ANEXO 7.1. EQUIPOS UTILIZADOS

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7.1.1. EQUIPO AERONÁUTICO

7.1.1.1. AERONAVE HK4870

Aeronave Tipo Cessna 182T matricula HK4870. Con todos los requisitos exigidos por la Aeronáutica Civil de Colombia y modificaciones para el montaje de Sensores Remotos hechas en USA y debidamente aprobadas por la Federal Aviation Administration de U.S.A.

- **Características**
  - Longitud: 8,8 m (29 ft)
  - Envergadura: 11 m (36 ft)
  - Altura: 2,8 m (9,3 ft)
  - Techo de servicio: 5.517 m (18.100 ft)
  - Velocidad máxima operativa: 370 km/h
  - Velocidad crucero: 268,5 km/h (167 MPH; 145 nudos) a 2.100m (6.890 ft).
  - Velocidad de entrada en pérdida: 100 km/h (62 MPH; 54 nudos)



Figura 1. Aeronave HK4870

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Figura 2. Visualización interna Aeronave.



Figura 3. Visualización interna Aeronave.

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7.1.2. EQUIPO AÉREO

7.1.2.1. SENSOR LIDAR TRIMBLE HARRIER 68I (400KHz)

DATASHEET

Trimble Harrier 68i Corridor Mapping System

KEY FEATURES

- Up to 400 kHz laser pulse rate
- Scan speed up to 200 Hz
- Full waveform digitization
- 45 – 60 degree field of view
- Roll compensation (software based)
- LiDAR operating altitude up to 1600 m AGL
- Integrated flight management system
- Portable storage system
- Integrated medium-format digital frame camera with fully integrated forward motion compensation (FMC)
- Image resolution up to 3 cm (with medium-format frame camera)

BENEFITS

- Integrated software workflow for laser and imagery data
- Compact, complete system
- High-quality data capture
- Flexible deployment scenarios
- Pilot only operation



PERFECTLY INTEGRATED SOLUTION PRODUCING VERY DENSE POINT CLOUDS AND GEOREFERENCED ORTHO IMAGES FOR YOUR MOST CHALLENGING AERIAL MISSIONS

The Trimble® Harrier 68i is an advanced corridor mapping system with a 400 kHz blasting pulse repetition rate to generate extremely dense point clouds in combination with high-quality, georeferenced ortho images.

The perfect integration of wide-angle full waveform digitization laser equipment, medium-format digital frame camera, direct georeferencing and flight management make the Harrier 68i the ideal solution for wide area mapping, powerline mapping, pipeline monitoring, corridor mapping, aerial survey and other demanding remote sensing operations. The built-in full waveform digitization features of the Harrier 68i enable comprehensive vertical information to be extracted from the acquired echo signals.

The integrated digital medium-format frame camera has been designed to generate geometrically and radiometrically consistent high-quality RGB digital imagery.

The Harrier 68i Multiple-Time-Around Technology allows multiple laser pulses and echoes in the air, thus increasing the point density of the mission.

Trimble

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Trimble Harrier 68i Corridor Mapping System

SPECIFICATIONS

Sensor Head Specifications

Beam deflection	Rotating polygon
Pulse repetition rate	80 kHz–400 kHz
Field of view	45 degrees to 60 degrees (max)
Measurement rate	266 kHz @ 60 degree 200 kHz @ 40 degree
Operating altitude	30 m AGL–1 600 m AGL
Beam divergence	≤ 0.5 mrad
Range capture	Full waveform digitization
Intensity capture	16 bit dynamic range for each echo
Scan frequency	10 Hz to 200 Hz
Eye safety class	Class 3R
Swath width	83% of op. altitude (45 degrees)
Range resolution	0.020 m
Vertical accuracy	<0.15 m (absolute)
Horizontal accuracy	<0.25 m (absolute)
Scan pattern	Parallel lines
Temperature	0 °C to +40 °C (operation) –10 °C to +50 °C (storage)
Humidity	0% to 85% non-condensing
Weight	42 kg
Dimensions	30 W x 64 L x 48 H cm

Available options ..... Integrated medium-format digital frame camera
Portable storage system

Digital Camera Specifications (Option)

Model	Trimble AC P65+
Operating altitude	0 to 10,000 ft AGL
Field of view	Different lenses can be selected for this camera
Array size	60 MP
Channels	Three (RGB)
FMC	Fully Integrated
Max. Exp. rate	Down to 2.8 sec.
Image pixel size	Down to 0.03 m
Image scales	1:250 to 1:10,000
Calibration	Geometrical and Radiometrical

Computer Rack Specifications

Log time	>8 h
Power	28 V DC, 22 A max.
Temperature	0 °C to +40 °C (operation) –10 °C to +50 °C (storage)
Humidity	0% – 90% Non-condensing
Positioning system	Applanix POS/AV
Weight	43 kg
Dimensions computer	44 W x 54 L x 40 H cm

Vibration isolated case mounts directly on the aircraft floor

Operations and Applications

- Corridor mapping and wide area mapping, aerial survey and remote sensing
- High-resolution ortho images, rapid response, pipeline monitoring, power line mapping, corridor mapping, city models, common LIDAR projects, detailed analysis and studies, target classification
- Helicopter and aeroplane operation
- Uninterruptible power supply provides the system with consistent power even through aircraft power glitches.

Data Processing

- Trimble TopPIT software package for pre- and post- processing of LIDAR data and true-ortho images generation
- Trimble TopPIT has a robust dataflow and workflow for both LIDAR and aerial imagery data.

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7.1.2.2. CÁMARA FOTOGRAMÉTRICA DIGITAL PHASE ONE IXU-RS 1000 (100_MEGAPIXELES), CON LENTE INFRARROJO RODENSTOCK

Phase One iXU-R/iXU

The Phase One iXU-R/iXU aerial cameras are the world's smallest and lightest integrated digital medium format aerial cameras. All iXU-R/iXU cameras are equipped with internal electronically controlled central leaf shutters to provide the image quality expected from a dedicated aerial photography camera.

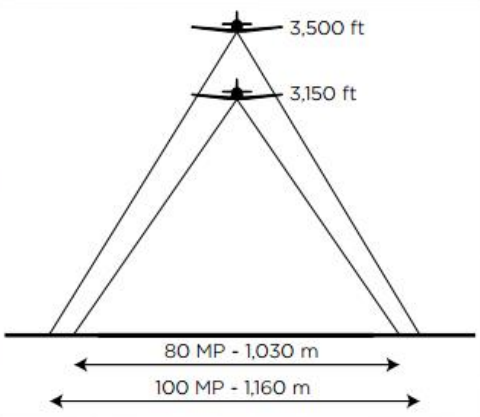
100 Megapixel sensors

Both the iXU-R 1000 and iXU 1000 are equipped with 100 MP CMOS sensors, offering large format coverage in a medium format body. The cameras deliver 11,608 pixels cross-track coverage, which is 12 percent greater than previously available medium format aerial camera systems.

Flying with an iXU-R 1000 or iXU 1000 enables users more coverage during a flight, while maintaining the same ground sample distance (GSD), or a lower GSD, while flying at the same height.

Widening Operational Hours

The CMOS technology of the iXU-R 1000, iXU 1000 and iXU 150 enables you to move from ISO 100 all the way up to 6400 providing quality images all across the ISO range. As weather conditions deteriorate or on days when you previously were unable to capture, the CMOS-based cameras provide the high sensitivities that can make a difference.



Phase One iXU-R series

The Phase One iXU-R cameras offer a small-bodied medium format camera with high performance Rodenstock optics. The small form factor make it an ideal camera for use as a standalone camera for photogrammetric work or as part of an array of multiple cameras, either to cover a larger swath or as part of an oblique camera system.

The iXU-R cameras are built with one of three Rodenstock lenses — 40 mm, 50 mm and 70 mm. The interchangeable lenses are individually inspected and factory calibrated for infinity focus.

Phase One iXU series

The Phase One iXU cameras are so small that their body is barely wider than their lens barrels. With camera weights starting at 1.3 kg with an 80 mm lens, they are well suited for users requiring a small, light camera with a broad range of focal lengths. The iXU cameras use removable Schneider-Kreuznach fast sync lenses, which are available in focal lengths from 28 mm to 240 mm.

UAV ready

Their light weight and small footprint make the iXU cameras perfectly suited for small aircraft and UAV integration. Using iX Link's RS-232 connectivity and internal CF storage, iXU cameras are able to capture thousands of images on a single mission. The iXU-R 1000, iXU 1000 and iXU 150, equipped with full HDMI output, can be guided to photograph specific objects seen by the operator on the ground.



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Technical Specifications iXU-R/iXU

	iXU-R 1000 iXU 1000	iXU-R 180 iXU 180	iXU-R 160 iXU 160	iXU-R 160 Achromatic iXU 160 Achromatic	iXU 150
Resolution	**100 MP** 11608 x 8708	**80 MP** 10328 x 7760	**60.5 MP** 8984 x 6732	**60 MP** 8964 x 6716	**50 MP** 8280 x 6208
Dynamic range	>84 db	>72 db			>84 db
Aspect ratio	4:3				
Pixel size	4.6 micron	5.2 micron	6.0 micron		5.3 micron
CCD size effective	53.4 x 40.0 mm	53.7 x 40.4 mm	53.9 x 40.4 mm	53.8 x 40.3 mm	43.8 x 32.9 mm
Lens factor	1.0				1.3
Light sensitivity (ISO)	50-6400	35-800	50-800	200-3200	100-6400
Camera type	Medium format camera for aerial photography				
Lens mount	- Phase One R dedicated mount — for iXU-R cameras - Phase One SK dedicated mount — for iXU cameras				
Shutter speed	Leaf shutter: up to 1/1600 second*				
Shutter control	1/3 f-stop increments				
Interfaces	- USB 3.0 - Secured power input (LEMO) - Camera trigger - Mid-exposure pulse - Camera status - iX Link				
Live View/HDMI	iXU 1000 - 1920 x 1080 25p/30p - 1280 x 720 50p/60p				- 1920 x 1080 25p/30p - 1280 x 720 50p/60p
GPS/IMU support	Applanix, NovAtel, IGI, NMEA Devices				
Forward Motion Compensation	N/A	TDI controlled			N/A
Data storage	- 1 TB SSD storage (optional iX Controller) - CompactFlash card Type I/II including UDMA 6 and 7				
Syncronization speed in multiple camera configuration	100 microseconds with factory calibrated (FS) lenses				

Capture rate — full resolution frame	**iXU-R**	**iXU**	**iXU-R**	**iXU**	**iXU-R**	**iXU**	**iXU-R**	**iXU**	**iXU**
	0.85 s	0.95 s	1.25 sec	1.6 sec	1.1 sec	1.45 sec	1.1 sec	1.45 sec	0.85 sec
RAW File compression	IIQ large: 100 MB IIQ small: 65 MB		IIQ large: 80 MB IIQ small: 54 MB		IIQ large: 60 MB IIQ small: 40 MB				IIQ large: 50 MB IIQ small: 33 MB

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Technical Specifications iXU-R/iXU

	iXU-R 1000 iXU 1000	iXU-R 180 iXU 180	iXU-R 160 iXU 160	iXU-R 160 Achromatic iXU 160 Achromatic	iXU 150
Lens + technology optimizes	- Color cast - Light falloff - Chromatic aberration - Fringing - Sharpness falloff - Lens distortion				
Output format	Phase One Raw, TIF and JPG				
Post processing	- iX Capture - Capture One Pro - Capture One Processing Engine				
IR cut-off filter	Camera system available either with or without IR filter				
Connection to pod	Four M4 bolts				
Tripod sockets	N/A				
Power input	12 – 30 V DC				
Maximum power consumption	10 W	12 W			10 W
Dimensions iXU (excluding lens)**	97.4 x 93 x 110 mm (w x h x l)				
Dimensions iXU-R (including lens 40)**	97.4 x 93 x 170.5 mm (w x h x l)				
Dimensions iXU-R (including lens 50)**	97.4 x 93 x 177 mm (w x h x l)				
Dimensions iXU-R (including lens 70)**	97.4 x 93 x 175.3 mm (w x h x l)				
Weight iXU (excluding lens)	.930 kg/2.05 lb – for iXU-R				.750 kg/1.7 lb
Weight iXU (with 80 mm lens)	1.430 kg/3.15 lb				1.25 kg/2.8 lb
Weight iXU-R	iXU-R 40 1.600 kg/3.5 lb iXU-R 50 1.700 kg/3.7 lb iXU-R 70 1.450 kg/3.2 lb				
Approvals	FCC (Class A), CE, RoHS				
Operating Conditions					
Temperature	-10° to 40°C (14° to 104°F)				
Humidity	15 to 80% (non-condensing)				

* 240 mm leaf shutter speed is 1/1000s.

