- when it has to be **right**

# Product Description Leica IPAS20

**Best Georeference**

**Any System**

**Anywhere**

The Leica IPAS20 systems provide direct georeferencing for various types of sensors. It also fits perfectly into Leica Geosystems's airborne sensing workflow. This product description gives an overview of the most important features for Leica IPAS20

## Main features

**Delivers direct georeferencing for airborne sensor data**
- Calculates - in real time - position, velocity, roll, pitch and heading at high data rates and accuracies
- The high-accuracy, real-time attitude improves the real-time application performance when used as input for gyro-stabilized mounts

**Flexible and scalable airborne system**
- Flexible interfaces support various sensor types as well as multi-sensor systems with up to four sensors
- Choice of different Inertial Measurement Units (IMU)
- Latest GNSS technology
- Leica IPAS20 can grow with technology and your future needs for system compatibility, upgrade, replacement and improved technology
- Perfect interfaces to FCMS Flight & Sensor Control Management System

**Highly automated operation and simplified data logging**
- Automatic sensor release according to trigger configuration
- Sensor release according to the flight plan if FCMS controlled
- Simplified logging of GNSS/IMU data and events on internal memory and CF cards and/or to external device via Ethernet

**Perfect data interfaces within the workflow**
- Streamlined data interface from flight planning to flight evaluation

**Powerful IPAS post-processing software**
- IPAS Pro software blends IMU data with GNSS trajectory to provide robust, post-mission solutions
- IPAS CO is Camera Orientation software providing the exterior orientation for the camera frames in accordance with the IPAS Pro solution

**High-quality hardware**
- Reliable, high-quality hardware conforming to ISO 7137, RTCA DO-160F, EUROCAE-14E and FAR§23.561

**Global service and support**

## Delivers direct georeferencing of airborne sensor data

Leica IPAS20 integrates precise GNSS solution with raw IMU measurements through a rigorous Kalman filter. The IMUs delivered with Leica IPAS20 are either based on fiber-optic, ring-laser or dry-tuned gyro technology. Each IMU type measures precise velocity increments and angular increments at high data rate, from 200Hz to 500Hz. Leica IPAS20 will combine the excellent short-term accuracy from IMU measurements with the long-term stability of the GPS solution to produce a highly accurate position, velocity and orientation during the entire mission. The Kalman filter will simultaneously estimate the errors coming from the accelerometers and gyros. Leica IPAS20 can also estimate the lever arm between the GNSS antenna and the sensor reference center.

The estimated real-time solution, including position, velocity and roll, pitch & heading, can be used for flight management, or can be used to control other sensors. The roll, pitch and heading can be output either as a digital signal for a stabilized mount, such as Leica PAV30, to improve the accuracy of the mount. Or, they can be output as an analog signal to control other sensor functions, such as roll compensation for the Leica ALS50 laser scanner.

## Flexible and scalable airborne system

The Leica IPAS20 system consists of the Leica IPAS20 Control Unit with integrated GNSS receiver board, GNSS antenna, IMU and Software. The system is designed for all types of airborne sensors:

- Film frame cameras
- Digital frame cameras
- Line scanners
- LIDAR sensors
- SAR
- Any other airborne sensor

Different IMU types can be used. The selection depends on the user's requirements. And, a large number of optional components are offered. This allows the user to set up the airborne sensing system with up to four sensors according to the user's needs.  This means up to four sensors can be triggered and events of up to four sensors can be time-tagged and stored together with other Leica IPAS data. Examples of Leica IPAS20  system configuration:

