



California Analytical Instruments  
FTIR Training  
Orange, CA



- Model 600 FTIR
- Model 600 FTIR-SC
- Model 700 FTIR



## FEATURES

- Measures multiple components simultaneously
- Can measure most components from sub-ppm to percent levels
- Sample Cell is heated to 50°C or 191°C
- Fast Response
- Small Form Factor (7" x 19" x 24" )
- Ease to use software interface
- NO LIQUID NITROGEN REQUIRED

## BENEFITS

- Only need one analyzer - saves money & space
- Flexibility for many applications
- Ambient or hot/wet applications – no need for sample conditioning
- Easily catches spikes in concentrations
- Transportable or rack mountable
- Anyone can operate and communicate
- Eliminates the hassle and cost of liquid N<sub>2</sub>

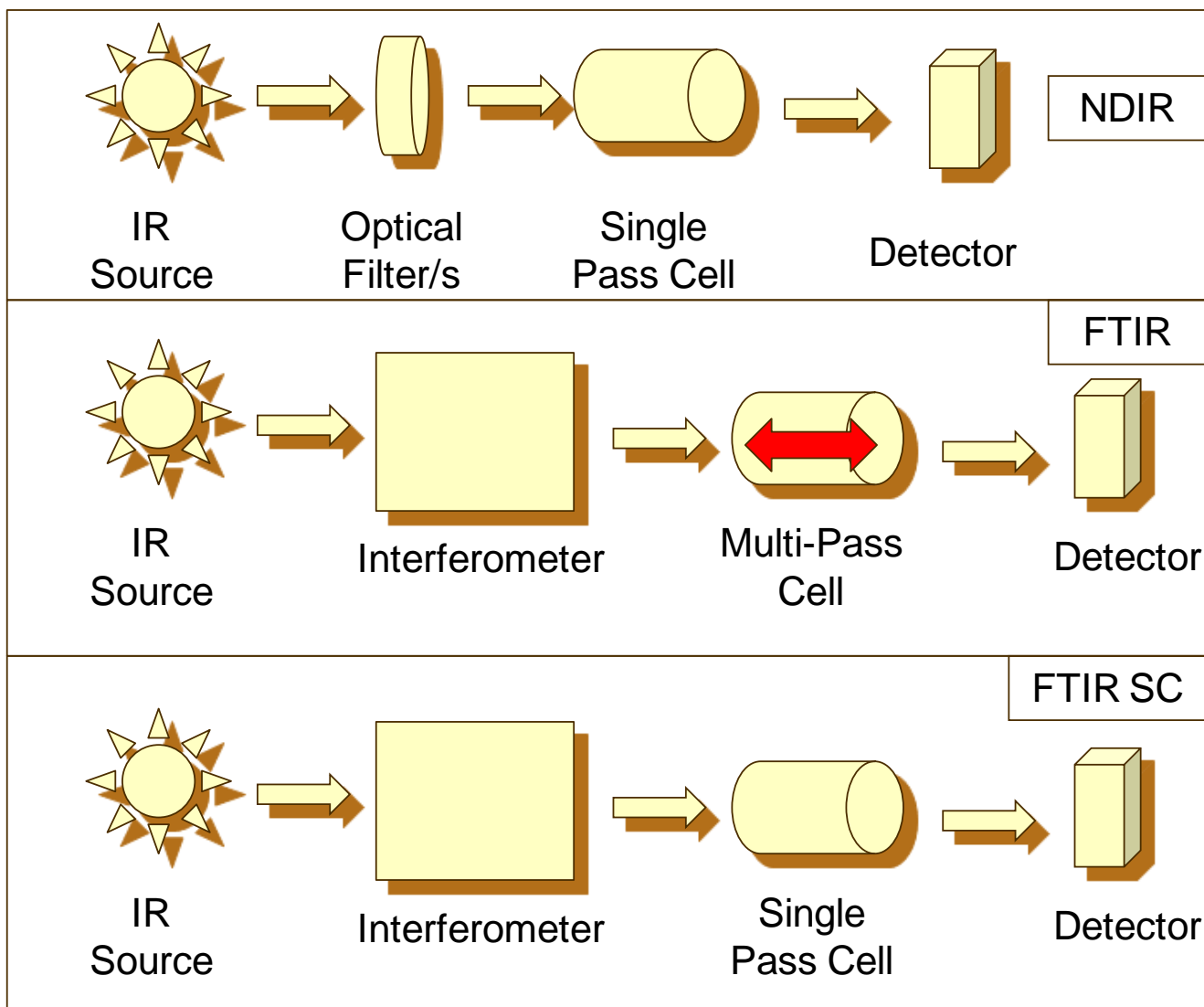


# Differentiation of NDIR -FTIR

The infrared spectrum of a sample is recorded by passing a **beam of infrared light through the sample and with optical filters**. When the frequency of the IR is the same as the vibrational frequency of a bond, absorption occurs.