** 2D and 3D drawings for integration of cameras are available from http://industrial.phaseone.com/downloads

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RODENSTOCK

Rodenstock Lenses

Phase One iXU-R and iXA-R cameras are equipped with Rodenstock lenses. Each lens/shutter combination is adapted for aerial photography and offers low distortion, high MTF and excellent contrast. The opening angles shown below are for the iXU-R 1000 cameras.

Lenses	Weight	Opening angle (short side)	Opening angle (long side)
Rodenstock 40 mm f/4.0	730 g	53.2°	67.4°
Rodenstock 50 mm f/4.0	800 g	43.7°	56.2°
Rodenstock 70 mm f/5.6	580 g	31.9°	41.8°

El Valle sí Avanza

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7.1.2.3. IMU Y GPS APPLANIX POS/AV. COMBINADO CON TECNOLOGÍA GNSS PARA PROVEER PRECISIÓN POSICIONAL 3D, VELOCIDAD Y ALTITUD



Top: *Geocorrected CASI-1500 image mosaic (60 cm resolution) processed using precision attitude (roll, pitch, heading) inputs from a POS AV, and orthocorrected using Lidar data.*
Bottom: *Closeup of identified subset showing excellent seam alignment of multiple north-trending CASI flight lines.*

Data provided by the Joint Airborne Lidar Bathymetry Technical Center of Expertise and collected with the US Naval Oceanographic Office's CHARTS system equipped with a CASI 1500. Toronto, Canada, January 2006.

itres
www.itres.com

GPS/IMU Option: ApplAnix POS AV

The following third party specifications are provided as a courtesy to ITRES sensor clients. They are based on information available at the time of writing from the manufacturer's website at www.applanix.com which should be consulted as the primary source of this information.

POS AV Absolute Accuracy (RMS)

		C/A GPS	DGPS	RTK	Post Processed
Model 310	**Position (m)**	4.0 6.0	0.5 2	0.1 0.3	0.05 0.3
	Velocity (m/s)	0.05	0.05	0.01	0.075
	Roll & Pitch (deg)	0.03	0.03	0.03	0.015
	True Heading[2] (deg)	0.10	0.08	0.07	0.035
Model 410	**Position (m)**	4.0 6.0	0.5 2	0.1 0.3	0.05 0.3
	Velocity (m/s)	0.05	0.05	0.01	0.005
	Roll & Pitch (deg)	0.015	0.015	0.015	0.008
	True Heading[2] (deg)	0.08	0.05	0.04	0.015
Model 510	**Position (m)**	4.0 6.0	0.5 2	0.1 0.3	0.05 0.3
	Velocity (m/s)	0.05	0.05	0.01	0.005
	Roll & Pitch (deg)	0.008	0.008	0.008	0.005
	True Heading[2] (deg)	0.07	0.05	0.04	0.008

[1] *Typical mission profile, max RMS error*

POS AV Relative Accuracy

	Model 310	Model 410	Model 510
Noise (deg/sqrt(hr))	0.15	0.07	0.02
Drift (deg/hr)[2]	0.5	0.5	0.1

[2] *Attitude will drift at this rate up to a max error defined by absolute accuracy shown in the table above*

Temp. Range:	IMU	54 deg C to +85 deg C
	PCS	20 deg C to +60 deg C
Size:	IMU	97 D x 86 H mm (3.8 D x 3.4 H inches)
	PCS	239 L x 158 W x 82 H mm (9.4 L x 6.2 W x 3.2 H inches)
Weight:	IMU	0.750 kg
	PCS	2.54 kg
Power:	20 32	Volts DC
	IMU	20 W, Max (supplied by PCS)
	PCS	30 W, Max (not including IMU)

General Specifications

IMU	GPS
200 Hz High Performance FOG Gyros, silicon accelerometers	12 channel dual frequency (L1/L2), low noise, DGPS ready, 10 Hz raw data

I/O

Ethernet (100 base-T)

Parameters	Time tag, status, position, attitude, velocity, track and speed, dynamics, performance Metrics, raw IMU data (200 Hz), raw GPS data (10 Hz)
Display Port	Low rate (1 Hz) UDP protocol output
Control Port	TCP/IP input for system commands
Primary Port	Real time (up to 200 Hz) TCP/IP protocol output
Secondary Port	Buffered TCP/IP protocol output for data logging to external device

Logging

Parameters	Time tag, status, position, attitude, velocity, track and speed, dynamics, performance metrics, raw IMU data (200 Hz), raw GPS data (10 Hz)
Media	External: Removable 1 Gbyte Flash Disk (2 supplied), Internal: Embedded 1 Gbyte Flash Disk for redundant logging

NMEA RS232 ASCII Output

Parameters	NMEA Standard ASCII messages: Position ($INGGA), Heading ($INHDT), Track and Speed ($INVTG), Statistics ($INGST)
Rate	Up to 50 HZ (user selectable)

RS232 High Rate Binary Output

Parameters	User selectable binary messages: Time, position, attitude, speed, track, PAV30 output, Yaw Drift Correction
Rate	Up to 200 Hz (user selectable)

RS232 Input Interfaces

Parameters	Gimbal encoder input, AUX GPS Input (RTK, NavCom Starfire, OmniStar HP), RTCM104 DGPS Corrections Input
Rate	1 to 200 Hz

Other I/O

1 PPS	1 pulse per second Time Sync output, normally high, active low pulse
Event Input (2)	Time mark of external events. TTL pulses > 1 msec width, max rate 100 Hz.

User Supplied Equipment

PC for POS Controller (Required for configuration)	*PC for POSPac Post-Processing Software*
•□ Pentium 90 processor (minimum) •□ 16 MB RAM, 1 MB free disk space •□ Ethernet adapter (RJ54 100 base T) •□ Windows 98/2000/NT/XP	•□ Pentium 90 processor (minimum) •□ 16 MB RAM, 1 MB free disk space •□ Windows 2000/NT/XP

Third party product specifications are provided based on information available from the manufacturer's website at the time of writing. Specifications subject to change without notice. POS AV is trademark of ApplAnix Corporation. Document #U10053-00 ©March 2007 ITRES Research Limited.

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7.1.2.4. RECEPTOR DE TRABAJO PESADO GNSS/INS SPAN-SE PROVEE SOLUCION DE POSICIÓN 3D, VELOCIDAD Y ALTITUD DEL VUELO.

SPAN™

SPAN-SE™



Rugged GNSS/INS Receiver Delivers 3D Position, Velocity and Attitude Solution

Benefits

Continuous, stable navigation

Supports IMUs from a variety of suppliers

Available as fully enclosed product or as board stack

Proven OEMV® technology

Features

SD card data logging

GPS or GPS+GLONASS options

Single antenna and dual antenna support

Wheel sensor input for ground systems

SPAN: World-Leading GNSS+INS Technology

SPAN (Synchronous Position, Attitude and Navigation) technology brings together two different, but complementary technologies: GNSS positioning and inertial navigation. The absolute accuracy of GNSS positioning and the stability of IMU gyro and accelerometer measurements are tightly coupled to provide an exceptional 3D navigation solution that is stable and continuously available, even through periods when satellite signals are blocked.

SPAN-SE Overview

The SPAN-SE receiver enclosure provides the user interface to SPAN. It outputs raw measurement data or solution data over several communication protocols or to a removable SD card. Multiple GPS-synchronous strobes and event input lines offer easy integration into a larger system. Combining SPAN-SE with a SPAN-supported IMU creates a complete GNSS/INS system. For applications requiring an external heading reference, a dual antenna version of SPAN-SE is available.

SPAN-SE Advantages

Tight coupling of the GPS and IMU measurements provides more satellite observations and the most accurate, continuous solution possible. Utilizes NovAtel's world-class GNSS receiver technology, the SPAN-SE delivers many powerful features including GPS+GLONASS capability and AdVance® RTK performance. A dedicated CPU for real-time GNSS/INS processing results in fast data rates and low raw data and solution latency for highly dynamic or time-critical applications.

Improve SPAN-SE Accuracy

Take advantage of our Advance RTK as well as support for satellite-based augmentation systems such as OmniSTAR® or SBAS to improve real-time performance and accuracy. For more demanding applications Inertial Explorer® (IE) post processing software from our Waypoint® product group can be used to post process SPAN-SE data and offers the highest level of accuracy with the system.

Dual Antenna option provides users with faster initial alignments in difficult low dynamics applications such as marine survey.

If you require more information about our SPAN products, visit novatel.com/products/span-gnss-inertial-systems

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or 403-295-4900
China 0086-21-54452990-8011
Europe 44-1993-848-736
SE Asia and Australia 61-400-833-601

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SPAN

SPAN-SE

SPAN System Performance[1]

Horizontal Position Accuracy (RMS)

Single Point L1	1.5 m
Single Point L1/L2	1.2 m
SBAS	0.6 m
CDGPS	0.6 m
DGPS	0.4 m
OmniSTAR	
VBS	0.6 m
XP	0.15 m
HP	0.1 m
RT-20®	0.2 m
RT-2™	1 cm+1 ppm

Measurement Precision

L1 C/A Code	4 cm RMS
L1 Carrier Phase	0.5 mm RMS (differential channel)
L2 P(Y) Code	8 cm RMS
L2 Carrier Phase	1 mm RMS (differential channel)

Data Rates

GPS Measurement	50 Hz
GPS Position	20 Hz
IMU Measurement	Up to 200 Hz
INS Solution	Up to 200 Hz
Time Accuracy[2]	50 ns RMS

Maximum Velocity[3] 515 m/s

Physical and Electrical

Dimensions	200 x 248 x 76 mm
Weight	3.4 kg

Power

Power Consumption (single antenna)	10 W (typical)
Power Consumption (dual antenna)	12 W (typical)
Input Voltage	+9 to +28 VDC

Antenna Port(s) Power Output

Output Voltage	+5 VDC
Maximum Current	100 mA

COM Port Output Power

Output Voltage	+9 to +30 VDC
Maximum Current	1.5 A

Connectors

Power	ODU Mini Snap, Series K, 4 pin
I/O 1	ODU Mini Snap, Series K, 30 pin
I/O 2	ODU Mini Snap, Series K, 30 pin
Ethernet	RJ-45
Primary RF	TNC Female
Secondary RF	TNC Female
USB Device	Type B
USB Host	Type A

Communication Ports

RS232/RS422 software configurable UART COM Ports	4
IMU Connection	1
RTK correction Input UART COM Port	1
USB 2.0 Host	1
USB 2.0 Device	1
Ethernet	1
Removable SD Card	1
Event Input Triggers	4
Configurable Output Strobes	3

Environmental

Temperature

Operating	-40°C to +65°C
Storage	-50°C to +80°C
Humidity	95% non-condensing
Waterproof	IEC 60529 IPX7
Dust	IEC 60529 IP6X

Vibration (operating)

Random	RTCA DO-160D, curve C
Sinusoidal	IEC 68-2-6
Shock (operating)	IEC 68-2-27, 25 g

Compliance

Emissions	FCC Part 15, Class B EN 55022, Class B
Immunity	EN 55024
Safety	EN 609050-1
MTBF	269 000 hrs

Features

- Field-upgradable firmware
- Supports RTCM SC-104 version 3.0, CMR version 3.0, CMR+, NMEA 0183 version 3.01, and RTCA DO-217 message types

Included Accessories

- VDC power cable
- Two serial cables
- SD card
- Mounting brackets
- CD
- USB 2.0 cable

Optional Accessories

- GPS-700 series antennas
- ANT series antennas
- RF cables – 5, 10 and 30 m lengths
- Easy post-processing using Inertial Explorer

Optional Dual Antenna

ALIGN® Heading Accuracy[4]

0.5 m Baseline	0.40°
1.0 m Baseline	0.20°
2.0 m Baseline	0.10°

Supported SPAN IMUs

- UIMU-LCI
- UIMU-LN200
- UIMU-HG58/62
- IMU-FSAS
- IMU-CPT

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Printed in Canada. D12767
SPAN-SE April 2011

For the most recent details of this product:
novatel.com/assets/Documents/Papers/SPAN-SE.pdf

[1] GNSS/INS performance is dictated by the IMU integrated with SPAN.
[2] Time accuracy does not include biases due to RF or antenna delay.
[3] Export licensing restricts operation to a maximum of 515 metres per second.
[4] A second receiver (Z-model) is required to enable ALIGN functionality.

