ALS50 Airborne Laser Scanner

Overview

The Leica ALS50 Airborne Laser Scanner is a laser-based system designed for the acquisition of topographical and return signal intensity data from a variety of airborne platforms. The data is computed using laser range and return signal intensity measurements recorded in-flight along with position and attitude data derived from airborne GPS and inertial subsystems. The ALS50 falls into a category of airborne instrumentation known as LIDAR (LIght Detection And Ranging).

Introduction

This document establishes the minimum performance, design, development, and test requirements for the ALS50 Airborne Laser Scanner, referred to as "the system" in these pages.

Product Description

Leica
Geosystems

Key Features

Basic Design

What is Included: The ALS50 is a turn key airborne LIDAR mapping system. The user can supply a survey-grade dual-frequency GPS base station (or Leica Geosystems can supply such a system, based on the SR530 series GPS units) and the post-processing computer (a high-end PC with appropriate removable HDD bays — the latest specifications are given on the Leica Geosystems Web site, gis.leica-geosystems.com; Leica Geosystems can supply this component as well if required). ALS50 systems include all post-processing software necessary to produce latitude/longitude/elevation output, with optional latitude/ longitude intensity and this software is designed to process output for a wide variety of system configurations.

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

Typical Configuration: ALS50 systems are typically configured to include the following:

- Low-inertia/high-speed scan mirror. The standard high-speed scan mirror is well proven for altitudes of up to 3000 m at fields of view (FOVs) to 75°, and may provide a suitable collection aperture for operation to 4000 m AGL.
- 3 Range-counting circuit cards
- Return signal intensity/AGC setting capture card
- 1 Spare range-counting card slot

Options

Ground Power Supply: The ALS50 normally operates on 28 VDC. For ground operation, a ground power supply is available which allows operation of the system from standard AC (110/220 VAC) mains.

Customer Feedback and Accuracy

Customer feedback is very positive, and all indications are that the system is superior to other manufacturers' offerings on performance, reliability and especially price.

- System vertical accuracies in the 15 cm range are consistently reported.
- Horizontal accuracies are a little lower than vertical, but always well below 1 m.
- Vertical accuracies of 6-10 cm are regularly seen during calibration testing.

Standard Configuration

The ALS50 system consists of the following physical assemblies:

- Scanner assembly
- Equipment rack
- Interconnecting cables
- Laptop control computer

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 volume with a rigid optical window. The following major components form the scanner assembly:

Laser Transmitter: The laser transmitter produces output laser pulses using a diode-pumped Nd:YVo^4 transmitter. It also contains a beam sampling optic, shutter/2-position attenuator assembly, beam expander/collimator and output optics that bring the laser output to the scan mirror.

Receiver: The receiver collects a sample of the output laser 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 low-inertia/high speed scan mirror optimized for fields-of-view up to 75° at altitudes to 3000 m AGL. Sufficient collection aperture is provided to allow operation at altitudes to 4000 m AGL, depending on conditions.

Interface Plate: An interface plate is provided to allow scanner assembly mounting directly to aircraft already equipped to accept Leica/LH Systems/Wild or other stabilized camera mounts.

The scanner assembly is designed so that the window cell, which normally protrudes through the aircraft floor, is significantly less than 18 inches in diameter (the typical clearance hole for Leica/LH Systems/Wild RC-series cameras).

Equipment Rack

The equipment rack contains electronic assemblies responsible for subsystem coordination, raw data measurement and data recording. The following major components make up the Equipment Rack:

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

Aircraft Position and Orientation System (POS): The POS provides and records master timing and aircraft position/attitude information using a GPS receiver, a high-accuracy IMU (mounted to the scanner housing) and an integral processor with PCMCIA flash storage.

Galvanometer Controller: 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).

Data Logger: The data logger stores output from the system controller, including range, timing and scanner position information, for later processing. The data is stored on a removable hard disc drive.

Laser Power Supply: The laser power supply provides power conditioning, control and optical pump energy for the laser head (located on the Scanner Assembly).

Power Distribution Module: The power distribution module provides separate primary power connections to each equipment rack subsystem from a single mains input, as well as providing regulated DC power for the laptop control computer.

