measurement accuracy	±45 mm*
Typical range	30 m (Max. 80m with 10% reflectivity)
Date rate	75 Hz sweep

<sup>1</sup> GNSS capable. Currently offered in the GPS only version.

\* Under optimal conditions

Your local authorised Topcon distributor is: