# Leica ALS Corridor Mapper

## Airborne Laser Corridor Mapper
## Product Specifications

- when it has to be **right**

Leica Geosystems

# Leica ALS Corridor Mapper Product Specifications

## Overview

ALS Corridor Mapper is a compact laser-based system designed for the acquisition of topographic and return signal intensity data from a variety of airborne platforms. The data is computed using range and return signal intensity measurements recorded in flight along with position and attitude data derived from airborne GNSS and inertial subsystems. The ALS Corridor Mapper falls into the category of airborne instrumentation known as LIDAR (*LI*ght *D*etection *A*nd *R*anging). This document establishes the minimum performance requirements for the ALS Corridor Mapper Airborne Laser Scanner, referred to as "the system" herein.

## Key Features

### Basic Design

What is included: The ALS Corridor Mapper is a turn-key airborne LIDAR mapping system. The user can supply a survey-grade dual-frequency GNSS base station (or Leica can supply such a base station) and the post-processing computer (a high-end PC – the latest specifications are given in a separate Technical Note). ALS Corridor Mapper systems include all post-processing software necessary to produce latitude / longitude / elevation / intensity output, and this software is designed to process output for a wide variety of ALS40, ALS50, ALS60 and ALS Corridor Mapper configurations.

Operating Principle: By measuring the location (latitude, longitude and altitude) and attitude (roll pitch and heading) of the aircraft, the distance to ground and scan angle (with respect to the base of the scanner housing), a ground position for the impact point of each laser pulse can be determined.

Typical Configuration: ALS Corridor Mapper systems are typically configured to include the following:

- large-aperture low-inertia/high speed scan mirror. The standard scan mirror is designed for use at altitudes up to 1000 m AGL at fields of view (FOVs) to 75 degrees.
- 4 range counting circuit cards (first, second, third, last)
- return signal intensity/AGC setting capture card (first, second and third return intensities plus AGC setting)
- integral XGA-resolution (1280 x 1024 pixels) digital camera with automatic data annotation

### Accessories

Ground Power Supply: The ALS Corridor Mapper normally operates on 28 VDC. For ground operations, the PS56 ground power supply is provided which allows operation of the system from standard AC (110/220 VAC) mains.

### Standard Components

The ALS Corridor Mapper system consists of the following physical assemblies:
- LS60 Scanner Assembly
- System Electronics (LC60 Laser Controller + SC60 System Controller)
- Interconnecting cables
- OC52 Operator Interface
- Vibration isolated interface plate assemblies for both scanner and electronics
- GNSS + GLONASS antenna

### Scanner Assembly

The Scanner Assembly produces controlled movement of the transceiver aim point by galvanometer actuation of a scan mirror. The aim point of the laser output (relative to the scanner housing) is measured by a high accuracy optical encoder. The scanner is a sealed, desiccated volume with a rigid optical window. The following major components form the Scanner Assembly.

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**Laser Transmitter:** The laser transmitter produces output laser pulses using a diode-pumped transmitter. It also contains an optical trigger output optic, shutter, and beam expansion/collimating optics that bring the laser output to the scan mirror.

**Receiver:** The receiver collects a sample of the laser output pulse and detects laser pulses reflected by the terrain below the aircraft.

**Scanner Mechanization:** A high-performance galvanometer scanner is used to actuate the scan mirror.

**Mirror and Window Assembly:** Standard systems are shipped with a large-aperture low-inertia/high-speed scan mirror optimized for fields of view up to 75 degrees at altitudes to 1000 m AGL.

**Digital Camera:** An XGA-resolution digital camera is included in the scanner. This integrated camera allows a real-time view of the terrain below the aircraft, as well as providing recorded images at fixed intervals. The recorded images contain embedded annotation data. Leica LCam Viewer software allows the user to search for a particular frame by GNSS time, enabling selection of the appropriate frame for any given portion of the LIDAR mission, and accesses the embedded annotation data in order to provide automatic north-up image orientation. Zoom functions are also provided.

**Interface plate:** A vibration-isolated interface plate is provided to allow Scanner Assembly mounting to aircraft already equipped to accept Leica/LH Systems/Wild or other stabilized camera mounts.

## System Electronics

The system electronics assembly contains assemblies responsible for subsystem coordination, raw data measurement and data recording. The following major components make up the System Electronics.

