

Section of Geophysics

AiRS infrastructure (Airborne Remote Sensing)



Equipment inventory

PIPER SENECA III – PA 34-220T

Engines	6 cylinder Turbocharged
Engine Model	Continental TSIO-360-RB and LTSIO-360RB
Engine Power (each)	220 hp
Propellers	3 blades, Mc Cauley
Top Speed	204 kts
Cruise Speed	188 kts
Stall Speed (dirty)	61 kts
Gross Weight	2165 kg
Empty Weight	1457 kg
Fuel Capacity	465 l
Range	870 nmi (1611 Km)
Service Ceiling	25000 ft
Seats	6

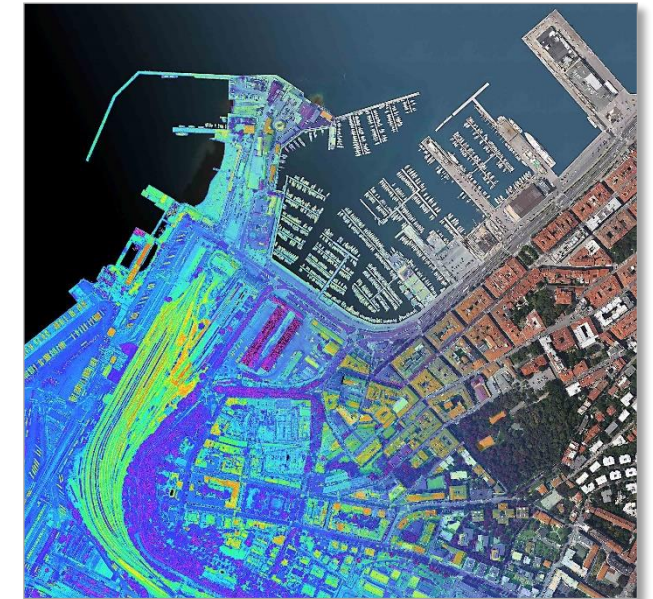


RIEGL VQ-480 II

Laser Product Classification	Class3R (according to IEC60825-1:2014)
Minimum Range	20 m
Maximum Range	2.500 m@150 kHz - 800 m@2000 kHz
Accuracy and Precision	20 mm
Laser Pulse Repetition Rate	up to 2000 kHz (user selectable)
Measurement Rate	up to 1.250.000 meas/sec
Laser Wavelength	near infrared (1550 nm)
Laser Beam Divergence	≤ 0.35 mrad
Scan Angle Range:	±37.5°= 75° total
Number of Targets per Pulse	15 - digitized waveform processing
Data Storage	SSD 2 TB
Software	RiACQUIRE, RiPROCESS (complete suite), Tscan, Tmodeler, Tphoto

**APPLANIX AP50 IMU (integrated)**

Data Rate	200 Hz (IMU), 5Hz (GNSS)
Position	0.5-2.0 m
Attitude Accuracy	Pitch, Roll: 0.008°; True Heading: 0.05°
Velocity Accuracy	0.05 m/s RMS
Channels	220 x 2
GNSS constellations	GPS, GLONASS, GALILEO, QZSS, SBAS, L-Band
I/O	LAN, TCP/IP, UDP, RS232, PPS
Dimensions	130x100x39 – 0.28 kg
Software	Applanix POSPac



RIEGL LMS-Q560**Range Measurement performance**

Laser Product Classification	Class1 (according to IEC60825-1:2007)
Minimum Range	30 m
Maximum Range	1.200 m@50 kHz - 550 m@240kHz
Accuracy	20 mm
Precision	10 mm
Laser Pulse Repetition Rate	up to 240 kHz (user selectable)
Laser Wavelength	near infrared
Laser Beam Divergence	≤ 0.5 mrad
Number of Targets per Pulse	unlimited - digitized waveform processing

Scanner performance

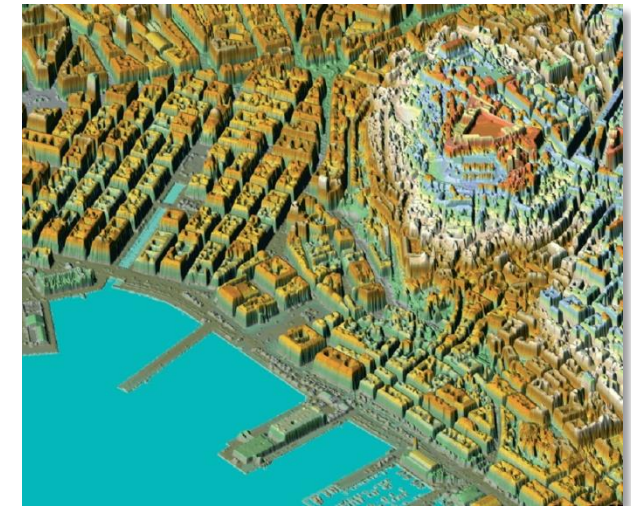
Scanning Mechanism:	rotating polygon mirror
Scan Pattern:	parallel scan lines
Scan Angle Range:	±30°= 60° total
Scan Speed:	10 - 160 lines/sec
Angle Measurement Resolution	0.001 °

Intensity Measurement for each echo signal, hi-res 16-bit intensity information is provided

Data Storage RIEGL DR560-RD

Acquisition software RiACQUIRE

Processing software RiPROCESS, RiANALYZE, RiWORLD, Terrascan, Terramodel, Terraphoto