The transmitted light reveals how much energy was absorbed at each frequency (or wavelength) by scanning the a single wavelength using a single pass cell (NDIR). One gas is measured through this process.

The **whole wavelength range** (many beams of light) is measured at once with a (FTIR) Fourier transform infrared radiation instrument which generates a **transmittance or absorbance spectrum**. The process is repeated many times at different frequencies, acquiring many light absorption data points. A common algorithm which processes the absorption data points called **Fourier Transform** is generated (called an interferogram).





# CAI FTIR Main Components

- A temperature-controlled gas cell (10.2m, 4.3m or 8.2cm)
- Ambient room-temperature DTGS detector (Deuterated Triglycine Sulfate) requires no liquid nitrogen
- User-replaceable SIC IR source with 5-year life
- 19-year-life laser (Class 1)
- Permanently aligned Rock Solid interferometer
- Internal pressure gauge to compensate pressure variations
- Compact size
- Laptop with OPUS software preinstalled



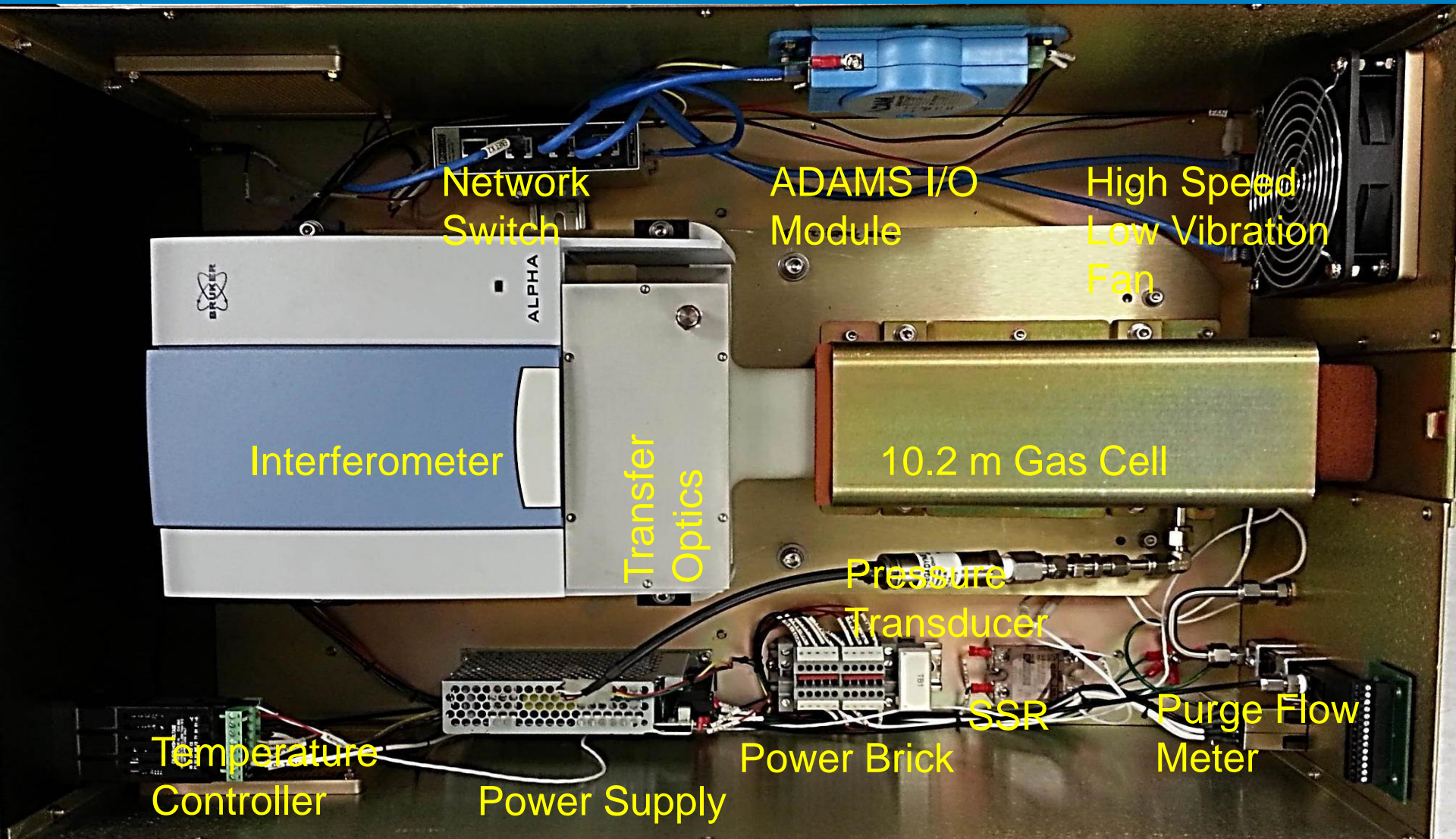
## 600 Series FTIR—Key Specifications

- SS316 electro polished gas cell -> Strong corrosion resistance and enhanced stability since entire cell is composed of the same material
- Low Volume transfer optics box that reduces purge volume (only 0.5 lpm N<sub>2</sub> or ZAG required)
- Cell windows are ZnSe for humidity protection
- Thermocouple location measures gas temperature
- Interferometers are all 0.8cm<sup>-1</sup> for better performance
- Pressure sensor is an absolute measurement (PSIA)
- Interferometer material is ZnSe for humidity protection





