

GEO

(Division 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 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

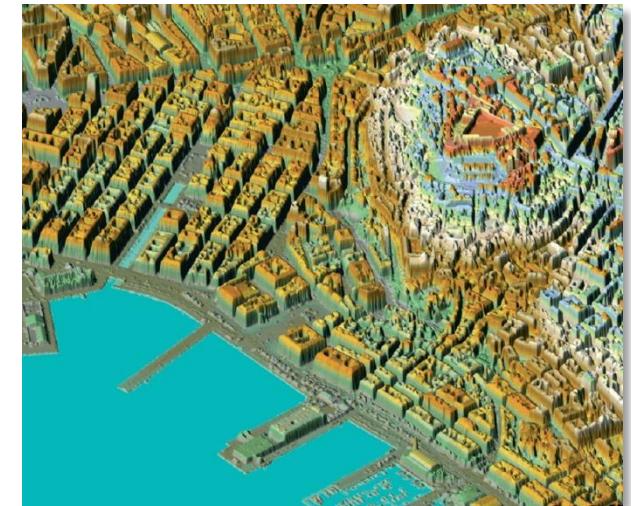
Scanning Mechanism:	rotating polygon mirror
Scan Pattern:	parallel scan lines
Scan Angle Range:	$\pm 30^\circ = 60^\circ$ total
Scan Speed:	10 - 160 lines/sec
Angle Measurement Resolution	0.001 °

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



SPECIM Aisa Eagle 1K

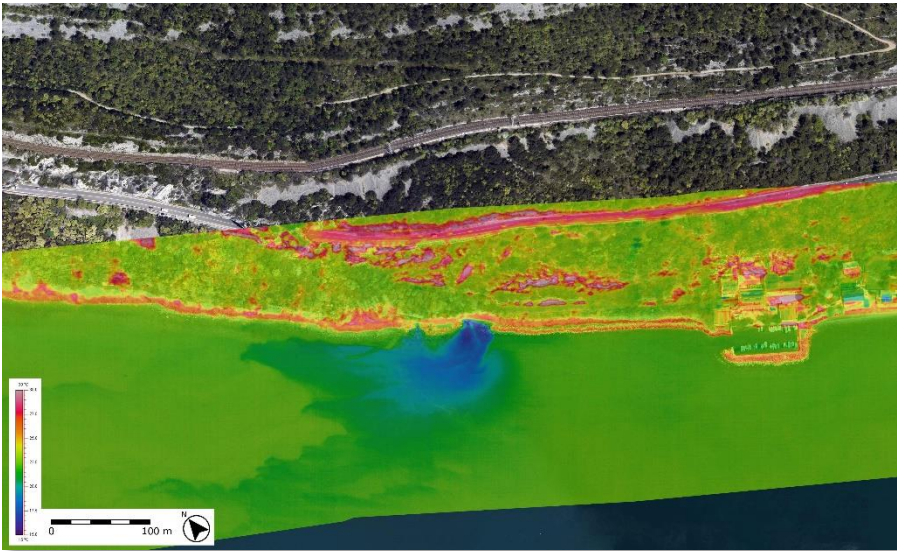
Spectrograph	High efficiency transmissive imaging spectrograph Throughput practically independent of polarization Smile and keystone < 5 microns.
F/#	F/2.4
Spectral Range	400 ÷ 970 nm (VNIR)
Spectral Sampling	2.5 nm
Spectral Pixel	252
Focal lenght	18.5 mm - 9 mm
Field Of View	35 ° - 63°
Spatial pixels	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

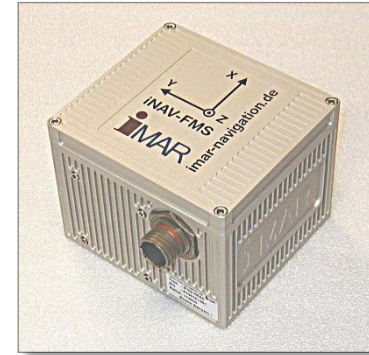


NOTES

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



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/sec
Resolution	Angle Meas. better 0.0005° (1.8 arcsec)

Acquisition/Processing software RiSCAN PRO

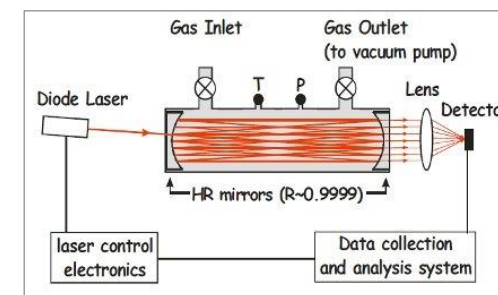


LGR - Ultraportable Greenhouse Gas Analyzer (CH₄, CO₂, H₂O)

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..)

