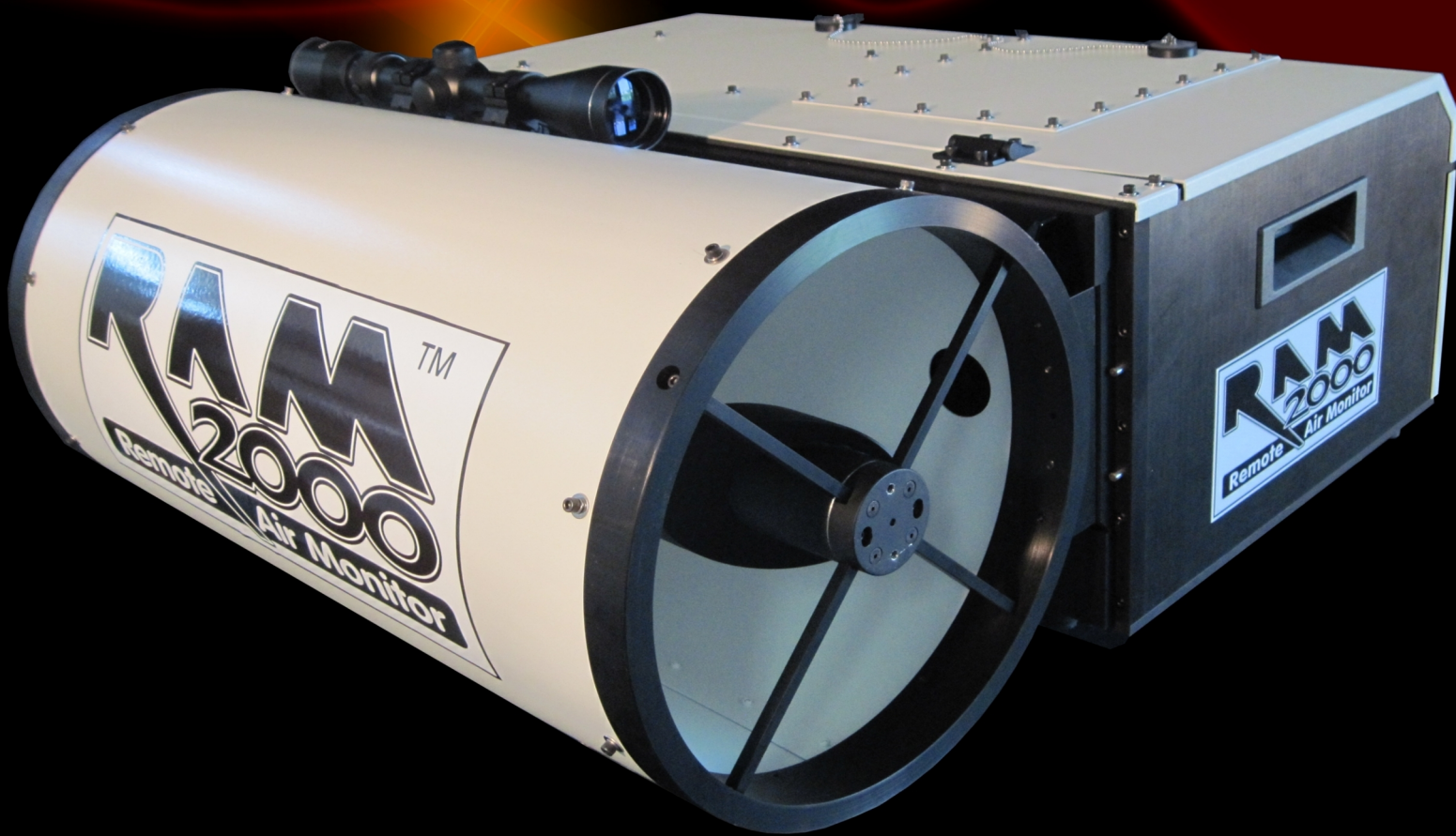


RAM 2000™ G2

FTIR SPECTROMETER



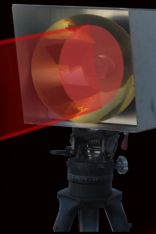
REMOTE OPEN PATH MONITORING

The RAM2000 G2 is an open-path air monitor designed to detect a wide range of gases in real time. The system is capable of the remote sensing of air plumes using three optical bench arrangements. By simple reconfiguration of the internal optical assemblies, the system can be switched to suit specific monitoring applications.

