GPS Surveying - System 300

SR399 GPS Sensor with built-in Antenna

Satellite Reception	Dual frequency.
Receiver channels:	9 L1 continuous tracking. 9 L2 continuous tracking.
L1 channels:	Carrier phase, P1 code, C/A code.
L2 channels:	Carrier phase, P2 code.
L1 carrier tracking - AS on or off:	Reconstructed carrier phase via C/A code.
L2 carrier tracking - AS off:	Reconstructed carrier phase via P2 code.
L2 carrier tracking - AS on:	Switches automatically to patented P code-aided technique providing full L2 reconstructed carrier phase.
L1 code measurements - AS off:	Carrier phase smoothed code measurements: C/A code narrow correlation. P1 code.
L1 code measurements - AS on	Carrier phase smoothed code measurements: C/A code narrow correlation. Patented P1 code-aided code.
L2 code measurements - AS off:	Carrier phase smoothed code measurements: P2 code.
L2 code measurements - AS on	Carrier phase smoothed code measurements: Patented P2 code-aided code.
Independent measurements:	Fully independent carrier phase and code measurements on L1 and L2 with AS on or off.
Satellites tracked:	Up to 9 simultaneously on L1 and L2.
Time to first phase measurement after switching on:	Typically less than 60 seconds.
Data collection interval:	Selectable, 1 to 60 seconds via Controller.
Cut off angle:	Selectable via Controller.
Satellite health and L2 tracking criteria:	Automatically acquired, but with user override capability via Controller.
Time-mark (pps) output:	Optional.
Accuracy of pps output:	100nsec (3 sigma, without SA).
Selectability of pps output:	Selectable from 1 to 20 seconds, via Controller.
Antenna type:	Microstrip L1/L2 antenna with groundplane built into Sensor.
Mounting:	Tripod with tribrach and carrier or Ranging pole and Quickstand.
Height of phase centre:	
1. Tripod Mounted:	Measured with height hook.
2. Ranging pole & Quickstand:	Fixed heights.
Weight (SR399 + adapter):	2.3kg (5.0lb)

SR9500 GPS Sensor with External Antenna

Specifications for SR9500 are as for SR399 opposite except:

Receiver channels:	12 L1 continuous tracking. 12 L2 continuous tracking.
Satellites tracked:	Up to 12 simultaneously on L1 and L2.
Event input:	Two event input ports can be fitted as an option

SR9500 GPS Sensor

Weight (SR9500 only):	2.6kg (5.7lb)

AT302 external antenna for SR9500

Antenna type:	Microstrip L1/L2 antenna with built in groundplane.
Standard cables, SR9500 to external antenna:	2.8m and 10m
Optional cable, SR9500 to external antenna:	30m
Optional 30cm groundplane:	Detachable
Mounting:	Tripod with tribrach and carrier or Ranging pole and Quickstand.
Height of phase centre:	
1. Tripod mounted:	Measured with height hook.
2. Ranging pole/ Quickstand:	Fixed heights.
Weight (external antenna and adapter):	0.6kg (1.3lb)