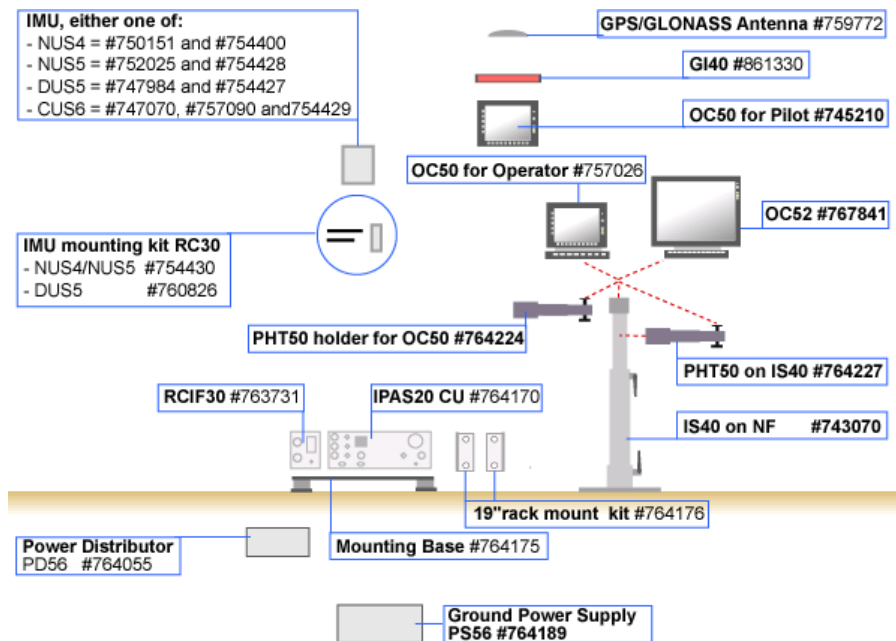| Sensor | Mount | Leica IPAS system | Choice of  IMU | Flight Management |
|--------|-------|-------------------|----------------|-------------------|
| Leica RC30 | PAV30 | IPAS20 with RCIF30 | NUS4, DUS5, NUS5 | Leica FCMS |
| Leica RC30 | PAV30 | Leica IPAS20 | NUS4, DUS5, NUS5 | 3rd party |
| Up to three 3rd party | PAV30 | Leica IPAS20 | NUS4, DUS5, NUS5, CUS6 | Leica FCMS |
| Up to three 3rd party | PAV30 | Leica PAS20 | NUS4, DUS5, NUS5, CUS6 | 3rd party |
| Up to four 3rd party | - | Leica IPAS20 | NUS4, DUS5, NUS5, CUS6 | Leica FCMS |
| Up to four 3rd party | - | Leica IPAS20 | NUS4, DUS5, NUS5, CUS6 | 3rd party |

Existing airborne systems can be upgraded with Leica IPAS20. Examples include:

- Upgrade from Leica ASCOT to Leica IPAS20 with Leica FCMS GNSS-only
- Upgrade from Leica IPAS20 with Leica FCMS GNSS-only to direct georeferencing
- Upgrade from Applanix POS AV4[TM] to Leica IPAS20

Details about the Leica IPAS20 system configurations and upgrades are given in the Leica IPAS20 Equipment List. Special consultation for other configurations is available on request.

Note: All configurations listed in the table above are also possible as configuration 'Airborne GNSS only'. See page 4. No IMU is required for the configuration 'Airborne GNSS only'.
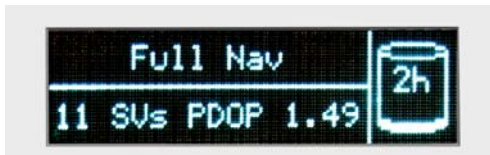
**Overview of the Leica IPAS20 system and the optional components**



The diagram includes the following labeled components:

- **IMU, either one of:**
  - NUS4 = #750151 and #754400
  - NUS5 = #752025 and #754428
  - DUS5 = #747984 and #754427
  - CUS6 = #747070, #757090 and754429
- **GPS/GLONASS Antenna #759772**
- **GI40 #861330**
- **OC50 for Pilot #745210**
- **OC50 for Operator #757026**
- **OC52 #767841**
- **IMU mounting kit RC30**
  - NUS4/NUS5 #754430
  - DUS5 #760826
- **PHT50 holder for OC50 #764224**
- **PHT50 on IS40 #764227**
- **RCIF30 #763731**
- **IPAS20 CU #764170**
- **IS40 on NF #743070**
- **19"rack mount kit #764176**
- **Power Distributor PD56 #764055**
- **Mounting Base #764175**
- **Ground Power Supply PS56 #764189**

## The Leica IPAS20 Control Unit



**Leica IPAS20 Control Unit**

The Leica IPAS20 Control Unit consists of a geodetic-grade GNSS receiver board, a high-speed motherboard, other electronic boards for digital and analog input/output, power supply boards, etc.

The connectors for the large number of interfaces are all located on the rear side. These include digital and analog input/output interfaces to other sensors, RS232, LAN, the universal IMU plug-and-play interface, the interface to FCMS, etc.



During operation, the status is displayed on three LEDs. A large 20 character VFD (vacuum fluorescent display) shows the system status, messages, GNSS status and memory capacity left, etc.

