

# Tac-7C®

## Tactical Bio-Aerosol Detector



*The Tac-7C® UV-based biodetector*

The Tac-7C® biological aerosol detector measures and records the biofluorescence and diffractive scattering produced by aerosol particles as they pass through an intense UV-C ultraviolet beam and classifies them as being of either biological or non-biological origin, and alarms if there is an abnormal change in bio-aerosol level. Applications range from homeland security to public health and military.

Operation with a UV-C light source minimizes false alarms that may come from aerosols such as burning vegetation that may contain aromatic hydrocarbons that fluoresce strongly under long wavelength UV light. Very stable operation is assured. Sampled air is first subjected to a two-stage filtering process that rejects aerosols such as pollen and insects. Photon counting methods minimize the effects of temperature and electro-optic component aging. The rugged UV-C LED source has a center emission wavelength of 280nm, maximum use temperature of 85 °C and half-life of 10,000-20,000 hours. An RS-232 serial data connection is provided and the Tac-7C will trigger sample collection by Research International air samplers. Signals may also be transmitted wirelessly between the Tac-7C and a monitoring PC or other equipment using BioLink™ transmitters and receivers.

Electric power consumption is less than 6 watts, allowing operation from either a small solar panel or for more than 40 hours on a swappable, rechargeable UBI 2590 style battery. Multiple units may be monitored remotely using RI's proprietary software for Windows® operating systems provided at no charge. The software can also be used to modify operating characteristics or alarm levels as needed or desired. All data is also automatically stored on an onboard removable solid state memory chip with a five-year capacity.

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### FEATURES

- True UV-C based "biological trigger"
- Photon counting: no analog drift
- Automated trigger/sampler protocols
- 40+ hours operation on swappable battery
- Wide operating temperature range
- Light weight/small size
- Long operating life
- RS-232 or wireless communications capable

### APPLICATION AREAS

- Indoor or outdoor use
- Sports stadiums and arenas
- Subways
- Military bases
- Airports

## Technical Discussion

This biodetector 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.

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-7C, 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.