CR333 GPS Controller

Function:	Controls GPS Sensor. Steers survey operation. Logs data. Input of point numbers, heights, attributes. Data management.
Display:	Liquid-crystal display. 8 lines of 40 characters. Can be illuminated.
Keyboard:	Full alphanumeric plus PC functions. All functions and alphanumeric input via single-key entries. No double-function or treble-function keys.
User Interface:	Easy to follow menus.
Displayed information:	Satellite status/Satellite health. Satellite-tracking information. Azimuth, elevation, signal to noise ratio etc. Data-logging information. Receiver information. Point numbers. Attributes and codes. Loss of lock information. Stop and Go information. Real-time navigation position. Latitiude, longitude, ell' height in WGS84. Grid co-ordinates in local system. GDOP/PDOP. Local time/GPS time/Time Zone. Real-time Navigation. Waypoints, course, bearing, distance, speed.
Observation types supported:	Static, Rapid Static, Reoccupation, Stop and Go, Kinematic,Kinematic on the Fly Navigation.
Time tags:	Time tagged point numbers and attributes in kinematic chains.
Start sequence:	Manual or automatic.
Automatic wake-up:	Multiple timer missions with wake-up times and duration.
Programmable:	User programmable missions, configuration, start-up sequence etc.
Stop and Go indicator:	Informs operator when sufficient measurements have been taken.
Point id and height entry:	16-character alphanumeric point identifier plus height and antenna offset.
For local co-ordinates:	Ellipsoid, map projection, transformation parameters.
Code and attribute system:	User definable codes and attributes based on layers. Ideal for GIS-type applications. Generated on PC. Transfer from PC to Controller and vice-versa.
Database:	OSW Open Survey World database. Common database between Leica GPS and TPS systems.
Weight without battery: Plug-in battery:	1.0kg (2.2lb) 0.2kg (0.4lb)

CR344 GPS Controller

Display, keyboard, function, capabilities, features:	As for CR333.

Plus

Connects to data-link:	Extra port for connection to a data link (radio modem).
RTCM:	Supports RTCM SC104 v.2.1 input and output when used together with SR399/ SR9500 Sensor.
NMEA:	Provides output of NMEA 0183 v.2.00 sentences.
Runs RT-SKI software:	Supports RTCM SC104 v.2.1. Will run optional RT-SKI Real-Time Static Kinematic software for real-time GPS surveying to centimetre accuracy levels.

Data logging via Controller

Data logging medium:	PCMCIA Cards. Optional 1MB internal memory.
PCMCIA cards:	Type I SRAM cards: 512KB, 2MB. 4MB. Type II FLASH cards: 20 MB
Optional internal memory:	1MB

Recording capacities:

Capacity	5 sats L1/L2 at 15 sec rec rate.	5 sats L1/L2 at 30 sec rec rate.	5 sats L1/L2 at 60 sec rec rate.
512 KB	about 9 hours	about 18 hours	about 36 hours
1 MB	about 18 hours	about 36 hours	about 72 hours
2 MB	about 36 hours	about 72 hours	about 144 hours
4 MB	about 72 hours	about 144 hours	about 288 hours
20 MB	about 360 hours	about 720 hours	about 1440 hours

Input/Output

I/O:	RS-232 and GLAN capability.

Power Requirements (Sensor and Controller)

Power consumption:

SR399 Sensor only:	9 Watts
SR399 & Controller:	12 Watts
SR9500 Sensor only:	10 Watts
SR9500 & Controller:	13 Watts
Supply voltage:	Nominal 12V DC.
Recommended battery:	GEB71 12V, 7Ah NiCd, for up to about 5 to 6 hours continuous operation at 20°C
Can also be used:	GEB70 12V, 2Ah NiCd, for up to about 1.5 hours continuous operation at 20°C Or any other suitable 12V DC power supply.

Code and Phase Measurements

Carrier-phase measurement precision, AS on or off.

On L1 frequency:	0.2mm (rms)
On L2 frequency:	0.2mm (rms)

Differential-Phase accuracy, AS on or off.

Nominal baseline accuracy for differential-phase in static mode:	5mm + 1ppm (rms)

Code-measurement precision, AS on or off.

On L1 frequency:	5cm (rms)
On L2 frequency:	5cm (rms)

Differential-code accuracy, AS on or off.

Nominal baseline accuracy for differential code:	30 to 50 cm (rms)

Baseline Accuracy with SKI Software (post-processing). AS on or off.

Differential-phase	Baseline rms (root mean square)
Static	5mm + 1ppm
Rapid static	5 to 10mm + 1ppm
Reoccupation	5 to 10mm + 1ppm
Stop and Go	10 to 20mm + 1ppm
Kinematic	10 to 20mm + 1ppm
Differential-code	Baseline rms (root mean square)
Static	30 cm
Kinematic	50 cm

Note on Baseline Accuracy

Baseline accuracy is dependent upon various factors including the number of satellites tracked, constellation geometry, observation time, ephemeris accuracy, ionospheric disturbance, multipath and resolved ambiguities.