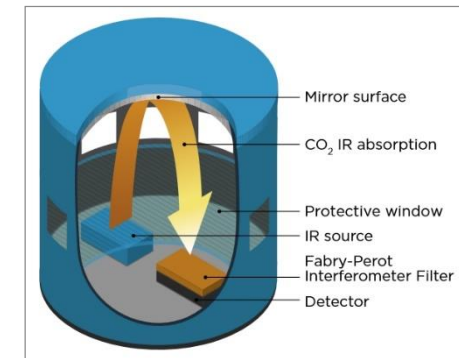
NOTES

Small enough to be carried on-board aircraft (47x36x18 cm – 15 kg)



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 $\pm(3 \text{ ppm CO}_2 + 1\% \text{ of reading})$ 0-2000 ppm $\pm(5 \text{ ppm CO}_2 + 2\% \text{ of reading})$
Noise (repeatability)	$\pm 3 \text{ ppm CO}_2$ $\pm 1 \text{ ppm CO}_2$
at 370 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)
-------	--



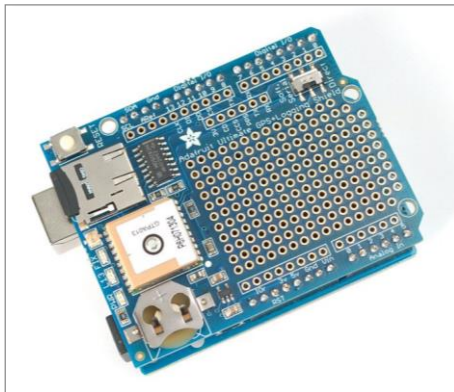
Arduino UNO Rev3 and Adafruit GPS



Arduino UNO Rev3

Microcontroller
Clock speed
Flash memory
SRAM memory
Available pins
Dimensions
Power consumption

Atmel ATmega328
16 MHz
32 KB
2 KB
14 digitali e 6 analogici
68,6x53,3 mm
50 mA



Adafruit Ultimate GPS Logger

Sensibility
Frequency
Channels
Accuracy
Antenna

Dimensions
Power consumption

-165 dBm
10 Hz
66
< 3 m
Inner + u.FL external

69x53x6.7 mm
20 mA

CO2 sensors**COZIR WX60**

Measuring method
Range
Accuracy
Heating time
Operative conditions
Dimensions
Power consumption

NDIR (Non Dispersive InfraRed)
0÷60 %
±70 ppm +/- 5% lettura
< 10s
0÷50 °C; 0÷95% RH
40x25x19 mm
< 1,5 mA

**VAISALA GMP343**

Measuring method
Sensor
Accuracy 0-1000 ppm
Accuracy 0-2000 ppm

Single-Beam Dual-Wavelength NDIR
Vaisala CARBOCAP
±(3 ppm CO2 +1% reading)
±(5 ppm CO2 +2% reading)

**LOS GATOS LGR UGGA**

Measuring method
Precision

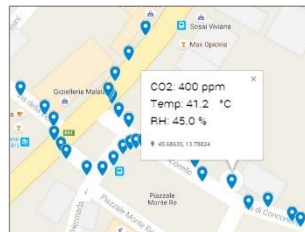
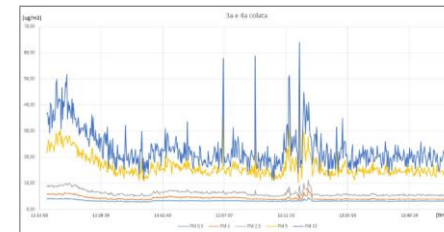
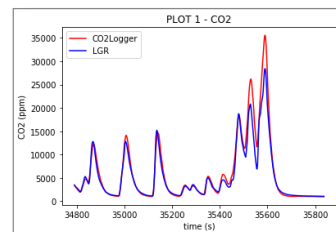
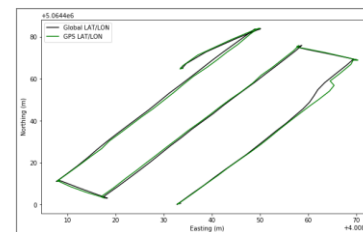
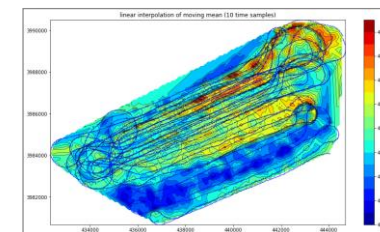
Measurement Rates
Accuracy
Measurement Range