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7.1.2.5. IMUCPT COMBINADO CON TECNOLOGÍA GNSS

SPAN™

IMU-CPT™



IMU-CPT Combined with NovAtel's GNSS Technology to Provide 3D Position, Velocity and Attitude Solution

Benefits

Continuous, stable positioning

Minimizes import/export issues

Withstands harsh environments

Easy integration with NovAtel's SPAN-SE™ GNSS/INS receiver

Features

Fiber optic gyros and MEMS accelerometers

Wheel sensor input for ground applications

SPAN: World-Leading GPS+INS Technology

SPAN (Synchronous Position, Attitude and Navigation) technology brings together two different, but complementary technologies: GPS positioning and inertial navigation. The absolute accuracy of GPS positioning and the stability of inertial measurement unit (IMU) gyro and accelerometer measurements are tightly coupled to provide an exceptional 3D navigation solution that is stable and continuously available, even through periods when satellite signals are blocked.

IMU-CPT Overview

The IMU-CPT is designed to be paired with NovAtel's SPAN-SE line of receivers. It is comprised of fiber optic gyros (FOG) and micro electrical mechanical systems (MEMS) accelerometers. FOGs offer exceptionally long life and stable performance compared with other similar gyro technologies. The IMU-CPT provides the best price/performance available on NovAtel's SPAN platform.

Improve IMU-CPT Accuracy

Paired with NovAtel's SPAN-SE receiver platform the IMU-CPT allows customers to benefit from a feature rich and ruggedized enclosure offering excellent price to performance value. This pairing offers a fully integrated tightly coupled GNSS and IMU system delivering the most satellite observations and the most accurate, continuous position, velocity and attitude solution possible. Further, the IMU-CPT is comprised entirely of commercial components, which means cross-border difficulties involved with traditional GPS/INS systems are greatly minimized. Additionally for more demanding applications Inertial Explorer® (IE) post processing software from our Waypoint® products group can be used to post process IMU-CPT data and offers the highest level of accuracy with the system.

If you require more information about our SPAN products, visit novatel.com/products/span-gnss-inertial-systems

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Europe 44-1993-848-736
SE Asia and Australia 61-400-833-601

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SPAN IMU-CPT

SPAN System Performance[1]

Horizontal Position Accuracy (RMS)

Single Point L1	1.5 m
Single Point L1/L2	1.2 m
SBAS	0.6 m
CDGPS	0.6 m
DGPS	0.4 m
OmniSTAR	
VBS	0.6 m
XP	0.15 m
HP	0.1 m
RT-20®[2]	0.2 m
RT-2™	1 cm+1 ppm

Data Rates

GPS Measurement	5 Hz
GPS Position	5 Hz
IMU Measurement	100 Hz
INS Solution	Up to 100 Hz
Time Accuracy[3]	20 ns RMS
Maximum Velocity[4]	515 m/s

IMU Performance[1]

IMU-CPT

Gyro Technology	FOG
Gyro Output Range	±375°/s
Gyro Bias	20°/hr
Gyro Bias Stability	±1°/hr
Gyro Scale Factor	1500 ppm
Angular Random Walk	0.0667°/√hr (max)
Accelerometer Range	±10 g
Accelerometer Bias	50 mg
Accelerometer Bias Stability	±0.75 mg
Accelerometer Scale Factor	4000 ppm

IMU Physical and Electrical

Dimensions	152 x 168 x 89 mm
Weight	2.29 kg

Power

Power Consumption	13 W Max
Input Voltage	+9 to +18 VDC

Input/Output Connectors

Power and I/O MIL-DTL-38999 Series 3

Environmental

Temperature	
Operating	-40°C to +65°C
Storage	-50°C to +80°C
Humidity	95% non-condensing
Waterproof	MIL-STD-810F, 506.4, Procedure I

Included Accessories

- Combined I/O and Power Cable

Optional Accessories

- Inertital Explorer post-processing software

Performance During GNSS Outages[1]

Outage Duration	Positioning Mode	Position Accuracy (m) RMS		Velocity Accuracy (m/s) RMS		Attitude Accuracy (degrees) RMS		
		Horizontal	Vertical	Horizontal	Vertical	Roll	Pitch	Heading
0s	RTK	0.020	0.050	0.020	0.010	0.015	0.015	0.050
	HP	0.100	0.080	0.020	0.010	0.015	0.015	0.050
	SP	1.200	0.600	0.020	0.010	0.015	0.015	0.060
	PP[6]	0.010	0.0150	0.020	0.010	0.015	0.015	0.030
10 s	RTK	0.230	0.010	0.050	0.016	0.020	0.020	0.060
	HP	0.770	0.750	0.051	0.023	0.020	0.017	0.060
	SP	1.380	0.680	0.034	0.014	0.020	0.017	0.065
	PP[6]	0.030	0.020	0.020	0.010	0.018	0.018	0.047
60 s	RTK	5.710	1.600	0.212	0.059	0.028	0.028	0.090
	HP	6.470	1.690	0.240	0.071	0.028	0.028	0.095
	SP	7.120	1.890	0.260	0.075	0.028	0.028	0.100
	PP[6]	0.290	0.100	0.030	0.020	0.018	0.018	0.049

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Printed in Canada. D16051
IMU-CPT April 2011
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[1] Typical SPAN system performance values when using this IMU. Performance specifications subject to GPS system characteristics, US DOD operational degradation, ionospheric and tropospheric conditions, satellite geometry, baseline length, multipath effects and the presence of intentional or unintentional interference.
[2] Expected accuracy after static convergence.
[3] GPS only.
[4] Time accuracy does not include biases due to RF or antenna delay.
[5] Export licensing restricts operation to a maximum of 515 metres/second.
[6] RMS, incremental error growth from steady-state accuracy. Computed with respect to full GPS, RTK trajectory.
[7] Post-processing accuracy using Inertial Explorer processing software.

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7.1.3. SOFTWARE ESPECIALIZADO

7.1.3.1. SUITE COMPLETA INPHO - TRIMBLE



Trimble.

inpho

Using a modular approach, the Inpho software suite can be deployed as a complete, perfectly tuned system, or as individual components that integrate into geospatial information production work flows.

	Geo-Referencing		Geo-Capturing		Geo-Modeling			Geo-Imaging	
	MATCH-AT	inBLOCK	MATCH-T DSM	Summit Evolution	DTMaster	SCOP++	DTM Extension	Ortho-Master	Ortho-Vista
Digital Photogrammetry	X	X	X	X	X			X	X
Aerial Triangulation	X	X							
Camera Calibration	X	X							
Surface / Terrain Extraction			X		X		X		
Orthophoto Production and Mosaicking								X	X
Stereo Data Capture				X	X				
Production Lines for Pushbroom Imagery	X		X	X	X			X	X
Processing of Satellite Imagery			X	X	X			X	X
Laser Scanning Data Processing					X	X	X		
DTM Processing and Management			X			X	X	X	
City Modeling			X		X				
INPHO BUNDLES									
Ortho Box								X	X
DTM Box			X		X		X		
LiDAR Box					X	X			

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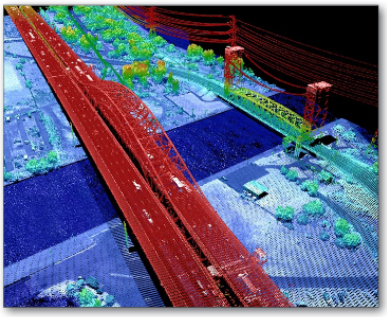
www.trimble.com/imaging

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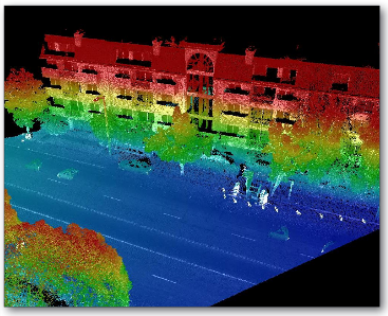
7.1.3.2. MERRICK ADVANCED REMOTE SENSING SOFTWARE - MARS (PRODUCTION LICENSE)

MARS®
MERRICK ADVANCED REMOTE SENSING SOFTWARE

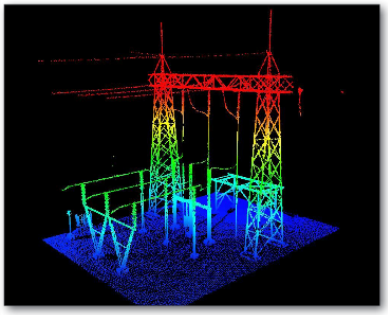
MERRICK
MARS® Merrick Advanced Remote Sensing Software



Airborne LiDAR – Urban Area



Mobile LiDAR – Street Corridor



Terrestrial LiDAR – Electric Substation

MARS® PRODUCT DESCRIPTION

The Merrick Advanced Remote Sensing (MARS®) software suite is a comprehensive, production-grade Windows application designed to visualize, manage, process and analyze LiDAR point cloud data.

The MARS® software suite is designed for 64-bit Windows operating systems and provides powerful LiDAR filtering, editing, and data management functions. Version 8.0 highlights a completely new, redesigned interface with tools organized into intuitive ribbon groups. With over 100 new features and enhancements as well as many bug fixes, MARS® version 8.0 is designed to improve data throughput and automation efficiency. Furthermore, MARS® now supports all versions of the ASPRS LAS file format specification including version 1.4.

MARS® SOFTWARE SUITE

MARS® FreeView

- Free viewing application supports basic LiDAR data navigation and 3D visualization – the perfect tool for casual users. No license required!

MARS® Explorer

- Robust commercial version of the MARS® software suite featuring LiDAR data classification, multi-thread processing, and enhanced visualization capabilities.

MARS® Explorer QC

- Includes all the functionality of MARS® Explorer, plus Merrick's automated LiDAR quality control (QC) module. The module generates a detailed QC report that saves significant time & money!

MARS® Production

- Production-grade version of the MARS® software suite. Provides additional functionality for breakline compilation, advanced production-level tools, and unlimited number of threads for multi-threading operations.

MARS® PRICING

MARS® FreeView	Free
MARS® Explorer Evaluation	Free
MARS® Explorer	$4,995*
MARS® Explorer QC	$9,995*
MARS® Production	$11,995**

* The MARS® Explorer and MARS® Explorer QC applications provide multi-thread processing support for a maximum of four (4) threads, except for the QC Module functionality in the MARS® Explorer QC application, which has no thread limit.

** The MARS® Production application provides multi-thread processing support for an unlimited number of threads.

Software pricing includes one (1) year of technical support and product upgrades.

Annual software maintenance fee is 20% of the list price at the time of purchase, regardless of discount. Enterprise, academic, and volume discounts available.

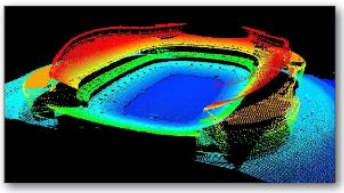
All prices are listed in U.S. Dollars.

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www.merrick.com/MARS

MERRICK
MARS® Merrick Advanced Remote Sensing Software

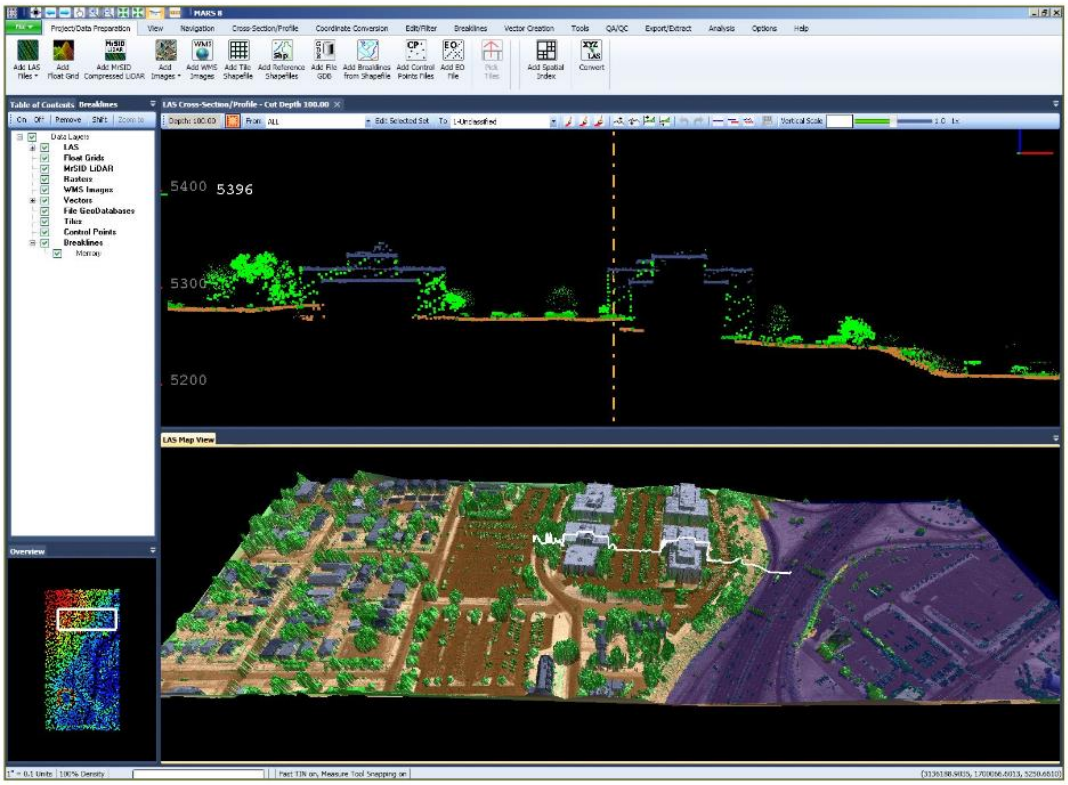
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MARS® SALES CONTACT
Josh Beck
Sr. Software Consultant
303-353-3715
josh.beck@merrick.com
www.merrick.com/MARS

