

SPOTSCAN™

Line-scanning Accessory for
Endurance™, Marathon MR,
Marathon MM, Modline® 5 and
Modline 7 Temperature Sensors



Operating Instructions

Safety Information – SpotScan

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Acceptable Operation

This instrument is intended only for the measurement of temperature. The instrument is appropriate for continuous use. The instrument operates reliably in demanding conditions, such as in high environmental temperatures, as long as the documented technical specifications for all instrument components are adhered to. Compliance with the operating instructions is necessary to ensure the expected results.

Unacceptable Operation

The instrument should not be used for medical diagnosis.

Replacement Parts and Accessories







Use only original parts and accessories approved by the manufacturer. The use of other products can compromise the operational safety and functionality of the instrument.



To prevent possible electrical shock, fire, or personal injury follow these guidelines:

- Read all safety information before you use the product.
- Use the product only as specified, or the protection supplied by the product can be compromised.
- Read all instructions.
- Do not use and disable the product if it is damaged.
- Do not use the product if it operates incorrectly.

Safety Symbols

	WARNING – RISK OF DANGER. Consult user documentation.
	Helpful information regarding the optimal use of the Product.
	DC (direct current)
	Conforms to European Union directive.
	Conforms to relevant South Korean EMC standards.
	Disposal of old instruments should be handled according to professional and environmental regulations as electronic waste.

Safety Specifications

Operating ambient temperature	0–60°C (32–140°F)
Storage temperature	–20 to 85°C (–4 to 185°F)
Power supply	18–32 V DC
Power consumption	12 W (maximum)

Warranty

The manufacturer warrants this product to be free from defects in material and workmanship under normal use and service for the period of two years from date of purchase, except as hereinafter provided. This warranty extends only to the original purchaser (a purchase from the manufacturer or a licensed distributor of the manufacturer is an original purchase). This warranty shall not apply to fuses, batteries, or any product which has been subject to misuse, neglect, accident, or abnormal conditions of operation.

In the event of failure of a product covered by this warranty, the manufacturer will repair the instrument when it is returned by the purchaser, freight prepaid, to an authorized Service Facility within the applicable warranty period, provided manufacturer's examination discloses to its satisfaction that the product was defective. The manufacturer may, at its option, replace the product in lieu of repair. With regard to any covered product returned within the applicable warranty period, repairs or replacement will be made without charge and with return freight paid by the manufacturer, unless the failure was caused by misuse, neglect, accident, or abnormal conditions of operation or storage, in which case repairs will be billed at a reasonable cost. In such a case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. THE MANUFACTURER SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

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1 Quick Start Instructions

1. Insert your temperature sensor into SpotScan body (p. 9).
2. Mount the assembly using (e.g.) Universal Adapter Accessory (p. 10).
3. Wire up SpotScan (p. 11).
4. Aim SpotScan at its target object (p. 11).
5. Adjust scan angle and scan frequency (p. 13).
6. Apply appropriate correction factor to temperature sensor (p. 14).
7. Select temperature sensor's peak-picking function if required (p. 14).

Description

2 Description

This accessory is used with temperature sensors in the following series: Endurance™, Marathon MR, Marathon MM, Modline® 5 and (if configured without water-cooling option) Modline 7; for compatibility, see Table 5 and Table 6 (p. 17). When mounted to the front of the sensor, the accessory allows the user to gather temperature information over a larger area on the target due to the scanning mechanism inside the accessory.

SpotScan differs from a line-scanner in that temperature readings are not synchronized with the mirror position and thus temperature readings are not precisely located within the scanned area, but – because of its essentially simple but innovative concept – SpotScan is quick and easy to setup and requires no hardware or firmware changes to existing sensor equipment.



Figure 1: SpotScan mounted using Universal Adapter Accessory (p. 18) and Right-angle Mount (p. 20). The end-plate is removed, showing the control panel (p. 13).