**SC60 System Controller Module:** The system controller controls laser operation, measures range to ground via the high-speed time interval counter, measures the intensity of reflected return signals, generates electrical signals needed to direct the optical scanner, reads the encoded scan angle, reads GNSS timing information and formats all these data for recording on a high-speed data logger.

**IPAS Inertial Position and Attitude System:** This subsystem provides and records master timing and aircraft position/attitude information using a GNSS receiver, a high-accuracy IMU (mounted inside the scanner housing) and an integral processor. The IPAS subsystem records data via an Ethernet connection to the SC60 Data Logger Module.

**SC60 Galvanometer Controller Module:** The galvanometer controller provides drive current to the scanner assembly's galvanometer by comparing a commanded scan position signal (provided by the system controller) to the galvanometer's actual position (provided by the galvanometer's position detector).

**SC60 Data Logger Module:** The data logger stores output from both system controller and IPAS modules, including GNSS timing and position, unprocessed IMU data, range, return signal intensity, synchronization data and scanner position information, for later processing. The data is stored on a removable hard disc drive (HDD). Four removable HDDs are supplied with the system, one in the SC60 System Controller and 3 additional HDDs for rotation from the field back to the processing center.

**LC60 Laser Controller:** The laser controller provides power conditioning, control and optical pump energy for the laser head (located inside the Scanner Assembly).

**SC60 Power Distribution Module:** The power distribution module provides reverse polarity protection, conducted EMI suppression and power connections to each SC60 functional model from a single DC input, as well as providing regulated DC power for the OC52 operator interface and the LC60 scanner assembly.

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## OC52 Operation Controller

The OC52 provides an airborne-qualified, outdoor-readable display platform for operator interface and flight navigation software. The operator interface software provides a graphical user interface for system setup, operation and monitoring. Primary input to the operator interface software is via the OC52's touch-screen display and compact weather-proof keyboard. Both the OC52 display unit and the compact keyboard are mounted to a rugged bracket that provides optimal viewing angles for both display and keyboard. The bracket provided allows mounting on horizontal or vertical surfaces, or on the optional IS40 pedestal or on the PHT50 holder.

## Additional Software

The following software is included with the system:

AeroPlan: This proprietary mission planning template is a subset of Leica FPES Flight Planning and Evaluation Software and is provided to aid users in determining proper system set-up and flight line spacing.

GNSS/IMU Processing Software: Combines GNSS base station data with IPAS airborne GNSS data to provide a DGNSS aircraft position solution; combines the DGNSS solution with Scanner Assembly IMU data to provide smoothed position and orientation data. This software also allows download of real-time (non differentially corrected) position and orientation data for "quick-look" processing.

ALS Post Processor: Assembles trajectory output from GNSS/IMU processing software with raw scanner files into a master data file and processes the master data file into ground coordinates including latitude, longitude, elevation and intensity values. File output is in a variety of projections including WGS84 and UTM as well as in a variety of formats, including:

- ASCII XYZ output compatible with a variety of third-party TIN/contouring software packages, such as TerraSolid's TerraModeler. ASCII output is available in WGS84 and UTM coordinates worldwide, as well as state-plane coordinates in the USA. All coordinate conversions are compatible with CORPSCON.
- Industry-standard LAS file format. The LAS file format is designed to provide maximum flexibility in a single adaptive-header format that offers the speed of a binary implementation.
- User-required custom projections or geoid corrections. Customers can provide the mathematical definitions for custom projections and/or geoid models to Leica Geosystems for incorporation into the delivered post-processing software.
- Gray-scale intensity image output (i.e., x/y/intensity bitmapped images).

## Controls/Indicators

Adequate controls and indicators are provided to allow compliance with CDRH requirements.

Emission Indicator: A laser emission indicator is provided on the underside of the Scanner Assembly. When the Scanner Assembly is installed in the aircraft, the emission indicator is readily visible from points below the scanner output window.

Warning Buzzer: A CDRH-compliant warning buzzer is incorporated into the Scanner Assembly.

Circuit Breakers/Fuses: Circuit breakers or fuses are provided to fuse primary power or limit damage due to an electrical fault inside major subassemblies. The primary (mains) breaker is a 50A magnetic-type breaker for accurate operation over a variety of ambient temperatures.