APPLICATION FEATURES

- Designed specifically for 64-bit Windows operating systems
- Unlimited data loading capacity for airborne, terrestrial & mobile LiDAR datasets
- Supports loading of LiDAR (LAS), imagery (RGB, CIR, hyperspectral, thermal) and GIS vectors
- Batch production of digital surface models and elevation contours
- Automated LiDAR quality control module with support for multi-channel sensor data
- Provides support for WMS imagery (ex. Bing Maps)
- Automated and manual LiDAR filtering tools
- Allows multi-thread data processing to maximize performance of PC hardware
- 3D coordinate transformation support for LAS files (horizontal and vertical)
- Free, 30-day evaluation download available from website
- 30 LiDAR data filtering algorithms and 20 data export formats



MARS® User Interface

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MERRICK
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7.1.3.3. TRIMBLE REAL WORKS

TRIMBLE REALWORKS SOFTWARE TECHNICAL NOTES

Trimble RealWorks is powerful office software from Trimble that imports rich data from your Spatial Imaging sensor and transforms it into compelling 3D deliverables. Powerful tools in Trimble RealWorks manage, process, and analyze large data files containing millions of points, enabling you to produce high-quality deliverables that will impress and satisfy your clients.

Trimble® RealWorks® software enables you to register, visualize, explore and manipulate as-built or scene point cloud data collected with a Trimble Spatial Imaging sensor.

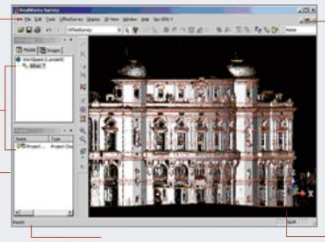
Advanced, but very easy to use, Trimble RealWorks lets you:

- Manage, process and analyze large datasets
- Effectively manage large data sets by using partial loading techniques
- Perform smart measurement – semi-auto clearance, projected vertical and horizontal
- Easily extract targets from scanned data
- Perform fully automatic registration
- Quickly check the quality of the targets
- Generate registration reports
- Efficiently integrate data from Trimble GNSS, Optical, and Spatial Imaging sensors
- Easily export to the CAD design package of your choice
- Communicate your results via video generation and Google Earth export (kml format)

While Trimble RealWorks is powerful enough to handle large datasets with ease, at the same time it is very easy to use. The software guides you through sophisticated data management and manipulation tasks step-by-step to ensure you always reach your objectives and those of your customers'.

The end result in Trimble RealWorks software is the production of compelling 2D and 3D deliverables for direct output or export to CAD packages such as AutoCAD and MicroStation.

Trimble RealWorks office software is your central solution for converting the data from Spatial Imaging sensors into the deliverables your customers need. And you can share your work using videos and models in Google Earth for effective project review.



MANAGE, PROCESS AND ANALYZE LARGE DATASETS

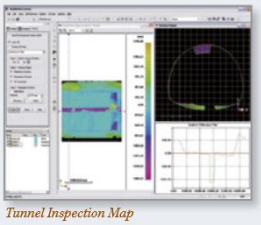
Advanced Inspection Tools

Compare as-built to design, pre-event to post-event, and more

The advanced inspection tools in Trimble RealWorks are ideal for monitoring applications such as civil engineering (roads and bridges) and mining. The resulting deliverables provide richer, more detailed, and more helpful information for your clients.

Use the RealWorks advanced tools to:

- Inspect as-built data, comparing it to the actual design.
- Generate and visualize inspection, detecting any variation.
- Obtain 2D & 3D graphic visualizations of gaps and deformations for easy analysis.
- Import profiles and geometric primitives from a CAD design file in .dxf or .dwg, and export graphic files in .dxf and .dgn.
- Share information by printing results directly using the RealWorks integrated print-out interface.



Tunnel Inspection Map

Trimble

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MANAGE, PROCESS AND ANALYZE LARGE DATASETS... CONT

Profiles / Cross-Sections

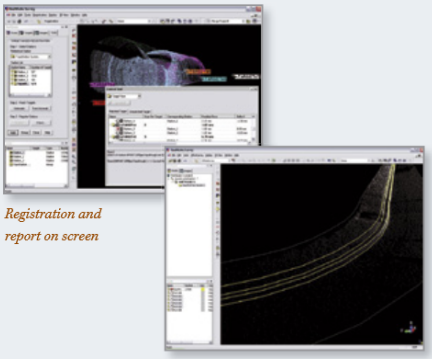
User-definable profiles for inspection and monitoring, and unique profile generation with EasyProfile™

In Trimble RealWorks, several constraints based on point clouds or models can be applied when generating profiles and cross-sections. For example, tunnel analysis data can accurately follow the tunnel center line. When working with lines and cross-sections, tools such as EasyLine™ and EasyProfile give you the next best thing to fully automatic creation of 2D drawings out of 3D data.

The EasyLine tool generates continuous polylines out of point clouds or images. Image-based 2D-drawing is a highly effective method where the user draws directly over images in Station-based Navigation mode. By making full use of photo-realistic image information, 2D drawing becomes easier and faster.

EasyProfile automatically extracts from a point cloud rail tracks, side walks, street profiles, road median barriers and almost any other linear object. This unique tool works like this: Internally generated or CAD imported profiles can be positioned relative to the point cloud by using the Profile Matcher tool.

EasyProfile, when activated, uses the matched profile to track through the cloud in both directions and at an angle. Feature lines are then automatically extracted according to break lines in the guide profile.



Registration and report on screen

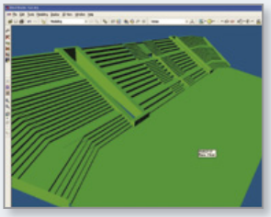
Final profiles generated by EasyProfile

Modeling Tools

Create 3D forms and geometries for rendering, computation, and other finite element usage

Trimble RealWorks can model diverse shapes to represent the as-built environment using simple CAD compliant geometrics. Data modeling makes the transfer of data for analysis packages faster. 3D models based on reality are the most efficient way to run simulations.

The RealWorks Modeling module enables you to create partial or full models very quickly, and is particularly suited to applications where modeled geometries enhance or complete the impact and scope of final deliverables.



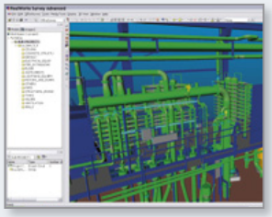
3D rendering of a stadium, created with the Modeling module

Plant Engineering

Trimble RealWorks includes a Plant module that brings the benefits of streamlined workflow to the world of engineering.

This module already includes the Modeling tools and provides in addition...

- The EasyPipe™ tool for automatic modeling of pipes by extracting points and fitting cylinders and elbows. Models are perfectly aligned and connected.
- Interactive steelworks tools that allow highly intuitive modeling of various beam types (H, I, U, T L). In addition, constraints can be applied based on pre-defined catalogs.
- Export of modeled objects to PDMS for integration to AVEVA and other software solutions.
- Export of pipe centerlines.



3D plant modeling in the RealWorks software environment

Volume and Surface Calculation

Extremely fast calculations to keep construction and mining work moving

Trimble RealWorks generates volume calculations based on a high-precision grid method, whatever the density of the point-cloud. Surface area and volume features are integrated into RealWorks results, which are displayed directly on screen.

Volume calculation includes cut and fill volume figures and can be calculated either between a scanned surface and a user-defined plane or between two scanned surfaces to assess the progress of a project on a regular basis. The final calculated results can be exported as slices, that is, as automatically generated polylines at user-defined intervals. A ready-to-print report is then automatically generated.

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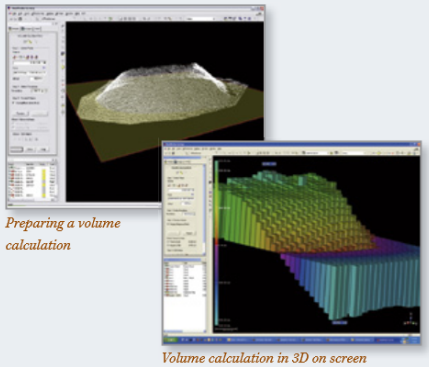
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El Valle sí Avanza



Preparing a volume calculation

Volume calculation in 3D on screen

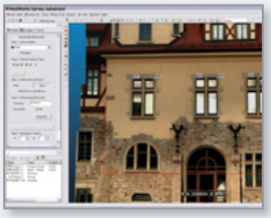
Ortho-projection and image rectification

Use the Ortho Projection tool to project a point cloud or (textured) mesh onto a plane as an ortho-projection.

For increased productivity in the case of multiple facades, use the Multi Ortho Projection tool to simultaneously create ortho projections along a polyline corresponding to the walls of a building for example.

And the Image rectification tool will allow you to easily create photo-realistic rectified images captured from the station view.

Export ortho-projection and images to CAD



Producing rectified images and ortho-projections

Registration – Alignment

In Trimble RealWorks you can easily register scans together using one of several methods: cloud-based, target-based, or geo-referencing.

To further increase productivity, registration of Trimble CX and FX datasets can be achieved in unattended full auto mode. "Checker" flat targets, as well as spherical targets, are auto-detected and automatically matched after extraction. Stations are then registered in batch mode.

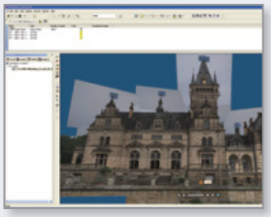
For registration via the geo-referencing tool, you can assign known coordinates to various points in all scans to be registered. For example, the points can be target centers, known points, or survey points from other instruments.

For cloud-based registration, pick the same points in two different scans with the option of automatically refining the registration in a second stage.

In target-based registration (when appropriate) you can benefit from fully automatic station-to-station registration with quality control reporting. Target-based registration applies to traverse/station setup and free stationing/resection, as well as un-leveled stationing.

If you used Trimble Spatial Imaging sensors with a traversing method to capture the data, the alignment is done automatically.

For quality assurance purposes, the Target Analyzer tool can be used to check if there are enough targets or survey points, to modify or delete those that are incorrectly fitted, and to create additional targets in the point cloud where such a target is identified visually as scanned. For results reporting, use the Entity-Based Registration Report tool to generate a full quality control report in .rtf format.

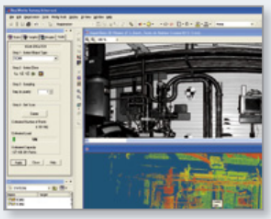


Realistic rendering is an easy way to share information from the field, to the office and to customers

Trimble FX and CX data processing

Trimble RealWorks is optimized to handle data captured with the Trimble FX and CX scanners

- Manage huge data sets efficiently
- Extract specific parts of the point cloud (by station, by zone)... use filters to extract pertinent data... excess points are rejected, kept points present homogenous spatial resolution
- Extract targets with just a few clicks!
- Processing of data in batch mode means that computers can run for extended periods without human interaction.
- Fluent data transfer to Trimble LASERGen
- Ability to generate preconfigured data for LASERGen server



Managing Trimble FX data in the familiar RealWorks environment

2024 - Valle Avanza

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CE

EASILY PRODUCE THE RESULTS YOU NEED WITH THE EASY GUIDED STEP SYSTEM

The Easy Guided Step™ system will easily bring you the results you need from your collected data sets. This Trimble-exclusive workflow is based on a step-by-step approach for every analysis to be carried out.

When you begin a task on a data set, you first select the information that you would like to extract. Then, the EGS displays the results, prompting you to adjust parameters if necessary. You can then preview the results before saving them.

For example, to extract a volume from a point cloud:
1. Define the reference for the volume.
2. Indicate the desired resolution.
3. Select appropriate cut and fill; then preview the volume.
4. Edit the volume if needed. (Optional step to optimize the results.)

Then simply create. You can extract the results in various forms, including customizable reports, or export them to your preferred CAD package.

The EGS system is unique to Trimble RealWorks. Not only does it offer a convenient workflow; it also increases productivity in Spatial Imaging data management to an unsurpassed level.