PHASE ONE iMX-RS150F

Resolution	150MP - 14204 x 10652
Dynamic range	83 dB
Aspect ratio	4:3
Pixel size	3.76 μ m
Effective sensor size	53.4 x 40.0 mm
Light sensitivity	50-6400 ISO
Capture rate	2 fps
Camera type	Medium-format camera for aerial imaging
Lens mount Phase	One RS
Data interfaces	USB3, Ethernet 10G
I/O interfaces	Trigger, mid exposure, ready, serial
HDMI	1920 x 1080 60p
Data storage	XQD card
Lens	50 mm Phase One RS
Shutter speed	Up to 1/2500
Aperture range	f/4 - f/22
FOV	54.6° long side – 42.3° short side



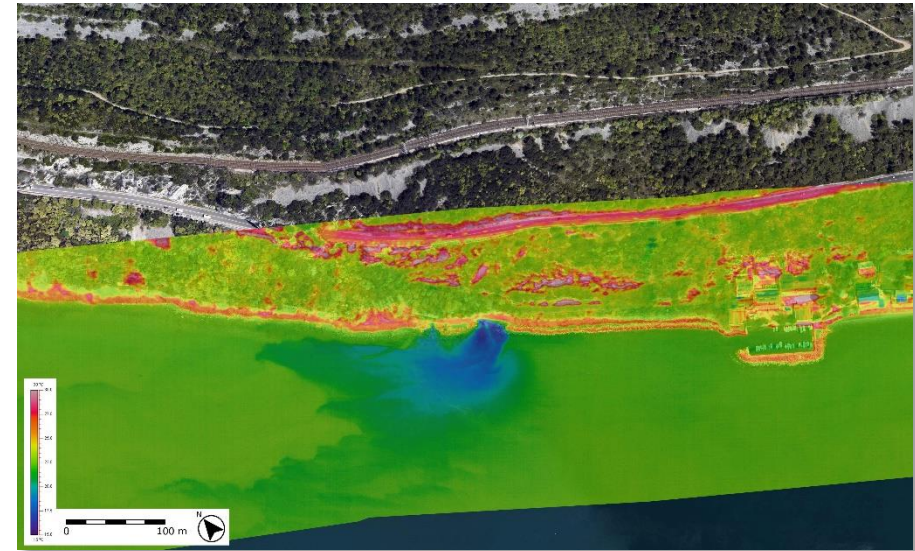
SPECIM Aisa Eagle 1K

Spectrograph	High efficiency transmissive imaging spectrograph Throughput practically independent of polarization Smile and keystone < 5 microns.
F/#	F/2.4
Spectral Range	400 ÷ 970 nm (VNIR)
Spectral Sampling	2.5 nm
Spectral Pixel	252
Focal length	18.5 mm - 9 mm
Field Of View	35 ° - 63°
Spatial pixels	up to 1024 (of wich 40 FODIS pixels)
Spatial Ground Resolution	0.7 m (@ 1000 m) – 0.5 m (@700 m)
Camera	progressive scan CCD camera
Image rate	Up to 50 images/s @ 252 bands Up to 80 images/s @ 60 bands
Output	12 bits digital
Integration time	Settable independet of image rate
Shutter	Electromechanical shutter for dark background registration
FODIS	Diffuse light collector and fiber optic cable
Software	RS Cube, CaliGeo, Project Builder



NEC Thermo Tracer TS9260

Spatial Resolution	640 x 480
Spectral Range	8 ÷ 13 μm
NETD	0.06°C (@30°C, 30Hz)
Thermal Resolution	0.08 °C
Temperature Range	-40 ÷ 500 °C
Field Of View	21.7° (H) x 16.4° (V)
IFOV	0.6 mrad
Frame Rate	30 frames/sec
Accuracy	±2%(Reading) or ±2°C
Focus	50 mm to infinity
A/D Resolution	14 bit

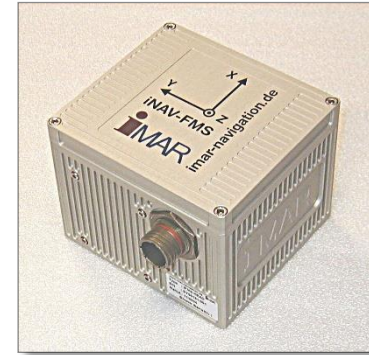


NOTES

This thermal camera can record both still images and video sequences. It has its own GPS system, which records the exact trigger time, so it is possible to georectify images

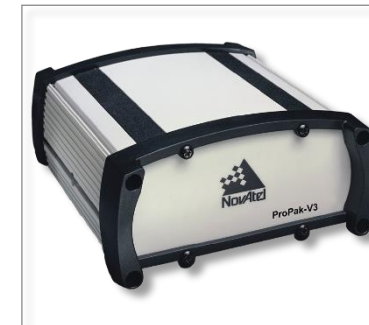
iMAR FSAS IMU

Data Rate	200 Hz
Attitude Accuracy	Pitch, Roll: 0.015° RMS; Azimuth: 0.05° RMS
Velocity Accuracy	0.02 m/s RMS
Acceleration Accuracy	0.03 m/s ² RMS
Gyro Input Range	±500 deg/sec
Gyro Rate Bias	<0.75 deg/hr
Gyro Rate Scale Factor	300 ppm
Angular Random Walk	0.1 deg/vhr
Accelerometer Bias	1.0 mg
Accelerometer Linearity/S.F.	400 ppm