Control Interface: The ALS Corridor Mapper system is controlled via a graphical user interface (GUI) operating on the OC52 Operation Controller, a high-brightness airborne-qualified touch-screen display with an accompanying rigidly-mounted compact weather-resistant keyboard. The GUI provides multiple modes for normal operation and test. In the normal operation mode, the GUI provides user selection of FOV, scan rate and range gates as well as control over stop/start functions of both laser and data logging. Normal operation mode GUI graphics include display of sub sampled

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range, intensity, height-above-ground and percent return data and continuous monitoring of key subsystems for any error messages generated.  In the test mode, the GUI provides the ability to operate and/or monitor key subsystems individually for diagnostic purposes.  Test mode graphics also include data histogram and "strip chart" display of raw data for diagnostic purposes.  GUI software is designed to run under Windows NT 4.0, 95, 98, 2000 or XP operating systems.

## Technical Specifications

### Critical Item Definition

The ALS Corridor Mapper consists of all hardware and software necessary to meet the specifications herein.  All assemblies are designed for rugged environments sustained on unpressurized light aircraft.  As such, the ALS Corridor Mapper is capable of operation while being subjected to variations in temperature, humidity and altitude experienced in flight.  In addition, surfaces of the system exposed during flight are capable of operation during exposure to precipitation and blowing dust.

### Physical Requirements

Size: The ALS Corridor Mapper is within the following envelope dimensions, as shown in drawings 766097 (Integration Drawing, LS60 Scanner w/o RCD), 766098 (Integration Drawing, LS60 Scanner w/ front-mount RCD) and 766099 (Integrations Drawing, SC60/LC60).  The standard configuration for the System Electronics is a "rackless" 8U-tall assembly on a vibration-isolated interface plate assembly.  Mounting provisions are available on the tops of the front and rear panel handles of the System Electronics for users wishing to install additional equipment (e.g., the CC105 Camera Controller for RCD105).  The standard low-profile interface plate 771406 can be used to allow vibration-isolated mounting of the scanner plus up to 2 CH39 camera heads.

Scanner Assembly Dimensions (NUS4, DUS5 IMUs):

| | | |
|---|---|---|
| Length (no handles, no interface plates) | 23.68" | (602 mm) |
| Length (parallel to flight direction, with handles, no interface plate) | 26.68" | (678 mm) |
| Length (no handles, on 771406 isolated interface plate assembly) | 32.98" | (838 mm) |
| Width (no interface plate) | 14.50" | (369 mm) |
| Width (on 771406 isolated interface plate assembly) | 19.52" | (496 mm) |
| Height (no interface plate) | 10.05" | (255 mm) |
| Height (on 771406 isolated interface plate assembly) | 10.05" | (255 mm) |

System Electronics Dimensions:

| | | |
|---|---|---|
| Depth (including handles, cabling) | 24.50" | (622 mm) |
| Width (bare stack) | 17.63" | (448 mm) |
| Width (on isolated interface plate assembly) | 19.50" | (495 mm) |
| Height (bare stack) | 14.00" | (356 mm) |
| Height (on isolated interface plate assembly) | 16.14" | (410 mm) |

Operator Interface (OC52 + keyboard):

| | | |
|---|---|---|
| Depth (keyboard horizontal) | 9.13" | (232 mm) |
| Width | 11.89" | (302 mm) |
| Height (keyboard horizontal) | 10.12" | (257 mm) |

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Weight:

The maximum weight of ALS Corridor Mapper components is as follows:

| | | |
|---|---|---|
| Scanner (max, with optional CUS6 IMU, incl. Cable) | 93.0 lb | (42.3 kg) |
| Scanner (on 753564 isolated interface plate assembly) | 111.4 lb | (50.7 kg) |
| Scanner (on 756791 isolated interface plate assembly) | 130.2 lb | (59.2 kg) |
| System Electronics (incl. LC60 cable, no interface plate) | 99.0 lb | (45.0 kg) |
| System Electronics (on isolated interface plate ass'y) | 107.0 lb | (48.6 kg) |
| OC52 Operation Controller (with keyboard, bracket) | 7.8 lb | (3.6 kg) |
| OC52 Cable | 1.8 lb | (0.8 kg) |
| Total (systems maximum, on 753564) | 228.0 lb | (103.7 kg) |

Notes: Subtract approximately 5.1 lb (2.3 kg) for systems equipped NUS4 IMU
Subtract approximately 5.6 lb (2.6 kg) for systems equipped NUS5 IMU
Subtract approximately 8.3 lb (3.8 kg) for systems equipped DUS5 IMU

## Mounting

Scanner Assembly: The Scanner Assembly is mounted to the aircraft using the included vibration-isolated interface plate. Mounting features are shown in drawings 766097 (Integration Drawing, LS60 Scanner w/o RCD), 766098 (Integration Drawing, LS60 Scanner w/ front-mount RCD) and 766099 (Integrations Drawing, SC60/LC60). All mounting surfaces are black anodized per MIL-A-8625 TY II CL 2 to resist corrosion. The vibration-isolated interface plates provided to allow Scanner Assembly mounting directly to aircraft already equipped to accept Leica/LH Systems/Wild PAV-series or other stabilized camera mounts. The Scanner Assembly is designed so that no structures protrude below the aircraft floor.