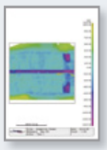
IN-FIELD CHECKS AND QA

Compelling, graphic deliverables available on paper in minutes ... or for export to a CAD package

Direct Print-Outs, Export to CAD, Text and Spreadsheet Reports



Cross-section print-out



Inspection Map print-out

All graphic results can be printed directly from Trimble RealWorks using the print-out interface, including legend, title, map scale and inset. Results are also exportable to major CAD packages, such as AutoCAD and MicroStation. Written reports in text, Word and Excel formats can also be generated. Trimble RealWorks offers maximum flexibility in your reporting requirements.

RealWorks also includes powerful communication tools such as movie generation and Google Earth exports, providing added value for decision makers and project stakeholders.

TRIMBLE REALWORKS CONFIGURATIONS

Trimble RealWorks software is available in different versions and licensed components which may vary over time. To allow customers to view advanced deliverables, to familiarize new users with the RealWorks suite of products, and to share the data from a 3D scanner or spatial station, the free Trimble RealWorks Viewer is available for download from www.trimble.com/spatialimaging.shtml.

SYSTEM REQUIREMENTS

- Intel® Pentium® 4 or later processor or compatible, 2 GHz (3 GHz or higher recommended)
- Microsoft Windows XP (Professional or Home Edition with SP1 or SP2) or Microsoft Vista.
- 2 GB RAM (4 GB recommended)
- 256 MB 3D Open GL graphics board
- DVD-ROM drive
- 3-button mouse

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7.1.3.4. TRIMBLE BUSINESS CENTER

NOTAS TÉCNICAS

Software de oficina Trimble Business Center

Una potente suite de software de oficina de datos geoespaciales

APROVECHE LA POTENCIA DE LOS DATOS GEOESPACIALES CON RAPIDEZ. COMO EL COMPONENTE DE ESCRITORIO DE LAS SOLUCIONES GEOESPACIALES DE TRIMBLE, EL SOFTWARE TRIMBLE® BUSINESS CENTER LE PERMITE EDITAR, PROCESAR Y AJUSTAR EFICIENTEMENTE LOS DATOS CON CONFIANZA.

¿Qué es el software Trimble Business Center?

Trimble Business Center es una aplicación de escritorio altamente automatizada para el procesamiento y administración de datos de nubes de puntos, fotogrametría, instrumentos ópticos y GNSS. Con capacidades únicas tales como procesamiento de datos GNSS, dibujo de secciones transversales y fotogrametría integrada, el software Trimble Business Center permite a los profesionales de las ciencias geoespaciales trabajar inmediatamente con los datos de campo para generar los resultados que ellos y sus clientes requieren. De la misma manera, los usuarios pueden editar rápidamente un diseño y enviarlo al campo para el replanteo.



Interfaz del usuario personalizable

LA INTERFAZ DEL USUARIO PERSONALIZABLE MEJORA SU EXPERIENCIA CON TRIMBLE BUSINESS CENTER. PARA LOS USUARIOS QUE QUIERAN MAXIMIZAR SU EFICIENCIA, LA INTERFAZ DE OPCIONES DE TRIMBLE BUSINESS CENTER FACILITA LA LOCALIZACIÓN Y EL USO DE LAS FUNCIONES.

- Agregue las funciones usadas con frecuencia a la barra de herramientas de acceso rápido.
- Cree fichas de opciones con flujos de trabajo simplificados.
- Especifique cualquier sitio web como la página de Inicio.



Trimble

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Flujos de trabajo soportados

TRIMBLE BUSINESS CENTER ES COMPATIBLE CON UN AMPLIO RANGO DE FLUJOS DE TRABAJO. UN SOFTWARE DE OFICINA LO HACE TODO.

Levantamiento de control

GENERE COORDENADAS DE PUNTOS DE CONTROL CONFIABLES PARA TODO EL PROYECTO.

- Cree proyectos con una amplia selección de sistemas de coordenadas y modelos de geoide.
- Revise, edite y procese observaciones de instrumentos de nivelación, GNSS y estaciones totales.
- Posprocese datos GNSS estáticos con el motor de procesamiento HD-GNSS de Trimble para obtener posiciones más confiables.
- Ajuste poligonales y complete redes que contengan observaciones de instrumentos de nivelación, GNSS, y estaciones totales.



Ajuste de datos de nivelación e integración en el ajuste de red para levantamientos catastrales.

Del campo al resultado en la oficina

CREE RESULTADOS CAD CON FACILIDAD DIRECTAMENTE A PARTIR LOS DATOS TOPOGRÁFICOS.

- Importe cualquier dato vectorial o ráster existente para estimar costos para la licitación de un trabajo y la planificación de proyectos.
- Procese códigos de característica, calcule volúmenes y modele el terreno automáticamente.
- Cree superficies y curvas de nivel a partir de puntos y líneas de rotura para modelar el terreno con precisión.
- Dibuje y guarde sus diseños topográficos en una variedad de formatos de CAD y SIG.



Búsqueda de datos vectoriales de Open Street Map desde Data Marketplace para el diseño topográfico.

Captura de características SIG

EXPANDA EL USO DE LOS SISTEMAS TOPOGRÁFICOS CREANDO RESULTADOS FINALES SIG PARA SUS CLIENTES.

- Cree y administre bibliotecas con abundantes características que asocien el esquema de atributos, capas y simbología entre SIG y CAD.
- Procese códigos de característica para crear automáticamente geometrías y atributos.
- Importe/Exporte características a una variedad de formatos de archivo incluyendo Esri Shape y archivos XML de base de datos geográfica.

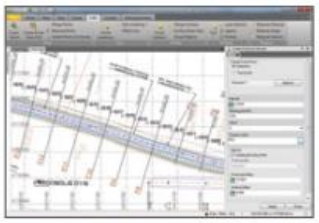


Defina características SIG manualmente o impórtelas de un archivo de base de datos geográfica XML

Replanteo para construcción

ASEGÚRESE DE QUE SUS PROYECTOS DE REPLANTEO SEAN REALIZADOS CORRECTAMENTE Y REGISTRADOS PARA SU VERIFICACIÓN.

- Importe diseños de obra y de los ejes directamente usando diversos formatos CAD y BIM.
- Cree puntos, líneas, alineaciones, superficies y corredores para replanteo con Trimble Access, sistemas de control de maquinaria y otras soluciones de posicionamiento.
- Revise e informe sobre las ubicaciones recién replanteadas desde los dispositivos de campo.



Cree puntos automáticamente con un desplazamiento horizontal y vertical respecto de una alineación para fines de replanteo.

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Data Prep

ASEGÚRESE DE QUE SUS DATOS NO ESTÉN DAÑADOS, ESTÉN ACTUALIZADOS Y SE ENTREGUEN EN EL FORMATO CORRECTO. DE ESTA FORMA PODRÁ HACER EL TRABAJO A TIEMPO.

- Importe y organice datos de CAD y PDF.
- Extraiga y digitalice datos rápidamente de archivos pdf de Adobe.
- Eleve las curvas de nivel, los puntos y los polígonos en 2D a modelos en 3D.

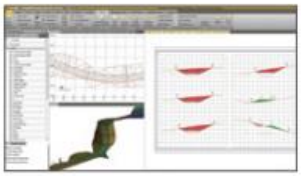


Eleve dibujos CAD del terreno en 2D a modelos en 3D para replanteo y control de maquinaria.

Dibujo

CREE SUS DIBUJOS DE DISEÑO FINAL DEL LEVANTAMIENTO Y LA CARRETERA CON FACILIDAD.

- Use vistas simultáneas o dinámicas para colocar eficazmente sus datos espaciales del modelo en las hojas de dibujo.
- Dibuje automáticamente secciones transversales para superficies basadas en alineaciones o corredores.
- Cree PDF en 3D para facilitar la comunicación y la colaboración entre los miembros del equipo del proyecto y los clientes.



Inspección final de la distribución de las secciones transversales en la vista de la hoja antes de su dibujo.

Fotogrametría terrestre

MIDA Y MODELE A PARTIR DE IMÁGENES DE TRIMBLE VISION SIN TENER QUE MOVERSE DE LA OFICINA.

- Extraiga elementos geométricos y características en 3D con precisión a partir de imágenes para crear resultados CAD y SIG con abundantes prestaciones.
- Genere nubes de puntos y superficies para fines de modelado y cálculos volumétricos.
- Cree imágenes panorámicas .html, Google Earth y .jpeg de alta resolución.

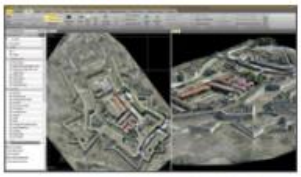


Imágenes panorámicas y nubes de puntos derivadas de Trimble V10 para la reconstrucción de fachadas.

Fotogrametría aérea

GENERE ORTOMOSAICOS Y MODELOS DEL TERRENO PRECISOS A PARTIR DE DATOS DE VEHÍCULOS AÉREOS NO TRIPULADOS CON FLUJOS DE TRABAJO ALTAMENTE AUTOMATIZADOS.

- Cree nubes de puntos, ortomosaicos y modelos digitales de alta resolución (tales como MDS y MDT en formato raster).
- Cree modelos del terreno en 3D precisos para cálculos volumétricos y diseño.
- Los resultados de los VANT se integran perfectamente con otros tipos de datos medidos.



Ortomosaicos y nubes de puntos derivadas del Trimble UX5 para la conservación del patrimonio cultural e histórico.

Una sola aplicación de software lo hace todo

TBC combina eficientemente los datos de sus sistemas ópticos, instrumentos de nivelación, fotogrametría, lidar y GNSS en una sola aplicación de software para generar resultados detallados precisos.

Use TBC para convertir dibujos 2D en modelos 3D editables para replanteo y otras aplicaciones. Descargue información del sitio de la obra de su proyecto desde Data Marketplace en internet y planifique su trabajo antes de estimar los costos para la licitación de un trabajo o visitar una obra. Ajuste poligonales y complete redes que contengan observaciones de instrumentos de nivelación, GNSS, y estaciones totales. Genere PDF en 3D para compartir fácilmente conjuntos de datos complejos con las partes interesadas en el proyecto. Importe los tipos de modelos inteligentes más recientes e integre la información tan abundante que contienen en mediciones, modelos y otros productos finales. Exporte imágenes y elementos 3D a Trimble SketchUp para un modelado rápido y un detallado simplificado usando el contenido de SketchUp 3D Warehouse. Transfiera datos con facilidad a y desde todas las soluciones CAD y SIG importantes para simplificar las operaciones.

Un solo software soporta todas las etapas de un proyecto, desde su planificación y análisis hasta su reporte ¡y le ayuda a realizar el trabajo más rápido!

Sitio web de Trimble:
https://www.trimble.com/Survey/trimble-business-center.aspx

YouTube:
https://www.youtube.com/user/TBCSurvey

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YA SEA QUE SU EMPRESA REQUIERA UNA LICENCIA INDIVIDUAL O UNA LICENCIA DE USUARIOS MÚLTIPLES, TRIMBLE BUSINESS CENTER OFRECE OPCIONES DE LICENCIA FLEXIBLES QUE SE ADAPTAN A SUS NECESIDADES.

- Funcionalidad ampliable que mejora la eficiencia y el presupuesto
- Licencias de hardware USB para estaciones de trabajo individuales
- Licencias de código de software para estaciones de trabajo individuales y servidores en red

Ediciones de Trimble Business Center que se adaptan a las necesidades de su empresa

UN COMPLETO CONJUNTO DE HERRAMIENTAS AMPLIABLES PARA CUALQUIER EMPRESA GEOESPACIAL.

- **Edición Base:** Soporta flujos de trabajo de control de calidad, ajuste de red, generación de informes y procesamiento L1 GPS.
- **Edición Complete (Completa):** Soporta la calibración del ajuste local, el procesamiento GNSS completo, y todos los flujos de trabajo relacionados con superficies e imágenes.
- **Edición Advanced (Avanzada):** Soporta la tecnología Trimble VISION y los flujos de trabajo de corredores.
- **Módulo de Fotogrametría aérea (APM):** Diseñado para trabajar con datos UAS de Trimble.
- **Módulo de Dibujo Avanzado:** Diseñado para la automatización de trazados de secciones transversales y generación de mapas topográficos.
- **Módulo Data Prep:** Le permite convertir los pdf y dibujos en 2D a modelos en 3D.