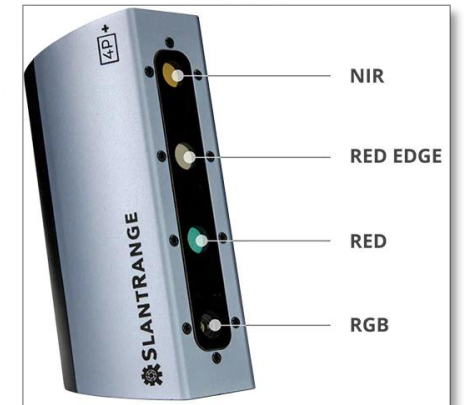
GNSS NOVATEL ProPak V3

Channels	72
Signals Tracked	GPS L1/L2/L5, Glonass L1/L2, SBAS
Position Accuracy	Single Point L1/L2 1.5 m DGPS 0.45 m RT-20 < 20 cm RT-2 1 cm + 1ppm
GNSS Antenna Type	NOVATEL 534C
Data Rate	50 Hz (measurements and position)
Communications Ports	2 RS232, 1 RS232 serial, 1 USB Auxiliary strobe signals, including a configurable PPS output and two mark inputs

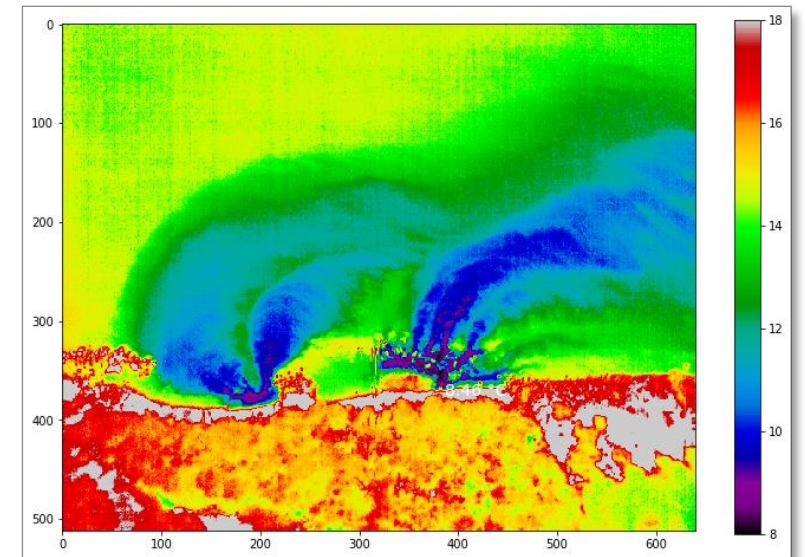


DJI MATRICE 210 V2

Weight	4,57 kg
Max takeoff weight	6,14 kg
Batteries	2 DJI TB55 7660 mAh
Max Flight Time (No Payload)	38 min
Max Flight Time (Full Payload)	24 min
Transmission Range	8 km
Max Wind Resistance	12 m/s
Remote controller	DJI Cendence+Cristal Sky
Anti-collision sensors	Forward (Optical), Downward (Ultrasonic), Upward (Infrared)
Gimbal	Single/Dual Downward and Single Upward Gimbal
TimeSync	
Support for DJI Zenmuse sensors	

**SENSORS**

Camera	Zenmuse X5S 15mm (Photo 21MP and Video 5,2k)
Thermal Camera	Zenmuse XT2 (640x512, 30Hz)
Multispectral Camera	Slanrange 4P+ (6 bands, 410-950 nm)
CO ₂ sensor	Cozir Arduino Based Data Logger



DJI MATRICE 300 RTK

Weight	6,3 kg
Max takeoff weight	9,0 kg
Max Payload	2,7 kg
Batteries	2 DJI TB60 5935 mAh
Max Flight Time (No Payload)	55 min
Max Flight Time (Full Payload)	31 min
Transmission Range	15 km
Max Wind Resistance	15 m/s
Remote controller	2 DJI Smart Controller Enterprise
Anti-collision sensors	Forward, Backward, Downward, Upward, Right, Left,
Gimbal	Single/Dual Downward and Single Upward Gimbal

**SENSORS**

Laser scanner	Riegl miniVUX3 (360°, 100-300kHz, 200.000 pt/s)
Inertial Unit	Applanix APX-20 (200 Hz)
Photo Camera	Zenmuse P1 (45 Mpx, Full-Frame)
Thermal Camera	Zenmuse XT2 (640x512, 30Hz)
Hyperspectral Camera	Senop HSC-2 (1000 bands, 500-900 nm)



DJI MATRICE 350 RTK

Weight	6,47 kg
Max takeoff weight	9,2 kg
Max Payload	2,7 kg
Batteries	2 DJI TB65 5880 mAh
Max Flight Time (No Payload)	55 min
Max Flight Time (Full Payload)	31 min
Transmission Range	20 km
Max Wind Resistance	12 m/s
Anti-collision sensors	6 directions
Gimbal	Single/Dual Downward and Single Upward Gimbal
Ingress protection	IP55
Remote controller	2 DJI RC plus

**SENSORS**

Laser scanner	DJI Zenmuse L2 (5 echoes, 240.000 pt/s, CMOS 20 Mpx)
Photo Camera	Zenmuse P1 (45 Mpx, Full-Frame)
Hyperspectral Camera	Cubert Ultris X20+ (164 bands, range 350-1000 nm, FWHM 10 nm)

