

RESONANCE_{LTD}

Optical Solutions & Technologies

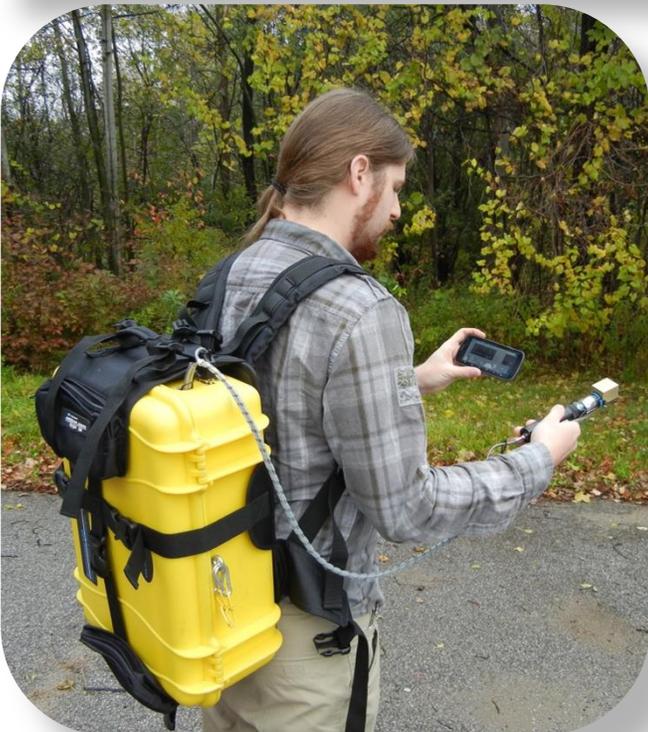


zSensor head (PACA)

- Motorized beam scanner
- Built-in shutter
- Can be detached / hand-held

Base Station

- Temp. stabilized CCD Spectrometer
- LiPo Batteries (10+ hour capacity)
- Tripod with protective weather shroud
- Securely mounted laptop
- Rugged Fibre-optic cables
- COSPEC calibration cells
- GPS integration with map software



Flexible Operating Modes

- Functional with lid closed & sealed
- External USB port for convenience
- Remotely controllable with wireless devices
- Backpack system available
- Can run from external AC or DC power

Information

The Resonance Mini-DOAS (RMD) *Expedition* is the culmination of over 25 years of experience in remote gas sensing technology. More than just a sensor, the *Expedition* combines everything needed for advanced gas monitoring into a rugged, portable base station. Paired with redesigned, powerful software developed in-house, no feature has been left behind!

The philosophy behind the *Expedition* is centered on accurate, reliable, and industry-leading measurements in a system rugged enough to withstand some of nature's most challenging environments. From the rooftop of an industrial plant to the precarious slopes of an active volcano, the *Expedition* has you covered.

As Resonance's flagship RMD system, the *Expedition* is loaded with features including 10+ Hour battery life, automatic plume profile scanner, a temperature stabilized spectrometer, calibration with COSPEC-traceable gas cells, GPS, and a clever tripod-based weather-resistant setup. With feedback from some of the leading names in the volcanology and plume monitoring fields we've taken the industry standard to the next level of performance.



Hardware Features

- ✓ **Thermoelectrically cooled and controlled spectrometer optical bench**
Stabilizes spectrometer wavelength scale for accurate DOAS measurements
- ✓ **Suitable for remote sensing of volcanic & industrial SO₂, NO₂, BrO, and other gases**
Better than 6 ppm-m SO₂ sensitivity!
- ✓ **Detachable Telescope/ PACA/ fibre-optic assembly which randomizes spatial content of beam within the telescope's field-of-view**
Minimizes unwanted signal offsets due to cloud edges crossing field of view



PACA being used in **Fibre-Optic Extension Mode** at Masaya volcano in Nicaragua

- ✓ **Auto Calibration System (Included in PACA)**
The system automatically self-calibrates using COSPEC-traceable gas cells
- ✓ **Motorized scanner fully controllable via RMD software (PACA)**
180° range of motion with variable scan speed – software allows for automatic or manual pointing & scanning
- ✓ **GPS with moving-map software**
Always know where you are and where and where you've been with GPS logging and real-time display in Google Earth
- ✓ **Multiple operating modes (See the “Operating Modes” section for details)**
Including a portable hand-held mode!