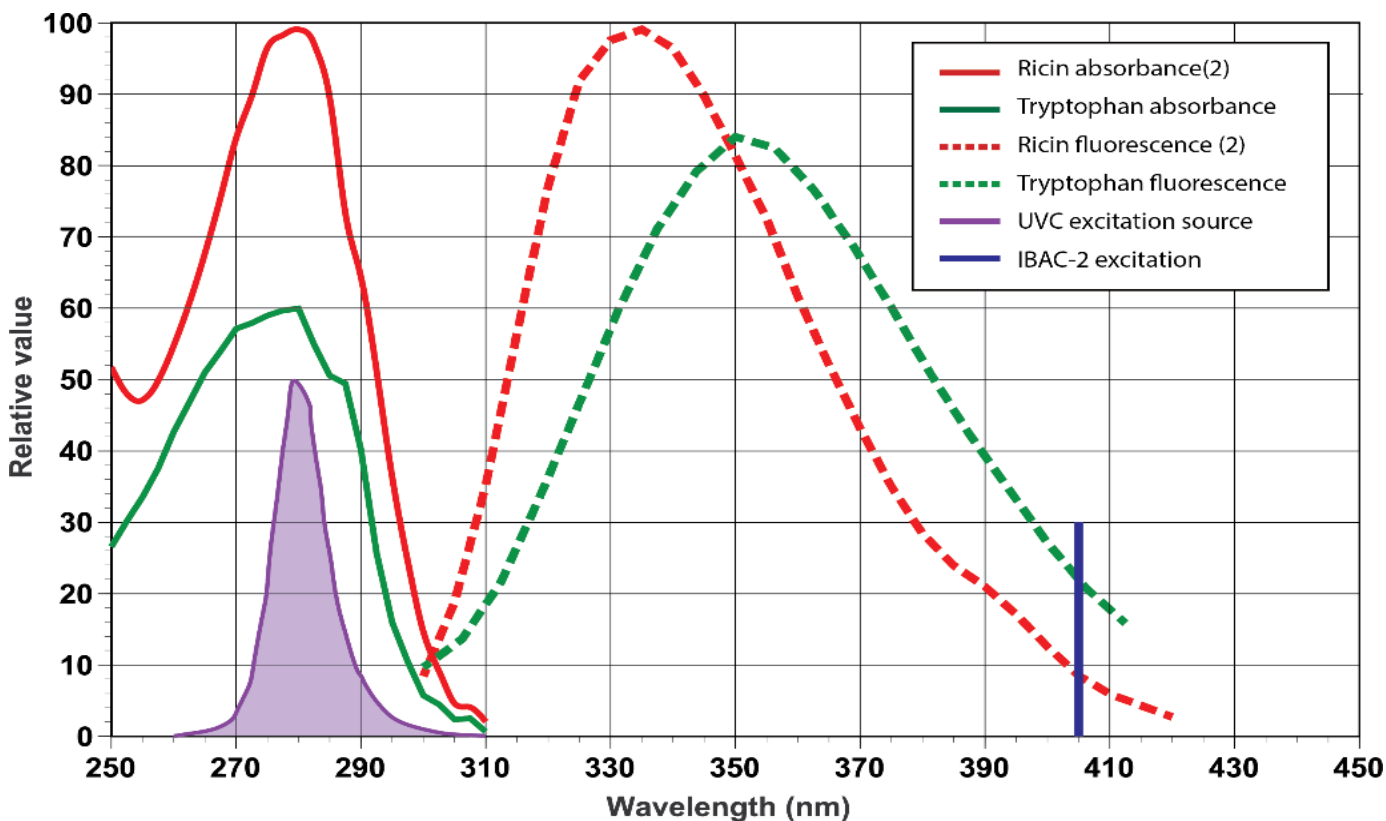


Figure 1. Absorbance and fluorescence spectra of ricin toxin and the protein tryptophan in relation to the BioHawk LF's excitation spectrum. The BioHawk LF is optimally designed to excite bio-fluorescence.

The fourth parameter is fluorescence emission intensity. Scattered light and fluorescent light emission levels are both monitored in the Tac-7C, 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." For example, if the brightness of the aerosolized protein tryptophan is given a brightness value of 100%, then interferences such as cement dust and sea salt spray have brightnesses less than 1%: This is clearly a useful parameter for excluding weakly fluorescing interferences 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 in 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-7C, 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 a user to create alarm parameters unique to their field environment based on collected historical data stored on the Tac-7C's internal SD card.

## Applications/Interfacing

The Tac-7C is a lightweight bioaerosol detector that may be operated as a hand-carry stand-alone field detector, as a low-maintenance vehicle-based or fixed-location monitor, or as a trigger to initiate the operation of other devices. As supplied, the Tac-7C can be used to trigger Research International's dry electret filter sampler, the SASS 3100, or the wetted wall cyclone product, the SASS 2300. In component form the Tac-7C is the bioaerosol trigger used in Research International's combination biodetector/sampler the Tac-7SD, the BioHawk LF bio-identifier, and as the biothreat monitor in a high-speed mail sorting system running at a 10Hz reporting rate.

A low-weight UAV version is slated for introduction in 2024.

Connection between the Tac-7C and Research International's stand-alone sampling systems or 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-7C 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-7, adjusting alarm parameters, and storing data remotely on the PC. In addition, 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-7C Instruction Manual.