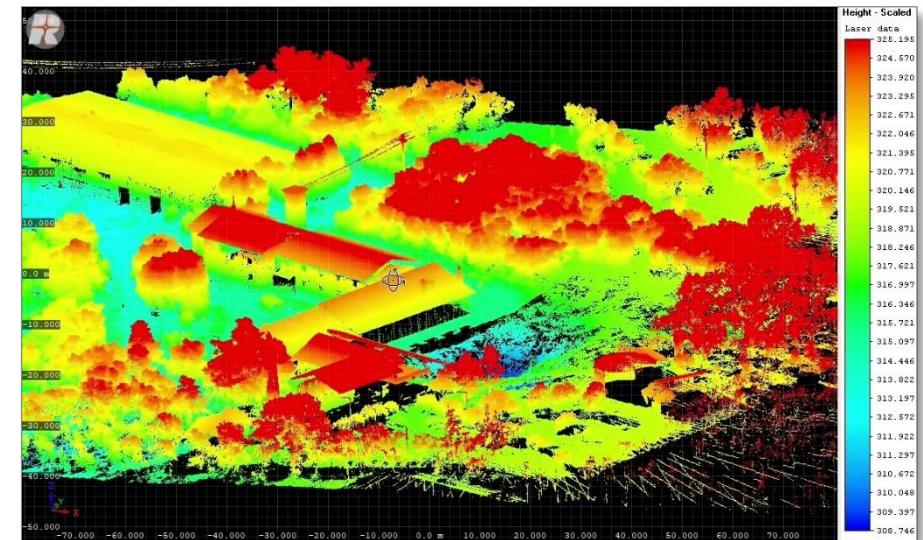


DJI MATRICE 350 RTK

Weight	6,47 kg
Max takeoff weight	9,2 kg
Max Payload	2,7 kg
Batteries	2 DJI TB65 5880 mAh
Max Flight Time (No Payload)	55 min
Max Flight Time (Full Payload)	31 min
Transmission Range	20 km
Max Wind Resistance	12 m/s
Anti-collision sensors	6 directions
Gimbal	Single/Dual Downward and Single Upward Gimbal
Ingress protection	IP55
Remote controller	2 DJI RC plus

SENSORS

Laser scanner	Riegl miniVUX3 (360°, 100-300kHz, 200.000 pt/s)
Inertial Unit	Applanix APX-20 (200 Hz)
Photo Camera	Zenmuse P1 (45 Mpx, Full-Frame)



DJI MATRICE 30 T RTK

Weight	3,77 kg
Max takeoff weight	4,07 kg
Batteries	DJI TB30 5880 mAh
Max Flight Time	41 min
Transmission Range	15 km
Max Wind Resistance	12 m/s
Anti-collision sensors	6 directions
Ingress protection	IP55
Remote controller	DJI RC plus

**SENSORS**

Wide Camera	12 Mpx, 24 mm, DFOV 84°, video 4K/30fps
Zoom Camera	48 Mpx, 113-405 mm, Optical zoom 5x-16x, Hybrid zoom 200x, 4K/30fps
Thermal Camera	VOx Microbolometer 640x512, 40 mm, 30 fps, $\pm 2^{\circ}\text{C}$ o $\pm 2\%$
Laser range finder	Raggio: 3 m - 1200 m, Precisione: $\pm(0,2 \text{ m} + D \times 0,15\%)5$



DJI MAVIC 3 THERMAL RTK

Weight	0,92 kg
Max takeoff weight	1,05 kg
Batteries	5000 mAh, LiPo 4S
Max Flight Time	45 min
Transmission Range	32 km
Max Wind Resistance	12 m/s
Anti-collision sensors	6 directions wide range
Ingress protection	IP55
Remote controller	DJI RC pro enterprise

Wide Camera	48 Mpx, 24 mm, DFOV 84°, video 4K/30fps
Zoom Camera	12 Mpx, DFOV 15°, 162 mm, Optical zoom 5x-16x, Hybrid zoom 56x, 4K/30fps
Thermal Camera	VOx Microbolometer 640x512, 61 mm, 30 fps, $\pm 2^{\circ}\text{C}$ o $\pm 2\%$

**DJI Mini 2 combo**

Weight	< 249 g
Batteries	2250 mAh, LiPo 2S
Max Flight Time	31 min
Transmission Range	32 km
Max Wind Resistance	8,5-10,5 m/s
Anti-collision sensors	downward

Wide Camera	48 Mpx, 24 mm, DFOV 84°, video 4K/30fps
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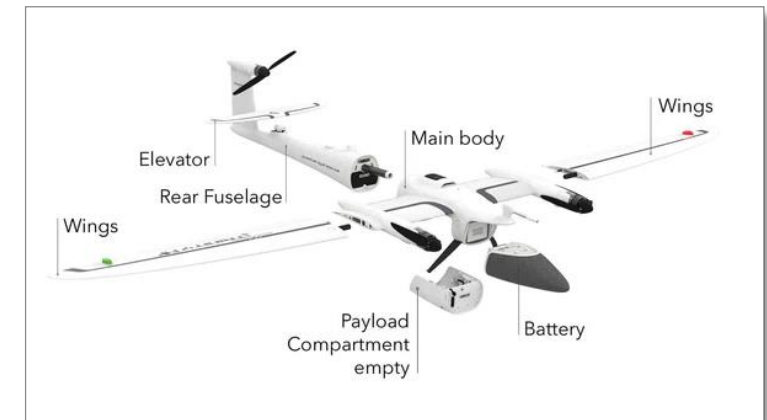


