

Tac-7SD[®]



UV-Based Biodetector/Collector

Integrated bioaerosol detection and filter collection

Features

- Compact and lightweight
- UV photon counting technology
- Alarms in 15 seconds (average)
- Battery life >24 hours
- Long collection periods
- Usable from -30°C to 50°C
- Adjustable air flow
- User-specified automated protocols
- Wireless control option
- Easy decontamination, including fan rotor
- No export restrictions

Application Areas

- Public health
- Military
- Homeland security

The TAC-7SD[®] is an integration of the latest digital photon bioaerosol detector technology with a 300 LPM sample collection module patterned after the electret filter-based SASS 3100. Research International has merged these capabilities into a single shell to create a world-class system for combined detection and sample collection. The Tac-7SD is equally suited for man-portable survey work or fixed location bioaerosol monitoring applications. Air sampling rates and battery operating times are best-in-class by a wide margin.

High sensitivity, low false positives The Tac-7SD tracks background levels of airborne non-biological and biological materials. It issues an alarm when it observes a suspicious increase in bioaerosol concentration levels, subject to a strict four-criterion decision algorithm which minimizes false positives.



Automatic sample collection Upon detection of a credible threat, the Tac-7SD automatically initiates sample collection onto dry electret filter media.

Optional remote operation The Tac-7SD control software for Windows allows the user to monitor the instrument remotely and adjust its settings as needed. Signals may be transmitted wirelessly between the Tac-7SD and a monitoring PC or other equipment using BioLink™ Bluetooth transmitters and receivers, or via RS232 cables.

Available worldwide The Tac-7SD is not subject to export restrictions. Research International Inc. has the worldwide right to manufacture and sell instruments containing this technology.

U.S. Patent Nos.: 10267723, 10274410, 10444137, 10794815, 11340153.

Technical Discussion: Biodetector Component

The biodetector in the Tac-7SD is a third-generation product based on photon-counting technology licensed from the U.S. Army in 2010. In this device, all aerosol particles in sampled air pass through a beam of UV-C excitation light and each particle is binned according to its light scattering, fluorescence emission intensity, and physical size. Since aerosol background levels often vary substantially in content over time, a 15 minute rolling average is maintained of key aerosol characteristics and every 15 seconds the latest recorded characteristics are compared to the rolling averages to determine whether a suspicious event has occurred.

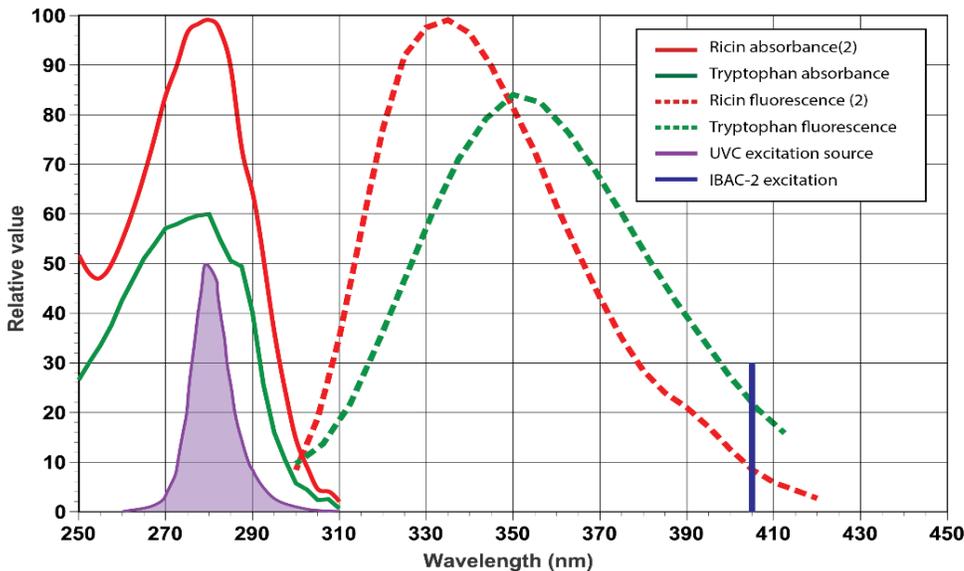


Figure 1. Absorbance and fluorescence spectra of ricin toxin and the protein tryptophan in relation to the BioHawk LF's excitation spectrum. The BioHawk LF is optimally designed to excite bio-fluorescence.

The highly variable composition of environmental aerosols makes it difficult to maintain adequate threat sensitivity while keeping false positives to an acceptable level. In the Tac-7SD, a good balance is maintained by monitoring four aerosol characteristics. Two of these alarm parameters are well-known statistical measures sensitive to unusually large changes in bioaerosol concentration. A third measure is the percentage of particles that have significant fluorescent emission.

