

California

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SSI INERTIAL PROFILING SYSTEMS Technical Specifications



▲ CS9300 Front/Rear Mount ▲

CS9100 Mid-Mount

CS9400 Portable Mount A

System Highlights

- Portable Profiling Options Available
- All Components are Modular
- Class I Profiler under ASTM E950
- Simple, User Friendly Software
- No Annual Factory Calibration Required
- Guaranteed Compliance with Smoothness Specifications
- Zero-Speed Upgrade for 0-113 mph Collections, Through Stoppages
- Zero-Speed Upgrade available on all SSI inertial profiling systems
- GPS-DMI Accurate Within 0.05%
- GPS Features Allow for One-Person Operation
- All-in-One Software Collect, Edit, Report, Export, View
- Components are Interchangeable Between Systems
 - Typical with a CS9100/CS9300 and a secondary CS8700 Lightweight Profiler



CS9300 Front Mount Zero-Speed A



Profiling System and Sensors Specifications:

| Device Compliance | ASTM E950 |
|-------------------------------|---|
| | AASHTO M328, R54, R56, R57 |
| | Any Applicable DOT Test Method |
| Collection Surface Type | Concrete, Asphalt, Gravel, Soil |
| Sampling Interval | 1-inch (25.4mm) at all collection speeds 0-100 mph (0-160 kph), default |
| | User configurable option in SSI Software |
| DMI Options (Accuracy) | Encoder DMI (0.1%) |
| | GPS-DMI or INS-DMI (<0.05%) |
| Collection Speed | 5-113 mph (8-182 kph) |
| Collection Speed | 0-113 mph with Zero-Speed Upgrade, through stoppages (0-182 kph) |
| | Dot Laser, single point |
| Height Sensor Ontions | Line Laser: 4-6 inches (100-150mm) |
| Height Sensor Options | Wide Scan Line Laser: 2.3-feet (0.7-meters) |
| | Sonic Sensor |
| | Dot Laser: up to 32kHz |
| Height Sensor Sampling Speeds | Line Laser: up 5kHz |
| | Wide Scan Line Laser: 5 kHz |
| | Sonic Sensor: 200 Hz |
| Lasor Posolution | Compliant with AASHTO r56 (0.01-inch) |
| | Typical accuracy is 0.002-0.005-inches (0.05-0.1mm) |
| Accelerometer | ±5 to ±10g with 0.0001g resolution |
| | Type 3B/IIIB |
| Laser Rating | Warning: Do not look directly into the laser housing. Laser is UNSAFE for |
| | eye exposure. Wear proper protection when working around laser beam. |
| INS Pitch/Roll Accuracy | 0.02 degrees |
| INS Heading Accuracy | 0.01 degrees |
| | ~0.75-meters with SBAS GPS constellation |
| GPS Accuracy, Horizontal | 4cm with subscription based corrections. |
| | 10mm with RTK |
| GPS Accuracy, Vertical | *Inertial profilers collect relative elevations – GPS elevations are not |
| | used in calculation of profiles |
| | See SSI's survey profiler models CS9500, CS9550, and offroad scanners |

Profiling System Data Accuracy:

| | SSI Inertial Profilers able to measure and preserve profile wavelengths |
|----------------------------|--|
| Profile Features and | from ~0.25-feet to ~8,000-feet (76.2mm to 2,438 meters). |
| Preservation | With optional survey subsystem long wavelengths can be preserved to |
| | theoretically infinite length. |
| Repeatability and Accuracy | Guaranteed compliance with industry standards. Including ASTM E950, |
| | AASHTO M328, R56, and Texas 1001-S. |
| | Guaranteed compliance with all commonly used agency specifications |
| Specification Compliance | and test methods regarding use of inertial profiling systems for quality |
| | control or quality assurance |

