Model: RAM2000-AA

Ambient Air
Multiple GAS FTIR Analyzer

The **RAM2000-AA Ambient Air monitor is a robust FTIR analyzer** designed for continuous unattended monitoring of chemicals in the ambient air. The analyzer combines a rugged FTIR spectrometer with a sensitive gas cell and integrated meteorological station so that all data is measure at the same discrete time interval. Data collected by both the FTIR and meterological station are stored conveniently together in a single file.

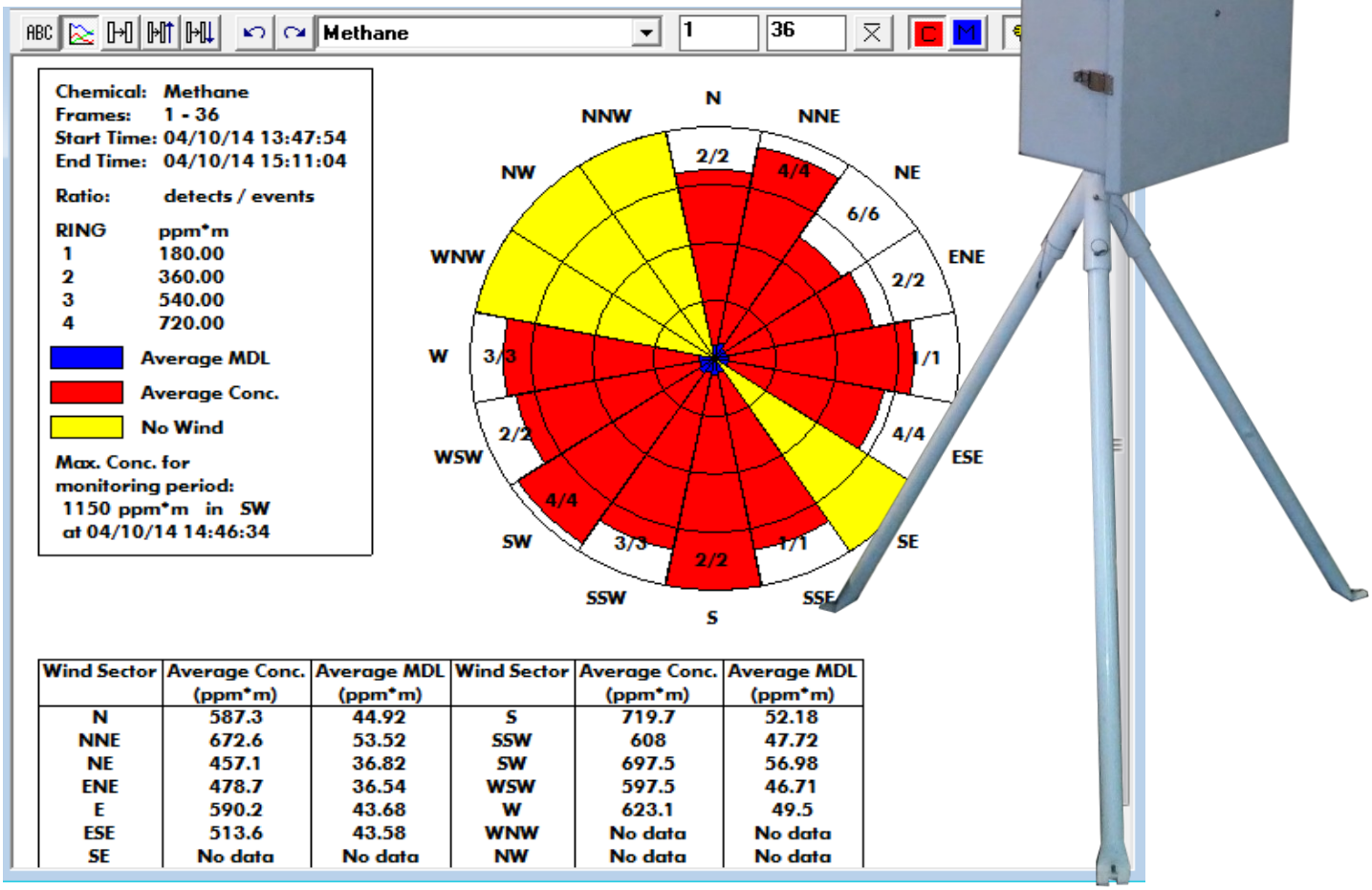
The **RAM2000-AA** gas library contains more than 250 gas references including volatile organic compounds (VOC's,) and Hazardous Air Pollutants (HAP's). Many toxic industrial chemicals such as BTEX, freons, alcohols,and other chemicals have references available.