QUANTUM Trinity Pro

Max. take-off weight	5.75 kg
Max. payload weight	1 kg
Wingspan	2.394 m
Max. flight time	90 min
Linear coverage	100 km
Area coverage	700 ha
Maximum flight altitude	5500 m
Optimal cruise speed	33 kn
Wind Tolerance	21.4 kn (Hover phase), 27.2 kn (Continuous), 35 kn (Gusting)
Ingress protection rating	IP55
Operating temperature range	-12 to +50°C
Command and control range	5-7.5 km
Landing	down facing LiDAR sensor
Software	QBase 3D, Applanix POSPac UAV, Metashape Pro

SENSORS

Spectral camera	MicaSense Altum-PT (RGB+NIR+Thermal LWIR)
Photo Camera	SONY RX1 RII (42.4 Mpx, Full-Frame, 35 mm F2.0)
Other sensors	Air data probe, anemometer, GNSS base station



RIEGL VZ-400**Range Measurement performance**

Laser Product Classification	Class1 (according to IEC60825-1:2007)
Minimum Range	1.5 m
Maximum Range	600 m@100 kHz - 350 m@300 kHz
Accuracy	5 mm
Precision	3 mm
Laser Pulse Repetition Rate	100 kHz (long range mode) - 300 kHz (high speed mode)
Laser Wavelength	near infrared
Laser Beam Divergence	≤ 0.35 mrad
Number of Targets per Pulse	unlimited - digitized waveform processing

Scanner performance

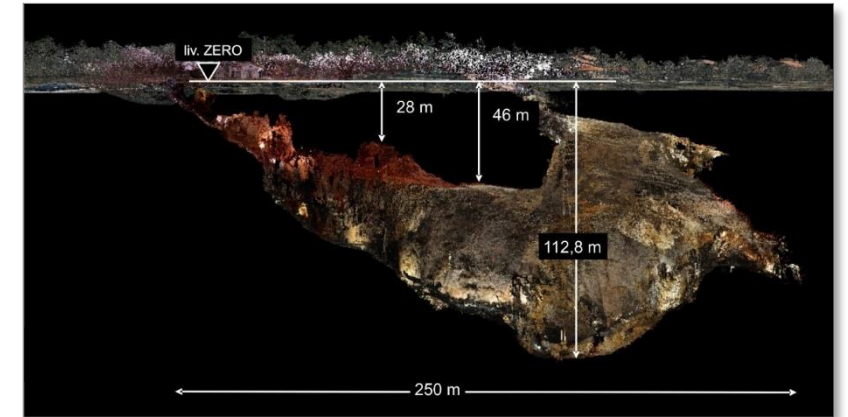
Scanning Mechanism	rotating multi-facet mirror and rotating head
Scan Angle Range	100° Vertical - 360° Horizontal
Scan Speed	3 lines/sec to 120 lines/secAngle Meas.
Resolution	better 0.0005°(1.8 arcsec)

Acquisition/Processing software RiSCAN PRO



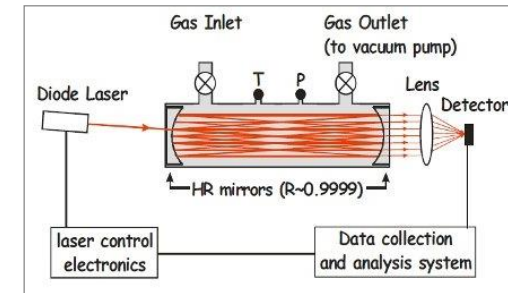
FARO FOCUS PREMIUM 150

Laser Product Classification	Class1 (according to IEC60825-1:2007)
Range	0.5 m - 150 m
Scan Angle Range	300° Vertical - 360° Horizontal
Scan Speed	2.000.000 Pts/sec
3D Accuracy	2 mm @10m, 3.5 mm @25m, 10 mm @100m
Ranging error	+/- 1 mm
Laser Wavelength	near infrared (1553.5 nm)
Laser Beam Divergence	0.3 mrad (1/e)
Camera	HDR integrated 266 MPX
Additional features	Dual axis compensator, compass, integrated GNSS, height sensor, on-site compensation
Ingress protection	IP54
Software	Faro Scene, Scene2go



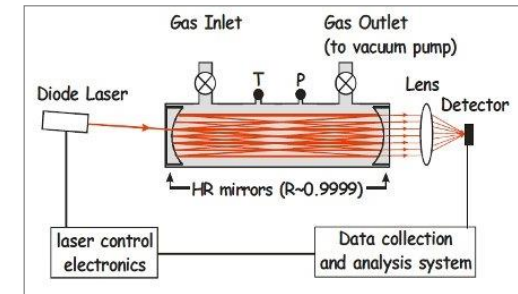
LGR - Ultraportable Greenhouse Gas Analyzer (CH₄, CO₂, H₂O)