Laptop Control Computer

The laptop control computer provides a high-brightness-display platform for operator interface software. This software provides a graphical user interface for system setup, operation and monitoring. Primary input to the graphical user interface is via the laptop's touch-screen display.

Post-Processing Software

The post-processing software smoothes POS data, assembles POS and data logger files into a master data file and processes the master data file into WGS84 ground coordinates. All systems include post-processing software that takes the raw data recorded during flight through to latitude, longitude and elevation points on the ground and includes intensity values. Default output is in a compact binary format in WGS84 coordinates. This format is available for archival purposes, and is generally about one-third to one-half the size of equivalent ASCII data.

Also included is a software module allowing conversion to ASCII output compatible with a variety of TIN/contouring software packages, such as Terrasolid's TerraModeller. 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.

The post-processing software also provides output in the new industry-standard LAS file format. This format is designed to provide maximum flexibility in a single adaptive-header format that offers the speed of a binary implementation.

Customers can provide custom projections to Leica Geosystems for incorporation into the delivered post-processing software. Leica Geosystems can also provide a module that creates grayscale elevation or intensity bitmap images.

Controls/Indicators

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

Emission Indicator: A laser emission indicator is provided. 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. The buzzer is co-located with the emission indicator to maximize audibility from points below the scanner output window.

Circuit Breakers and Fuses: Circuit breakers or fuses are provided to fuse prime power and limit damage due to an electrical fault inside major subassemblies.

Diagnostic Output: Diagnostic data output is provided on a single, dedicated output connection on the system controller. This connection is accessible without removal of any access panels. An industry-standard D-subminiature connector is used. Serial messages use an RS-232 protocol. Baud rate is 19200.

Control Interface: The ALS50 System is controlled via a graphical user interface (GUI) operating on a rugged notebook-type computer featuring a high-brightness touch screen display. The GUI provides two modes of operation: normal and test. In the normal operation mode, the GUI provides user selection of FOV, scan rate and range gate as well as control over stop/start functions of both laser and data logging. Normal mode GUI graphics include display of sampled range/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 the Windows NT 4.0, 95, 98 or 2000 operating systems.

Technical Specifications

Critical Item Definition

The ALS50 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 ALS50 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 ALS50 is within the following envelope dimensions, as shown in drawings 700O046001 (Outline Drawing, Scanner Assembly, ALS50) and 700O036011 (Outline Drawing, Equipment Rack, 24 VDC. The standard configuration for the Equipment Rack is an 11-U vibration-isolated rack-mount shipping container. A 21-U shipping container is available as an option.

Scanner Assembly Dimensions:

Length (parallel to fuselage,no interface plate)	22.00" (558.8 mm)
Length (with PAV30 interface plate)	25.83" (656.1 mm)
Width (no interface plate)	15.00" (381.0 mm)
Width (with PAV30 interface plate)	20.87" (530.1 mm)
Height (including interface plate)	9.00" (228.6 mm)

Equipment Rack Dimensions:

Depth (bare rack, including handles, cabling)	27.00" (685.8 mm)
Depth (in shipping container, no covers)	28.25" (717.6 mm)
Depth (ship container, with covers)	
(11-U)	35.25" (895.4 mm)
(21-U)	37.25" (946.2 mm)
Width (bare rack)	19.00" (482.6 mm)
Width (rack in shipping container)	27.00" (685.8 mm)
Height (bare 11-U rack)	20.63" (524.0 mm)
Height (bare 21-U rack)	38.13" (968.5 mm)
Height (rack in 11-U container)	29.13" (739.9 mm)
Height (rack in 21-U container)	46.63" (1184.4 mm)

Laptop Control Computer Dimensions (display closed):

Depth (including carry handle)	10.50" (262.5 mm)
Width	12.00" (304.8 mm)
Height	2.30" (58.4 mm)

Weight: The maximum weight of ALS50 components is as follows:

Scanner (no interface plate)	65 lbs. (29.5 kg)
Scanner (with interface plate)	80 lbs. (36.4 kg)
Equipment Rack (11-U, non-iso install)	144 lbs. (65.4 kg)
Equipment Rack (11-U, iso install)	185 lbs. (84.1 kg)
Equipment Rack (11-U, ship weight with covers)	207 lbs. (94.1 kg)
Equipment Rack (21-U, non-iso install)	147 lbs. (66.8 kg)
Equipment Rack (21-U, iso install)	195 lbs. (97.5 kg)
Equipment Rack (21-U, ship weight with covers)	226 lbs. (102.7 kg)
Laptop Control Computer	9 lbs. (4.1 kg)
Total	262+ lbs. (99.1 kg)

Mounting

Scanner Assembly: The scanner assembly is mounted to the aircraft using the mounting features shown on Drawing 700O046001 (Outline Drawing, Scanner Assembly, ALS50). The mounting surface is flat so that the possibility of warping the scanner housing is minimized. If stainless steel is used, the mounting surface is passivated per QQ-P-35 or, if aluminum, treated with chemical film per MIL-C-5541 CL 1 or black anodize per MIL-A-8625 TY II CL 2. An interface plate is provided to allow scanner assembly mounting directly to aircraft already equipped to accept a Leica/LH Systems/Wild PAV series or other stabilized camera mounts (see Leica Geosystems drawing number 736M043).

The scanner assembly is designed so that any structures protruding through the aircraft floor are less than 18" in diameter (the typical clearance hole diameter for Leica/LH Systems/Wild RC-series cameras).

Equipment Rack: The equipment rack is normally mounted using cargo straps. Optional mounting brackets can be provided. The optional mounting brackets are installed on the outside of the rack-mount shipping container. Modifications to the rack structure can also be made to allow alternate mounting, with the approval of Leica Geosystems.

Interconnecting Cables: Interconnecting cables are permanently restrained at a lower rear corner of the equipment rack, and at appropriate points on the scanner assembly. Retention for 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.

Laptop Control Computer: The laptop control computer should be mounted in an appropriate fashion to minimize strain on the high-density connectors used for interface with the Equipment Rack, and to minimize movement of the computer when exposed to atmospheric turbulence during flight.

Finish: Surfaces of components that are exposed to external environments after installation in the aircraft are black anodized per MIL-A-8625 TY II CL 2. Exterior surfaces that, for design reasons, cannot be coated as above (e.g. connectors and optics) are suitably protected from corrosion due to exposure to the outdoor environments specified elsewhere in this document.

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: The system is capable of operating at all temperatures over the range of 0 to +35° C.

Vibration: The system is capable of operation while subjected to vibrations of 0.5 g at 50-350 Hz in any orientation.

Shock: The system maintains mechanical integrity and is capable of operation after exposure to shock of 10 g from any direction.

Humidity: The system is capable of operating over the humidity range of 10 to 90 percent, non-condensing.

Pressure Altitude (Ambient Pressure): The system is capable of operating at all altitudes over the range of sea level to 3048 m (10,000 feet) or equivalent cabin pressure.

Operating Attitude: The scanner assembly is designed to operate with system nadir approximately equal to true nadir. The equipment rack is capable of operation in any attitude, given adequate cable clearance and airflow access.

Rain: When installed in the aircraft, the scanner assembly is capable of operating while being exposed to rain. Degraded maximum range and/or accuracy is expected when operating under these conditions.

Sand and Dust: When installed in the aircraft, the scanner assembly is capable of operating while being exposed to blowing sand and dust as defined in MIL-STD-810D, 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/or accuracy is expected when operating under these conditions.

Wind: When installed in the aircraft, the scanner assembly is capable of operating while being exposed to sustained air speeds up to 200 knots.

Performance Requirements

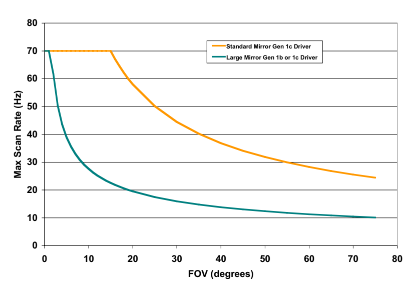
Slant Range: The recommended maximum slant range for the standard low-inertia/high-speed scan mirror configuration is approximately 3800 meters (see graph for pulse rate), though some standard mirror systems have achieved slant ranges to 4300 meters. Recommended minimum slant range is 500 meters.