System Electronics: The System Electronics are normally mounted using the included vibration isolated interface plate. Optional mounting "wings" can be designed for installation in standard 19-inch EIA racks.

Interconnecting Cables: Interconnecting cables are unrestrained at the rear panel connections on the System Electronics in order to facilitate disconnection. An integral strain relief is provided where the main cable bundle enters the Scanner Assembly. Retention for the remaining portions of the interconnecting cables must be installed by the end user in such a fashion as to prevent a tripping hazard in the aircraft.

Operator Interface: The Operator Interface is designed for mounting to sturdy horizontal or vertical surfaces, to the optional IS40 mounting pedestal or to the optional PHT50 Holder. Mounting for this assembly should be provided by the user in an appropriate fashion to minimize strain on the high-density connectors used for interface between the SC60 System Controller and the OC52 Operation Controller, and to minimize movement of the assembly or cables when exposed to atmospheric turbulence during flight.

## Environmental Requirements

The system is capable of meeting all performance specifications during or after (as applicable) exposure to the following environments. Such exposure does not result in system damage or shortened useful life.

Operating Temperature: Per ISO 7137 (RTCA/DO-160E) Section 4 Category B1, except that the system is capable of operating at all cabin temperatures over the range of 0 to +40 C.

Pressure Altitude (ambient pressure): Per ISO 7137 (RTCA/DO-160E) Section 4 Category B1, except that the system is capable of operating over the range of sea level to 4000 m (13,000 feet) or equivalent cabin pressure.

Temperature Variation: Per ISO 7137 (RTCA/DO-160E) Section 5 Category B. The system is capable of operating when subjected to temperature variations up to 5 degrees C per minute.

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**Humidity:** Per ISO 7137 (RTCA/DO-160E) Section 6 Category B. The system is capable of operating after exposure to humidity of up to 95 percent, non-condensing.

**Operational Shock:** Per ISO 7137 (RTCA/DO-160E) Section 7 Category E and FAR 27.561. The system maintains mechanical integrity and is capable of operation after exposure to shock of 6 g, 20 ms from any direction.

**Crash Safety:** Per ISO 7137 (RTCA/DO-160E) Section 7 Category E and FAR 27.561. The system maintains mechanical integrity during exposure to loading of 20 g, 3 seconds from any direction.

**Vibration:** Per ISO 7137 (RTCA/DO-160E) Section 8 Category S. The system is capable of operation while subjected to sine vibration of 0.5 mm / fg at 55 Hz to 3.0 g at 150 Hz in any orientation.

**Magnetic Effect:** Per ISO 7137 (RTCA/DO-160E) Section 15 Category A

**Power Input:** Per ISO 7137 (RTCA/DO-160E) Section 16 Category B. Normal operation is sustained over the voltage range of 22.0 – 30.3 VDC.

**Voltage Spike:** Per ISO 7137 (RTCA/DO-160E) Section 17 Category A. The system is designed to sustain voltage spikes of 600 V 10 us.

**Audio Frequency Conducted Susceptibility – Power Inputs:** Per ISO 7137 (RTCA/DO-160E) Section 18 Category B.

**Induced Signal Susceptibility:** Per ISO 7137 (RTCA/DO-160E) Section 19 Category BC

**Radio Frequency Susceptibility (Radiated and Conducted):** Per ISO 7137 (RTCA/DO-160E) Section 20 Category RR

**Emission of Radio Frequency Energy:** Per ISO 7137 (RTCA/DO-160E) Section 21 Category M

**Lightning Induced Transient Susceptibility:** Per ISO 7137 (RTCA/DO-160E) Section 22 Category A3E3X

**Lightning Direct Effects:** Per ISO 7137 (RTCA/DO-160E) Section 23 (applies to GNSS antenna only). Only antennas with FAA 8130-3 Airworthiness Approval Tag are used.