Measurement Principle	Cavity enhanced laser absorption based (OA-ICOS technology)
Precision	CH ₄ : 2 ppb/0.6 ppb CO ₂ : 300 ppb / 100 ppb H ₂ O: 200 ppm/60 ppm
Measurement Rates	0.01–1 Hz (user selectable)
Accuracy	uncertainty < 1% w/o calibration
Measurement Range	CH ₄ : 0.1–100 ppm CO ₂ : 200–20,000 ppm H ₂ O: 7,000–70,000 ppm
Operational Range	CH ₄ : 0–1,000 ppm CH ₄ : 0–10% CO ₂ : 0–20% H ₂ O: 0–70,000 ppm
Sample Temperature	-10–50°C
Operating Temperature	5–45°C
Ambient Humidity	0 - 100% RH non-condensing
Data Logging System	multi-channel data logging system records and synchronizes serial (RS-232) outputs from multiple LGR analyzers and other devices (GPS, anemometers, ecc..)
NOTES	Small enough to be carried on-board aircraft (47x36x18 cm – 15 kg)



LGA 132-GGA - Microportable Greenhouse Gas Analyzer (CH₄, CO₂, H₂O)

Measurement Principle	Cavity enhanced laser absorption based (OA-ICOS technology)
Precision (1 σ ,1s/10/100s)	CH ₄ : 0.9 ppb/0.3 ppb CO ₂ : 0.35 ppb /0.12 ppb H ₂ O: 200 ppm/60 ppm
Measurement Rates	0.01–1 Hz (user selectable)
Accuracy	uncertainty<1% w/o calibration
Measurement Range	CH ₄ : 0.1–100 ppm CO ₂ : 200–20.000 ppm H ₂ O: 0–30.000 ppm
Operational Range	CH ₄ : 0–1.000 ppm CH ₄ : up to 1% CO ₂ : up to 3% H ₂ O: <99% relative humidity
Sample Temperature	-10–50°C
Operating Temperature	5–45°C
Ambient Humidity	0 - 100% RH non-condensing
Data Logging System	internal computer that can store data and send real-time recordings to a data logger through its analog and digital (RS232) outputs (USB x2, Ethernet LAN VGA display, 8 MIU, WiFi)
Dimensions	12x34x29.5 cm – 6.1 kg



LI-COR LI-850**General**

Output rate:	Up to 2 measurements per second
Measurement principle:	Non-Dispersive Infrared
Pressure compensation range:	50 to 110 kPa
Maximum gas flow rate:	1 liter min ⁻¹
Output signals:	Two analog voltage (0 to 2.5 V or 0 to 5 V) Two current (4 to 20 mA)
Digital outputs:	TTL (0 to 5 V) or Open Collector
DAC resolution:	16 bits across user-specified range

CO₂ measurements

Measurement Range:	0 to 20,000 ppm
Accuracy:	Within 1.5% of reading
RMS noise at 370 ppm:	<1 ppm
Lower limit of detection:	1.5 ppm

H₂O measurements

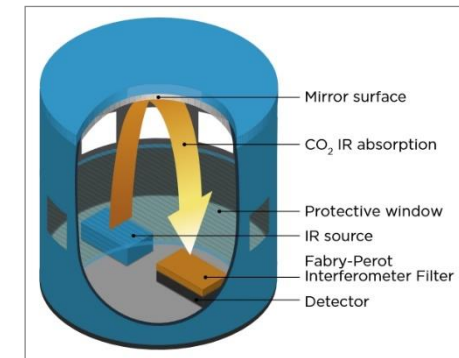
Measurement range:	0 to 60 mmol mol ⁻¹
Accuracy:	Better than 1.5% of reading
RMS noise at 10 mmol mol ⁻¹ :	<0.01 mmol mol ⁻¹
Lower limit of detection:	0.015 mmol mol ⁻¹



VAISALA GMP343

Measurement Principle	Single-Beam Dual-Wavelength NDIR
Sensor	Vaisala CARBOCAP
Measurement Range Options	0 - 1000, 2000, 3000, 4000, 5000 ppm 0 - 2 %
Accuracy	0-1000 ppm ±(3 ppm CO ₂ +1% of reading) 0-2000 ppm ±(5 ppm CO ₂ +2% of reading)
Noise (repeatability - 370ppm)	±3 ppm CO ₂ ±1 ppm CO ₂
Temperature Compensation	built-in Pt1000 sensor
Operating Temperature	-40 +60°C

NOTES
Small enough to be carried on-board drone
(19x5.5x5.5 cm – 360 g)



LIGHTHOUSE HANDHELD 3016 IAQ

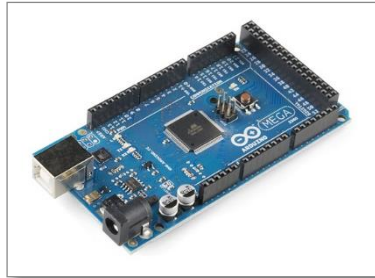
Principle of Operation	laser (diode)
Size Range	0.3 - 10.0 μm
Channel Sizes	0.3, 0.5, 0.7, 1.0, 2.5, 5.0, 10.0 μm
Counting Efficiency	50% @ 0.3 μm ; 100% for particles > 0.45 μm
Count Modes	Concentration, manual/automatic, beep, cumulative/differential
Flow Rate	0.1 CFM
Calibration	NIST Traceable
Data Storage	3,000 sample records
Concentration Limits	2,000,000 particles/ft ³ @ 5% coincidence loss
Sample Inlet	Isokinetic sampling probe
Sample Output	Internally filtered to HEPA standards
Vacuum Source	Internal pump, flow controlled
Environmental Sensors	Temperature/Relative Humidity probe
NOTES	Small enough to be carried on-board drone (22x13x6 cm – 1 kg)