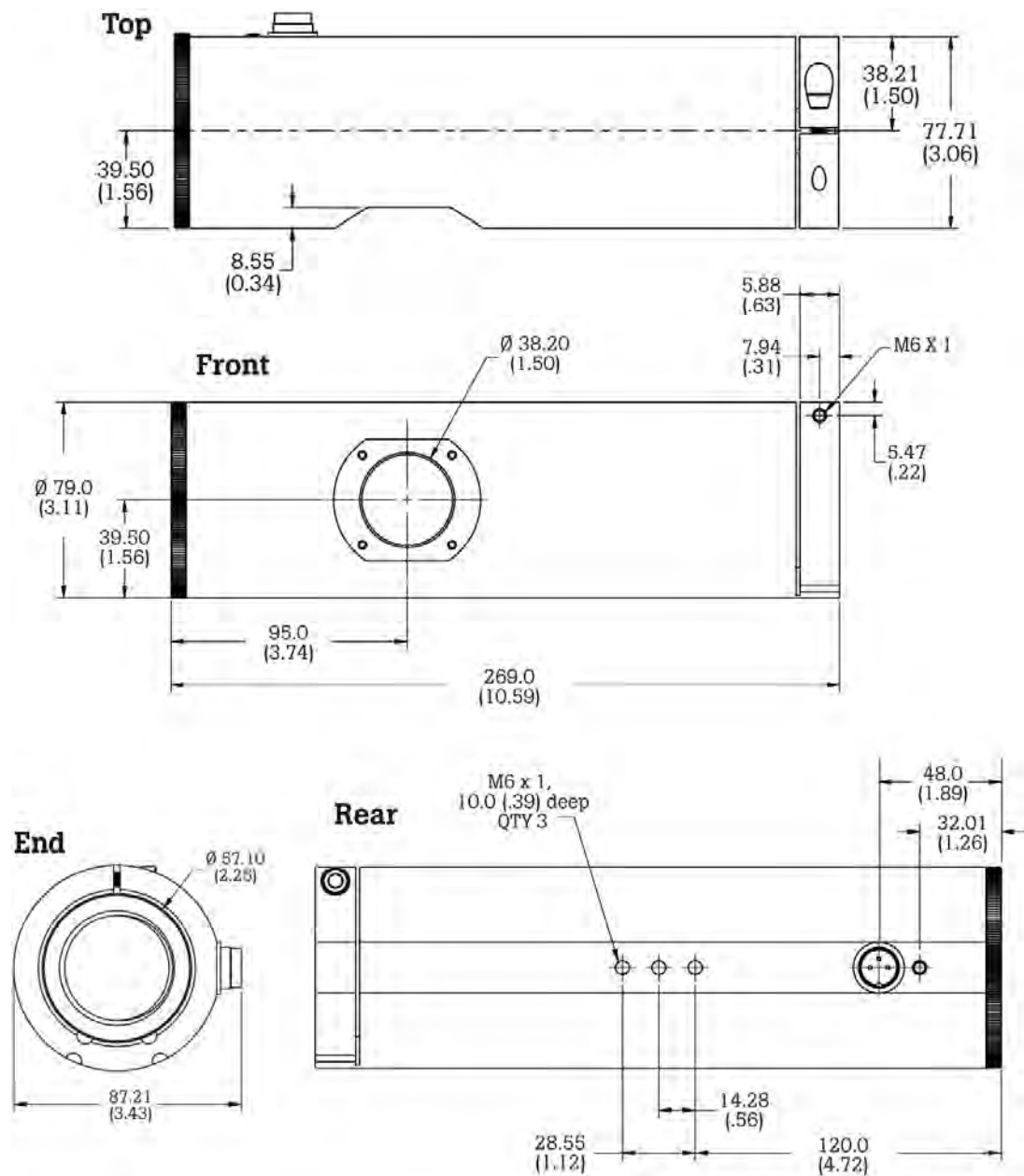


Figure 2: Dimensions of the SpotScan, in mm (and inches).

Technical Data

3 Technical Data

3.1 General Specifications

Scan angle	2–15°, adjustable by control knob (p. 13).
Scan frequency	1–10 Hz, adjustable by control knob (p. 13).
Status indicator	Stationary, Power on, Scanning (p. 14).
Power requirement	18–32 V DC, 12 W (p. 11)
Operating temperature	0–60°C (32–140°F)
Storage temperature	–20 to 85°C (–4 to 185°F)
Relative humidity	10–95%, non-condensing
Height × width × length	79 × 87.2 × 269 mm (3.11 × 3.43 × 10.59 in.) (see p. 7)
Weight	1.99 kg (4.38 lb)
Ingress protection	IEC 60529: IP 65 (with compatible sensor properly fitted).
Electromagnetic compatibility	<p><i>International</i></p> <p>IEC 61326-1: Industrial Electromagnetic Environment. CISPR 11: Group 1, Class A.</p> <p><i>Group 1: Equipment has intentionally generated and/or use conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself.</i> <i>Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted and radiated disturbances.</i></p> <p><i>USA</i></p> <p>FCC: 47 CFR 15 subpart B. <i>This product is considered an exempt device per clause 15.103.</i></p> <p><i>Korea</i></p> <p>KCC: Class A Equipment (Industrial Broadcasting & Communication Equipment) <i>Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and not to be used in homes.</i></p>
Mechanical	<p>IEC 60068-2-27 (mechanical shock): 50G, 6 ms, 3 axis. IEC 60068-2-26 (sinusoidal vibration): 3G, 11–200 Hz, 3 axis.</p>