Real-time firmware controls the data acquisition from GNSS, IMU and other boards, performs real-time navigation calculation and controls the interface with external devices. The raw sensor data, real-time solution and other information can be logged for post processing either internally through a PC card or externally through an Ethernet port.

# Flexible interfaces to sensors

- Simultaneous handling of event input signals from four sources and output trigger signals to four external sensors with precise time-tagging of all four input and output signals
- High-speed data output through five physical Ethernet ports and six TCP ports, allowing Leica IPAS20 to simultaneously provide high-speed direct georeferencing solutions to six users
- Support of four serial ports for output of real-time solution
- Support of data input from Leica PAV30 and other camera mounts through serial port
- Support of RTCM input through the serial port
- Three analog outputs allow three-axis control of external sensor
- Four PPS signals are provided to allow easy synchronization for external sensors

**See page 6 for photographs of the connectors on the rear panel of the Leica IPAS20 Control Unit and the Leica RCIF30.**

# Choice of different Inertial Measurement Units (IMU)

The universal plug-and-play IMU interface of the IPAS system allows the connection of the IMU of best choice for a particular sensor system and application. The IMU is selected, aided by Leica Geosystems, depending on the customer requirements for performance, accuracy, exportability and cost. All IMU types, with different accuracy classes and manufacturers, have passed 's extensive qualification process before they are released for Leica IPAS20.

| IMU model type | | NUS4 | DUS5 | NUS5 | CUS6 |
|---|---|---|---|---|---|
| **Absolute accuracy after post-processing (RMS)** | Position | 0.05 – 0.3 m | 0.05 – 0.3 m | 0.05 – 0.3 m | 0.05 – 0.3 m |
| | Velocity | 0.005 m/s | 0.005 m/s | 0.005 m/s | 0.005 m/s |
| | Roll & Pitch | 0.008 deg | 0.005 deg | 0.005 deg | 0.0025 deg[1] |
| | Heading | 0.015 deg | 0.008 deg | 0.008 deg | 0.005 deg[1] |
| **Relative accuracy** | Angular random noise | <0.05 deg/sqrt(hour) | <0.01 deg/sqrt(hour) | <0.01 deg/sqrt(hour) | <0.01 deg/sqrt(hour) |
| | Drift | <0.5 deg/hour | <0.1 deg/hour | <0.1 deg/hour | <0.01 deg/hour |
| **IMU** | High-performance gyros | 200Hz Fiber-optic Gyro | 200Hz Fiber-optic Gyro | 500Hz Dry-tuned Gyro | 200Hz Ring-laser Gyro |

[1] Achievable if installed in a gyro-stabilized mount

# Latest GNSS technology



The embedded state-of-the-art GNSS receiver board for high dynamic airborne applications features:

- Support of GPS and GLONASS
- Provides easy upgrade for other GNSS services like GPS L5 or Galileo if these systems become operational

**IPAS controller GNSS status page**

# 'Airborne GNSS only' configuration

An Leica IPAS20 without IMU is a cost-saving solution for airborne imagery and photogrammetry projects. This GNSS-only solution provides precise photo centers after GNSS data post-processing. Post-processing with IPAS Pro includes Precise Point Positioning (PPP) technology that takes advantage of downloaded precise satellite orbit and clock corrections. PPP reduces, or even eliminates in some cases, the necessity to have a DGPS ground station close to the project area. Through the acquisition of precise positional coordinates of the photo centers and their use in an AT photogrammetric block adjustment, the number of ground control points (GCP's) can be reduced to a few check points. This results in a significant cost saving in GCP establishment compared to those required for traditional airborne projects. System accuracies, when converted to ground coordinates and considering the GNSS satellite constellations and final ephemeris data, may result in photo center positional accuracy of +/- 15cm rms, or better.

The investment in the GNSS-only solution is lower because the IMU is not part of the system. On the other hand, the full benefits of direct georeferencing are not available in this cost-saving configuration.