The fourth parameter is fluorescence emission intensity. Scattered light and fluorescent light emission levels are both monitored in the Tac-7SD, and it has been found that most aerosol targets in pure form produce a characteristic ratio of fluorescence photons to scattering photons that is independent of particle size. This parameter is called a material's "Brightness." Figure 2 shows the Brightness of 28 different simulant and interferent materials that have been converted to aerosolized powders. In this Figure, a Research International calibration simulant has been defined to have a Brightness of 100. On this scale, the protein tryptophan displays a ratiometric Brightness of 200-300, while interferents such as cement powder and sea salt have Brightnesses that are no more a few percent of the reference simulant's value. This is clearly a useful parameter for excluding weakly fluorescing interferents that may nevertheless be encountered at high concentration.

This alarm parameter is strongly enhanced by using a light source with a center wavelength in the range of 280nm. As illustrated in Figure 1, many proteins found in toxins, viruses, and bacteria have peak absorbance and peak fluorescence emission when excited at this wavelength. This excitation wavelength is optimum for the detection of the full gamut of bio-threats, both because of the high intrinsic Brightness and because the exterior surfaces of most threats have high levels of these fluorescing materials.

For an alarm to be issued by the Tac-7SD, all four parameters must exceed specific alarm levels. Nominal alarm levels for the four parameters are loaded into the units at the factory, but Research International's software program "Tac-Optimum" can also be employed by the user to create alarm parameters unique to their field environment based on collected historical data stored on the Tac-7SD's internal SD card.

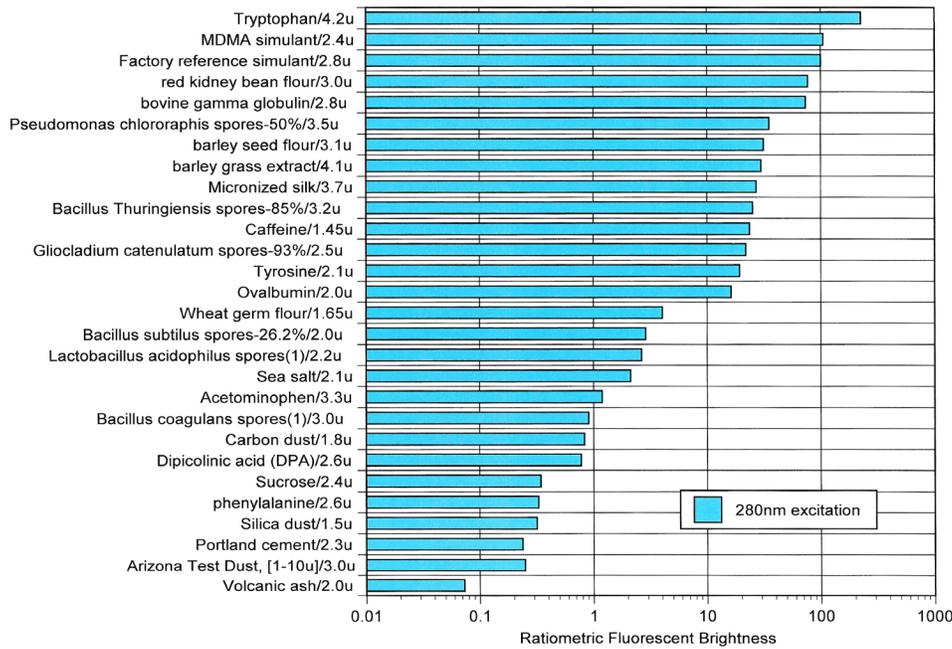


Figure 2. Relative fluorescence of 28 aerosolized materials referenced to factory simulant, which has a Brightness of 100. Each aerosol's mass median diameter (MMD) in microns is also shown.

The percentages noted for spore materials are the nominal active fractions.

For each material, the MMD is based on the statistical distribution of all particles >0.5 microns in size.

Applications/Interfacing

The Tac-7SD is lightweight and may be operated as a hand-carry stand-alone field detector/collector, or as a low-maintenance vehicle-based or fixed-location monitor. Connection between the Tac-7SD and a remote PC may be by hard-wired RS-232 connection or by wireless link. The new BioLink™ LR encrypted wireless link from Research International is capable of connecting the Tac-7SD to other hardware at ranges of 2km or more.

A Windows®-based PC program is supplied at no charge that is useful for communicating with the Tac-7SD, adjusting alarm parameters, and storing data remotely on the PC. All interface control commands needed to query the unit and link the serial data output to another data monitoring program are provided in the Tac-7SD instruction manual.

