

Personal and Area Monitors

**SMARTS™
 AREA MONITORS**

- 2 MHz to 100 GHz Detection
- Audible, Visible, Remote Alarms
- Continuous, Automatic Monitoring
- Failsafe
- Requires No Operator
- Indoor and Outdoor Models



DESCRIPTION

Narda's SMARTS family of area monitors provides continuous detection of RF radiation within a specific area. Models are available to cover any frequency between 2 MHz and 100 GHz. These monitors represent a major advance in safety monitoring programs for non-ionizing radiation. In the past, a safety program was limited to performing periodic surveys of a particular system or area, which meant an acute failure could go undetected until the next survey was performed. And since all major international safety standards set limits for average exposure level over a few minutes, the use of survey instruments alone meant a hazardous condition could exist for days, weeks, or even months. With the SMARTS, potentially hazardous areas can be continuously monitored to help insure a hazard-free environment as well as compliance with industry and government standards.

Four models cover wide frequency bands from 2 MHz to 100 GHz. Model 8810 covers the 2 to 30 MHz HF band, Model 8815 operates from 10 to 500 MHz, and Model 8820 monitors frequencies between 500 MHz and 18 GHz. The ultra broadband Model 8825B covers 500 MHz to 100 GHz.

Each model features a unique design for accurate detection in a specific environment. At low frequencies, such as

those around HF antennas and metallic shelters, the electric field component is typically greatly distorted. Therefore, the Model 8810 (2 to 30 MHz) monitors the magnetic field which is more consistent in these environments. The standards from Australia, Germany, the U.K. and the U.S. all vary permissible exposure levels by 20 dB over these frequencies. The Model 8810's frequency curve has a shape very similar to these standards. Its alarm threshold is set to approximately one tenth of the exposure limits to provide coverage over an area of several square meters.

The Model 8815 (10 to 500 MHz) utilizes what has been termed "transitional" monitoring. At frequencies below approximately 200 MHz, it responds to the magnetic field component and it *transitions* to electric field detection at frequencies above 200 MHz.

Model 8820 (500 MHz to 18 GHz) and Model 8825B (500 MHz to 100 GHz) use broadband thermocouple detectors to monitor the electric field. Both models sound an alarm only when the average power level is exceeded and are ideal for use with microwave systems where pulse modulation is normally employed.

SMARTS monitors are available in a totally nonmetallic, weatherproof enclosure for outdoor mounting. This enclosure will protect the SMARTS from dust, rain, or heavy seas.

OPERATION

Indoor SMARTS

SMARTS monitors operate like common household smoke detectors. When operating normally, the alarm LED will flash approximately every 40 seconds. If the main battery needs to be replaced, the flash will be accompanied by a “chirp.” When the SMARTS detects radiation at its preset alarm threshold or higher, a continuous audible and visual alarm is generated. During this alarm period an electronic signal is provided at the STATUS jack (J1) to activate various user-supplied remote circuitry. If the main battery drops below critical levels, or if the detection elements should fail, the system will remain in the alarm mode until the problem is corrected. If the main battery should fail completely there will still be a voltage at the J1 produced by a backup battery circuit.

Operation can be verified at any time by depressing the TEST button which activates a full system test. In situations where standard operating procedure produces RF or microwave power in excess of the threshold and exposure to people is possible (e.g., in an anechoic chamber or on the deck of a ship), the Model 8808 Personnel Sensor can be used. This sensor will disable the SMARTS alarm (via the J2 ENABLE jack) unless personnel and high power radiation are both present.

Outdoor SMARTS

Since standard visual and audio signals would be masked by the weatherproof enclosure, outdoor SMARTS models supply information to a remote location via a weatherproof, multi-pin, MIL-type connector (J101). Normal or alarm STATUS information is continuously available at this remote location. Also operated by remote control are the ENABLE jack (J2) and the TEST function. Outdoor SMARTS models operate from an external low voltage, very low current supply brought in through the same connector. This separate DC source allows operation over a broader temperature range.

The comprehensive SMARTS family of area monitors should be part of every safety program involved with high power RF or microwave energy. Other options or configurations, such as different alarm thresholds or calibration frequencies, can be provided. Consult the factory for details.