# 700 Series FTIR—Internal Components



Network  
Switch

ADAMS I/O  
Module

High Speed  
Low Vibration  
Fan

Interferometer

Transfer  
Optics

10.2 m Gas Cell

Pressure  
Transducer

SSR

Purge Flow  
Meter

Temperature  
Controller

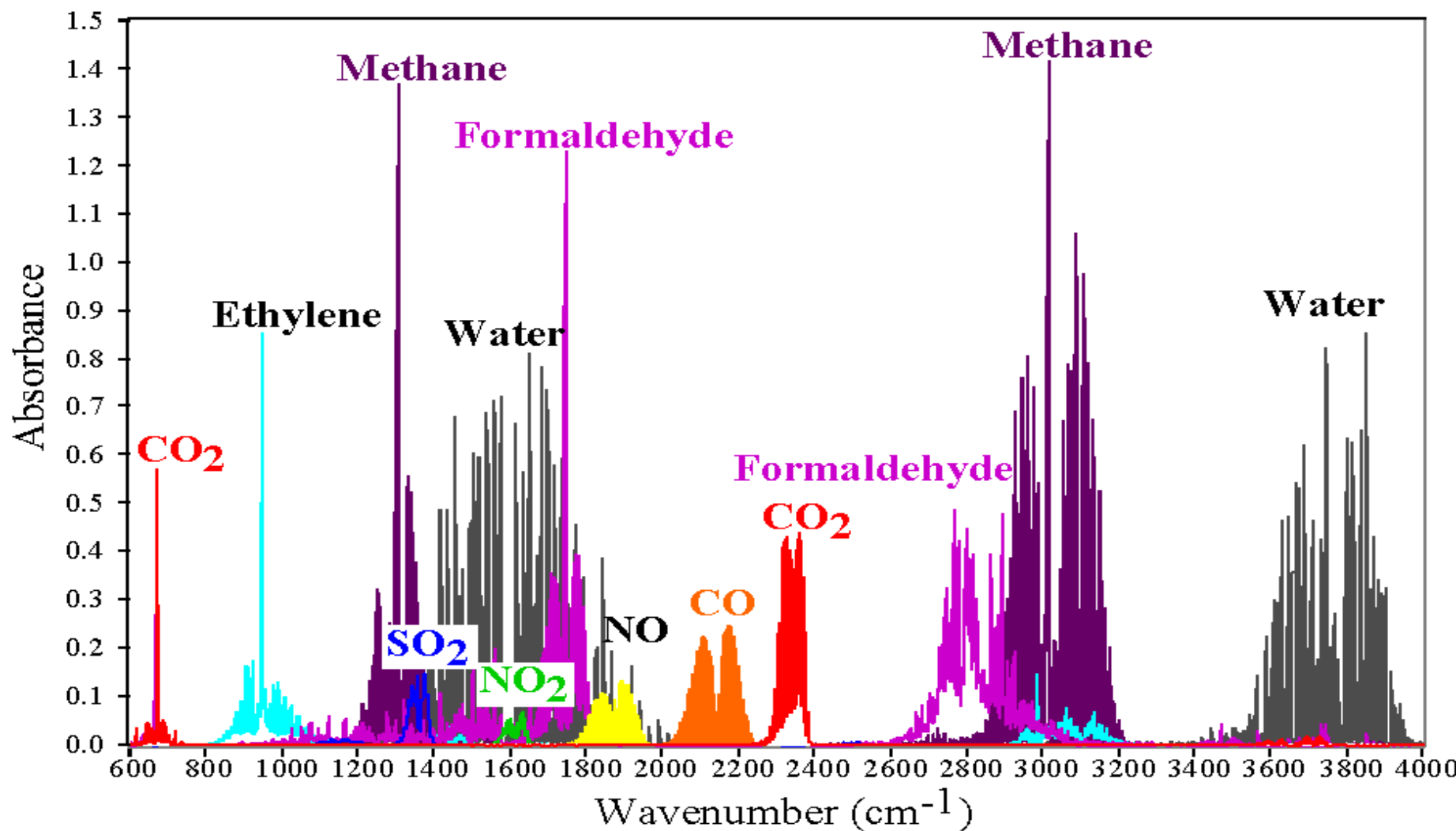
Power Supply

Power Brick





# Absorbance Spectrum





# Equipment Used



- Ambient Cooled DTGS Detector
- 0.8 cm<sup>-1</sup> Resolution
- 10.2m or 4.3m Sample Cell Path Length
- 700 Heated Sampler for all QA/QC Checks and Remote Interface
- Laptop Computer



Multipoint Sampler – 19 in rack mount unit that allows sampling of up to 16 points (currently low temp only)

Heated Sampler - 19 in rack mount unit that includes pump, filter, cal control, and gas handling to FTIR. All components are heated to 191C.

I/O Module - 19 in rack mount unit that allows 16 Analog Outs / 8 Digital Ins / 8 Digital outs

Zero Air Generator (ZAG) – Produces purge and background quality air

Rack Mount Computer – Replaces laptop with a rack mount computer and panel mounted monitor