Hardware Features

- ✓ **Electronics and the spectrometer are contained inside ruggedized case**
Allows operation in the harshest conditions.
- ✓ **Machined-aluminum case panel with hardware switches, LEDs, and LCD display**
Provides a solid interface between the sensitive internal components and the outside world while giving the user access to the system's hardware toggles and indicators.
- ✓ **Stable contractor-grade tripod for the sensor head**
We know from experience there is nothing more frustrating than a flimsy tripod!
- ✓ **Internal lithium battery packs with integrated charger**
We researched the most advanced lithium packs to run the system all day. The smart charger is conveniently integrated under the removable top panel for easy access.
- ✓ **Laptop securely docks onto the base station**
Provides stability and protection during transportation without sacrificing portability the laptop can be used external to the base station!
- ✓ **Accepts 100 – 240 VAC or external 12 – 16 VDC supply**
Designed to charge from any AC source or run from a suitable DC source. Never get stuck with dead batteries and no way of using the instrument!
- ✓ **Built-in, deployable sun shroud for reading the laptop display in sunlight**
The shroud folds out of the case lid to protect the display from the sun and allow for easy viewing.
- ✓ **LCD information panel showing system telemetry**
Displays the CCD temperature, system battery capacity and other useful information.
- ✓ **Hermetically sealed accessory box included**
Holds extra fibres, electronics, or sensitive accessories and keeps them safe while you take measurements!
- ✓ **Wireless control via Smartphone, Tablet, or Laptop**
An ad-hoc WiFi network can be created from the system's laptop which allows the user to remotely connect and control the unit from nearly any wireless device.
- ✓ **Intuitive, powerful software facilitates setup, calibration, and logging of data**

Operating Modes

Mode 1: Transverse Mode

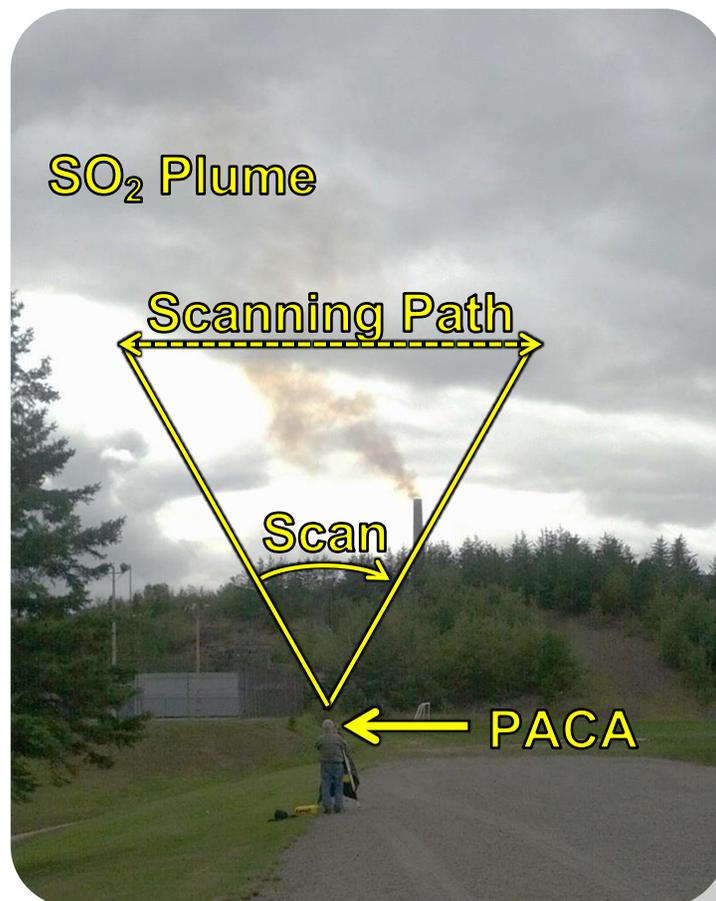
In this mode the instrument is deployed in a vehicle such as a car or truck for zenith viewing or an aircraft for nadir viewing. As the vehicle passes over or under the plume a profile is constructed which, along with a plume velocity, will yield a total flux of the gas being measured (tonnes / day).

