

RAPTOR™

A Rapid, Automatic, and Portable Fluorometer Assay System



DESCRIPTION

The RAPTOR™ is a portable, 4-channel fluorometric assay system that can be used for high-sensitivity monitoring of biological agents, toxins, explosives, and chemical contaminants. It represents a careful integration of optics, fluidics, electronics, and software into one compact system for use in laboratory settings and field assays. This unit can automatically perform a user-defined, multi-step, assay protocol while simultaneously tracking fluorescently-tagged chemical reactions occurring on the surface of each of the system's four disposable optical waveguide sensors.

Using immunoassay techniques, toxins and markers such as *Y. pestis* F1 antigen have been detected at levels below 1 ppb from samples of a few hundred microliters. Each waveguide may be functionalized with a different assay, allowing up to four different assays to be run si-

multaneously. The results of these assays are displayed on a four line x 16 character LCD. The RAPTOR can also be run from a desktop PC, via an RS-232 link, using Windows-based software that is provided with the system.

FEATURES

The RAPTOR features an injection-molded disposable coupon containing four injection-molded optical waveguides (Patent No. 6,136,611). These waveguides are functionalized with the desired chemistry and then inserted into the coupon. They are then simultaneously interrogated using 635 nm light while monitoring the return fluorescent signal. To run an assay, the user simply inserts a coupon and presses the Run Assay key.

All of the fluidics have been automated using computer-controlled miniature valves. The system is

equipped with its own internal supply of buffer, a waste bag, and constant temperature reagent storage. It supports the re-use of reagent to minimize consumption of costly immuno-chemistries; and battery power allows for up to eight hours of continuous field operation.

Assay data is automatically stored in the system's 1 MB non-volatile EEPROM with a date and time stamp, and can be downloaded to a desktop PC using an RS-232 link. Assays typically take between 2 to 12 minutes and the results are displayed on the four line x 16 character LCD for each of the four waveguides. Additionally, an optional voice chip can provide audio messages that can be transferred over any radio or telephone to a remote-monitoring site.

The Windows-based software allows the user to graphically monitor data recovery while an assay is running. It also provides the user with the ability to customize the various steps involved in running an assay, such as incubation times, buffer flush protocols, or the amount of data to be taken. These assay 'recipes' can be transferred, by the software, to nonvolatile memory in the RAPTOR. Upon insertion of a coupon into the instrument, an optical bar code on the coupon is automatically interrogated for recipe information. Up to 63 different assay recipes can be stored in the RAPTOR at one time.

An optional water-resistant, foam-lined carrying case can be provided with the RAPTOR for easy transport. A zipper on top of the case allows it to be folded back, revealing a storage area for extra coupons and syringes. It is a system



designed for ultimate portability; assays can be run even while the instrument is being carried.

An auxiliary electronic port is provided for controlling accessories. For example, this port can be used to interface with a Research International cyclone air sampler, the SASS 2000™, that allows airborne particulates to be concentrated in a buffer solution. Liquid levels in the sampler are maintained by micro-controller-driven electronics, and samples are automatically transferred to the RAPTOR when it is ready to run an assay. The sampler draws power from its own battery and comes equipped with a supply of buffer and a waste storage bag. The light weight and compact size of the sampler (2.8 kg w/o battery; 14.2 cm W x 19.8 cm D x 30.5 cm H) makes it easily transportable as well.

DESIGN

Internally, the RAPTOR uses a mother board/daughter card strategy allowing six different printed circuit boards to be connected together. The operation of these boards is controlled by an Intel™ 386 SX 33 MHz processor, the operating code for this processor is stored in nonvolatile flash RAM, which allows the operating software to be upgraded easily by the user in the field.

Excitation light is provided by four 635 nm laser diodes which are electronically chopped at a frequency of 135 Hz to provide AC optical signals analogous to those produced by a mechanical chopper. Each laser is coupled to its injection-molded waveguide using a novel excitation light injection technique that incorporates a molded aspherical dielectric mirror (Patent No. 6,136,611). Fluorescent signal light from each channel is gathered using a high efficiency lens system that collects essentially all light captured by the sensor waveguide; and a high-performance dichroic filter is used to separate excitation light from the fluorescent signal. All optics are located in one compact aluminum module with a single entrance/exit window, mak-

SPECIFICATIONS	
Characteristic	Description
Use Profile	Indoor/outdoor sample collection, transfer, and assay; storage of 63 assay recipes; user in full MOPP gear either walking or in a slowly moving vehicle.
Physical Size	27.9 cm W x 20.2 cm H x 18.5 cm D.
Weight	6.45 kg (w/o battery).
Operating Temp. Range	1 to 35°C.
Storage Range	-29 to 66°C.
Assay Coupon	Four simultaneous assays, disposable, coded for assay identification. Coupon reseals upon removal for archival storage.
Fluids Handling	All fluids manipulated pneumatically; sample may be oscillated to lower assay time; reagent recovered.
Fluids Storage	On-board storage of buffer and reagent. Reagent stored at constant temperature in reusable thermal storage module.
Sensitivity	Dependent on analyte, 1 to 10 ppb typical.
Photocurrent Resolution	0.02 pA; 12-bit A/D
Dynamic Range	1:10 ⁶ (0.02 to 22,500 pA)
Assay Time	Dependent on assay, 10 to 15 minutes typical.
Data/Command Entry	Day/night visible keypad and display, usable in MOPP gear.
Visual	Liquid crystal display provides a positive, negative or retest result for each channel.
Communication	RS-232 bi-directional serial link and RF telemetry capability via BioLink™ RF Data Radio.
Data Storage	EEPROM retains raw or processed data for 200 assays.
Batteries	Primary battery BA-5590/U, 1.05 kg (2.3 lb); lifetime 9 to 24 hours.
Power Consumption	7.2 W, nominal
Survivability	MILSPEC 810-E
Humidity	20 to 90%, noncondensing.
Ancillary Equipment	Nylon twill photographer's-style carrying case, carry strap compatible with MOPP gear; weight 1.2 kg (2.6 lb); lump-in-cord power supply.
Accessories Support	Three digital input lines and six software-controlled external drivers.

Research International reserves the right to change specifications on any of the devices in this data sheet without prior notice.

ing it possible to quickly and easily clean the optics.

FOR MORE INFORMATION

System specifications of a general nature are indicated herein. For further details concerning specific system or sensor characteristics or applications, please contact Research International directly.



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