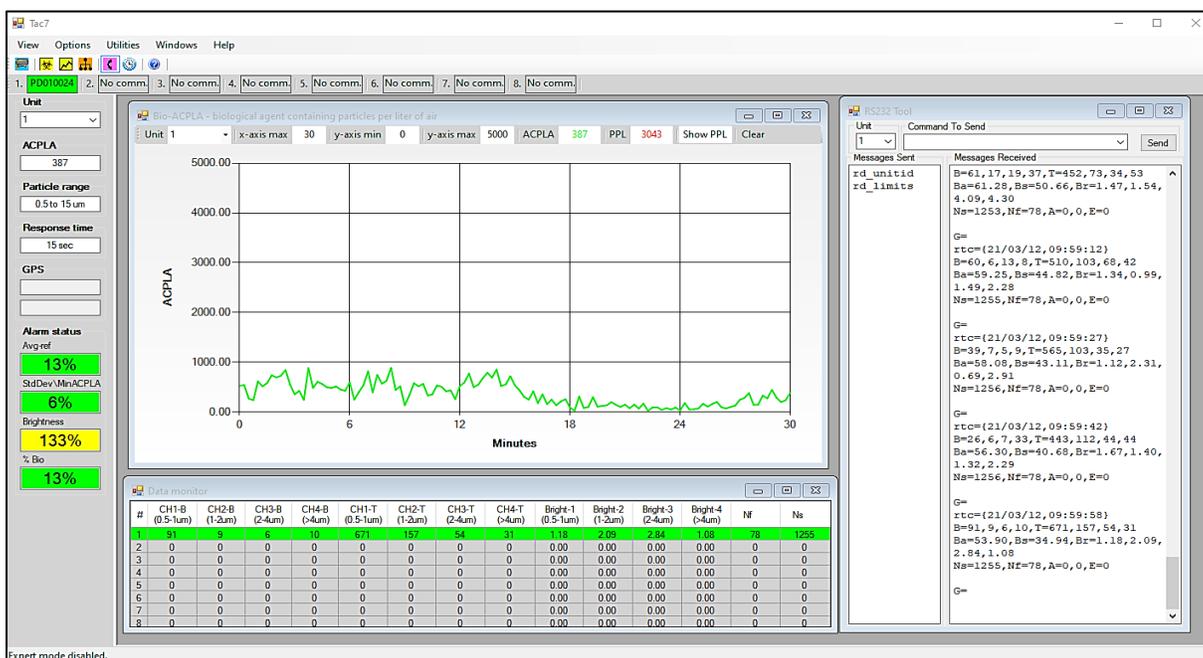


Figure 3. Typical main window on the Tac-7 PC control program.

Tac-7SD Performance Specifications

Operating principles	Aerosol particle counter with 280nm UV-stimulated fluorescence signature detection using photon counting coupled with high efficiency electret filter-style aerosol sample collector.
Particle size range and type	1 to 15 microns in four size ranges. Respirable aerosolized bacteria, spores, viruses, and toxins. Biofluorescence intensity in each size range is monitored and reported.
Sampling volume	Detector: 1.2 liter per min of ambient air, nominal. Sampler: 300 liters per minute.
Air Collection Rate	Standard (bioaerosol) electret filter: User adjustable 50 LPM to 300 LPM. HEPA-style (radiological) electret filter: User adjustable 10 LPM to 49 LPM.
Detector Interferents	Interferent resistant to burning vegetation, diesel smoke, pollen, silica dust.
Detection limit	100 ACPLA in most natural environments, 20-30 ACPLA under laboratory test conditions.
Start-up time	1 minute.
Alarms	Red LED and >100dB piezoacoustic alarm, plus serial link digital alarm output.
Time to alarm	15 second average, 30 seconds maximum. 15-minute trailing history is used in alarm protocols.
Continuous operating time (approximate)	Essentially unlimited if powered externally. Detection mode: Over 40 hours with UBI 2590 rechargeable battery. Detector plus sampler: 17 hours continuous on UBI 2590.
Operating life	Air pump: 30,000 - 40,000 hours. UV light source: greater than 10,000 hours.

Power & Communications

Power source	Can be used with BA-5590 primary battery or UBI 2590 rechargeable battery. Operable on AC mains power or vehicle power with proper converter.
Power Usage	Detector: <6 watts. Sampler: 10 watts.
Communication	RS-232, optional Bluetooth wireless BioLink, or optional embedded BioLink LR.
Data storage	Collected data is stored on a removable SD-type data card. An 8.0 GB card will store more than 5 years of aerosol data.
GPS	Optional embedded module.

Physical Specifications

Dimensions	35.8 x 17.2 x 21.7 cm without inlet air stack attached. 35.8 x 17.2 x 29.6 cm with inlet stack attached.
Weight	2.4 kg without battery / 4.2 kg with battery
Package	EMI-resistant aluminum shell. Electronics panel is IP66.
Operating temp. range	-30°C to 50°C. Operation to 60°C is permitted up to a total time of 1,000 hours.
Humidity Range	0 to 95% non-condensing.

Software, Accessories, and Consumables

PC software requirements	OS: Windows version 7 and up; processor: 400 MHz Pentium or equivalent (min.); RAM: 96 MB (min.), 256 MB (recommended); hard disk: 1.2 MB available space; USB port.
Optional Accessories	Rain cover for air sampler; battery charger; rechargeable UBI 2590 battery; tripod; transport case
Consumables	Detector: None. Sampler: Electret filters (see below).
Filter Mass and Composition	Standard (bioaerosol) electret filter: 12 mg/cm ² . HEPA-style (radiological) electret filter: 2.2 mg/cm ² for active media; 8.6 mg/cm ² including backing scrim. Both filter types are made from polypropylene electret microfiber.
Filter Media Size	4.4 cm active diameter filter, mounted in 6.0 cm diameter injection-molded holder.



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