Mode 2: Static Pointing Mode

The sensor is simply directed at the plume to be measured. The scanner can be used to point at a specific area of the plume, and then remain fixed for the duration of the measurements.

Mode 3: Stationary Scanning Mode

The motorized scanner is used to generate a profile by scanning transversely through the plume.



Operating Modes

Mode 5: Hand-Held Mode

The PACA / spectrometer assembly head can be removed from the base station and operated with the tablet computer docked onto it. With its own battery pack and remaining FULLY operational, the system becomes truly portable and may be carried around the field to take measurements wherever you dare to go.

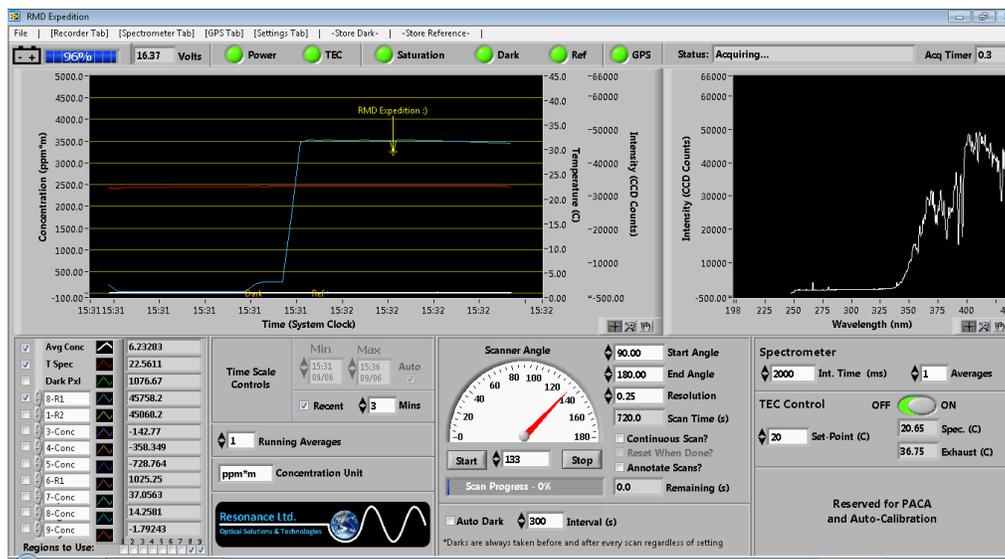
Mode 4: Weather Resistant & Collaborative Mode

Because all supplied computers have WiFi capability, an ad-hoc wireless network is present at the site. The laptop can be left in the base station running the instrument with the lid closed, and the tablet can be undocked and used as a portable terminal. In addition, any PC, iOS, or Android device with WiFi can be used to view and control the instrument wirelessly. Imagine the possibilities when an entire team can view the instrument's data simultaneously, from any vantage point.