Benefits & Features

- Fully integrated weather & FTIR data results
- Easily deployable: no shelter required
- Direct data access by assigned IP Address
- PPB detection limits for hundreds of chemicals
- Fast response time (2 - 60 seconds)
- Optional: >10m long path cells for trace gas.

Applications

- Greenhouse Gas Monitoring (CHG)
- Ambient Air Monitoring (AAM)
- Fence line Air Monitoring
- Industrial / Residential
- Landfills, Remediations



Wind Sector	Average Conc. (ppm*m)	Average MDL (ppm*m)	Wind Sector	Average Conc. (ppm*m)	Average MDL (ppm*m)
N	587.3	44.92	S	719.7	52.18
NNE	672.6	53.52	SSW	608	47.72
NE	457.1	36.82	SW	697.5	56.98
ENE	478.7	36.54	WSW	597.5	46.71
E	590.2	43.68	W	623.1	49.5
ESE	513.6	43.58	WNW	No data	No data
SE	No data	No data	NW	No data	No data

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Principal of Operation

Within the enclosure, the **RAM2000-AA** internal source emits an Infrared light energy beam which is modulated through a high resolution (0.5 cm-1) interferometer and directed through transfer optics into the multiple path gas cell. At the same time, ambient air is drawn into the gas cell by the internal air pump. All operations are controlled by PC Based RMMSoft Software.

The gas cell has mirrors inside that direct the infrared beam to pass many times through the gas sample. With every pass, the gas molecules absorb more of the infrared energy. Increasing the number of passes improves the sensitivity, lowering the MDL.

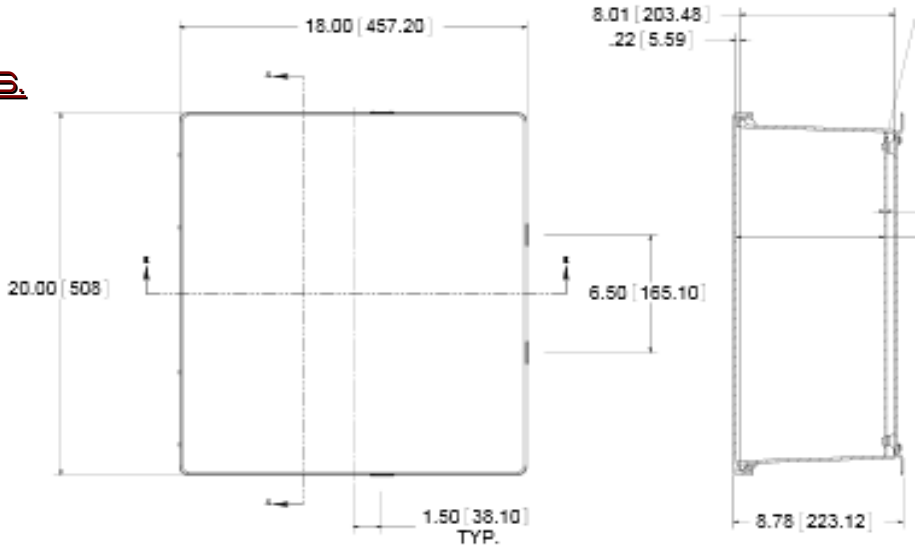
Infrared absorbing chemicals are quantified by the **RAM2000-AA** in real time, continuously and unattended. Chemicals are individually speciated in ppb-ppm levels with the capability to display up to 36 species at a time. A library with more then 250 references is included, and with the capability to add or import others.

FTIR Enclosure Specs.

Dimensions: L: 20 in.
W: 18 in.
H: 8.78 in.

Weight: 50 lbs.

UL 508: Type 1,2,3,4,4x,12, 13
CSA : Type 1,2,3,4,4X,12,13
Complies with
NEMA Type 1,2,3,4,4x,12, 13
IEC 60529,IP66



Meteorological Options

Tactical/Mobile:
Climatronics: Tacmet I (TM)
Campbell: WXT520(TM)

USEPA PSD/SRDT Sensors
Climatronics: F460(TM)

Other: Upon Request

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Model: RAM2000-AA
SOFTWARE
RMMSoft

Simple & Powerful

The **RAM2000-FS** is controlled by RMMSoft , a stand-alone program with patented algorithms for quantifying FTIR spectral data. Customers enjoy the simplicity of full control of hardware through a singular console program.

RMMSoft does not rely on embedded third-party software algorithms to process data.