Custom Systems – Custom rack mount enclosures can be designed based on the needs of the application. Can utilize other CAI product lines and custom sampling

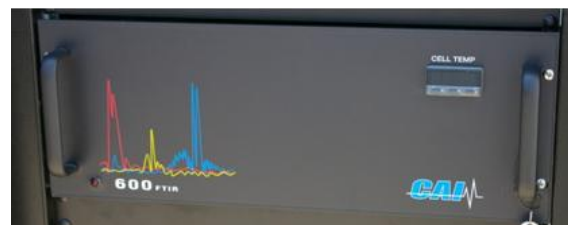


# 600 FTIR System Picture



FID

% O<sub>2</sub>



FTIR



Computer

Control  
Panel



## 600 Series FTIR—Performance Data

<u>Symbol</u>	<u>Gas Name</u>	<u>LOD (ppm)</u>
C <sub>3</sub> H <sub>8</sub>	Propane	0.074
CH <sub>4</sub>	Methane	0.054
CO	Carbon Monoxide	0.182
CO <sub>2</sub>	Carbon Dioxide	1.83
H <sub>2</sub> O	Water	223
HCHO	Formaldehyde	0.0818
HCL	Hydrogen Chloride	0.049
HCN	Hydrogen Cyanide	0.0963
HF	Hydrogen Flouride	0.054
NH <sub>3</sub>	Ammonia	0.04
NO	Nitric Oxide	0.2
NO <sub>2</sub>	Nitrogen Dioxide	0.32
SO <sub>2</sub>	Sulfur Dioxide	0.3
N <sub>2</sub> O	Nitrous Oxide	0.04
CH <sub>3</sub> CHO	Acetaldehyde	0.14
CH <sub>3</sub> OH	Methanol	0.05
C <sub>2</sub> H <sub>6</sub> O	Ethanol	0.42
CH <sub>2</sub> O <sub>2</sub>	Formic Acid	0.23

- 2 min response time, 1cm<sup>-1</sup>, 191° C, bottle gas, accounting for interferences (PLS)