Requerimientos del sistema recomendados

SISTEMA OPERATIVO
- Microsoft Windows® 7 (versión de 64 bits)
- Microsoft Windows 8 (versión de 64 bits)

PROCESADOR

Recomendado. . . . . Intel® Pentium® Doble núcleo E2160 (1.80 GHz, 1 MB L2 de caché, 800 FSB) o mejor

MEMORIA DE ACCESO AL AZAR (RAM)

Mínima. . . . . 2 GB
Recomendada. . . . . 8 GB o más

DISCO DURO

Recomendado. . . . . 5 GB o más
Gráficos . . . . Tarjeta gráfica compatible con DirectX 9 (o superior) con 512 MB de memoria o más
Nota: Para visualizar datos de nubes de puntos (cuando corresponda), la tarjeta gráfica debe ser compatible con Open GL 3.2
Monitor . . . . . Resolución de 1280x1024 o superior con 256 o más colores (con 96 DPI)
Puertos E/S . . . . . Puerto USB 2.0

Idiomas soportados

- Alemán
- Chino simplificado
- Checo
- Coreano
- Español
- Finlandés
- Francés
- Holandés
- Inglés británico
- Inglés estadounidense
- Italiano
- Japonés
- Noruego
- Portugués
- Ruso
- Sueco

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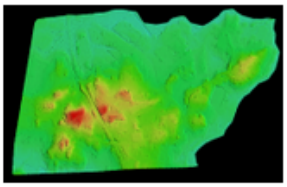
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7.1.3.5. SUITE COMPLETA TERRASOLID

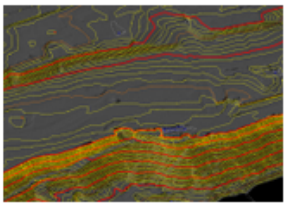
TerraModeler – Surface Modeling and Terrain Mapping

With TerraModeler you can create, edit and utilize surface models. TerraModeler creates surface models (TINs) from various sources, such as LiDAR points stored in binary files or loaded in TerraScan, XYZ ascii files and graphical design elements. The software offers versatile visualization options including colored shaded surfaces, contour lines, grids, colored triangle nets, elevation texts, slope directions and textured surfaces (in combination with TerraPhoto). Additional functionality includes the production of contour lines and lattice models in batch processing, modification of the TIN, creation of profiles, calculation of volumes, calculation of elevation or volume differences between two surface models, several labeling options as well as other tools for design purposes. Completed with various export options, TerraModeler is a versatile tool for many kinds of design and modeling tasks.

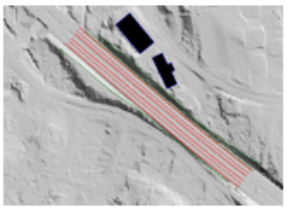
DTM - Shaded surface



DTM - Contour lines



DTM - Breaklines



TerraModeler Lite

The lighter version of TerraModeler, TerraModeler Lite, has a reduced functionality and is optimized for designers, surveyors and other users whose primary aim is to create TINs, display models and calculate volumes from a small amount of survey data. It replaced the former TerraModeler Field in 2012.

The functionality of TerraModeler Lite includes:

- creation of surface models from several sources, e.g. laser points, breakline elements, xyz text files
- display of surfaces using different display methods, such as contour lines, grids, triangles, elevation texts or slope directions
- modification of surfaces by excluding long triangles, thinning, modifying elevations, inserting breaklines, inserting or removing elevation points, manipulating elevations inside specified areas
- creation of new surfaces by copying, subtracting or merging existing surface models
- visual analysis of surface models by displaying elevations, elevation differences between surfaces, slope gradients and directions
- drawing vector elements based on surface elevations
- drawing labels for slopes and areas
- manipulation of vector elements by changing their elevation, thinning or inserting vertices, copy elements, place elements relative to an alignment element
- creation of rule files for breakline handling in surface triangulation
- creation of setting files for contour lines and peaks/pits in preparation of batch contour line or lattice file production in TerraModeler
- display of profiles based on surfaces, draw profiles in the dgn-file
- calculation of quantities and intersections between two surfaces

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TerraScan – Software for LiDAR Data Processing and 3D Vector Data Creation

TerraScan is the main application in the Terrasolid Software family for managing and processing LiDAR point clouds. It offers import and project structuring tools for handling the large amount of points of a laser scanning campaign as well as the corresponding trajectory information. Various classification routines enable the automatic filtering of the point cloud. The results from the automatic classification can be refined by using half-automatic and manual classification tools in combination with versatile 3D point cloud visualization options.

Most of the automatic classification routines can be combined in macros for batch processing. In combination with TerraSlave macros can be executed outside TerraScan and MicroStation, even on other workstations over a LAN.

TerraScan supports several import and export formats, including the LAS format, TerraScan Binary and TerraScan Fast Binary formats, as well as ASCII formats that can be defined according to the users' needs.

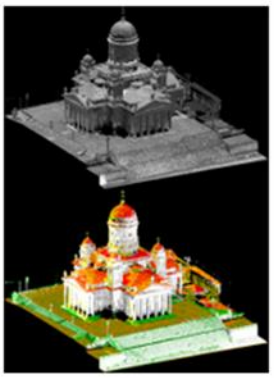
Point cloud management, processing and visualization is only one part of TerraScan. In addition, the software provides tools for creating 3D vector data based on the laser points. There is also the opportunity to produce 3D vector models of buildings (up to LOD2) automatically over large areas. Toolsets for checking and modifying the building models manually enable the creation of more accurate and higher-quality building models. For the application field of power line processing, TerraScan contains tools for the automatic vectorization of power line wires, manual placement of tower models as well as labeling, reporting and danger object analysis tools.

TerraScan Lite

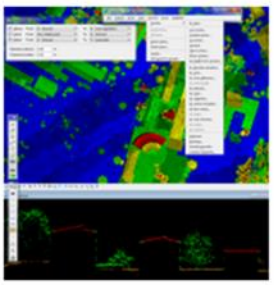
TerraScan Lite is a lighter version of TerraScan for viewing laser points that are already automatically classified and for performing processing steps that require manual effort. It replaced the previous TerraScan Viewer in 2012 when more functionality was added to the software.

The typical uses of TerraScan Lite are visualization of laser data, manual point classification, automatic classification of model or contour keypoints and model extraction, as well as manual check and modification of building vector models that have been created automatically with the TerraScan building vectorization tool. The functionality of TerraScan Lite includes:

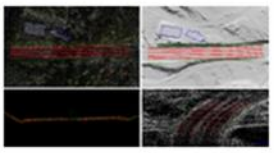
Point display methods



Automatic and manual classification tools

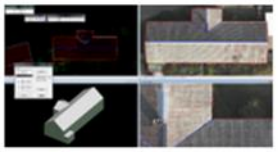


3D vector data creation



Building vectorization

- loading and saving laser data in various formats
- loading trajectories
- setting up projects
- manual classification tools
- export options such as export lattice models or raster files
- tools for drawing 3D vector data based on laser points
- various commands for processing loaded points like transform points, cut overlap or color extraction from images in TerraPhoto (Lite)
- adjusting laser points to geoid models
- convert geoid models
- set polygon elevations
- read building vector models from text files generated with the TerraScan building vectorization macro function



3D building models



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TerraPhoto – Ortho-rectification of Images and Data Visualization

TerraPhoto is specifically developed for processing images captured together with laser data during a survey mission. The software enables the production of rectified images and ortho mosaics based on ground model that has been extracted from the laser data. The positioning of the source images can be refined by using tie points for image-to-image adjustment while ground control point can be involved for improving the absolute accuracy of the image block. With additional functionality, such as color adjustment options, the creation of selection shapes for several object types or areas (e.g. buildings, water), the inclusion of vector models for true-ortho photo production, TerraPhoto lets you create ortho photos of good positional and color-coordinated quality.

Besides starting a camera calibration from scratch, TerraPhoto is able to convert calibration files from several mobile and airborne systems into its own camera file format. It reads numerous image formats, such as ECW, GeoTIFF, TIF, BMP, CIT, COT, RLE, PIC, PCX, GIF, JPG2000 and PMG.

TerraPhoto offers many tools for visualizing laser and image data together, partly in combination with tools from TerraScan and TerraModeler. This includes the opportunity of draping ortho photos on a ground model or on building roofs, the creation of wall textures from horizontally-looking cameras of mobile or airborne systems, as well as the display of rendered views. With TerraPhoto you can also create fly-through animations from laser and image data in an easy and intuitive way. Finally, the extraction of color values from images or ortho photos to laser points can be performed with TerraPhoto and TerraScan.

TerraPhoto Lite

TerraPhoto Lite is a light version of TerraPhoto, designed for doing the extensive manual work for preparing the production of high-quality ortho photo and for visualization tasks. It replaced the previous TerraPhoto Viewer in 2012 when more functionality was added to the software.

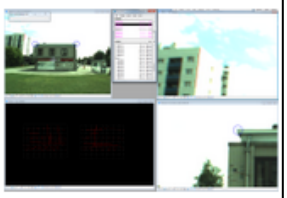
Typical uses for TerraPhoto Lite are the display of raster data as background information e.g. for mapping tasks, rendering of 3D scenes with large image volumes, production of fly-through animations, as well as improving the color balance between images and creating seamlines for TerraPhoto ortho photo production. The functionality of TerraPhoto Lite includes:

- create and edit mission files
- import Lynx survey and Pictometry survey data
- create and modify camera definitions
- convert camera system calibrations into TerraPhoto camera definitions
- manage trajectories
- load and edit image lists, edit image information
- define color corrections
- define color points
- create and edit selection shapes and seamlines
- draw image footprints, draw projections into the design file
- create camera views
- manage raster references
- create rendered views and fly-through animations
- fix normals of 3D building models

Ortho photos from aerial images



Camera calibration for mobile systems



Ortho photos and tree models in rendered views



Oblique images as wall textures



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TerraMatch - Calibration and Strip Adjustment

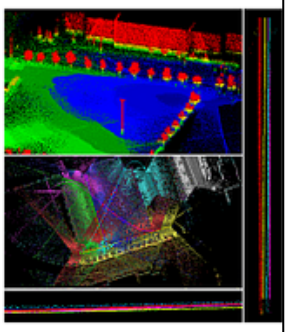
TerraMatch is a sophisticated tool for improving the accuracy and quality of the raw laser point cloud. It compares laser data from overlapping flight or drive paths and calculates correction values for the misalignment angles as well as xyz location errors. The comparison and correction value calculation can be either based on surface matching or on different types of tie lines. Tie line matching comprises points or lines on horizontal, vertical or sloped surfaces that can be used for matching flight/drive paths to each other, but also known point or line locations that enable the adjustment of the laser point cloud to control measurements.

Especially in terrestrial mobile laser scanning, the mismatch between overlapping drive paths usally changes over time during a surveying campaign, depending on the quality of the GPS signal on different locations. This requires a fluctuating correction solution which can be achieved with control measurements and TerraMatch tie lines.

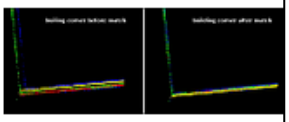
TerraMatch is also used for misalignment angle calibration which should be checked and possibly improved at the beginning of data processing. For this purpose, data is collected on a specific calibration side which offers a point cloud dedicated for the calibration task to the software. If the system includes several laser scanners, the calibration involves scanner-to-scanner matching.

TerraMatch must be accompanied by TerraScan.

calibration side example



adjustment of a building corner



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7.1.3.6. GLOBAL MAPPER

Global Mapper™

Surprisingly Affordable – Unexpectedly Powerful

GIS Software for Everyone

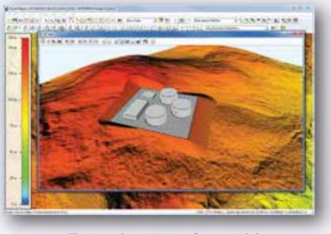
Global Mapper is a robust and inexpensive GIS application that combines a comprehensive array of spatial data processing tools with access to an unparalleled variety of data formats. Developed for both GIS professionals and map enthusiasts, this versatile software is equally well suited as a standalone GIS data management tool or as a complement to an established GIS infrastructure.

Trusted by thousands of GIS professionals around the world, Global Mapper's renowned capabilities are used by companies of all shapes and sizes. Industries include:

- Business Development
- Mapping and Charting
- Transportation
- Education
- Natural Resources
- Utilities
- Government
- Public Safety
- Oil & Gas

Highlights

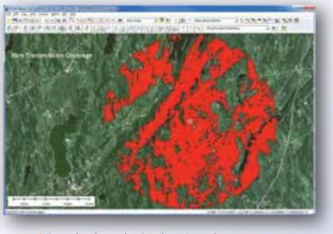
- Supports 250+ File Formats
- Countless Free Online Data Sources
- Powerful LiDAR Processing Tools
- 3D Rendering & Elevation Tools
- Batch File Conversion
- Advanced Analysis Tools
- Volume Calculation & Terrain Modification Tools
- Extensive Drawing & Digitizing Tools
- GPS Data Management Tools
- Support for Scripting
- Geographic Calculator Integration
- Utilizes 64 Bit Speed



• Flattened terrain surface model with 3D Vector features



• Proximity analysis using concentric range rings



• Viewshed analysis showing the coverage area for a transmission signal

Global Mapper embodies virtually everything you need in a GIS: Complete interoperability with unparalleled data support; straightforward installation and setup; just the right balance of powerful data processing and ease of use; free and unlimited technical support; and genuinely affordable pricing.