Field of View (FOV): FOV is adjustable over the range of 10 - 75 degrees. Contact Leica Geosystems for inquiries regarding installation in a specific aircraft.

Scan Rate: Maximum scan rate degrades as a function of increasing FOV. Systems equipped with the standard low-inertia/high-speed scan mirror are capable of scan rates up to a maximum value approximately defined as:

scan frequency in Hz = 412.33 x FOV in degrees $^{-0.6548}$

Scan rate maximum limits are summarized in the graph below:

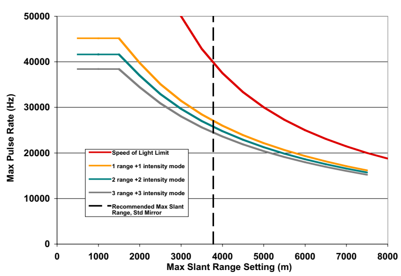


The scan rate is user-selectable from 0 to 70 Hz in 0.1 Hz increments via the graphical user interface. System control software prevents out-of-range inputs for scan rate based on the user selection for FOV.

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

Instantaneous FOV: Output beam divergence is 0.33 milliradian nominal, measured at the $1/e^2$ point.

Pulse Rate: The maximum achievable pulse rate of the system is affected by both the range gate setting (maximum range) and the operational mode selected (i.e., 1+1, 2+2, 3+3 — see additional descriptions of intensity and multi-mode features and graph below). Both the range gate maximum setting and operating mode are selectable via the graphical user interface during flight. The pulse rate used by the system for a given mode and range gate maximum will be the point where a vertical line drawn up from the X-axis at the maximum slant range setting intersects the colored line for the particular mode chosen.



For example, a system set to collect data at maximum slant ranges of 2300 meters would be capable of operating at a pulse rate of 34 kHz in the 2+2 mode. In 1+1 or 3+3 modes, the system would be able to operate at around 37 kHz and 30 kHz, respectively. For most flying heights, these are the highest pulse rates advertised for a standard, commercially available system. For the user, this means the tightest possible post spacing between points acquired on the terrain.

Conversely when the system is set to a longer maximum range, two things happen: (1) the maximum attainable pulse rates are lower and (2) the difference between the maximum pulse rate in various modes are smaller. For example, a system set to collect data at maximum slant ranges of 5000 meters would be capable of operating at a pulse rate of 21 kHz in the 2+2 mode. In 1+1 or 3+3 modes, the system would be able to operate at around 22 kHz and 19 kHz, respectively.

Multiple Targets: The system is capable of detecting up to 3 targets for each outbound laser pulse, provided each target results in adequate signal strength for detection. Installation of more than 3 range-counting cards is not recommended owing to the extremely low occurrence of more than 3 returns and the fact that the maximum allowable pulse rate will be further reduced with the installation of each additional range-counting card.

Multi Return Intensity: Systems are now shipped with a multiple-return intensity feature. In this feature, the sizes of the reflected returns at various levels of the forest canopy are measured in addition to the distances to each reflecting surface measured by the range-counting cards. The ability to digitize either the signal strength or the range to the reflecting surface is dependent on the surface having adequate reflectivity.

Intensity images can be used as an aid to the filtering out of buildings, or as a basis for additional feature collection. The intensity image will reveal surface changes not visible in the elevation data. For example, the intensity image can reveal the presence of differing surface materials by detecting the higher or lower reflectivity of a surface, even though it may lie at the same elevation as the surrounding terrain (e.g., a black roadway through grassy terrain). The same ability to distinguish differing surface materials can also be used as an aid to filtering out unwanted terrain features (e.g., vegetation) while retaining critical ones (e.g., rock outcrop).