Profiling System Electronics and Computer Hardware:

| SSI Electronics Rating | ISO 9001 |
|-------------------------------------|---|
| Core Electronics Housing Size | Portable: 15" x 16" x 8" (38 x 41 x 20 cm) |
| Electronics Power Input | 10-16 VDC; Power regulation components available |
| Electronics Power Draw | 2.4 amps per laser |
| Power Source/Connection | Vehicle Cigarette, Vehicle 7-pin Trailer, Vehicle battery |
| Cabling and Connector Rating | IP67 minimum, including quick disconnect |
| Operating Computer | Mil-Spec Panasonic Toughbook CF-33 or CF-55 |
| Operating Computer Typical Specs | Intel i5 processor, Win10 Pro, 8GB RAM, 512 GB SSD, Gigabit Ethernet |
| | LAN, wireless 802.11 a/b/g/n, Bluetooth, 14.1" HD display – Daylight |
| | Readable, Lithium-ion internal battery. Additional options available. |
| In-Vehicle Workstation | Pedestal Mount system and docking station for operating computer and |
| | power supply. Adjustable computer position between driver and |
| | passenger for safe one-person operation. |

Professionally Engineered Profiling System Mount Hardware:

| CS9300 Front Mount Vehicle | Connection to, or replacement of tow hooks. Horizontal rigid bar mount |
|----------------------------|---|
| Connection | for three points of contact to profiling system. Bolt connection. |
| CS0200/CS0400 Boar Mount | Rear mounted system can connect to any 2-inch Class III receiver. |
| Vehicle Connection | Connected and clamped to hitch with SSI hardware. Core front mount |
| venicie connection | and rear mount systems are interchangeable. |
| CS9100 Mid-Mount Vehicle | Connection to vehicle chassis. Dovetail hardware and cabling remains on |
| Connection | vehicle. Sensors are removed when not in use. |
| (Same as CS8700 LWP) | |
| Laser Standoff Height | Lasers typically stand 12-inches off ground (30.5cm) |
| Distance DMI Hardware | Optical encoder mounted on wheel or use of GPS-DMI |
| Sensor Adjustment | Dovetail hardware supplied for horizontal and vertical adjustment of |
| | sensor modules |
| Custom Vehicle Mounting | Options available for custom vehicle mounting |

Profiling System Software:

| SSI Profiler Software | All-in-one software for calibration, collection, analysis, editing, reporting, |
|-------------------------------|--|
| | and exporting. |
| Software Operating System | Windows 7, 10+ |
| Calibration Routines | Distance, accelerometer, inclinometer (if equipped) |
| Verification Routines | Bounce Test, Laser Height Verification |
| Diagnostic Routines | Real-time monitoring of sensor data and sensor status |
| Software Analysis Units | English or Metric |
| Ride Value Reporting | IRI, MRI, HRI, PRI, RN, RMS |
| Localized Roughness Reporting | Profilograph, IRI short continuous ALR, MRI, HRI, Rolling Straightedge, |
| | Relative Height, Texas 1001-S. |
| Real Time Display | Displays vehicle position and raw elevations during collections |

| Data Collection and Event | (i) Reverse Direction, (ii) Electric-Eye Photocell, (iii) On-the-Fly Hot Key, |
|-------------------------------|---|
| Triggers | (iv) GPS Coordinates |
| Event/Exclusion Input Methods | (i) On-the-Fly Hot Key, (ii) Electric-Eye Photocell, (iii) GPS Coordinates, |
| | (iv) Post-Collection System GPS, (v) Post-Collection Stationing |
| Urban Area Collections | Zero-Speed option allows collection speeds at 0-100 mph, including |
| | through stoppages. Without Zero-Speed option, continuous collection |
| | software suspends data collection below 5mph. Collection resumes with |
| | a vehicle speed above 5mph. |
| Re-Writeable Data | Data can be reanalyzed infinitely to review multiple parameters |
| Configurable Filtering | Low pass, high pass and band pass for Butterworth or Moving Average |
| | type filters |
| Multiple Trace Reporting | Patented multiple profile trace data acquisition and reporting. |
| Export Types | ERD, PPF, PRO, ASCII, CSV, Excel, PDF, GIS shapefiles, Google Earth |
| | KML/KMZ, configurable text (PNEZD, raw sensor, speed, elevations, etc.) |
| Software Licenses | License for each specific user. One perpetual license for SSI Profiler |
| | included with each system. |
| Feedback and Errors | All software errors and feedback is sent to SSI developers |
| Software Updates | Automatic software updates supplied to each user as available |
| Data Encryption | Encrypted raw data files for data integrity security |