# RCIF30 interface for RC30 aerial camera system as ASCOT successor



**Leica IPAS20 Control Unit with RCIF30 attached**

The Leica RCIF30 interface is available for users of the Leica RC30 aerial camera system. It is side mounted on the Leica IPAS20 Control Unit and connects the aerial camera system in an optimal way to the Leica IPAS20 and Leica FCMS. All components act as one compact system which provides direct georeferencing, flight guidance and camera control for Leica RC30 users. This setup is the successor to the Leica ASCOT for Leica RC30.
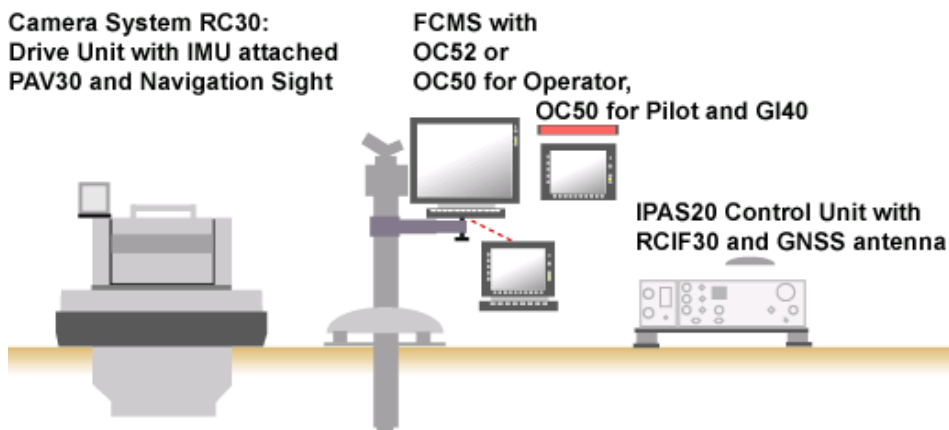


# Highly automated operation and simplified data logging

The Leica IPAS Controller Software is the operator's interface to the Leica IPAS20 airborne system. The Leica IPAS Controller Software features:

- User-friendly Windows-based software
- Encapsulated main operation information in a single window
- Intuitive system configuration setup
- Straightforward Leica IPAS20 system handling

Leica IPAS20 is a simple turnkey system. Only the initial configuration has to be set up after system installation in the aircraft. After that, Leica IPAS20 operates fully automatically. Just the power ON button has to be pushed.

Leica IPAS20 provides automatic sensor release in various modes for up to four sensors according to the trigger configuration made in the Leica IPAS controller. Sensor release can also be performed according to the flight plan if Leica FCMS controlled

Leica IPAS20 provides simplified data logging of GNSS/IMU data and events on:

- internal memory
- CF cards
- external via Ethernet

A 2GB CF card can hold up to 10 hours of data in standard logging mode and 6 hours of data in full logging mode for a 200Hz IMU. A 2GB CF card can hold up to 6 hours of data in standard logging mode and 2.5 hours of data in full logging mode for a 500Hz IMU.  The CF cards can be exchanged in-flight. The internal memory can hold up to 15 hours of data for backup logging.