**Icing:** Per ISO 7137 (RTCA/DO-160E) Section 24 Category A (applies to GNSS antenna only). Only antennas with FAA 8130-3 Airworthiness Approval Tag are used.

**Electrostatic Discharge:** Per ISO 7137 (RTCA/DO-160E) Section 25 Category A (+/-15 kV, similar to IEC 6100-4-2).

**Fire/Flammability:** Per ISO 7137 (RTCA/DO-160E) Section 26 Category C

**Operating Attitude:** The Scanner Assembly is designed to operate with system nadir approximately equal to true nadir. Optional forward, rear or side oblique mountings can be provided. System Electronics and Operator Interface hardware are capable of operation in any attitude, given adequate cable clearance and airflow access.

**Rain:** When installed in the aircraft, the underside of the Scanner Assembly is capable of operating while being exposed to rain. Degraded maximum range and accuracy are expected when operating under these conditions.

**Sand and Dust:** When installed in the aircraft, the underside of the Scanner Assembly is capable of operating while being exposed to blowing sand and dust as defined in MIL-STD810D, Method 510.2, Procedure I (blowing dust) and Procedure II (blowing sand) equating to a reduced visibility of 10,000 m. Degraded maximum range and accuracy are expected when operating under these conditions.

**Wind:** When installed in the aircraft, the underside of the Scanner Assembly is capable of operating while being exposed to sustained wind speeds up to 200 knots.

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## Performance Requirements

**Slant Range:** The recommended maximum slant range for the system is approximately 1274 m (see graph describing maximum pulse rate for given slant range). Systems can be operated at longer slant ranges, though low-reflectivity targets may not produce adequate signal for detection, resulting in “drop-outs” over areas of low reflectivity, such as freshly-paved asphalt. Recommended minimum slant range is 200 m.

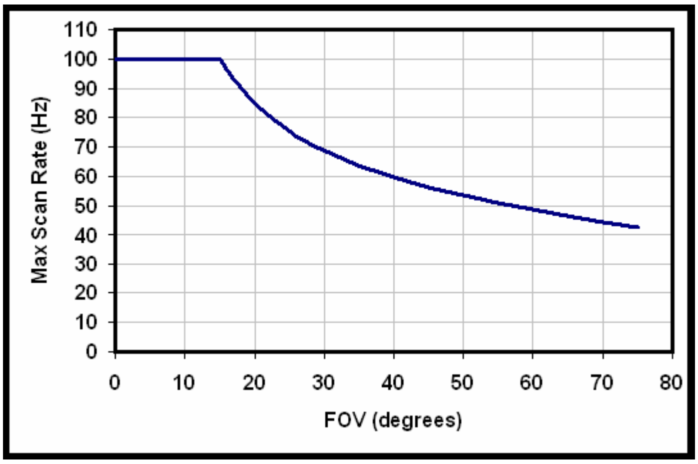
**Field of View (FOV):** System FOV is adjustable over the range of 0-75 degrees, in 1-degree increments. Contact Leica Geosystems for inquiries regarding maximum unvignetted FOV for installation in specific aircraft.

**Scan Rate:** Maximum scan rate degrades as a function of increasing FOV. Systems equipped with the standard scan mirror are capable of scan rates up to a maximum value approximately defined by:

$$\text{Scan rate in Hz} = 0.0000000052837977\ FOV^6 - 0.0000016389933\ FOV^5 + 0.00021185838\ FOV^4 - 0.014764005\ FOV^3 + 0.59674918\ FOV^2 - 14.099895\ FOV + 217.51259,$$

Where FOV is full-angle, specified in degrees.

Scan rate maximum limits are summarized in the graph below:




The scan rate is user-selectable from 0 to 100 Hz in 0.1 Hz increments via the graphical user interface. System control software prevents out-of-range inputs for scan rate based on user selection for FOV.

**Scan Pattern:** The system provides a sinusoidal scan pattern in a plane nominally orthogonal to the longitudinal axis of the scanner, nominally centered about nadir.

**Illuminated Footprint:** Output beam divergence is 0.22 mr nominal, measured at the $1/e^2$ point. For reference, this is equivalent to 0.15 mr measured at the 1/e point.

**Pulse Rate:** The maximum achievable pulse rate of the system is affected by the range gate setting (maximum range setting). The graph below summarizes maximum pulse rates at various flying heights, assuming a 40-degree FOV.