Global Mapper is capable of displaying, converting, and analyzing virtually any type of geospatial data whether 2D or 3D, cloud hosted or local, raster or vector, flat file or spatial database. The software converts, edits, publishes, prints, tracks GPS, mosaics, tiles and allows users to conduct spatial analysis of the highest order including NDVI change detection, watershed and terrain analysis, volume calculations and much more.

Resources

- Free Monthly Webinars
- Training Classes - Public, Online & Custom
- Getting Started Guide
- Academic Curriculums
- Social Media User Groups

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www.bluemarblegeo.com



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44° 17' 15.40" N, 69° 47' 24.55" W, WGS84
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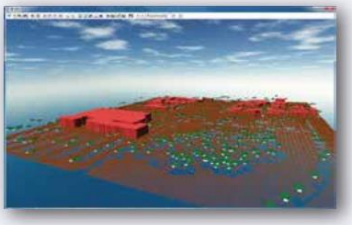
What's New?

To address the ever-changing needs of the geospatial community, Global Mapper is in a continual state of development. Updates and enhancements are released on a frequent schedule to ensure that users have virtually immediate access to the latest tools and can work with current versions of all of the common data formats. Among the recent additions to Global Mapper are:

- Fly-through visualization and recording in the 3D Viewer



- Graph and Chart generation for visualizing patterns in vector or raster data
- Raster calculation for advanced analysis of imagery or grid layers
- Integration of **the Geographic Calculator's** datasource for powerful projection and coordinate management



- Automatic classification and feature extraction with the optional LiDAR module
- And Much More

Download a **FREE** trial at www.bluemarblegeo.com/global-mapper and discover why Global Mapper will change the way you think about GIS.



- 2D and 3D viewer linked for editing, panning, zooming, and adding vector features

Built-in Data Access!

Global Mapper supports over 250 geospatial data types and offers built-in WMS support for direct access to countless free online data servers providing imagery, topographic maps, and elevation datasets for the entire world.

Stunning 3D Rendering and Elevation Tools

Global Mapper's 3D viewer is more powerful then ever! It now includes stunning capabilities to make the experience more lifelike. Users can simulate HD fly-through recordings, view/ track live GPS data, choose from existing sky templates to enable the Skybox tool as well as link the 2D and 3D viewer for easier editing.

Powerful LiDAR Processing Tools

View and process LiDAR point clouds with a billion points or more! With dramatically faster processing and displaying speeds, Global Mapper makes creating gridded surface models easy and fast. If you are looking for advanced point cloud analysis tools check out the **LiDAR Module** offered for Global Mapper v15 or higher

Energy Features

Global Mapper now includes all of the energy-focused features previously found in **Global Energy Mapper**. These features include leveraging the power of the Geographic Calculator for coordinate transformation in Global Mapper, symbols for the oil & gas industry, Site Pad Placement tools, Cut and Fill tools as well as Volumetric Calculation tools and much more.

Scripting

Did you know that many functions in Global Mapper can be performed by initiating a script? For more information visit our website today!

Support for User Extensions

Create your own custom apps to run in Global Mapper! Leverage the power of Global Mapper by purchasing our Software Developer Kit (SDK)to create custom toolbars and/or menu items. For more information contact our sales team at sales@bluemarblegeo.com.

Global Mapper™

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7.1.3.7. PHASE ONE IX CAPTURE 2.5

PHASEONE
INDUSTRIAL



Streamline Aerial Data Acquisition

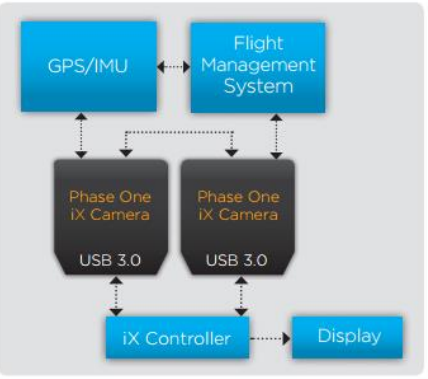
Specifically designed for use with Phase One aerial cameras, the iX Capture application was built from the ground up for in-flight capture and RAW conversion.

On a computer equipped with a touchscreen or mouse, users can easily control all essential camera functions.

Intuitive GUI

The intuitive interface makes setting up the camera an easy task — with a well organized display of essential information, including exposure settings, time interval captures, available disk space, GPS data and frame count. An interface option enables users to choose different skins to match the ambient lighting condition of the aircraft.

Users easily follow each capture in real time and control essential settings on Phase One aerial cameras — streamlining the data-acquisition process. By pausing the display of images, operators also can inspect individual captures, zooming up to 100 percent. As light conditions change, the Auto Exposure mode can automatically make necessary adjustments to ensure perfect exposures to give operators the confidence that each image is shot correctly.



Single- or up to Six-Camera Configurations

iX Capture is the perfect tool for single-camera use as well as up to six-camera configurations.

File Processing

Operators can process files during or after flights with industry-standard parameters and formats while applying user-created styles to save time in post-production.

Download iX Capture:
industrial.phaseone.com/downloads

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7.1.4. CERTIFICADOS DE CALIBRACIÓN

Es importante mencionar que los sensores ópticos como lo son la cámara fotogramétrica y el sensor LiDAR cuentan con certificados de calibración los cuales fueron involucrados en el presente informe, los certificados de calibración se encuentran vigentes puesto que no se han realizado modificaciones ni mantenimientos que involucren la integridad y posición de los componentes de los equipos, el procedimiento que se realiza para verificar el correcto funcionamiento de los sensores es realizar un vuelo de verificación de calibración periódicamente el cual consiste en identificar unos valores iniciales con puntos de control en campo los cuales se procesan en oficina y se verifica la precisión de los sensores tomando como referencia estos puntos de control, en caso de encontrar diferencias fuera de un rango aceptable o de realizar modificaciones y mantenimientos que involucren la integridad y posición de los componentes de los equipos se realizará una nueva calibración.

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6.1.3.1. CÁMARA FOTOGRAMÉTRICA DIGITAL PHASE ONE IXU RS 1000

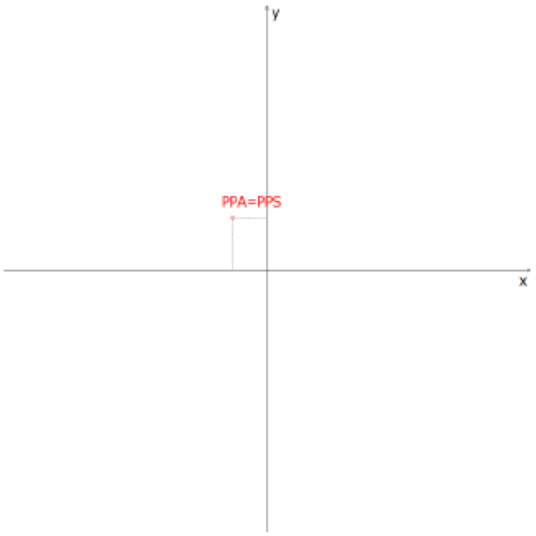
Camera Calibration

Block Adjustment - Version 8.0.1.51411 (64bit), build #22 of 2017-11-01 02:42 at 22.12.2017 10:01

Camera:	AICP65PRO_201209182_12087_calibration_10:00:37_22/12/2017
Manufacturer:	TAC Px CaptureOne v.x
Ser.No.:	201209182
sensor width:	8984
sensor height:	6732
pixel size:	6.00 x 6.00 [µm]

Internal Geometry

	original	calibrated	Std.Dev.
Focal Length:	51.8560 mm	51.6112 mm	+/- 1.4481 um
Princ. Point x:	-0.3039 mm	-0.3197 mm	+/- 0.9771 um
Princ. Point y:	0.4471 mm	0.4889 mm	+/- 0.9437 um



Calibration Report - Page 1

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Additional Parameters

Physical

correction for radial distortion

$$DX = X*(K_0 + K_1*R^2 + K_2*R^4 + K_3*R^6 + K_4*R^8 + K_5*R^{10} + K_6*R^{12} + K_7*R^{14})$$
$$DY = Y*(K_0 + K_1*R^2 + K_2*R^4 + K_3*R^6 + K_4*R^8 + K_5*R^{10} + K_6*R^{12} + K_7*R^{14})$$

correction for decentering distortion

$$DX = P_1*(R^2+2*X^2) + 2*P_2*X*Y$$
$$DY = 2*P_1*X*Y + P_2*(R^2+2*Y^2)$$

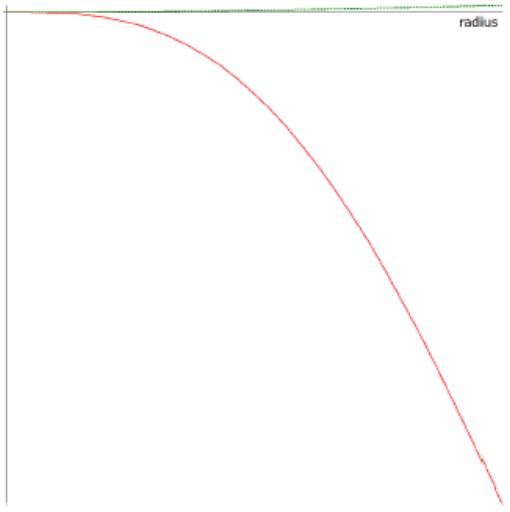
with $R = (X*X + Y*Y)^{1/2}$

X and Y are with respect to principal point (PPA=PPS)

Parameter	Value	Std.Dev.
K_0	0.00000e+00	
K_1	-1.39728e-05	+/- 4.3e-08
K_2	3.98214e-09	+/- 8.8e-11
K_3	-2.79360e-13	+/- 5.5e-14
P_1	-8.21448e-07	+/- 9.4e-08
P_2	-4.15452e-06	+/- 9.0e-08

Distortion Error of radial symmetric components of above parameters

Radius [mm]	Distortion [um]
0.0000	-0.0000
2.0000	-0.1117
4.0000	-0.8902
6.0000	-2.9872
8.0000	-7.0242
10.0000	-13.5774
12.0000	-23.1642
14.0000	-36.2292
16.0000	-53.1322
18.0000	-74.1361
20.0000	-99.3975
22.0000	-128.9572
24.0000	-162.7336
26.0000	-200.5172
28.0000	-241.9672
30.0000	-286.6105
32.0000	-333.8426
34.0000	-382.9316



The dashed green lines show the magnitude of the decentering distortions on the four image diagonals. This gives an impression of what will be missed if only radial distortion components are used.

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6.1.3.2. SENSOR LIDAR TRIMBLE HARRIER 68I (400 KHZ)

Factory Calibration Report

Trimble Harrier 68

Serial Number : H68_035

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2 Disclaimer

This document is supplied "as it is" without express, implied, or limited warranty of any kind by Trimble. In no event shall Trimble be liable for any loss or damage caused by information obtained from this report. The results present in this report are only applied for specific conditions. The reader must therefore be sure that the application at hand is exactly similar to the assumptions made herein to be able to use the results presented in this report. If the user's application(s) is different from those presented in this report, it is recommended to consult Trimble.