## 600 Series FTIR—Gas Spectra

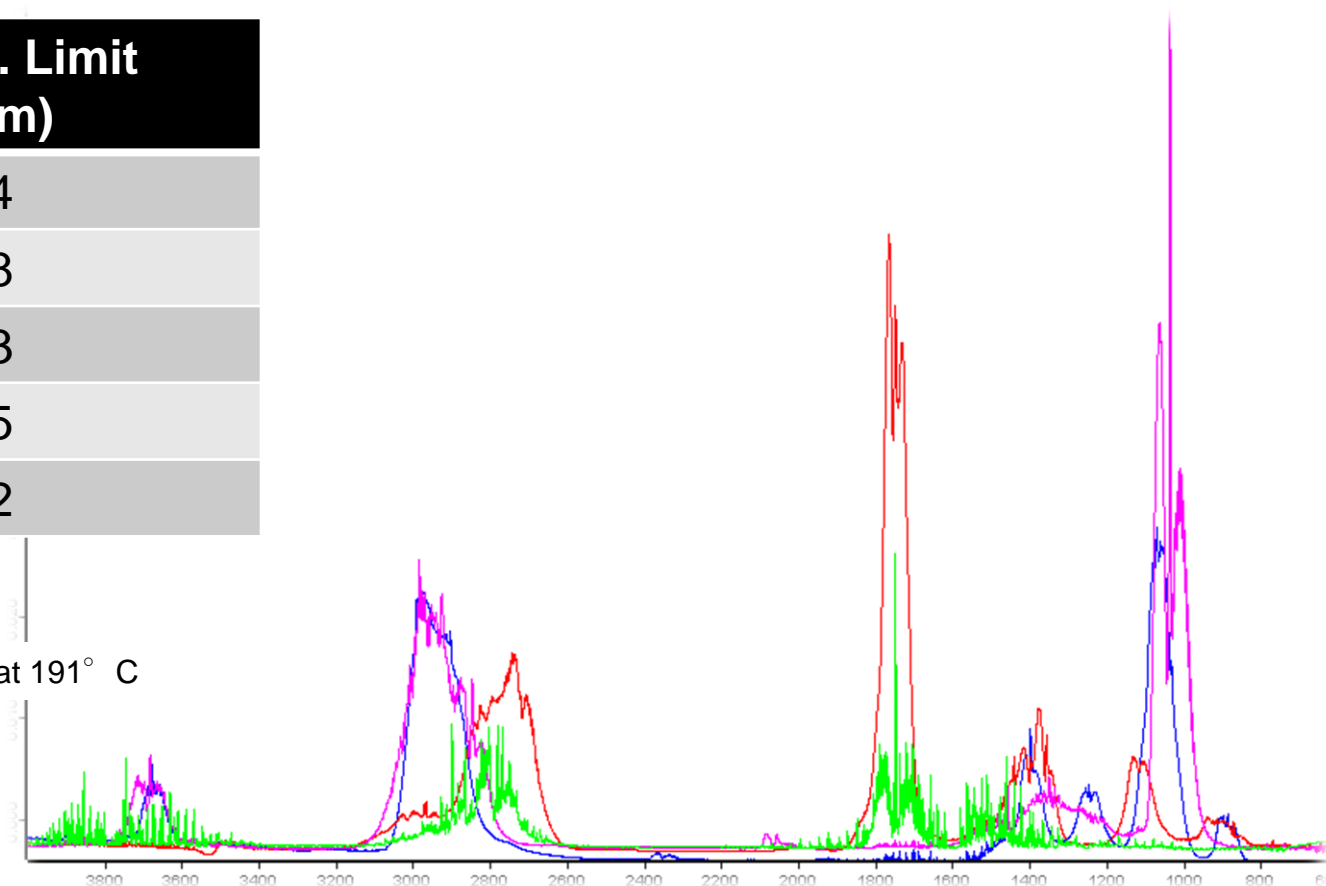
Acetaldehyde:  
CH3CHO 65.3 ppm

Methanol:  
CH3OH 65.4 ppm

Ethanol:  
C2H6O 51.7ppm

Formaldehyde:  
HCHO 14.3ppm

Component	Det. Limit (ppm)
Acetaldehyde	0.14
Formaldehyde	0.08
Formic Acid	0.23
Methanol	0.05
Ethanol	0.42