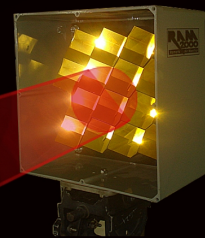
Bistatic - The infrared energy is received from a remote infrared source placed at a far distance from RAM2000 G2. In this configuration the G2 operates as a detector/reciever to a remotely located (active) infrared transmitter.

Monostatic Retro-Reflector - A harmless beam of (active) infrared energy is propagated out of the system through a Newtonian telescope to a remote reflector called a Retro-Reflector. The retro reflector returns the infrared beam to G2 sensor where the super-cooled detector records the infrared spectrum. Active Monostatic configuration is the preferred method of open-path monitoring for ease of setup and spectral processing.

Passive - Energy from a heated plume, the sky, or other source is used in place of a remote source.



Bistatic – Remote source



Monostatic Retro-reflector



Passive

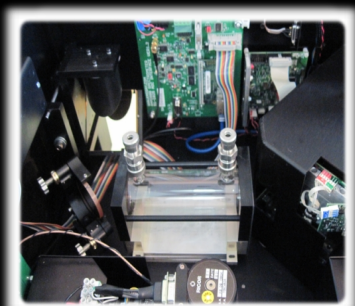
RAM2000 G2 GAS CELL OPTIONS

The RAM2000 G2 bench can accept single-pass or multi-pass gas cells. A gas stream can be directed into the gas cell through fittings in the instrument bulkhead. This arrangement allows the system to be used for measuring the concentration of gases in process or exhaust gas streams, often referred to as "extractive FTIR monitoring." The telescope assembly can be removed or remain attached when using gas cells.

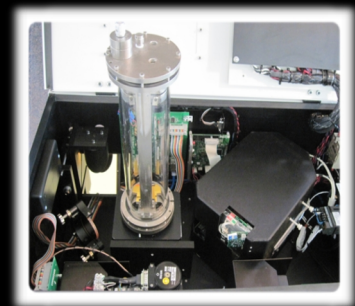
When using gas cells with the telescope attached, the IR source energy can be directed out through the telescope to a reflector and then back to the detector. This arrangement facilitates QC procedures like those in Compendium Method TO-16. Cylinder gases can be flowed into the cells to create new infrared reference spectra.



Chasis with lid open



Single-pass Cell



Extractor Cell

RAM2000 systems are controlled by RMMSoft, a mature and sophisticated software program that has been continuously improved since first deployed in 1995. RMMSoft has powerful signal processing algorithms originally developed for military applications. The software includes generous display and reporting options to allow for a great variety of customer needs.

Integrated servers control hardware accessories:

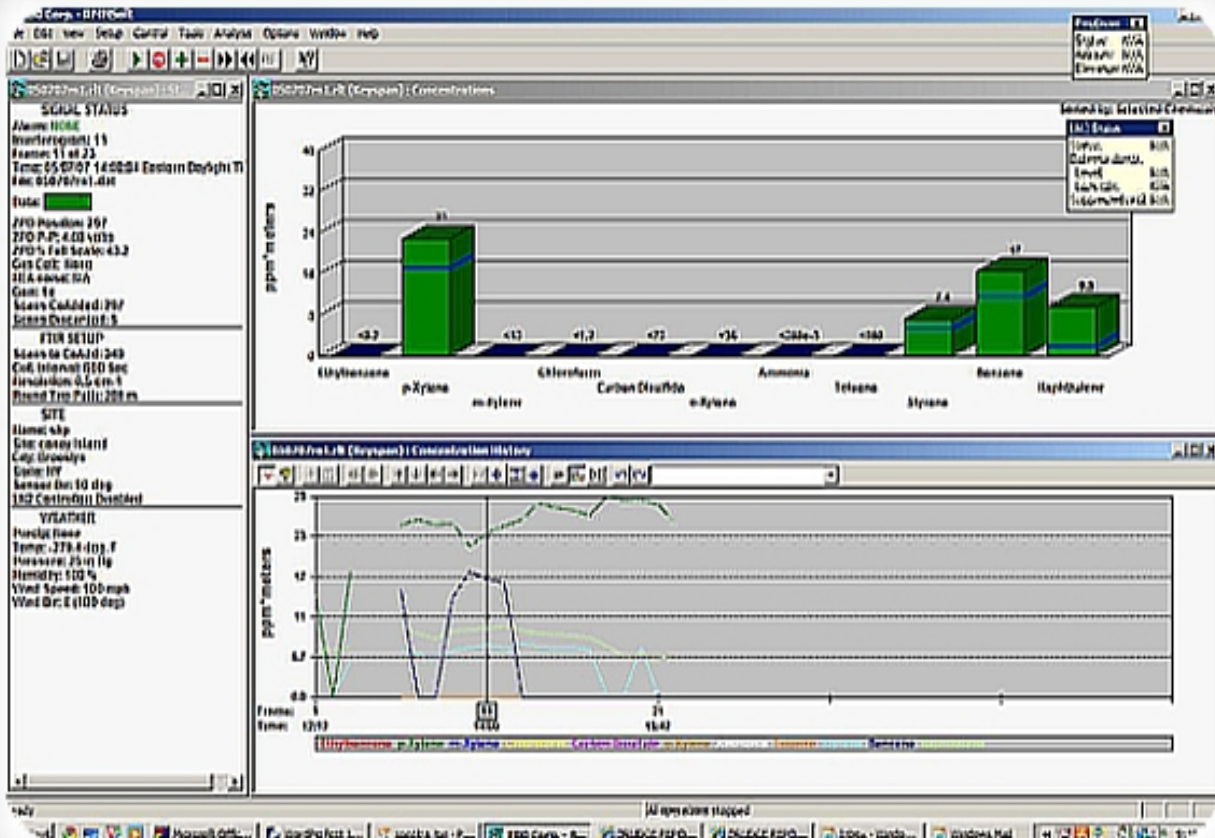
- FTIR spectrometer
- Auto positioner for directing the IR beam to multiple retro-reflectors
- Meteorological Sensors for integrating weather and FTIR data
- Liquid Nitrogen Controller (LN2) for autofilling of detector dewar

Analytical Algorithms are user selectable or automatic:

- Adaptive background filtering
- Target chemical (spectral) subtraction
- Spectral line position alignment
- Spectral library searches
- Iterative (Io) reprocessing
- NEA noise calculations for each frame
- Programmable macros

Data Quantitation and Presentation:

- Fully adjustable graphics displays: 3D, % of alarm, concentrations & history
- MDLs can be presented as sigma values or by USEPA Compendium Method TO-16
- User-determined warning and trigger alarms
- Concentration averaging for separate time frames.
- Emissions modeling using tracer ratio technique
- Integration of meteorological and spectral results (pollution rose)
- QA/QC cylinder gas calibration menu
- Selectable concentration units
- Reports generation for export to spreadsheets
- Spectral export in SPC format
- Unknown spectral search algorithm