# System integration and the optimal workflow

Perfect integration of hardware and software into one complete system is the key for effective airborne sensing projects. Leica Geosystems has decades of experience in this field and provides system solutions which are highly integrated, but also flexible and modular, when used as standalone components. In a complete airborne sensor system, the Leica IPAS20 with Leica IPAS Pro and Leica IPAS CO permits data acquisition and direct georeferencing of airborne sensor data and camera orientation. Leica FPES is used for optimized flight planning, flight evaluation and project management. Leica FCMS performs flight guidance and sensor control, as well as in-flight data evaluation, recording and reporting.
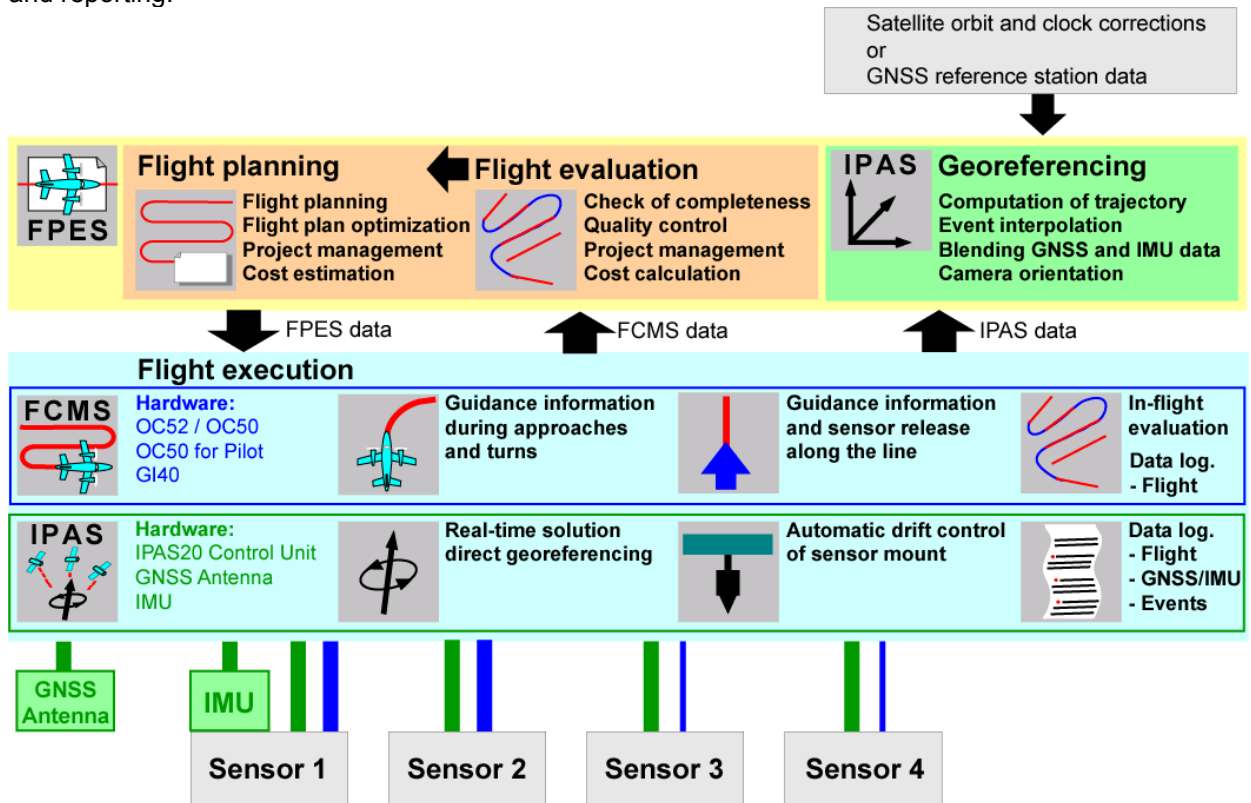


Green: Leica IPAS Hardware and Software, airborne and office components
Brown: Leica FPES, Flight Planning & Flight Evaluation, office components
Blue: Leica FCMS, Flight & Sensor Control Management System, airborne components

# Rear panels of Leica IPAS20 Control Unit and Leica RC30IF
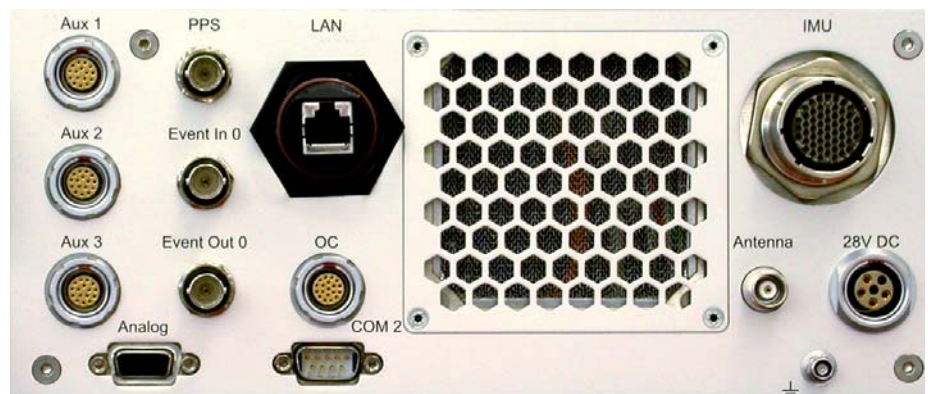


Leica RCIF30                    Leica IPAS20 Control Unit

# Powerful IPAS office software

### Leica IPAS Pro

Leica IPAS Pro software blends IMU data with GNSS trajectory to provide robust, post-mission solutions featuring:

- Post processing of GNSS/IMU data based on proven error modeling principles
- Simplified and refined Windows-based user interface for reliable data handling
- Uses well known Waypoint GrafNav software with PPP option for GNSS trajectory processing
- Refines GNSS antenna lever arm input value using Kalman filtering
- Handy tools to display raw data, solution results and quality control information
- Forward and backward processing and smoothing to produce optimal, integrated georeferencing
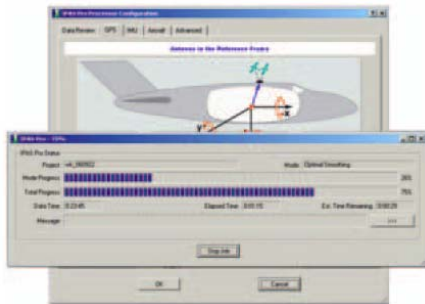


### Leica IPAS CO

Leica IPAS CO is Camera Orientation software providing the exterior orientation for the camera frames in accordance with the Leica IPAS Pro solution.