3 LiDAR System

Lever Arms from IMU to LIDAR:

```
X = -0.056 m
Y = -0.025 m
Z = +0.153 m
```

Boresight Calibration:

```
droll  = -0.01827 °
dpitch = +0.04846 °
dhead  = -0.02837 °
```

Based on the GPS reference data and the IMU the calibration strip adjustment result is:

```
0.0231 m (RMS)
```


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4 Digital Camera (1) TAC AICpro P65

4.1 Camera SN 201209182

Camera (Sensor) Orientation = 0°

4.2 Lens SN 12087861 [CAMERA_1]

Type RGB

INC = 0.0060 mm
XPIX = 8984 pix
YPIX = 6732 pix

Lever Arms from IMU to Camera:

XLEVER = +0.160 m
YLEVER = +0.000 m
ZLEVER = +0.243 m

Camera Calibration:

See Inpho Camera Calibration report

Boresight Calibration Camera:

ROLL = +0.2941 °
PITCH = +0.0098 °
HEAD = +0.2353 °

Radial Symmetric Lens Distortion:

See Inpho Camera Calibration report

According to ISPRS regulations:

$dR = A1 * R * (R^2-R0^2) + A2 * R * (R^4-R0^4)$

Radial Symmetric Distortion Table (1 page each)
Radial Symmetric Distortion Diagram (1 page each)

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4.3 Lens SN 12103600 [CAMERA_2]

Type RGB

```
INC          = 0.0060 mm
XPIX         = 8984 pix
YPIX         = 6732 pix
```

Lever Arms from IMU to Camera:

```
XLEVER = +0.160 m
YLEVER = +0.000 m
ZLEVER = +0.243 m
```

Camera Calibration:

See Inpho Camera Calibration report

Boresight Calibration Camera:

```
ROLL  = +0.2406 °
PITCH = +0.2066 °
HEAD  = +0.1727 °
```

Radial Symmetric Lens Distortion:

See Inpho Camera Calibration report

According to ISPRS regulations:

$dR = A1 * R * (R^2-R0^2) + A2 * R * (R^4-R0^4)$

Radial Symmetric Distortion Table (1 page each)
Radial Symmetric Distortion Diagram (1 page each)

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5 Center of Gravity and lever arms

Camera Orientation

Z	0 deg

IMU Orientation with Respect to Harrier Coordinate System

X	0 deg
Y	0 deg
Z	180 deg

Lever Arms from Origin to LiDAR Perspective Center

Lx	-0.056 m
Ly	-0.025 m
Lz	+0.153 m

Lever Arms from Origin to Camera Perspective Center

Cx	+0.160 m
Cy	+0.000 m
Cz	+0.243 m

Lever Arms from Origin to Housing Reference Corner

Rx	-0.380 m
Ry	-0.175 m
Rz	-0.128 m

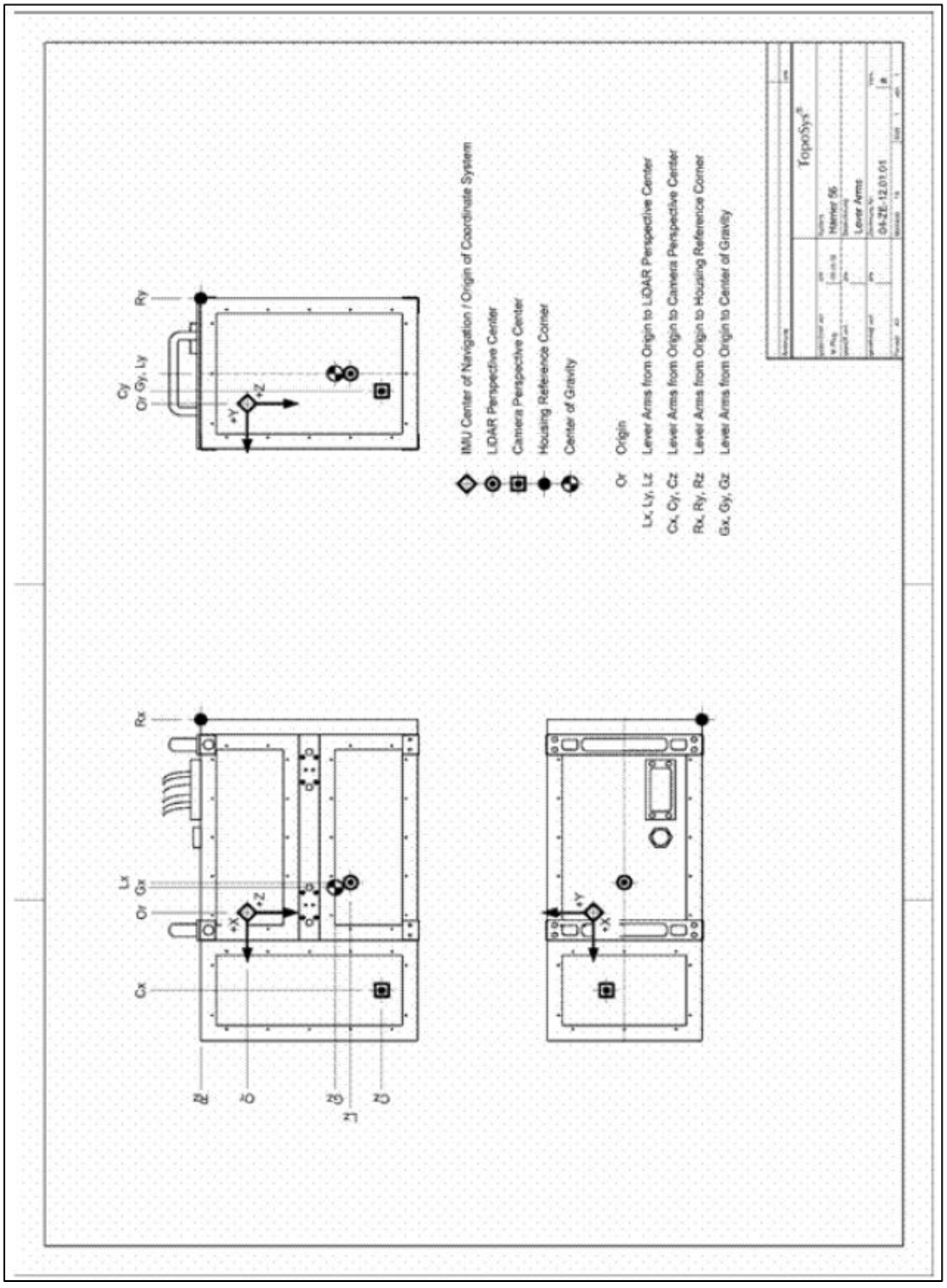
Lever Arms from Origin to Center of Gravity

Gx	-0.050 m
Gy	-0.025 m
Gz	-0.160 m

Distance from Housing Reference Corner to Center of Gravity

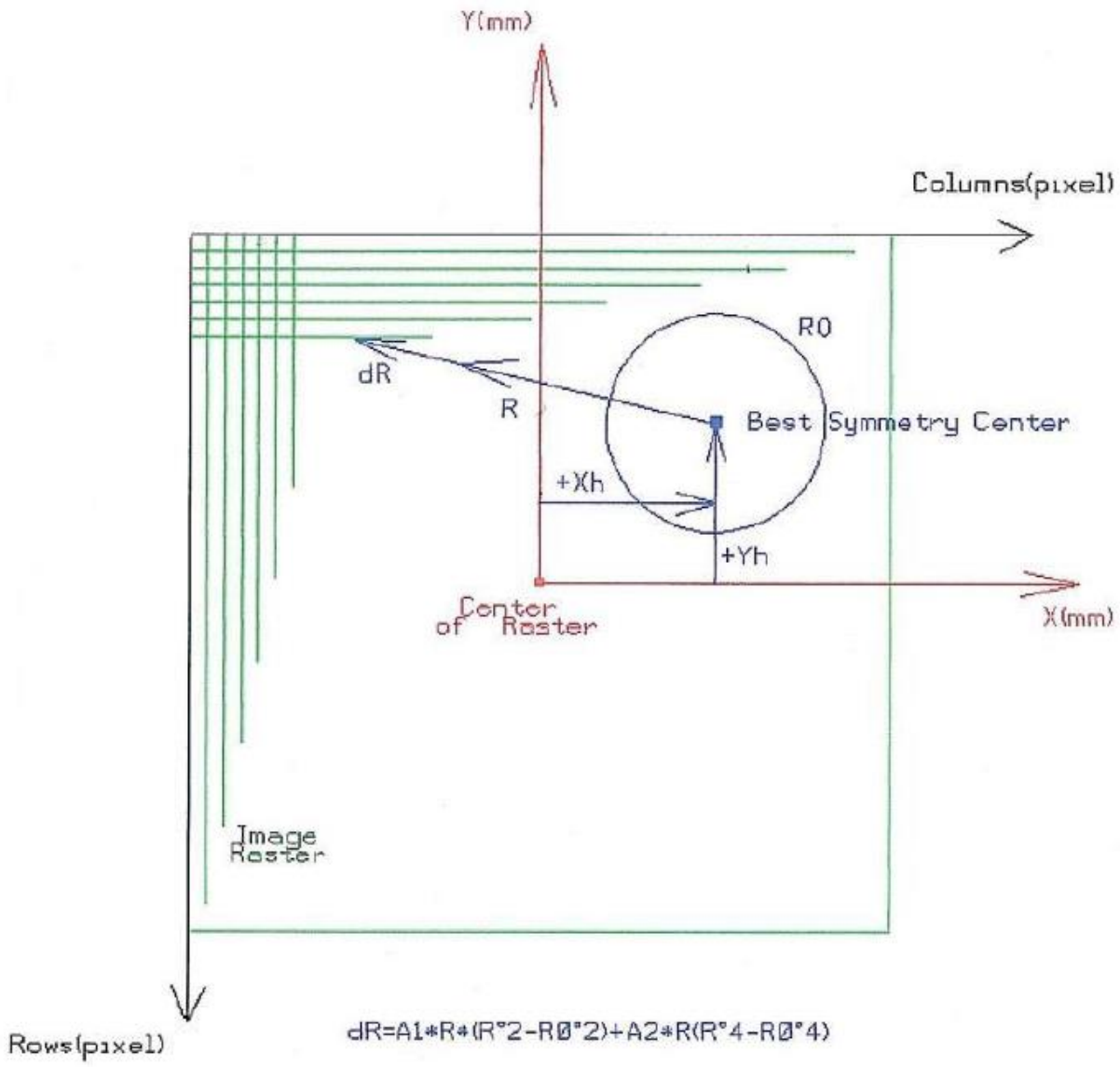
X	+0.330 m
Y	+0.150 m
Z	+0.278 m

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Definition Camera Coordinate System:



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6.1.4. INFORMACIÓN COMPLEMENTARIA RELEVANTE

6.1.4.1. CERTIFICADO DE OPERACIONES

ISATECH CORPORATION S.A.S. es una empresa certificada ante la Aeronáutica Civil como **EMPRESA DE SERVICIO AÉREO COMERCIAL DE TRABAJOS AÉREOS EN LA MODALIDAD DE AEROFOTOGRAFÍA.**



Republica de Colombia
Unidad Administrativa Especial de Aeronáutica Civil
Secretaria de Seguridad Aérea

CERTIFICADO DE OPERACIÓN

EMPRESA DE SERVICIO AEREO COMERCIAL DE TRABAJOS AEREOS ESPECIALES MODALIDAD AEROFOTOGRAFIA

Se certifica por el presente que la Empresa Aérea
ISATECH CORPORATION S.A.S.

Siendo su dirección comercial:
Aeropuerto Guaymaral, Hangar ATG

Satisface los requisitos del Código de Comercio Colombiano y las regulaciones de los Reglamentos Aeronáuticos de Colombia, en fe de lo cual se le expide el presente CERTIFICADO DE OPERACION que le autoriza a efectuar operaciones Aéreas Comerciales de Trabajos Aéreos Especiales en la Modalidad de Aerofotografía.

De conformidad con dicho Código y las regulaciones de los Reglamentos Aeronáuticos de Colombia, ISATECH CORPORATION S.A.S. con sus aeronaves y pistas autorizadas debe regirse con las limitaciones y condiciones estipuladas en las ESPECIFICACIONES DE OPERACIÓN respectivas (FORMA RAC 8710-3), anexadas al presente.

Este Certificado es intransferible y salvo renuncia por parte del titular, suspensión o revocación por parte de esta autoridad, la duración de su validez es indefinida.

Certificado No: UAEAC-CDO-AA-033
Revisión: 1
Lugar y Fecha de Expedición: Bogotá D.C., 12 de Septiembre de 2014
El presente certificado remplaza la revisión Original emitido en la fecha 29/01/2014. La revisión 1 se debe a corrección de error en la modalidad de operación de la empresa

GUSTAVO A. LENIS STEFFENS
Director General UAEAC

Cr(R) MIGUEL CAMACHO MARTINEZ
Secretario de Seguridad Aérea (E)

RAC-8430-21-2

Revisión: 2
Fecha: Dic 01 de 2005

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ANEXO 7.2. PERMISOS DE VUELO

Se encuentra disponible en Drive en el enlace
https://drive.google.com/drive/u/2/folders/1KCIhiQgYyFlzBsdZhg2ekSqk4nxx26kp

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ANEXO 7.3. PUNTOS DE FOTOCONTROL

Se encuentra disponible en Drive en el enlace
https://drive.google.com/drive/u/2/folders/1KCIhiQgYyFlzBsdZhg2ekSqk4nxx26kp

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ANEXO 7.4. MODELO DIGITAL DE TERRENO – MDT

Se encuentra disponible en Drive en el enlace
https://drive.google.com/drive/u/2/folders/1KCIhiQgYyFlzBsdZhg2ekSqk4nxx26kp

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ANEXO 7.5. MODELO DIGITAL DE SUPERFICIE – MDS

Se encuentra disponible en Drive en el enlace
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ANEXO 7.6. ORTOFOTO

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ANEXO 7.7. GDBs (INFORMACIÓN VECTORIAL)

Se encuentra disponible en Drive en el enlace
https://drive.google.com/drive/folders/14umpN2SQBj__PrwQzrmgkBr5kkRjMt80

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