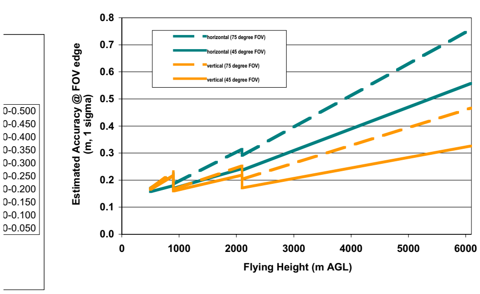
Two features of the ALS50 intensity capture function deserve note. First, the ALS50 has the ability to determine the intensity for up to 3 return reflections from each outbound laser pulse. For users interested in the shape of the waveform for individual pulse returns (e.g., forestry research applications), this 3-return intensity starts to approach that capability by providing 3 amplitudes and 3 ranges (given adequate signal strength). Since the major characteristics of the returned pulse train (timing and amplitude) are recorded, rather than a fully digitized waveform, there is little or no degradation of maximum pulse rate.

The second highlight of the intensity capture function is the ability to record the gain of the receiver subsystem at the time of each laser shot. This gives the unique ability to monitor system performance while post processing. This valuable information can help the user to establish or adjust operational settings that are unique to a particular application. In addition, the recorded AGC value can be used in the ALS50 post processor's unique intensity normalization function. This intensity normalization function adjusts the recorded raw intensity values for variations in slant range, flying height and system AGC gain value. By digitizing the intensity after application of an adjustable gain (AGC) stage, the effective dynamic range of the intensities that can be measured is expanded. Raw intensity (after application of variable gain) is digitized at the 8-bit level (i.e., 256 levels). The use of an automatic gain control effectively increases the dynamic range by almost 4 additional bits, allowing data collection at a greater variety of flying heights than can be accommodated by an intensity capture feature that does not use an AGC.

Multi-Mode Operation: Multi-mode operation puts some of the basic system configuration in the hands of users. Depending on the data depth needed, the user can select, in flight, the number of range returns and their associated intensity measurements. There is no need to collect more data than that required for the job. In sparsely vegetated terrain, the user can opt for only a single return range measurement with its associated intensity value (1+1 mode). In areas where multiple returns are likely, the 2+2 or 3+3 modes can be selected. The 3+3 mode can potentially be used as a proxy for waveform digitization, as mentioned above.

In addition to reducing the burden of data storage and processing, the selection of the lower-order modes (1+1 and 2+2) result in the ability to use the system at higher pulse rates, as described above. Although the difference in maximum pulse rate for 1+1 and 3+3 modes is small at long slant ranges, the difference is more pronounced when the system is set for shorter maximum slant ranges.

Accuracy: The system produces data after post-processing with lateral placement accuracy of 0.3 meters and vertical placement accuracy of 0.2 meters (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 3000 m AGL. Accuracy estimates for particular mission profiles (i.e. flying height above terrain and FOV) are shown in the graph below, and can be provided in detail by using the AeroPlan mission planning template. The system is calibrated at maximum pulse rates and use at lower pulse rates may require system re-calibration.



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

Laser Optical Pump Life: The system usable life before replacement of the laser's optical pumping device is at least 3000 hours.

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

Input Power: The system draws less than 900 watts while operating, 1100 watts maximum. The system will not sustain damage due to out-of-range voltage.

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.

Integrated Shutter and Attenuator: The system has an integrated shutter and two-position attenuator assembly, allowing full output, attenuated output (1:3 and 1:10 attenuation) or complete obscuration of the outbound laser beam. The assembly is manually actuated. The assembly provides status signals to the system controller sufficient to allow confirmation of assembly position (closed, 1:10 attenuated, 1:3 attenuated or open).

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 system 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 capacity is defined below.

Recording Capacity: The system has a nominal recording capacity for scanner raw data of approximately 6 hours when operating at maximum pulse rate in 3+3 mode. A record is defined as all data associated with a single outbound laser pulse. Maximum recording time of the POS subsystem is limited to approximately 10 hours with the standard 1.0 GB PCMCIA drive.

Built-In Test (BIT): The system has a BIT mode that provides simulated target signals to the rangefinding 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 to prevent improper mating.

Electrical Interface: The electrical interfaces to the ALS50 are as shown in drawing 700U046002 (Interconnect Drawing, ALS50).

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-nanometer 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 buildup of more than 0.5 PSI (differential).