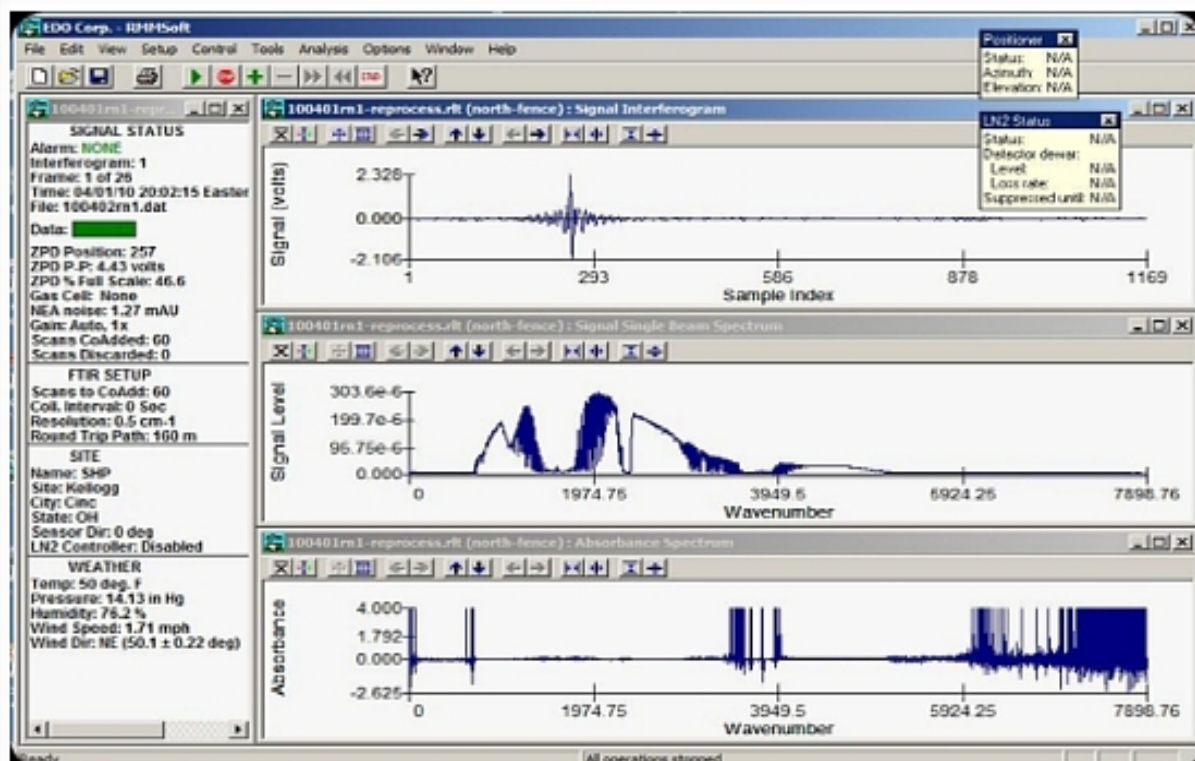


Simple & Powerful

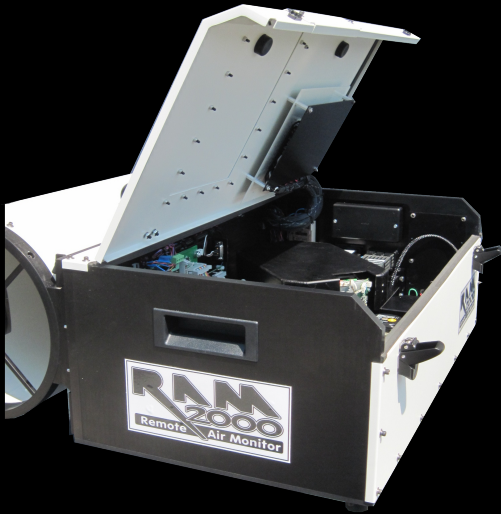
RMMSoft is a standalone program with patented algorithms for quantifying open-path FTIR data. Customers enjoy the simplicity of full integrated command over hardware and software procedures through the console program. Optional accessories such as the autopositioner, LN2 auto-fill, weather station, and FTIR are controlled through the programs servers. RMMSoft does not rely on embedded third-party software algorithms to process data. For unattended operations, the system can be set for alarming with trigger and warning thresholds. Technician-level operators can collect and process data through simple toolbar menus. Scientists can display and manipulate interferograms, single beams, and absorbance spectra.

Sophisticated Algorithms

RMMSoft includes powerful algorithms to check and (if necessary) correct the indexing of the interferogram and the location of the spectral line positions. As a result, spectra collected by RMMSoft match proper resolution and frequency locations of the reference target chemicals. For continuous monitoring, an adaptive background filtering algorithm allows continuous updating of the background conditions. A selectable menu of chemicals can be allowed to "subtract" or "roll" into the background.