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



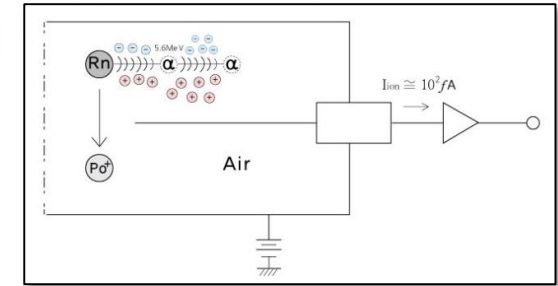
PM counter sensor

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

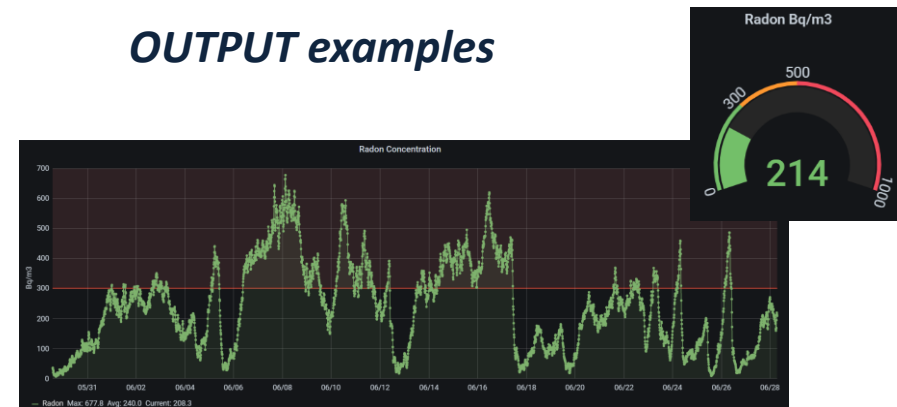
**LIGHTHOUSE HANDHELD 3016 IAQ****OUTPUT examples****Google MAPS integration****Google EARTH integration****Data analysis****Data charts****Trajectory analysis****Data visualization**

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/m³)
 Reproducibility: <±10% at 10pCi/L
 Accuracy: <±10% (min. error <±0.5pCi/L)
 Sensor Size: Ø68(mm) x 98(mm)
 Data communication: UART

*FTLab RD200M Radon Sensor****Microcontroller WiFi****WEMOS D1 Mini Lite*

11 digital IO, interrupt/pwm/I2C/one-wire supported
 1 analog input (3.2V max input)
 Micro USB connection
 1M Bytes FLASH inside
 Compatible with MicroPython, Arduino, nodemcu

OUTPUT examples

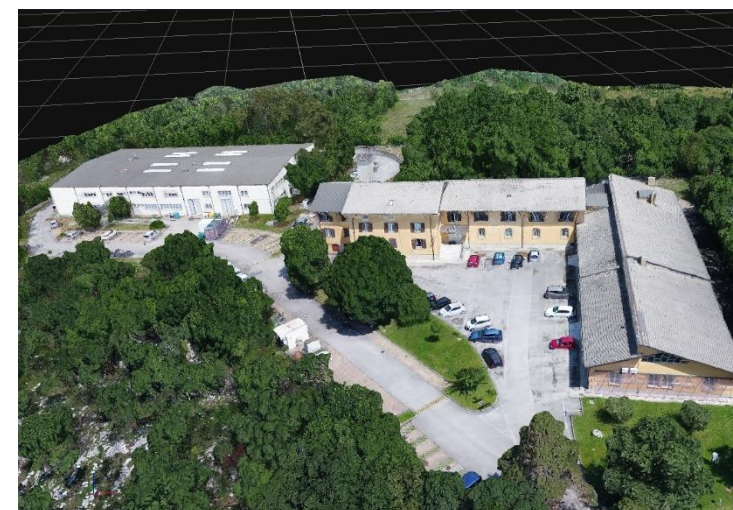
DJI MATRICE 210 V2

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



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



ASHTECH Z-XTREME (2 Systems)

Channels	12 (All-In-View)
Signals Tracked	GPS L1/L2
Accuracy	Static: H 0.5 cm + 0.1 ppm, V 1 cm + 0.4 ppm Kinematic: H 1 cm + 1 ppm, V 2 cm + 1 ppm RTK: H 1 cm + 2 ppm, V 2 cm+2 ppm
GNSS Antenna Type	Geodetic IV - ASHTECH 701975