Software Features

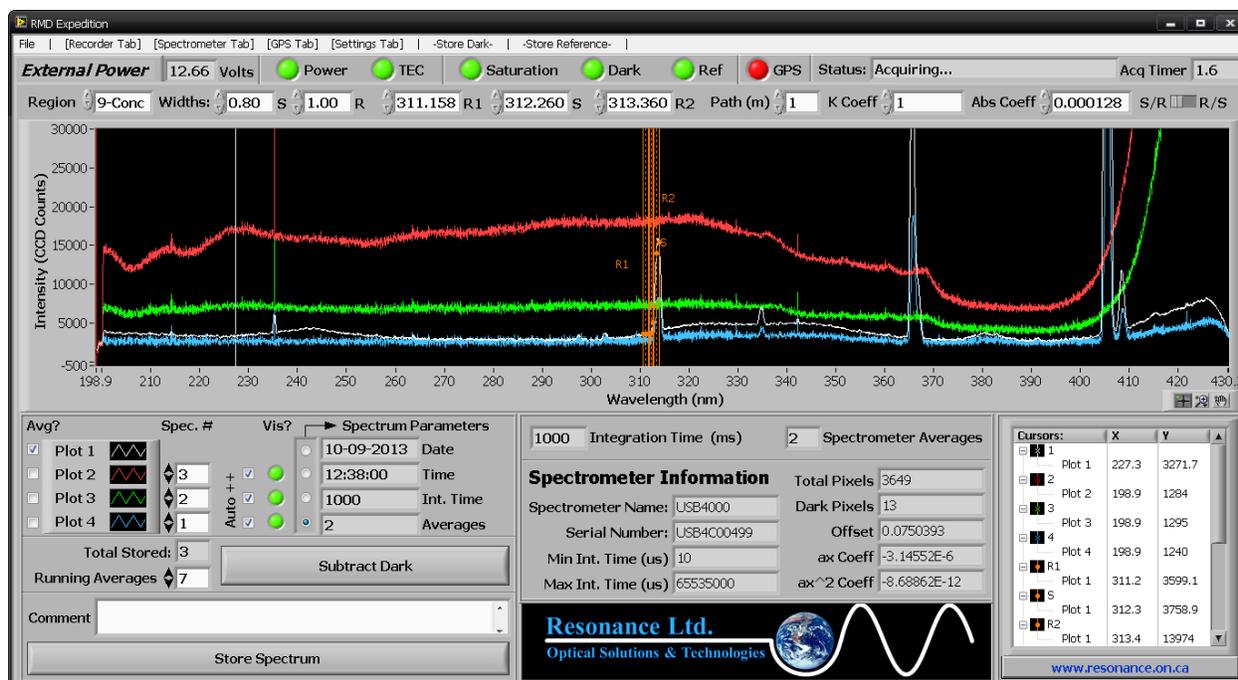
Resonance Ltd. is well aware of the impact software can have on an instrument's overall quality – especially one as complex as the *Expedition*. That's why our software package has been programmed in-house and tailored specifically for the *Expedition*. A single USB cable connects the laptop to all the hardware inside the case and provides the user with a feature-rich control centre:



- ✓ **FAST, real-time calculation, display, and recording of SO₂ or NO₂ gases**
Acquire concentration readings within 1 second, with no post-processing required!
- ✓ **Configurable wavelength regions for fine tuning of the gas correlation algorithm**
Allows for research and development for the adventurous scientists who want to characterize gases or contaminants and possibly investigate other gases with absorption properties in the 280 to 440 nm region.
- ✓ **GPS, CCD thermal control, spectrometer, motorized scanner head, battery monitoring, and correlation algorithm tunings all seamlessly integrated into a single application**
Tabbed, graphical interface for easy navigation between control modes!
- ✓ **Large, widescreen-optimized display**
Spectral data looks so much more impressive on a large, fully customizable graph
- ✓ **Fully adjustable scans**
Adjust scan speed, angles, resolution, integration time, and whether to scan continuously or on-command. Single measurements supported as well!

Software Features

- ✓ **Powerful data logging and export into Excel-compatible text files**
Test parameters are stored in a comprehensive data file which allows for post-processing and calibration of data!
- ✓ **Helpful tips and tutorials built directly into the software**
- ✓ **Chart-recorder tab included and always running**
Provides a complete record of each software session to ensure no data is ever lost, even between scans
- ✓ **Multi-plot graphing**
Great for comparing data!