- Transformation of Leica IPAS Pro solution, camera events and photo ID's for further processing in various photogrammetric software programs
- Computation of misalignment angles
- Transformation of points
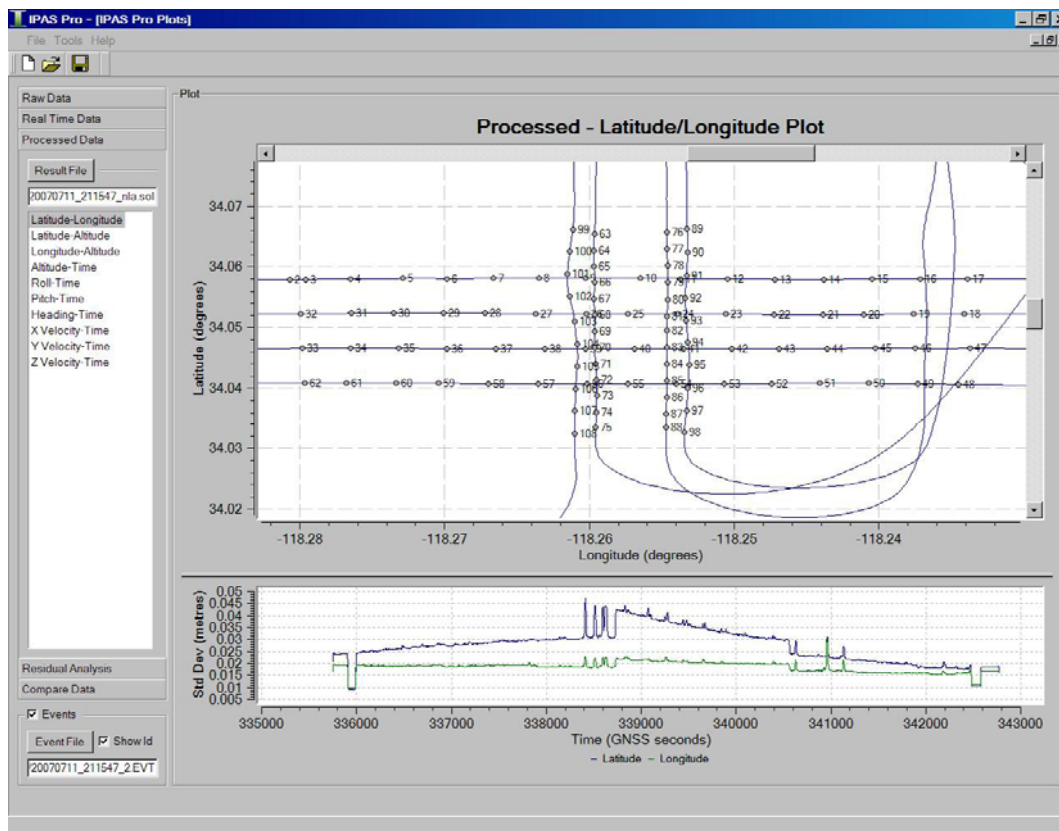
# Perfect interface to Leica FCMS for flight and sensor control

The Leica IPAS20 Control Unit provides an interface to the Leica FCMS. The   Flight & Sensor Control Management System makes survey flights an easier task for pilot and operator.

See the Leica FCMS Brochure and the Leica FCMS Product Description for details. A short description is given below

Main features of Leica FCMS

- Supports various sensor types as well as multi-sensor systems
- Reliable, high-quality hardware conforming to ISO 7137, RTCA DO-160E, EUROCAE-14E and FAR§23.561
- Simple and easy to learn operation with clear icons and quick navigation within the menu options
- Simulator software to train operators and pilots on the ground
- Optimized flight guidance with different displays of suggested flight path, approach and turns
- Vector data and ground control points as a backdrop for flight guidance
- Automatic sensor release according to the flight plan
- Monitors various parameters such as GNSS quality, completeness of project, etc.
- Operator and pilot can display different views configured differently to show the views optimized for pilot or operator
- In-flight evaluation for quality control
- Perfect data interfaces within the workflow

## OC52 Operation Controller with keyboard



The OC52 has a rugged single-board computer with a 12.1 inch / 30 cm high-contrast color LCD touch screen. The resolution is 1024 x 768 pixels. The OC52 can be attached to the IS40 Interface Stand. It can also be mounted on a shelf, typically located in front of the operator. The Airborne Digital Sensor operator communicates with Leica FCMS by means of the OC52.