SPECIFICATIONS FOR INDOOR MODELS

MODEL No.	8810	8815	8820	8825B
Frequency Range	2 to 30 MHz	10 to 500 MHz	0.5 to 18 GHz	0.5 to 100 GHz
Frequency Sensitivity	±1.5 dB	±2.0 dB	3.0 dB ^a	4.5 dB ^a 0.5 - 50 GHz 6.0 dB ^a 0.5 - 100 GHz
Alarm Threshold	10 % of Standard ^b	0.1 mW/cm ²	1.0 mW/cm ²	0.5 mW/cm ²
Overload CW Peak	60 mW/cm ² 60 W/cm ²		300 mW/cm ² 100 W/cm ²	
3 dB Intercept Angle	>180°	>180°	>180° ^c	>180° ^c
Temperature Operating Non-operating	-10°C to +55°C -40°C to +75°C			
Batteries Circuit ^d Fail-safe ^e	9V lithium (supplied) 3V lithium (supplied)			
Weight (approx)	24 oz. (0.7 kg)			
Calibration Frequencies ^f	2, 3, 10 and 30 MHz	10, 30, 100, 300, 400 and 500 MHz	8.2 ^f GHz	8.2 ^f GHz
Accessories Supplied	Operation Manual, J1 and J2 Mating Connectors			

Notes:

- ^a Peak to peak. The threshold can be factory set to provide optimum performance over a specific band of interest.
- ^b The alarm threshold is proportionate to IEEE C95.1-1991 Standard and varies over the 2 to 30 MHz band. The threshold is 0.9% of the H field Maximum Permissible Exposure (MPE) from 3 to 30 MHz and equal to 10% of the E field MPE from 2 to 30 MHz. (Controlled Environments)
- ^c The 3 dB intercept angle is >180° with the E field tangential to the mounting plane and >165° with the E field perpendicular to the mounting plane.
- ^d The rated life is two years. It is recommended that this battery be replaced annually during calibration.
- ^e The fail-safe battery has a rated life of 5 to 10 years. It is recommended that it be checked annually during calibration and replaced every three years.
- ^f Other calibration frequencies available for narrow band applications. Contact the factory.

ALARM OPERATION

CONDITION	AUDIBLE & VISUAL INDICATIONS	J1 OUTPUT ¹
Normal Operation	Light flashes every 40 sec.	Low
Low Battery	Alarm chirps, light flashes	Low
Test Button Depressed	Steady sound and light	High
Alarm	Steady sound and light	High
Main Battery Failure	No sound or light	High
Sensor Failure	Steady sound and light	High

CONTROL INPUT

CONDITION	J2 INPUT ²
Normal Operation	Open Circuit
Alarm Disabled	Short Circuit
People Present ³	Open Circuit
No People Present ³	Short Circuit

Notes:

- ¹ The STATUS signal available at J1 is a voltage source that provides >2.4 Vdc into a 500 kΩ load when "High." The voltage drops to <0.8 Vdc when "Low." The load impedance can be reduced to 24 kΩ providing that the Main Battery Failure signal is not required. Jack type is 3.5mm miniature phone.
- ² J2 Input: Normal condition is an open circuit. A short circuit (<100 ohms) disables the SMARTS. Jack type is 2.5 mm miniature phone.
- ³ When used with the Model 8808 Personnel Sensor.

SPECIFICATIONS FOR OUTDOOR MODELS



MODEL No.	8810B-WP	8815B-WP	8820B-WP
Frequency Range	2 to 30 MHz	10 to 500 MHz	0.5 to 18 GHz
Frequency Sensitivity	±1.5 dB	±2.0 dB	±3.0 dB ^a
Alarm Threshold	10% of Standard ^b	0.1 mW/cm ²	1.0 mW/cm ²
Overload CW Peak	60 mW/cm ² 60 W/cm ²		300 mW/cm ² 100 W/cm ²
3 dB Intercept Angle	> 180°	> 180°	> 180° ^c
Temperature Operating Non-operating	-20°C to +55°C ^d -40°C to +75°C		
Power Requirements External Supply	8.5-12.5 Vdc, 5 ma (max)		
Enclosure Rating	NEMA 4X ^f		
Weight (approx)	69 oz. (2.0 kg)		66 oz. (1.9 kg)
Calibration Frequencies ^g	2, 3, 10 and 30 MHz	10, 30, 100, 300, 400 and 500 MHz	8.2 GHz
Accessories Supplied	Operation Manual, J101 Mating Connector		

Notes:

- ^a Includes enclosure effects. The threshold can be factory set to provide optimum performance over a specific band of interest.
- ^b The alarm threshold is proportionate to IEEE C95.1-1991 Standard and varies over the 2 to 30 MHz band. The threshold is 0.9% of the H field Maximum Permissible Exposure (MPE) from 3 to 30 MHz and equal to 10% of the E field MPE from 2 to 30 MHz.
- ^c The 3 dB intercept angle is >180° with the E field tangential to the mounting plane and >165° with the E field perpendicular to the mounting plane.
- ^d The SMARTS circuitry will operate from -20°C to +65°C. Extensive thermal analysis indicates that, under worst-case conditions (no wind, no shade), the temperature inside the weatherproof enclosure will be a maximum of 10°C higher than the ambient air temperature. Therefore, the maximum ambient air temperature is 55° C.
- ^e The fail-safe battery has a rated life of 5 to 10 years. It is recommended that it be checked annually during calibration and replaced every three years.
- ^f This is the equivalent of IEC Publication 529, Type IP66 or CSA Standard C22.2, No. 94.
- ^g Other calibration frequencies available for narrow band applications. Contact the factory.