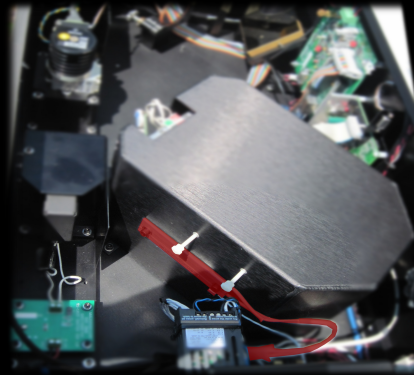


RAM2000 G2 SPECIAL FEATURES



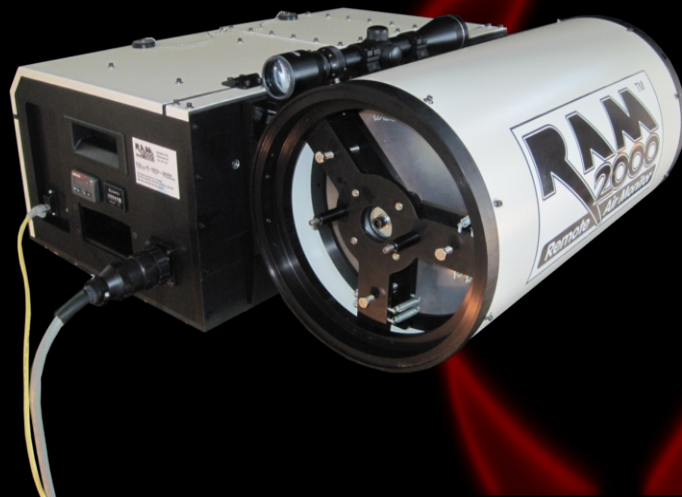
Easy access bench with
removable telescope

Thermally stabilized
Interferometer



External Power Controller with Low-Noise
Linear Power Supplies

Rear Bulkhead includes:
Elapsed Time Meter
Temperature Controller
Ethernet Communication
Field-Adjustable Optics



RAM2000 G2 SPECIFICATIONS

Overview: In the primary configuration, the RAM2000 G2 uses an infrared energy source which is modulated by a Michelson interferometer, transmitted by the telescope, and directed as a beam through the atmosphere of interest to a retro-reflector. The retro-reflector returns the beam of energy back to the transmitter/receiver to a cryogenically cooled infrared detector. The modulated beam is converted to a signal spectrum by Fourier transform. The frequency spectrum is processed to become an absorbance spectrum which has a relationship to the concentration of the chemical times the beam path. The concentration of chemical species is determined from a regression analysis of the absorbance spectrum.

Primary Configuration: Monostatic active spectrometer for open-path remote sensing

Secondary Configuration: Passive, Bi-static - included by bench reconfiguration

Interferometer: Continuous scan Michelson interferometer

VCSEL laser frequency sampling index

High-throughput 38mm beam

Thermal Stabilization: Heated interferometer housing assembly with feedback control

Power: Externally controlled linear power supplies for reduce noise

Spectral Range: 700 to 4,500 cm⁻¹

Resolution: 0.5cm⁻¹

Infrared Source: Proprietary ceramic element at 1200° Celsius max temp

Detector: Mercury Cadmium Telluride (MCT) detector element

Option of Liquid Nitrogen (LN2) dewar or,

Closed-Loop sterling engine cryocooler

ADC: 18-bit integrated with embedded controller

Pre-Amplifier: Dual-stage, variable gain, software controllable.

Embedded Controller: On-board module with both RS-232 and ethernet access

Communication: Ethernet to MS Windows-based PC

Minimum Detection Limits: Detection limits for chemicals measured by open-path FTIR systems will depend on the chemical, atmospheric conditions (humidity and temperature) and whether interfering chemicals are present. The range of detection limits for a 100-meter separation between the sensor and retro-reflector is from 0.15 to 15 ppb for most infrared active chemicals. Contact representative for specific application.

Open-Path Range: Up to 1 km distance (with appropriate retro)

Operational Temperature: Outdoor temperature limits for beam path: -20° to 60° Celsius.

Indoor (shelter) temperature limits for RAM2000: -15° to 45° Celsius. *Note: For best performance during long-term installations, the recommended indoor shelter temperature range is 15° to 35° Celsius.*