The keyboard is used to command sensor specific software, if installed on the OC52.

## OC50 for Operator



The OC50 for Operator is a small size alternative sensor operator interface. It has a rugged single-board computer with a high-contrast LCD color screen. The screen size is 6.3 inches / 16 cm  and the resolution is 1024 x 768 pixels. Hard keys are located below the icons displayed on the screen to command Leica FCMS. The keyboard is used to command sensor specific software, if  installed on the OC50.

The OC50 for Operator can be attached or mounted like the OC52.

## Optional 2nd operator display



If the operator prefers to display permanently a specific view during operation an optional 2nd display device can be connected. This is either an OC52 or an OC50 (without keyboard).

The 2nd operator display can be mounted onto a holder attached to the IS40 Interface Stand.

### Leica OC50 for Pilot



The OC50 for Pilot is the interface for the pilot. The OC50 is a rugged, single-board computer with a high-contrast LCD color screen. The screen size is 6.3 inch / 16 cm and the resolution is 1024 x 768 pixels. The OC50 is designed for the cockpit environment and its compact size allows easy placement in the cockpit.

The OC50 allows remote control of FCMS. Hard keys are located below the icons displayed on the screen to command FCMS. This ensures operation in all flight conditions.

### Leica GI40 Guidance Indicator



The GI40 provides guidance information to the pilot. It can be used in parallel with the OC50 and is designed to be placed in the cockpit; e.g., on the dashboard. The center portion of the GI40 shows guidance information on a large LED array during the approach to the flight line. When flying along the line, it shows the deviation graphically. Numeric displays located on the left and right side show information such as line direction, bearing, heading correction, desired altitude and flying time from current position to the beginning or to the end of the line.

## Leica FCMS flight guidance and in-flight evaluation views

Leica FCMS makes a flight-plan-controlled flight a simpler task for the operator and the pilot. Leica FCMS guides the pilot through all phases of the survey flight. It monitors completeness of the project coverage. During flight execution, the operator and the pilot can freely select various views independent from each other.  Each view is optimized for a specific task and target user like operator or pilot. To relieve the pilot from interactions, Leica FCMS operates in a highly automated manner. It switches to the preferred view for the approach or along the line. The switch criteria can be freely configured. But anytime, manual override is possible.

### North-up view
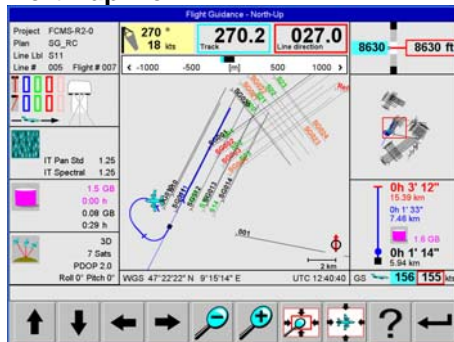


The center portion of the North-up view provides a graphical presentation of the project. The position of the aircraft and the optimal path to the selected line is displayed.

The project area control displayed on the left side shows the whole project area in a thumbnail. A frame indicates the area displayed on the graphical presentation in the center of the view.

Vector data and ground control points can be displayed as a backdrop.

### Nose-up view



The center portion of the Nose-up view provides graphical information optimized for the pilot to approach a line. The optimal route-finder algorithm suggests the flight path with the shortest approach to the line. Deviation of the aircraft from the suggested path is indicated in the upper part of the view. Relative position of the aircraft to the line is shown in the aircraft-to-target control displayed on the middle right side of the view. When flying along the line, this control shows the relative position of the aircraft to the next line. Vector data and ground control points can be displayed as a backdrop.