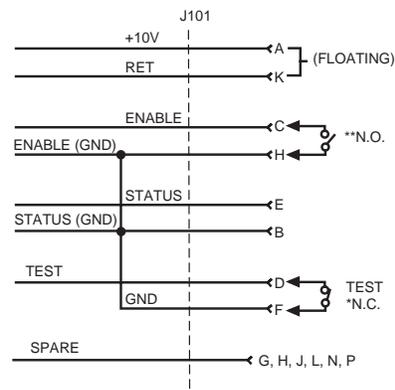
ALARM OPERATION

Condition	J101 Output ¹
Normal Operation	Low
Test Circuit Opened	High
Alarm	High
Sensor Failure	High
Enable Circuit Closed	Low
External Power Failure	High

Note:

- ¹ The STATUS signal available at J101 provides >2.4 VDC into a 24 kΩ load when "High." The voltage drops to <0.8 VDC when "Low." Maximum sink current is 3 ma.

J101 WIRING DIAGRAM



- * MUST BE CLOSED FOR PROPER OPERATION
- ** MUST BE OPEN FOR PROPER OPERATION

DETERMINING LOCATION AND AREA COVERAGE

To calculate where an area monitor should be mounted, various considerations are necessary. They include:

1. Areas where personnel are likely to be present
2. Probable radiation emanation point (or points)
3. Size of the area to be monitored
4. Safety standard level being used
5. Frequency and wavelength

Figure 2 shows the typical relationship between distance and the reduction of the field strength in terms of equivalent power density in the far field. When calculating the area a SMARTS can effectively monitor, first determine where the unit is to be mounted and what the alarm threshold level is. The minimum protection area is based on the assumption that the energy at the source of a leak will not be known. For example, if the SMARTS was located 10 feet ("X") from the source of the energy and it reached its threshold of 1mW/cm², a level of 10mW/cm² (the standard) would be present at a distance of 3.16 feet (\sqrt{x}) from the source. Therefore, the minimum protected area would be all points at a distance less than 6.84 ($x\sqrt{x}$) feet from the SMARTS. If a failure results in a higher or lower amount of energy at the source, then one could calculate an even smaller "unprotected" area.

Most safety standards average exposure over a period of six minutes. Therefore, an additional safety margin exists since the SMARTS sounds its alarm in less than one second and corrective action could be enacted quickly by removing power or exiting the area).

Figures 3 and 4 represent a shelter-mounting application. Figure 3 shows one SMARTS and its associated "safe" zone. Figure 4 denotes the same shelter but with two SMARTS installed. It may be advisable to use multiple monitors depending on where the high power is generated or routed.

It is always best to make actual measurements before installation since calculations cannot account for the various objects that can perturb the field. Measurements are more critical when determining the mounting position for the Models 8810 and 8815 as they may be located in the near field, where field strengths are very difficult to calculate. When monitoring a test stand where the energy would leak from a defined area, the SMARTS should always be placed as close as possible to the operator or technician. Ideally, the SMARTS and the person should be located the same distance from the source.