For unattended operations, the system can be set for dual level alarming (trigger and warning) thresholds.

Technician-level operators can collect and process data through simple toolbar menus, while research scientists have access to inspect interferograms, single beams, and absorbance spectra.

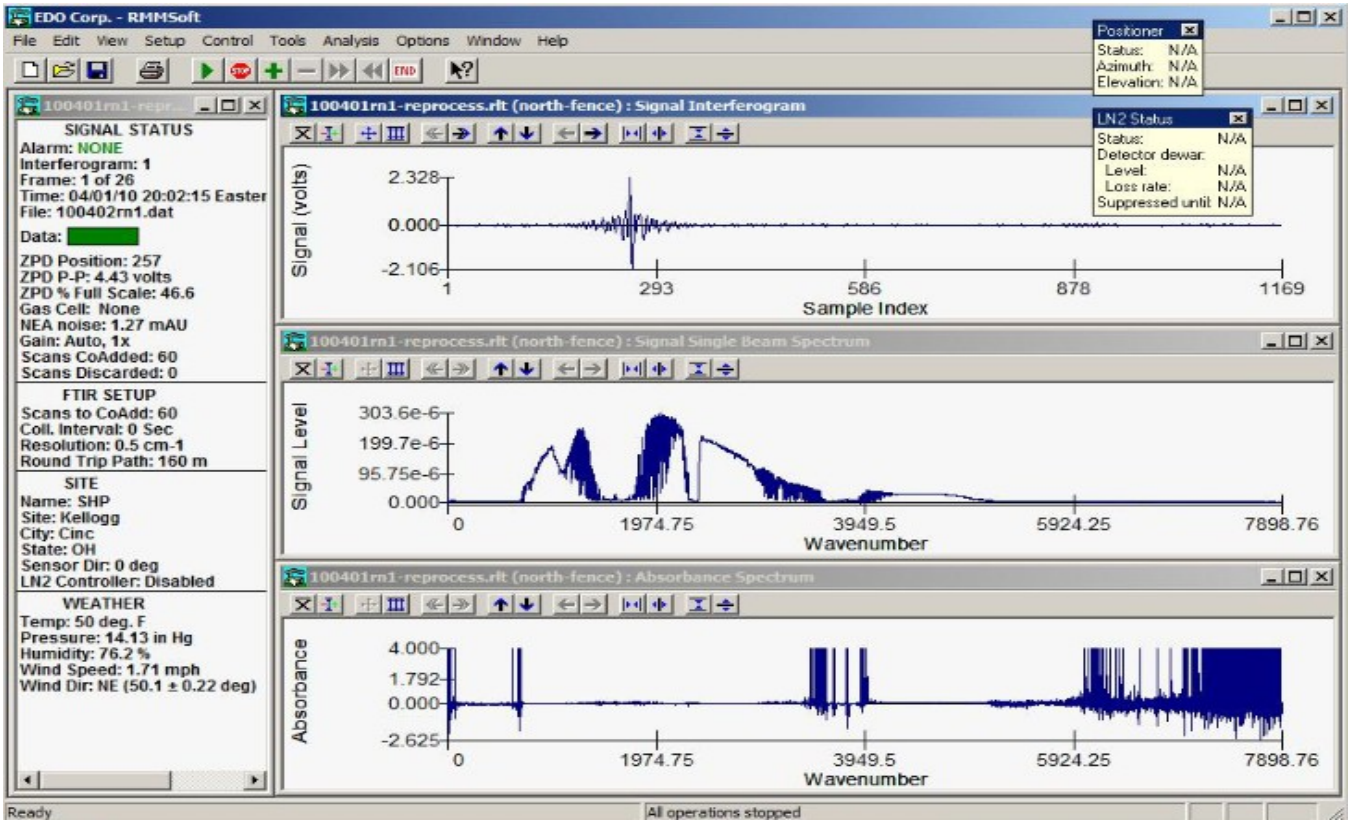
Sophisticated Algorithms

RMMSoft includes algorithms to check and (if necessary) correct the indexing of the interferogram and the location of the spectral line positions.

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 menu allows the choice of chemicals to “subtract” or “roll” into the background.

Log Files: Every step performed by the hardware and software is logged. All activities can be tracked so that data can be reconstructed and performance can be monitored.