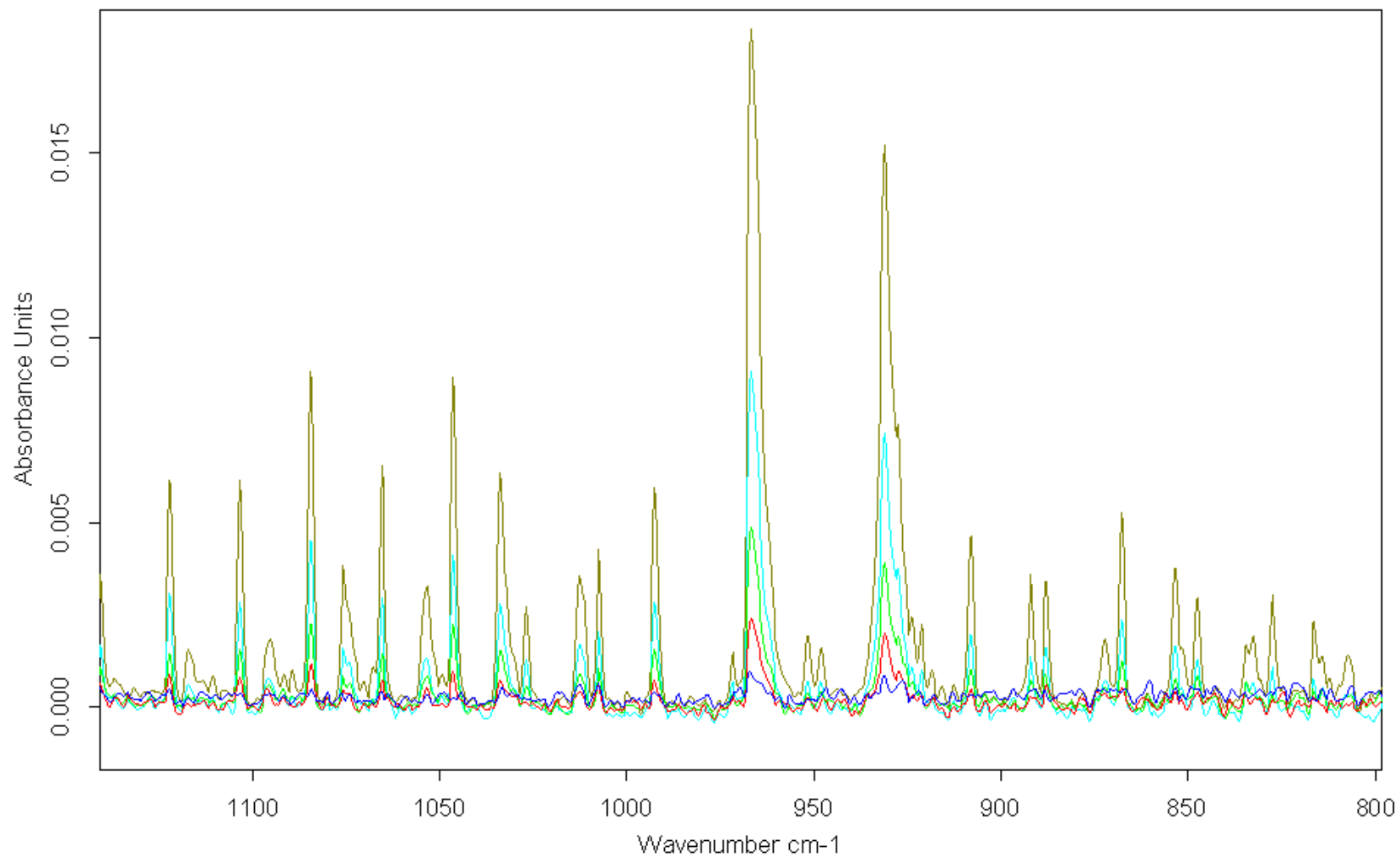


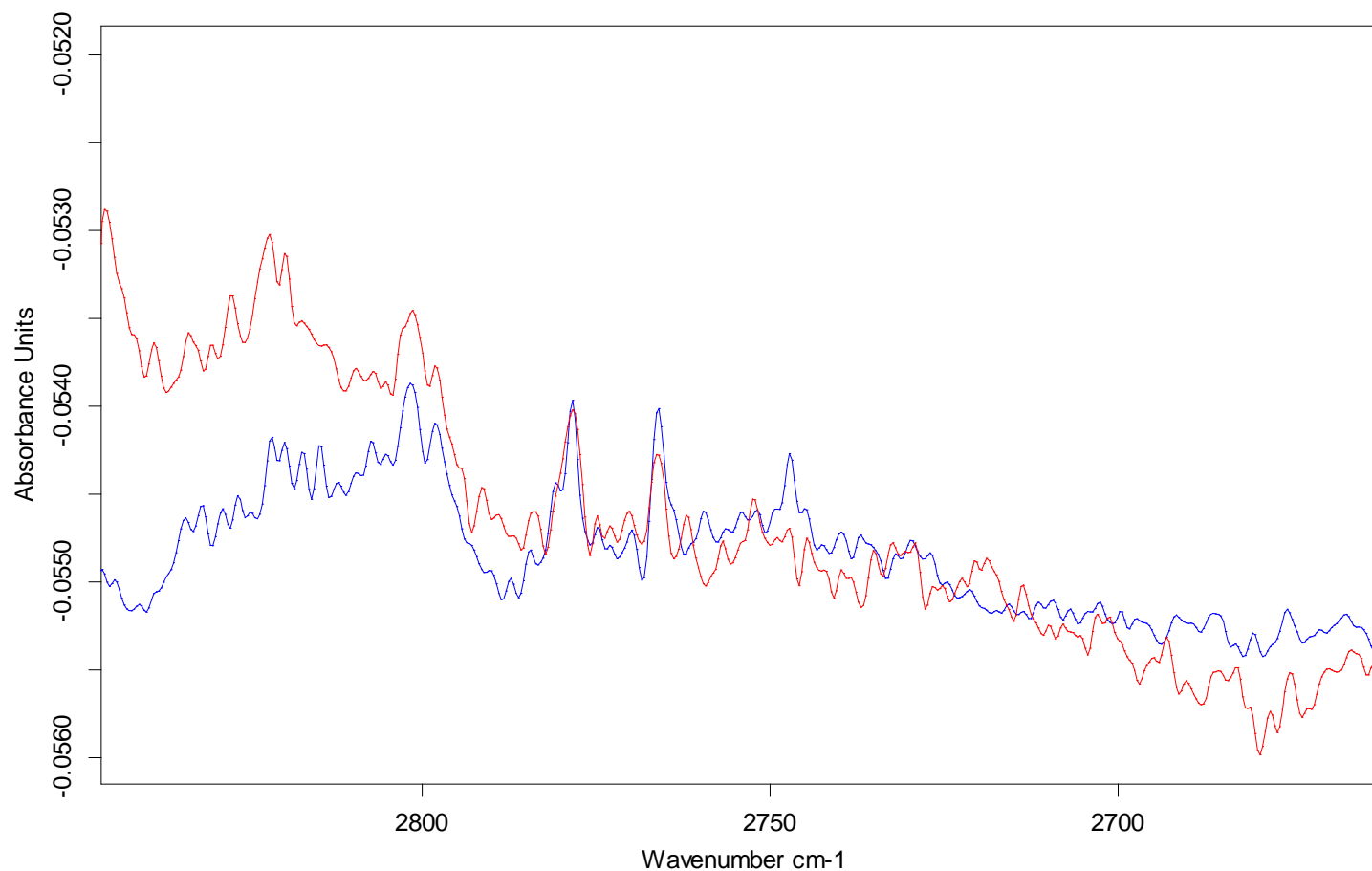
-Dry gas, single component values at 191° C





# NH<sub>3</sub> Spectra (0.16, 0.65, 1.3, 2.6, 5.2 ppm)





- HCHO spectra was reviewed to confirm measurement results



# Summary

- FTIR has proven the ability to measure low levels of NH<sub>3</sub>, NO<sub>x</sub>, CO, CO<sub>2</sub>, SO<sub>2</sub>, CH<sub>2</sub>O, N<sub>2</sub>O and others.
- FTIR has been used for CEMS in Europe and in USA.
- FTIR can be used for regulated and process control.
- Spectra can be saved for future comparison.
- FTIR is an effective method to measure multiple gases from a single sample stream