Arduino components



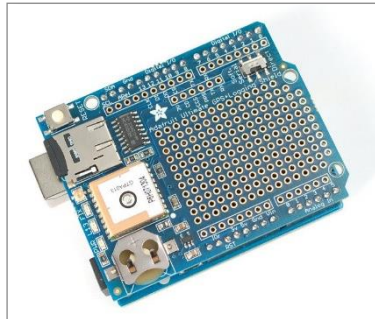
Arduino UNO Rev3



Arduino Mega 2560

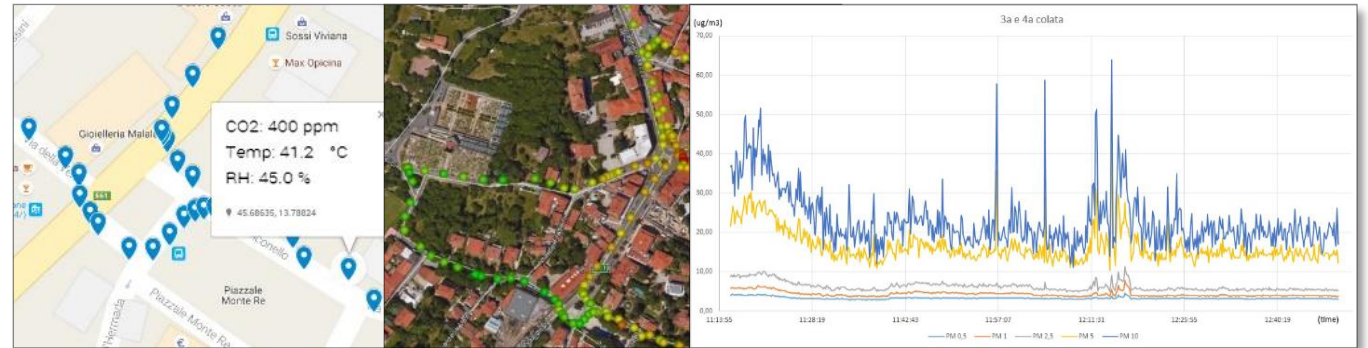


WEMOS D1 Mini Lite



Adafruit Ultimate GPS Logger

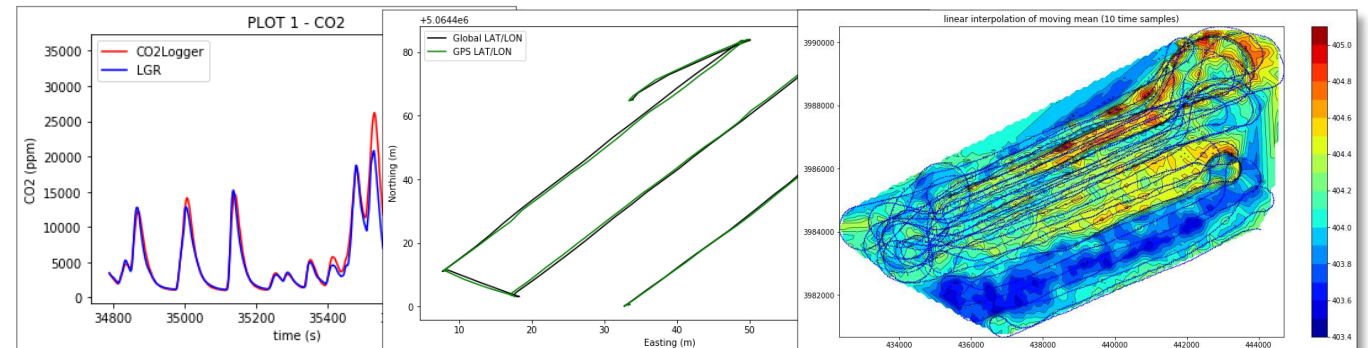
OUTPUT examples



Google MAPS integration

Google EARTH integration

Data analysis



Data charts

Trajectory analysis

Data visualization

CO2 sensors



COZIR WX60

Measuring method	NDIR (Non Dispersive InfraRed)
Range	0÷60 %
Accuracy	±70 ppm +/- 5% lettura
Heating time	< 10s
Operative conditions	0÷50 °C; 0÷95% RH
Dimensions	40x25x19 mm
Power consumption	< 1,5 mA



VAISALA GMP343

Measuring method	Single-Beam Dual-Wavelength NDIR
Sensor	Vaisala CARBOCAP
Accuracy 0-1000 ppm	±(3 ppm CO2 +1% reading)
Accuracy 0-2000 ppm	±(5 ppm CO2 +2% reading)



LOS GATOS LGR UGGA

Measuring method	Cavity enhanced laser absorption based
Precision	CH4: 2 ppb/0.6 ppb CO2: 300 ppb / 100 ppb H2O:200 ppm/60 ppm
Measurement Rates	0.01–1 Hz (user selectable)
Accuracy	uncertainty<1% w/o calibration
Measurement Range	CH4: 0.1–100 ppm CO2: 200–20.000 ppm H2O: 7.000–70.000 ppm