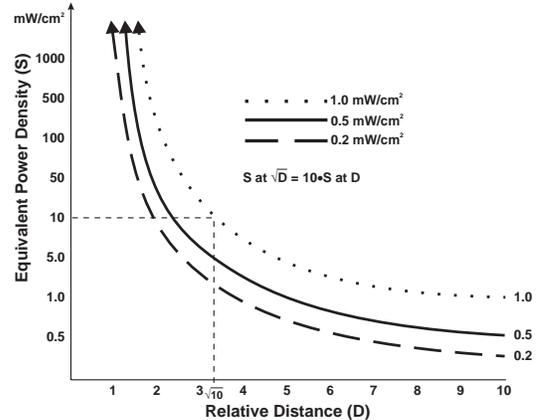


Figure 2. Equivalent Power Density versus Distance from Source

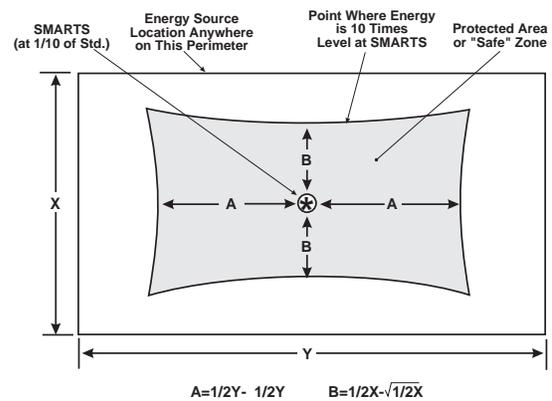


Figure 3. Single SMARTS Installation

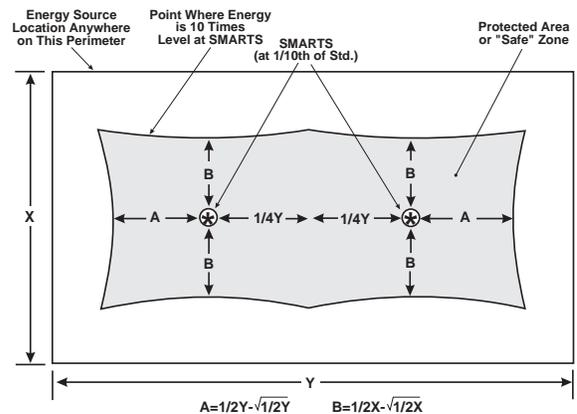
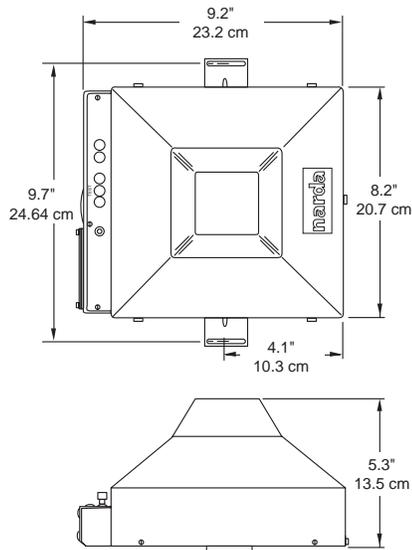
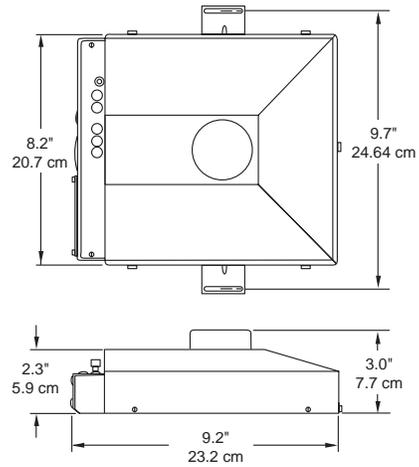


Figure 4. Dual SMARTS Installation

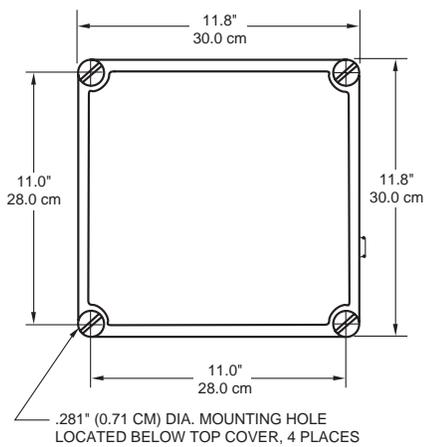
OUTLINE DRAWINGS



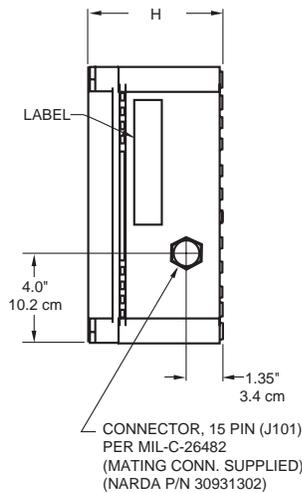
Models 8810, 8815



Models 8820, 8825B



.281" (0.71 CM) DIA. MOUNTING HOLE
LOCATED BELOW TOP COVER, 4 PLACES



CONNECTOR, 15 PIN (J101)
PER MIL-C-26482
(MATING CONN. SUPPLIED)
(NARDA P/N 30931302)

Model	Height (H)
8810B-WP	7.2" 18.3 cm
8815B-WP	7.2" 18.3 cm
8820B-WP	5.2" 13.2 cm