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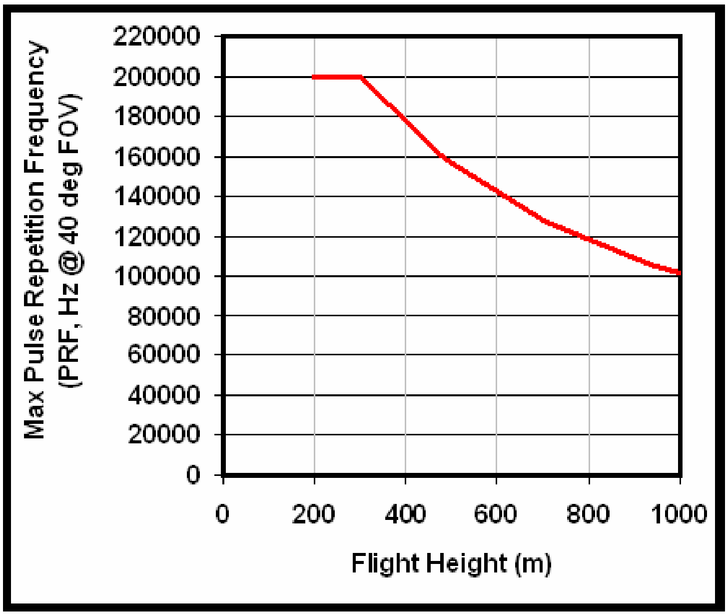


The range gate maximum setting is user selectable via the graphical user interface during flight.

Multiple targets: The system is capable of detecting up to 4 targets for each outbound laser pulse (first, second, third, last) provided each target results in adequate signal strength for detection. Vertical discrimination distance is approximately 3.5 m.

Multi-Return Intensity: Systems are shipped with a multiple-return intensity measurement feature. With this feature, the sizes of the reflected returns at various levels of the forest canopy (up to the first three returns) are measured in addition to the distances to each reflecting surface measured by the range counting cards. An 8-bit scale is used. The ability to digitize either the signal strength or the range to the reflecting surface is dependent on the surface having adequate reflectivity.

AGC Setting Capture: The system digitizes the AGC value being used during detection of each return. An 8-bit scale is used.

Accuracy: The system produces data after post processing with a lateral placement accuracy of 8 – 9 cm and vertical placement accuracy of 6 - 18 cm (one standard deviation) from full-field-filling targets of 10 percent diffuse reflectivity or greater with atmospheric visibility of 23.5 km or better for flying heights up to 1000 m AGL and nominal FOV of 40 degrees. Accuracy estimates for particular mission profiles (i.e., flying height above terrain and position within FOV) are shown below and can be provided in detail by using the AeroPlan mission planning template. Estimates below are made assuming a 40-degree FOV and a nominal 5 cm GNSS error.

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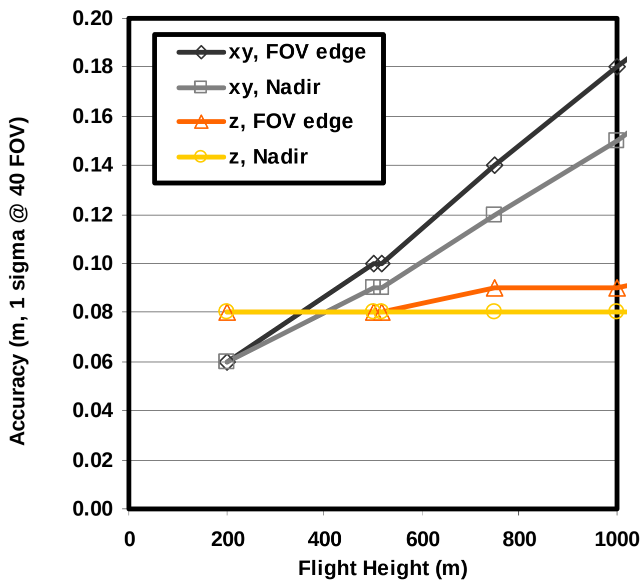


**Side Lobes:** The laser output beam does not have any side lobes outside the main beam.

**Input Voltage:** The system is powered by 28 VDC nominal.

**Input Power:** The system is designed to minimize damage due to out-of-range supply voltage. Maximum average power draw is 910 watts.

**Reverse Polarity Protection:** The system is designed to sustain accidental exposure to reverse polarity applied to the main power input. The system will not operate under such a condition.