RADON sensor

Sensor Type:	Pulsed Ion Chamber
First data out:	< 60min
Data interval:	10min update
Sensitivity:	0.5cpm/pCi/L
Operating range:	10~40°C, RH < 80%
Range:	0.2~99.9pCi/L (7~3,700Bq/m ³)
Reproducibility:	<±10% at 10pCi/L
Accuracy:	<±10% (min. error <±0.5pCi/L)
Sensor Size:	Φ68(mm) x 98(mm)
Data communication:	UART

*FTLab RD200M Radon Sensor****PM counter sensor***

Principle of Operation	laser (diode)
Size Range	0.3 - 10.0 μm
Channel Sizes	0.3, 0.5, 0.7, 1.0, 2.5, 5.0, 10.0 μm
Counting Efficiency	50% @ 0.3 μm; 100% for particles > 0.45 μm
Data Storage	3.000 sample records
Concentration Limits	2mln particles/ft ³ @ 5% coincidence loss
Sample Inlet	Isokinetic sampling probe
Sample Output	Internally filtered to HEPA standards

*LIGHTHOUSE HANDHELD 3016 IAQ*

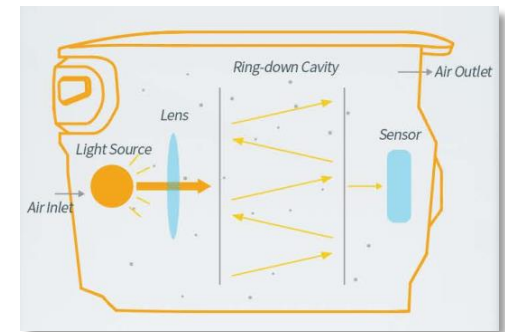
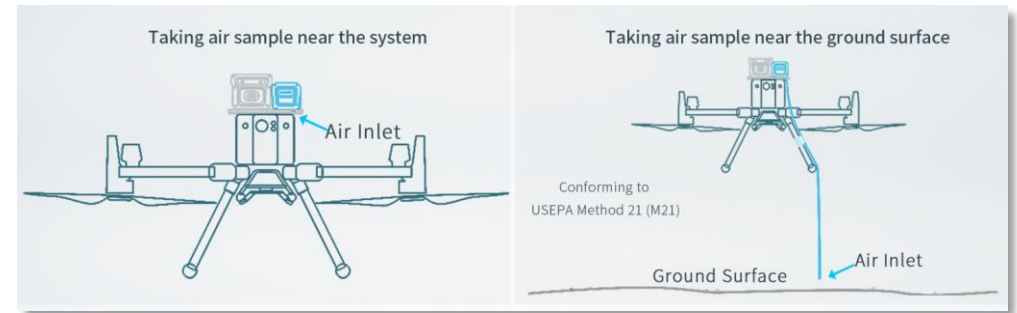
CH₄

Measurement Principle	Tunable Diode Laser Absorption Spectroscopy
Resolution	1ppm (Static Noise Level < 300ppb)
Range	0 ~ 15000ppm
Detection Limit	1~1.5ppm
Connectivity	4G/3G/EDGE/GPRS, Automatic Data Forwarding to Cloud
Ingress protection	IPX2 Rated
Weight	300 gr
Auto calibration	

CO₂

Measurement Principle	Non-dispersive infrared (NDIR)
Resolution	0.01% / 100ppm
Range	0~5%VOL / 50000ppm
Detection Limit	0.01% 100ppm
Accuracy	±10%
Zero drift	<±0.05% VOL/month
Connectivity	4G/3G/EDGE/GPRS, Automatic Data Forwarding to Cloud
Ingress protection	IPX2 Rated
Weight	250 gr
On-chip proprietary temperature compensation algorithms	

Advanced real-time data visualization and analytical software
 Display real-time gas concentration values and temporal graphs



JAVAD Triumph 1M

Channels	864 (All-In-View)
Signals Tracked	GPS L1/L2/L2C/L5, Glonass L1/L2, WAAS, EGNOS, Beidou, Galileo, QZSS
Accuracy	Static: H 0.3 cm + 0.1 ppm, V 0.35 cm + 0.4 ppm Kinematic: H 1 cm + 1 ppm, V 1.5 cm + 1 ppm RTK: H 1 cm + 1 ppm, V 1.5 cm+1 ppm
GNSS Antenna Type	Integrated Microstrip (Zero Centered)
Anti-Interferences Features	Advanced Multipath Reduction J-Shield jamming protection
Radio	Internal UHF 40-470 MHz
Internet	Internal 4G LTE modem
Communications ports	Serial, USB, Bluetooth, WiFi, Ethernet, PPS, Event Marker
RTK Rate & Update Rate	10Hz, 20Hz, 50Hz & 100Hz
Batteries	2 Internal (Up to 18 Hours)
Other Features	Tilt Sensor, Integrated Compass



#2 E-SURVEY E300 PRO

Channels	800 (All-In-View)
Signals Tracked	GPS L1 CA-C-P/L2 C-P/L2C/L5, Glonass L1/L2, WAAS, EGNOS, Beidou, Galileo, QZSS, IRNSS, SBAS, L-Band
Accuracy	Static: H 0.2 cm + 0.1 ppm, V 0.3 cm + 0.4 ppm Kinematic: H 1 cm + 1 ppm, V 1.5 cm + 1 ppm RTK: H 0.5 cm + 1 ppm, V 1.0 cm+1 ppm
Radio	Internal UHF 410-470 MHz
Internet	Internal 4G LTE modem
Other Features	Tilt Sensor, Integrated IMU (MEMS)