Single-Point Position Accuracy with SKI Software

Single-point position 3D:	1 to 5m for each co-ordinate, provided that observation time is sufficient to reduce influence of Selective Availability (SA).

Navigation Position Accuracy in Controller

Navigation position 3D:	15m rms for each co-ordinate.

Note: Navigation position accuracy is subject to degradation by DoD Selective Availability (SA) policy. DoD policy is that there is 95% guarantee of 100m accuracy with SA.

Navigation Position Accuracy with RTCM

With CR344 or SPCS for RTDGPS:	Via RTCM corrections
With 4 satellites, good GDOP, and range to reference up to about 100km:	Typically 0.5m (rms)

Observation Times for GPS Baselines

Observation times cannot be defined exactly. Observation times depend upon baseline length, number of satellites, satellite geometry (GDOP), ionospheric conditions, expected accuracy etc. The following provide only a guide:

Differential phase:	Min. 4 sats, GDOP < 8, good conditions.
Rapid Static:	Typically less than 5 minutes for up to 5km. Typically about 5 minutes for 5 to 10km.
Stop and Go:	Typically 2 epochs per point.
Kinematic:	1 epoch.
Differential code:	Min. 4 sats, GDOP < 8, good conditions.
Static:	Typically 0.5 to 3 minutes.
Kinematic:	1 epoch.

Environmental Specifications

Temperature:	Operation	Storage
SR399 Sensor:	-20°C to +50°C	-40°C to +70°C
SR9500 Sensor:	-20°C to +60°C	-40°C to +70°C
External antenna for SR9500 Sensor:	-40°C to +75°C	-40°C to +75°C
CR333 and CR344 Controllers:	-20°C to +55°C	-40°C to +70°C
Leica PCMCIA card:	-20°C to +70°C	-40°C to +70°C
Optional 1MB Internal Memory:	-20°C to +55°C	-40°C to +70°C

Humidity: Up to 95% non-condensing.

Weather: Will withstand rain, snow, dust, sand etc.

Separation Distance Sensor to Controller

Standard survey applications:

With standard cables: 2.8m

With optional 10m extension cable: 12.8m

Special applications:
With 30m extension cables: Up to 150m.
Communication cable only, power needed at both Sensor and Controller.

Separation distance SR9500 Sensor to External Antenna

With standard cables: 2.8m and 10m.

With optional cable: 30m.

Longer cables: Available on request.

Transport Case for Sensor and Controller

The equipment is delivered in a sturdy, waterproof transport case. The case has space for the Controller, Sensor, battery, height hook, cables, memory cards, tribrach and carrier.

Transport Case for External Antenna

The External Antenna is delivered in a separate case. The case has space for the external antenna, cables and optional groundplane.

Software

SKI Static Kinematic Post-Processing Software

Major Components

System Configuration:	Configure to user requirements.
Planning component:	Includes: Satellite visibility PDOP and GDOP Azimuth and elevation Graphical and tabular forms Obstructions Sky plots etc.
Data management:	Full database system. User not concerned with file handling etc. Full project management.
Import of data:	Data transfer from Controller, from stand-alone reader or from back-up disks. Data back-up in Leica System format and RINEX format.
Data processing:	Graphical interface facilitates selection of baselines and processing parameters etc. Data processing fast and fully automatic. Multi-baseline batch processing. User not concerned with data screening, outlier detection, cycle-slip fixing etc. Software handles differential phase and differential code, and all GPS survey modes: Static Rapid Static Reoccupation Stop and Go Kinematic Single-Point Position No restriction to number of baselines.
View and Edit:	Graphical display of observed points, baselines, stop and go chains, and kinematic chains. Comprehensive view and edit facility.
Output:	Output from various components. ASCII files in defined format.
Network Adjustment: (optional)	Least squares adjustment of networks of GPS baselines. Free or constrained adjustment. Output: adjusted co-ordinates and related statistical information.