**Laser Output Shutter:** The system has an integrated shutter allowing full output or complete obscuration of the output laser beam. The assembly is remotely actuated using the graphical user interface software. The assembly provides status signals to the system controller sufficient to allow confirmation of assembly position (closed or open).

**Laser Output Control:** The system provides control over laser output over approximately 100:1 range.

**Hazardous Voltage Exposure:** When the system is installed in the aircraft, no exposure to potentially harmful voltages is possible.

**Beam Uniformity:** The ratio of the laser's peak beam intensity to average beam intensity should not exceed 4:1.

**Warm-Up Time:** The system is ready for use within 10 minutes of application of primary power.

**Duty Cycle:** The system is capable of continuous operation at maximum pulse rate. Maximum recording time is defined below.

**Recording Capacity:** The system has a nominal recording capacity of approximately 18 hours when operating at maximum pulse rate.

**Built-In Test (BIT):** The system has a BIT mode that provides simulated multiple-return target signals to the range finding subsystem. These signals allow system self-test of all range processing circuits.

**Electrical Connectors:** Connectors will not disconnect or become loose under the environmental conditions specified elsewhere in this document during the service life of the equipment. All connectors are keyed and/or labeled where needed to prevent damage due to improper mating.

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Electrical Interface: The electrical interfaces to the ALS Corridor Mapper are as shown in the Interconnect Drawing, ALS Corridor Mapper.

Sighting Window: A sighting window is provided on the Scanner Assembly. The sighting window allows the user to view the condition of the scanner output window from inside the aircraft for evidence of fogging, icing or gross contamination. The sighting window provides high visible light transmission while providing attenuation of 1064 nm laser energy with an optical density of 6.0 or greater.

Pressure Relief: The Scanner Assembly features a pressure relief valve to prevent pressure or vacuum build-up of more than 0.5 PSI (differential).

Desiccation: The Scanner Assembly has provisions for a disposable desiccant packet to remove moisture from any air entering the scanner housing via the relief valve. Desiccation is adequate to prevent fogging or condensation on the interior of the scanner housing when operated in the environments specified elsewhere in this document.

Post Processing Software: Software is provided which processes raw data collected in the air and on the DGNSS base station and produces an output data set in WGS84 coordinates. Industry standard LAS format is used for output of the post processed data. Post processing software is designed to run under Windows 2000 and XP operating systems.

## Documentation

Test Report: Each system is supplied with an outgoing test report. Unless otherwise specified, all data are provided at maximum pulse rate. The test report provides at least the following information:

- Beam diameter (1/e and $1/e^2$, nominal), at the exit aperture of the beam expander
- Beam divergence (1/e and 1/ $e^{2}$, nominal)
- Pulse width (Full Width Half Max)
- Maximum single-pulse energy
- Emitted wavelength
- IMU offset (boresight) settings
- Encoder and range calibration offsets, including IBRC

User Documentation: User Documentation is provided with the delivered system. This documentation includes the following:

- Safety Data
- Unpacking instructions
- System description, including concept of operation and functional descriptions of subsystems
- Interfaces
- Installation instructions
- Operation instructions
- Post processing instructions, including boresight calibration
- Preventive maintenance instructions
- Trouble-shooting instructions

Proprietary information is supplied at the discretion of Leica Geosystems. All technical data shall remain proprietary to Leica Geosystems and is provided for the sole purpose of assisting in system usage and maintenance.

Software Documentation: Leica Geosystems provides detailed documentation of any user-accessible software interfaces, including a complete description of command syntax and error codes, if used.

## Support and Maintenance

Systems include three (3) one-week training sessions at the customer's site to support installation, operator training and processing technician training. Additional training support is available on a fee-for-service basis. An extended support program including provisions for replacement parts and labor can also be purchased. Extended support programs do not cover limited life and/or damage sensitive items.

Whether you want to capture airborne data of an agricultural area or of a city, record the challenges in a disaster area or the expanse of a high tension line, you need reliable measurements and solutions for your entire workflow to build image-based maps. Leica Geosystems' broad array of airborne sensors and integrated software solutions capture data efficiently, reference imagery accurately, measure easily, analyze and present spatial information in 3D.

Those who use Leica Geosystems products every day trust them for their precision, their seamless integration and their superior customer support. When data really counts, Leica Geosystems delivers geospatial imaging solutions with precision, integration and service.

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