## 6000 FTIR System Picture



Monitor

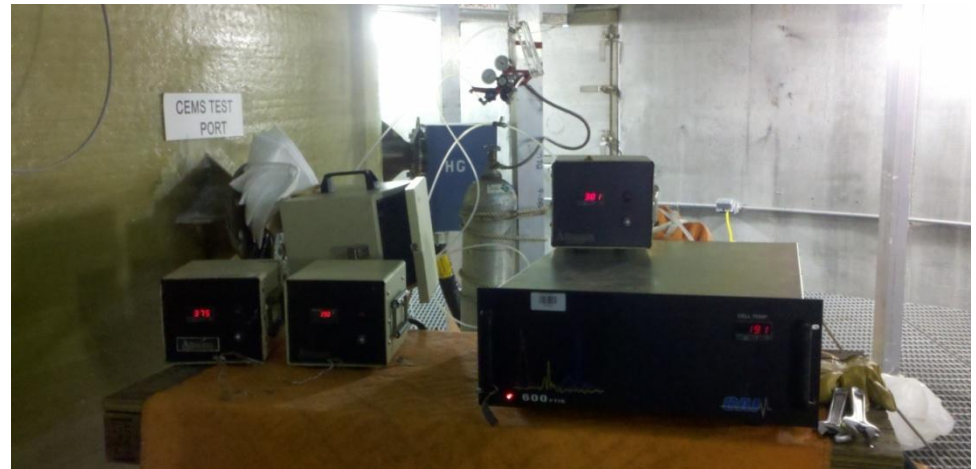
Computer

Sample System  
Temp controllers

6000FTIR



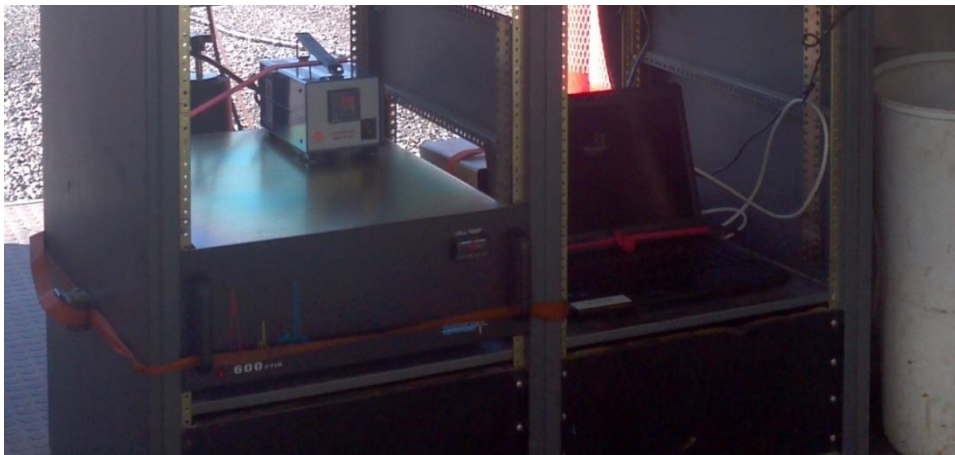
# On Site Pictures—Power Plant







# On Site Pictures—Natural Gas Compressor







- Laser – 19 year life
- IR Source - 5 year life, user replaceable
- Rocksolid™ Interferometer – Gold Mirrors, High throughput, Permanent alignment
- Process – Allows anyone to operate



## CAI FTIR Advantages

- No liquid N<sub>2</sub> Required
- Small Form Factor
- No Sample Pressure Restrictions
- ZnSe Beam-Splitter (for Humidity Protection)
- 19 year Laser Life
- 5 Year IR Source Life
- Partial Least Squares (PLS) Quantification
- 316SS Electro-Polished Cell Standard
- Digital & Analog Inputs/Outputs
- Minimal Service Required
- Library Search Capability
- Easy-to-Maintain
- Permanently Aligned – Dual Corner Cube Designed Interferometer (Pinned)
- Macros:
  - Makes Repetitive Tasks Easier
  - Allows User to Easily Customize each Application



# 600 Series—Applications Feasibility Form



California Analytical Instruments, Inc.

## FTIR Application Feasibility Request

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Email: \_\_\_\_\_

### Application

Please describe the desired applications for this analyzer:

### Gas Parameters

Gas Temperature: \_\_\_\_\_

Gas Pressure: \_\_\_\_\_

Est. Water %: \_\_\_\_\_

Gas Flow Rate: \_\_\_\_\_

### Environmental Parameters

Give the parameters for the environment in which the analyzer will be placed.

Temperature Range: \_\_\_\_\_

Relative Humidity Range: \_\_\_\_\_

Vibration Level: \_\_\_\_\_

### Gases to be Analyzed

List the gases to be quantified using the FTIR and their estimated maximum, minimum and average concentration in ppm:

Gas	Maximum Concentration	Minimum Concentration	Average Concentration

### Background Gases

List the gases that may be present which do not need to be analyzed

Gas	Maximum Concentration	Minimum Concentration	Average Concentration

Please email this form to Dr. Kevin Ramazan at [kramazan@gasanalyzers.com](mailto:kramazan@gasanalyzers.com) for evaluation.