SKI Software (continued)

Datum and Map: (optional)	Comprehensive map projection, ellipsoid, and data transformation package. Permits the input and output of co-ordinates and defining of ellipsoids and map projections. Includes global geoidal model. Supports user-defined geoidal model. Converts Cartesian to Geodetic co-ordinates, and vice-versa. Also conversion to grid co-ordinates on a defined map projection and vice-versa. Three transformation approaches: i) Classical 3D, 7-parameter transformation between 2 Cartesian systems. ii) 2D transformation of positions between 2 co-ordinate systems. Heights transformed separately. iii) Direct transformation from WGS84 to grid co-ordinates without knowledge of projection, ellipsoid or geoid. iv) One Step transformation from WGS84 to grid coordinates.
Auto Program: (optional)	Highly automated processing from pre-selected reference stations. Ideal for routine GIS-style processing. Output in WGS84 or local co-ordinates. Output formats include: ASCII AutoCAD DXF MicroStation DGN ArcInfo Moss LISCAD CAD
RINEX Import: (optional)	Import of data in RINEX format from non-Leica receivers.
AROF: (optional)	Ambiguity resolution on the fly. Kinematic on the fly without static initialisation and reinitialisation.

Minimum PC Configuration for SKI software

Minimum configuration for SKI:	IBM or Compaq 386 PC or compatible. Math Co-processor. 4MB RAM. Asynchronous communication adapter. Parallel port (for software protection key). 1.4MB 3.5" drive. VGA colour monitor. Mouse installed. Microsoft® Windows™ v.3.1.
Enhanced configuration is preferable:	As above but with: IBM or Compaq 486 PC or compatible. 8MB RAM.

SPCS Sensor PC-Control Software For controlling Sensor from a PC

PC with SPCS software functions as a Controller.
Controls Sensor, steers survey operation, logs data.
Display, control and operation almost exactly as with CR333 Controller.
Data logging on hard disk.
Capacity depends largely on hard disk.
Ideal for certain kinematic operations.

SPCS Sensor PC-Control Software Supporting RTDGPS

As above for SPCS.
Plus following additional capabilities:
- Supports RTCM SC104 V.2.0 input/output.
- Provides NMEA 0183 V.2.00 sentence output.

Display, control, operation and functions almost exactly as with CR344 Controller.

Minimum PC Configuration for SPCS software

Minimum PC configuration for SPCS software (enhanced configuration is preferable)	IBM or Compaq 386 PC or compatible. Math co-processor. 2MB RAM. Asynchronous communication adapter. Parallel port (needed for protection key). 1.4MB 3.5" drive. EGA or VGA colour or monochrome monitor. DOS 5.0 or higher. Note: Additional RS232 ports required for input of RTCM corrections (communication link) and output of NMEA sentences.

Multistation Base-station software

PC with Multistation functions as base station.
Supports any amount of users in area.
Controls Sensor, logs data.
Users can access data files.
Connection to modem and telephone possible.
Output of Real Time messages possible (RTCM v.2.1 or RT-SKI)

Minimum PC Configuration for Multistation software

Minimum PC configuration for Multistation. (Enhanced configuration preferable)	**For data logging only.** IBM or Compaq 386 PC or compatible. 2MB RAM. Asynchronous communication adapter. Parallel port (needed for protection key). 1.4MB 3.5" drive. VGA colour monitor. Mouse installed. Microsoft® Windows™ v.3.1. **For multi-tasking with bulletin board software** IBM or Compaq 486DX or compatible. 8MB RAM. Rest as above.

Note on PC Configurations

Minimum PC configurations for running the software are listed.
Enhanced configurations - 486DX processor with at least 8MB RAM are preferable.

RT-SKI Real-Time Static Kinematic Software

RT-SKI: (optional)	Software for CR344 GPS Controller For real-time GPS Surveying to centimetre-level accuracies.

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G1-543-Oen - II.98 - INT