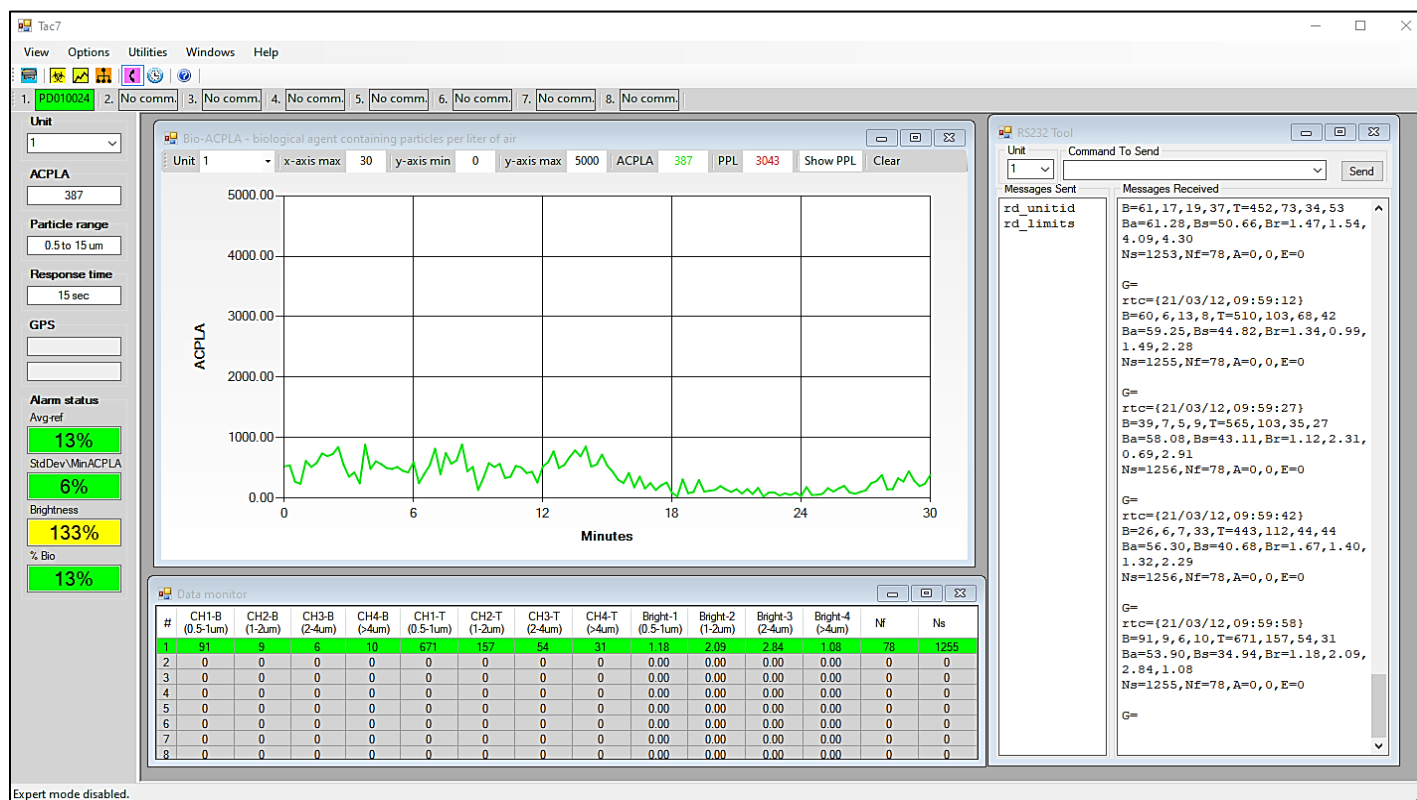


Figure 2. Typical main window on the Tac-7C PC control program.

## Tac-7C® Specifications

<b>Operating principle</b>	Monitoring of 280nm UV-stimulated particle scattering and biofluorescence using photon counting electro-optics. Alarm decisions are based on algorithms that consider bioaerosol statistical behavior, bio-fluorescence intensity, and aerosol composition.
<b>Particle size and type</b>	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.
<b>Interferents</b>	Interferent resistant to burning vegetation, diesel smoke, pollen, silica dust.
<b>Detection limit</b>	100 ACPLA in most natural environments, 20-30 ACPLA under laboratory test conditions.
<b>Sampling rate</b>	1.2 liter per min of ambient air nominal.
<b>Consumables</b>	None.
<b>Time to alarm</b>	15 second average, 30 seconds maximum. 15-minute trailing history is used in alarm protocols.
<b>Alarms</b>	Red LED and >100dB piezoacoustic alarm, plus serial link digital alarm output.
<b>Communication</b>	RS-232 or wireless BioLink; pre-programmed for use with sampler.
<b>Serial data output</b>	Alarm, particles per liter of air in each size bin; percentage of particles that are biological; relative biofluorescence compared to scattering intensity for each size bin.
<b>Operating time</b>	Essentially unlimited if powered externally or 40 hours on UBI 2590 rechargeable battery.
<b>Operating life</b>	Air pump: 30,000 - 40,000 hours. UV light source: greater than 10,000 hours.
<b>Temperature range</b>	-40° C to 50° C. Operation to 60° C is permitted up to a total time of 1,000 hours.
<b>Humidity</b>	0 to 95% non-condensing.
<b>Power source</b>	Uses BA-5590/U primary battery or UBI 2590 rechargeable battery. AC mains or vehicle power can be used with proper converter.
<b>Power consumption</b>	Less than 6 watts at 18 VDC to 36 VDC.
<b>Start-up time</b>	1 minute.
<b>Data storage</b>	Onboard removable SD-type data card. Stores more than 5 years of aerosol data.
<b>Dimensions</b>	16 x 18 x 28 cm with no inlet air stack. 16 x 18 x 39 cm with inlet stack attached. 16 x 15 x 39 cm without side handle.
<b>Weight</b>	3.5 kg without battery / 4.5 kg with battery.
<b>Package</b>	EMI-resistant aluminum shell construction.
<b>Optional Accessories Purchased separately</b>	Rechargeable UBI 2590 battery, P/N 1000-0003-12. Battery charger, P/N 1000-0003-13. Tripod, P/N 1770-0009-02.

*Research International reserves the right to change specifications without prior notice.*

*This leading-edge biodetector subsystem has been granted several patents, including US 10267723 B1; US 10274410 B1; US 10444137 B2; US 10794815 B2; and US 11340153 B2.*

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