## In-line view
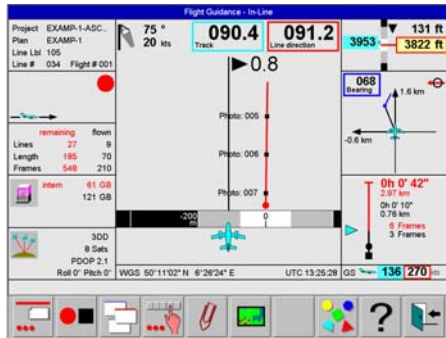


The center portion of the In-line view provides graphical information optimized for the pilot to navigate along the line. Located on the lower right side, the line progress control provides line execution progress information.

## 3-D navigation view
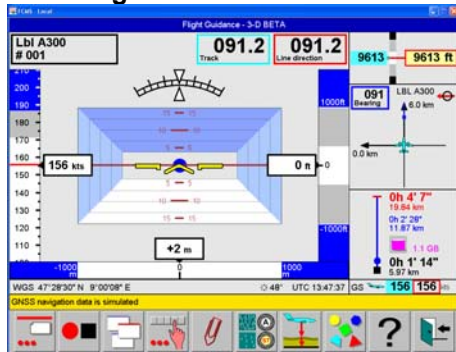


This view is optimized for the pilot to do corridor mapping flown at constant ALT AGL, typically with Helicopters. It shows relevant navigation and flight guidance information like:

- 3D line indicator
- Bank indicator
- Pitch indicator
- Ground speed indicator
- Height deviation indicator
- Track and line deviation indicator

## In-flight evaluation views

Leica FCMS monitors the progress of project execution. In-flight evaluation is provided in graphic and alphanumeric views. Controls on the left side show information about the project, the project execution progress and the configuration of the data display. The icon toolbar on the bottom with the ten large icons allows user interactions.

## Graphic view



The large, color-coded graphic presentation shows the planning, flown lines, lines not yet flown, lines flown with errors (e.g. due to deviation form the line), etc. Zoom and shift functions allow convenient evaluation and simplified analysis. The project area control located on the lower left side shows the whole project area in a thumbnail. A frame indicates the area displayed by the graphical presentation.

## Alphanumeric view



The listing shows for each flight line the flight plan name, the line number, the line label, status information plus the maximum horizontal and vertical deviation of the flown line to the planned line.

## Leica FPES Flight Planning & Evaluation software
**Key features of Leica FPES - 's solution for flight planning and flight evaluation**

- Efficient flight planning for all types of sensors including Leica ADS80, Leica ALS60, Leica RCD100, Leica RC30 and other frame, line or ON/OFF sensors and multi-sensor systems
- Flight planning using all common types of geographic and grid systems
- Interactive graphical flight planning using digital raster and vector maps or coordinates
- Parallel flight lines computed automatically to ensure stereoscopic coverage of areas of any shape
- Corridor mapping feature that splits a polyline automatically for coverage with a minimum number of flight lines or generates a winding flight line for Helicopter flights.
- DTM taken into account to compute area coverage
- Comfortable editing, modification and optimization of flight plans
- User definable free line labeling and definition of flight line sequence
- Output of calculated and summarized data for flight preparation, proposals, flight reporting and invoicing
- Flexible data import and data export in different formats like *.txt, *.xls., *.shp, *.dgn and Google Earth *.kml
- Graphical presentation of the flight joined with the planning
- Evaluation of multiple flights
- Powerful integrated utilities such as SunAngle tool, SRTM (Shuttle Radar Topography Mission ) elevation data converter and georeferencing tool
- Project management

## Flight plan database for Leica FCMS and Leica FPES

The flight plan database is a relational database. The SQL database server comes with the Leica FCMS / FPES software. This powerful database ensures data storage in a logical structure with fast access and secure and flexible data management. Leica FPES and Leica FCMS use the same flight plan database. This simplifies data handling and project management, because the status of a project is easy to monitor.

## High-quality airborne hardware

Leica Geosystems airborne Hardware is well known for its reliability. The high-quality hardware conforms to ISO 7137, RTCA DO-160F, EUROCAE-14E and FAR§23.561

## Global service and support



Leica Geosystems' worldwide network of support provides professional service 24 hours per day, 7 days per week. Service engineers are available from Leica Geosystems Service Centers located in all main regions around the world to ensure high uptime of the airborne systems for all Leica Geosystems users.

Leica Geosystems provides customized, complete solutions for the airborne sensing system and for user training, maintenance and support. All components and services provided by one supplier enhances support and service tasks for Leica Geosystems customers. The service, warranty and support packages are offered with varying and flexible content from 'Basic' to 'Gold' levels.