Operational & Physical Attributes:

| One Person Operation | Operation can be hands free with GPS assistance |
|--------------------------------------|--|
| Collection Speed | All collections may be made at highway speed without leaving vehicle |
| Operation Ambient Temperature | ~30° to 128°F (~0° to 53°C) |
| Storage Temperature | -22° to 158°F (-30°to 70°C) |
| Humidity | <90% (non-condensing) |
| Wet Pavement or Raining | Pavement must be drier than saturated surface dry. No spraying water |
| Condition | from tires of standing water or ponding on the surface. |
| CS9300 Dimensions | 60" x 8" x 24" (152 x 20.3 x 61 cm) |
| CS9300 Weight | ~75 lbs (34 kg) |
| CS9100 Dimensions | Laser cover: 10" x 7" x 6" (25 x 18 x 15 cm) |
| CS9100 Weight | 35 lbs (16 kg) |
| CS9400 Dimensions | 20" x 8" x 24" (51 x 20.3 x 61 cm) |
| CS9400 Weight | 35 lbs (16 kg) |

Options & Accessories:

| GPS Upgrades and Accuracy | Constellation Upgrades: GPS, Glonass, Beidou, Galileo (~35+ satellites) |
|---------------------------|---|
| | RTK Post-Processing – 10mm horizontal, 20-25mm vertical |
| | NTRIP, data or subscription based corrections (4cm accuracy) |
| Wide Footprint Lasers | Common – typical for high textured pavement: concrete, grooved or |
| | coarse pavement with high voids |
| Rut Depth Measurement | Available in: |
| | 3-point |
| | 5-point (AASHTO PP38) |

| | Full transverse (AASHTO R87 and R88) |
|-----------------------------|---|
| Texture | Macrotexture measurement reporting MPD (ASTM E1845), ETD, RMS |
| | One or multiple track texture measurement |
| Cross-Slope | INS-GNSS instrumentation. Reports within 0.1% of smart level |
| | 5MP, 12MP or 24MP camera for ROW images. Camera images merged |
| ROW Camera | with profile data and embedded with GPS. |
| | May add up to two cameras |
| Down Easing Camora for | Continuous, full lane width images for pavement distresses. Distance- |
| Down Facing Camera 101 | based triggering of images for accurate location measurement and |
| Pavement Condition | timing. |
| | 2D or 3D point cloud survey scanning with additional hardware. Available |
| | with PPK post-processing. SSI software allows to merge correction points |
| Mobile Surveying | for 95% of point cloud within vertical accuracy of 6mm. |
| wobile surveying | Full lane or half-lane with collections. |
| | Typical 2" x 0.5" grid collected at 55 mph (50mm x 12mm at 88 kph) |
| | LAS, PNEZD or DXF export formats. |
| | Collect offroad data with accelerometer only or sonic sensor. Ideal for IRI |
| Terrain Profiling | or RMS assessments of unpaved roads or trails. |
| | Option to export survey grade profiles with PPK processing. |
| | Kvalue export for vertical curve monitoring and assessment |
| Multiple System Integration | Support available to integrate other systems for distress and pavement |
| | management (LCMS/LRMS, GPS, GPS/GIS, etc. |
| Printer | Optional on-board thermal printer |

Support:

| Operator Training | Worldwide multi-lingual on-site operator training available |
|--------------------------------|---|
| Real Time Diagnostics | In-software diagnostics of components, sensors and data streams |
| | Automatic updates sent over internet connection. |
| Software Updates | Manual updates can be easily installed with executable file from SSI |
| | staff. |
| In-Field Component Replacement | All collection system components are portable, modular and can be |
| | replaced in-field |
| Warranty | Industry standard limited warranty on all profiling system components |
| | and accessories. |
| Customer Support | Customer assistance available worldwide by telephonic, e-mail and on- |
| | site assistance (24x7 support available as requested or needed). |

Patented Technology:

SSI profiling systems include technology within the scope of patents granted by (or filed with) the U.S. Patent and Trademark Office. Contact SSI for further patent or other technical information.