Model: RAM2000-AA

SOFTWARE

RMMSoft

Automated Control

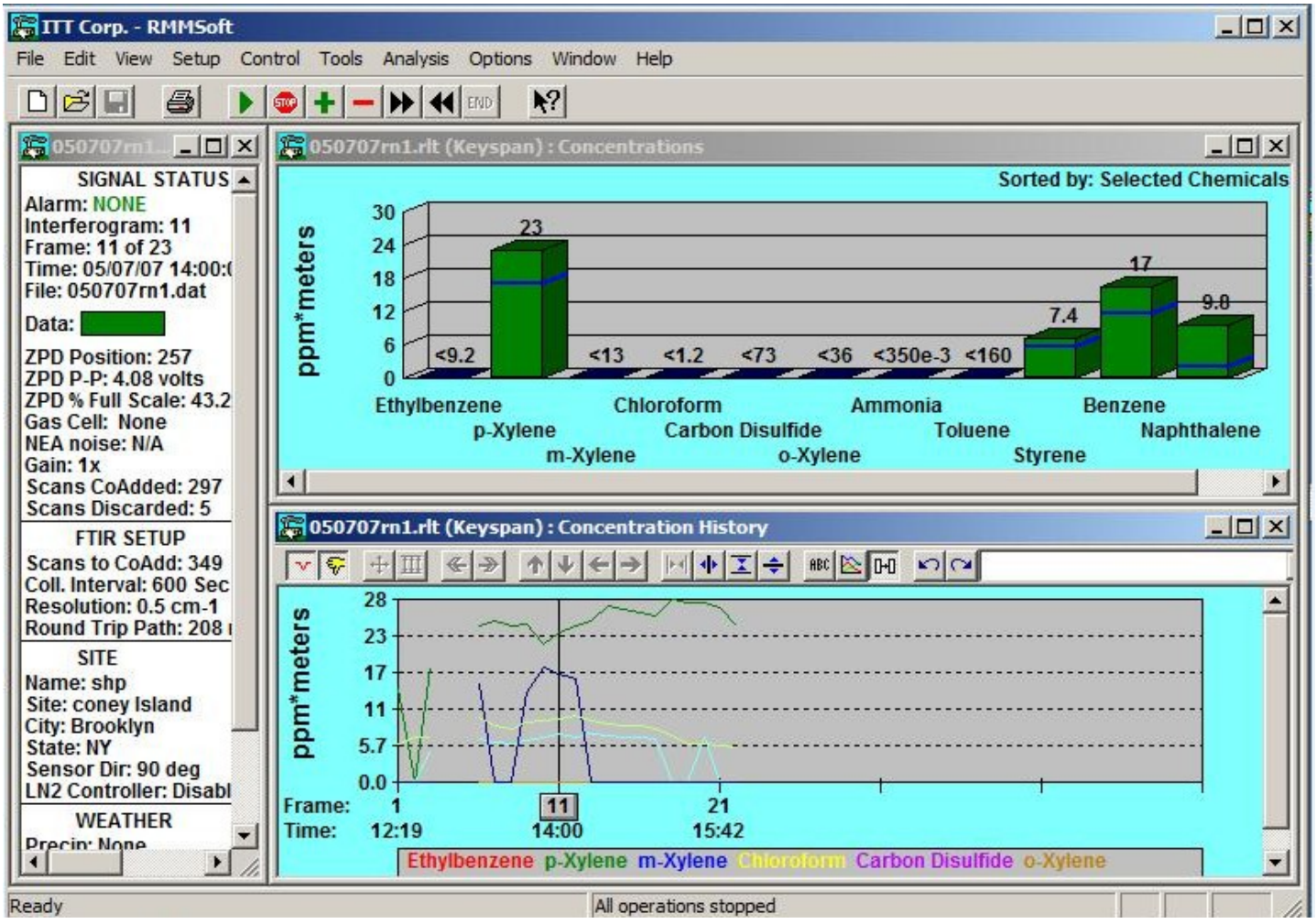
Integrated servers control hardware accessories:

- FTIR spectrometer (no com boards required)
- Optional: Integrated Temperature and Pressure Sensors
- 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
- Pre-selected analysis regions
- Co-analysis for interferences

Information Processing

Data Quantitation and Presentation:

- Fully adjustable graphics displays: 3D, % of alarm, concentrations & history
- MDLs can be presented as a multiple of sigma values or by a format consistent with USEPA Compendium Method TO-16
- User selectable warning and trigger alarms
- Concentration averaging for separate time frames
- QA/QC cylinder gas calibration menu
- Selectable concentration units
- Reports easily export to spreadsheets
- Spectral export in SPC format
- Unknown spectral search algorithm



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Model: RAM2000-AA

Ambient Air
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Overview: The **RAM2000-AA** uses an infrared energy source which is modulated by a Michelson interferometer, transmitted through transfer optics through the gas cell to an 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. Chemicals are quantified in ppb to ppm concentration which depends on the absorbance strength, interferences, and measurement conditions.