Desiccation: The pressure relief valve has provisions for a removable desiccant cartridge or 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 the data collected in the air and produces an output data set in WGS84 coordinates. The format of the post-processed data is defined in 700U036004 (Output Format, Post-Processed Data, ALS50). Industry standard LAS output is also available. A description of the LAS file format is available at www.lasfileformat.org. Post-processing software is designed to run under the Windows NT 4.0 and 2000 operating systems.

Documentaton

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

- Beam diameter (1/e and 1/e2, nominal at the exit aperture of the beam expander)
- Pulse width (FWHM)
- Pulse rise time (10–90 percent)
- Optical peak power (or energy per pulse)
- Optical average power
- Pulse energy (derived from average power and pulse rate)
- Average Power (Watts, nominal)
- IMU offset (boresight) settings
- Rangefinder test data
- Receiver noise level
- Range standard deviation (BIT mode)
- Receiver bias voltage setting
- Discriminator setting
- Range calibration offset

User Guide: User Guide is provided with the delivered system. This guide 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, including boresight calibration
- Preventative maintenance instructions
- Trouble-shooting information

Information provided in the manual is sufficient to allow system installation, operation and preventative maintenance, as well as basic troubleshooting. 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 operation and maintenance.

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

Safety

The ALS50, when operated in accordance with instructions provided in the user guide, is eye-safe for single pulse exposure when viewed through binoculars by persons on the ground. The ALS50 also meets all requirements of 21 CFR section 1040.

GIS & Mapping Division

Reference Material

Unless otherwise specified, in the event of conflict between the documents referenced herein and the contents of this document, the contents of this document are to be considered a superseding requirement.

Government Documents (USA): The following documents (of the exact issue shown or if no issue specified then the latest revision in effect) form a part of this document to the extent specified herein.

QQ-P-35B	Passivation Treatments for Corrosion Resisting Steel
MIL-STD-810D	Environmental Test Methods and Engineering Guidelines
MIL-C-5541D	Chemical Conversion Coatings On Aluminum and Aluminum Alloys
MIL-A-8625E	Anodic Coatings, for Aluminum and Aluminum Alloys

Non-Government Documents (Leica Geosystems): The following documents (of the exact issue shown or if no issue specified then the latest revision in effect) shall form a part of this document to the extent specified herein.

700U036004	Output Format, Post-Processed Data, ALS40/50 System
700O036011	Outline Drawing, Equipment Rack (24 VDC)
700O046001	Outline Drawing, Scanner Assembly, ALS50
700U046002	Interconnect Drawing, ALS50 (24 VDC)
AeroPlan	Planning Template for ALS50 Airborne Laser Scanner (Microsoft Excel spreadsheet)

Articles: There have been a number of articles in Professional Surveyor magazine, over the past few years, written by Steve DeLoach of EarthData Technologies.

EarthData owns two Leica ALS series systems and has used them extensively.

- March 1998, "Photogrammetry: A Revolution in Technology"
- May 1999, "Photogrammetry — NOT!"
- April 2000, "Making Photogrammetric History"

Another series of articles published in GEOWorld magazine provides additional background. Although the author does not use an ALS50 system, the insights into working with LIDAR data are relevant.

- October 2000, "Have you seen the light?"
- November 2000, "LIDAR Provides Better DEM Data"
- January 2001, "Discover the Importance of LIDAR Technology"

Availability

Delivery is typically 4 months, driven primarily by Export license approval (required for international sales).

Support and Maintenance

All systems include three weeks of on-site installation support and operator/data processing training. Additional installation support is available if required.

Leica Geosystems can provide an extended warranty for ALS50 systems. This covers replacement parts and labor, except for limited life and/or damage-sensitive items (laser diode and scanner window). Leica Geosystems will perform repairs at the factory (user pays freight to factory) or in the field (user pays travel expenses).

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LH Systems

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Leica Geosystems

Leica Geosystems
GIS & Mapping Division
2801 Buford Highway
Atlanta, Georgia 30329, USA
Phone +1 404 248 9000
Fax +1 404 248 9400
gis.leica-geosystems.com