Specifications

General

Base station Dimensions	54.4 cm (L) x 41.9 cm (W) x 20 cm (H)
Base station Weight	19.3 kg
Accessory Box Dimensions	37.8 cm (L) x 30.8 cm (H) x 17.5cm (H)
Accessory Box Weight	5 kg (With all extra cables etc.)
Operating Temperature Range	-10 to 50 °C*
Software	LabVIEW-based full control application

* control to -40°C achieved with, auxiliary heater accessory

Power Requirements

AC Input Voltage	100 – 240 VAC (50 – 60 Hz)
DC Input Voltage	12 VDC
Charge Source	AC
Run Source	AC, DC, or Batteries

Batteries

Battery Chemistry	Lithium-Polymer (LiPo)
Battery Voltage	14.8 V
Battery Capacity	474 Watt-Hours + Laptop battery (Typically 60 Watt-Hours)
Battery Time to Charge	4 hours
Battery Life	10 + Hours*

*System uptime depends on many variables, including ambient temperature, spectrometer temperature set-point, scan rates, and laptop draw

Spectral Performance

Field of View	0.86° (with standard telescope, options available)
Spectral Range	280 – 420 nm
Spectral Resolution	0.4 nm
Dark Noise	2.5 RMS counts (2.5 / 65535)
Integration Time	100 ms – minutes
Detectable Gases	SO ₂ , NO ₂ , BrO, CS ₂ , CHOH, O ₃ *, Hg, H ₂ S, NH ₃ **
Sensitivity (SO ₂)	6 ppm-m
Sensitivity (NO ₂)	100 ppm-m
Concentration Range	1 – 4000 ppm-m
Spectrometer	Ocean Optics USB2000+ UV-VIS with UV2 detector window and L2 collector lens upgrades

*BrO, CS₂, CHOH, O₃ requires additional software

**Active mode with UV light-source accessory

Scanner

Scan Range	180°*
Scan Resolution	0.25°
Scan Speed	15°/min (typ with 0.25° step at 1000 ms integration time)**

*Scanner start and finish angles can be set to any values in range and scanner can be manually controlled to stop at any angle

**set by integration time (1 step per acquisition)

Thermoelectric Temperature Control

Method	Proportional-Integral-Derivative (PID) Control Loop
Maximum Cooling	30° C below ambient temperature

Options & Accessories

- ✓ **Backpack-mountable**
The RMD-*Expedition* can be outfitted with mounting rails to bolt onto a backpack to ease transportation in the field.



A backpack can really make trips out to the field much more manageable. The Expedition was designed with this option in mind!

- ✓ **Video goggles**
These goggles use the laptop's external display port to bring a full-resolution picture directly to your eyes!



For direct instrument control in the brightest of conditions, consider using video goggles. Resonance has tested various systems and found a perfect match for the *Expedition*.

- ✓ **Larger battery capacity**
Additional 4, 8 or 12 battery packs for extended operations

RMD Comparison

Resonance Ltd. has been making RMD remote sensors for decades, and over the years has produced various models. The following chart compares the features of all current DOAS systems including the *Expedition*:

Feature	COSPEC VII	RMD Expedition	RMD I
Spectrometer (for < 2 ppm-m SO ₂)	Yes	No	No
Spectrometer (for < 6 ppm-m SO ₂)	-	Yes	No
Dual-Beam Plume Velocity Measurement	Yes	Yes	No
Temperature-Stabilized Spectrometer	Yes	Yes	No
10+ Hour Battery Life with Rechargeable, Integrated LiPo Packs	Yes	Yes	No
Ruggedized Integrated Instrument Case	Yes	Yes	No
Hermetic Accessory Case	Yes	Yes	No*
Heavy-Duty Tripod	Yes	Yes	No*
Sun Shroud	Yes	Yes	No
Flexible Power Options: AC(100-250V), DC (12-16V)	Yes	Yes	No*
Sensor Package (GPS, Compass & Tilt)	Yes	Yes	Yes
Automatic Plume Scanner	Yes	Yes	Yes
2 COSPEC-Traceable Calibration Cells	Yes	Yes	Yes
Automatic Cell Changer (with 3 Cells)	Yes	Yes	Yes
Dedicated Laptop	Yes	Yes	Yes
Wireless Control	Yes	Yes	Yes
RMD Software	Yes	Yes	Yes
Weather Resistant	Yes	Yes	Yes

*Available upon request at an additional cost

Contact

Resonance Ltd. stands behind every product we sell. We welcome feedback and encourage any of our customers to contact us with questions, or concerns. You may contact us through e-mail, our website, telephone, or fax!

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