Primary Configuration: 10 meter multi-pass gas cell with MCT detector, ambient temperature and pressure

Cell Options: Up to 32m, heatable to 200C, glass or metal body, Choice of window material

Instrument Purge: Flow fittings for dry gas, nitrogen, or zero air

Interferometer: Continuous scan Michelson interferometer;
VCSEL laser frequency sampling index; (HeNe option)
Highest industry throughput: 38mm beam, ZnSe (non hydroscopic)

Thermal Stabilization: Optional: Heated interferometer housing assembly with feedback control

Power: 110 to 220 VAC, Internal. Option for external power controller for reduced noise

Spectral Range: 700 - 5,000 cm-1 for super cooled MCT & DLATGS; 2000-5000 cm-1 for TE MCT

Resolution: 0.5cm-1 standard (1, 2, 4, 8, 16, 32 cm-1 available)

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

Detector: Standard: Mercury Cadmium Telluride (MCT) detector element
Option: Liquid Nitrogen (LN2) dewar or, Closed Loop sterling engine crycooler
Option: DTLAGS or MCT with TE cooling

ADC: 18-bit ADC with signal filter and integrated embedded controller

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

Embedded Controller: Assignable IP: 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, gas stream conditions (humidity and temperature) and whether interfering chemicals are present. The range of detection limits for a 10-meter separation between the sensor and retro-reflector is from 1 to 150 ppb for most Infrared active chemicals. Contact representative for specific application.

Gases Detected: Library of 250 (0.5 cm-1) Infrared Chemicals with capability to import additional

Operational Temperature: 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

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RAM2000 Technology

RAM2000™ Technology describes the specialized FTIR hardware & patented analytical software incorporated in all of KASSAY's FTIR spectrometers to allow gas chemicals to be continuously monitored more accurately than conventional methods.

More than $10 million dollars was invested to develop RAM2000™ technology in partnership with the US government under the DARPA sponsored Technology Reinvestment Program (TRP).

Challenges Solved by RAM2000™ Technology

▪Spectral Noise▪

FTIR Challenge: FTIR detector circuits are prone pick up sources of mechanical and electrical noise.

RAM2000™ Solution: RAM2000™ circuits employ military technology. The ADC circuit is specially designed to highly filter and digitize signal in a linear mode. The pre-amplifier circuit delivers a signal that is amplified in a way to minimize the detector noise. Power supplies and cables are better shielded and grounded.

▪Thermal Stability▪

FTIR Challenge: FTIR signal strength will drift as a result of ambient temperature changes. Drift can cause "false positive" identifications, poor MDLs, or incorrect concentration values

RAM2000 Solution: RAM2000™ optical benches are sold with optional temperature stabilization to keep internal alignment consistent and eliminate voltage drift. VCSEL Lasers are additionally temperature stabilized.

▪Analytical Algorithms▪

FTIR Challenge: FTIR algorithms need to handle rapid changes in water vapor, CO2, or other atmospheric chemicals.

RAM2000 Solution: RAM2000 Software (RMMSoft) employs patented algorithms to 'lock' interferogram ZPD and micro-shift to know water peaks. An adaptive background filtering (ABF) algorithms aggressively handle concentration changes in atmospheric chemicals.

RAM2000 Awards

The **RAM2000™** design team received the Presidential Recognition Award for being one of only 133 projects completed on time, budget and within scope.

RMMSoft™ received the prestigious LISTnet award (Long Island Software Award) for powerful GUI interface to the RAM2000™ and SEI compliant development process.

RAM2000 Accreditations

The RAM2000™ open path monitor completed the USEPA's Environmental Technology Verification Program (ETV)*. A copy of the report and findings can be found at: http://www.epa.gov/etv/pubs/01_vr_ail.pdf

The RAM2000™ open path monitor used by the Pennsylvania Department of Environmental Protection (PADEP) Mobil lab went through the accreditation process according to NELAC standards. More information about the Nelac Institute can be found at: http://www.nelac-institute.org/

RAM2000™ open path monitor was approved in USDHS 'Guide for the Selection of Chemical Agent and Toxic Industrial Material Detection Equipment for Emergency First Responders, Vol. II as part of the SAVER* program. http://www.firstresponder.gov/saver/Pages/Savers.aspx?s=Saver

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