3.2 Scope of Delivery

- SpotScan
- PSCB7HT power-supply cable, 7.5 m
- CD containing *Operating Instructions* (incorporating quick start instructions)
- Protective cap
- Mounting hardware
- Hex key

4 Installation

4.1 Positioning

See your temperature sensor's *Operating Instructions* for factors to consider when siting the equipment, including ambient temperature and distance from the target object. Siting of the temperature sensor with SpotScan fitted is subject to the same considerations. SpotScan can operate in ambient temperatures up to 60°C (140°F).



Before beginning the installation, refer to 'Geometry of Measurement Spot' (p. 14).

In environments with high vibration or mechanical shock, site SpotScan to minimize the transmitted vibration, or use isolation techniques.

4.2 Mechanical Installation

4.2.1 Inserting the Temperature Sensor

1. At the sensor-end of the SpotScan, use a 5-mm hex key to undo the clamping ring on the end of the unit and ease out the protective cap (Figure 3). Put the cap aside, and keep it for re-use whenever there is no sensor in place in the SpotScan.

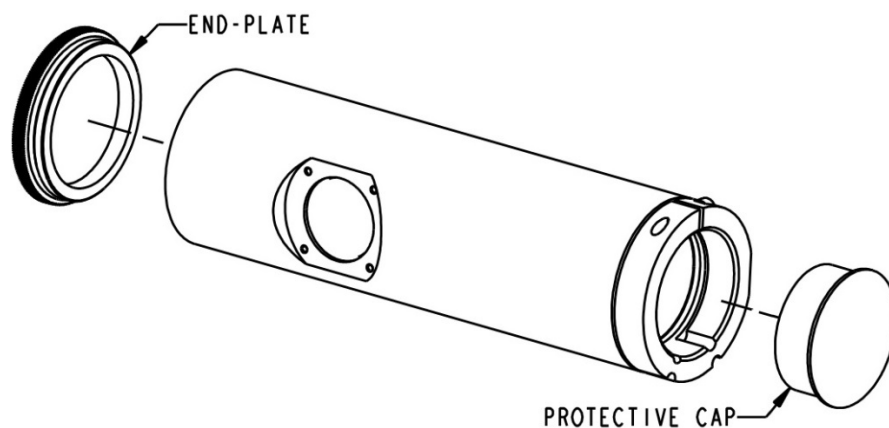


Figure 3: The end-plate (covering the SpotScan's control panel) and protective cap.

2. At the opposite end of the SpotScan, unscrew the end-plate (Figure 3) which covers the unit's control panel (the end-plate is sealed by an O-ring, so will be tight). This relieves the air pressure in the unit and should be done whenever the temperature sensor is being installed or removed.
3. For Endurance and Marathon MR sensors, set the sensor's focus before inserting into the SpotScan (see the *Operating Instructions* for those units).
4. Wipe any dust or grit from the body of the sensor.
5. Insert the sensor into the end of the SpotScan body and push it fully home (see Figure 4, below).

Installation



In harsh environments, it may help to apply a light film of silicone grease to O-rings inside SpotScan before inserting sensor (the O-ring as supplied is already greased).

6. Re-tighten the clamping ring at the end of the SpotScan.




For removal of the temperature sensor, see p. 23.



Figure 4: Temperature sensors in place in the SpotScan.

4.2.2 Mounting the Assembly

1. Mount the SpotScan and temperature sensor assembly as required. The SpotScan Universal Adapter Accessory gives a robust and flexible means of achieving this; see p. 18.
2. To facilitate setting of the temperature sensor's controls, rotate the temperature sensor as necessary within the body of the SpotScan to give an optimal view of, and access to, the sensor's rear panel. Secure the temperature sensor in position by tightening the clamping ring at the end of the SpotScan.
3. If setting up for the first time, remove the window protector from the SpotScan window.
4. After setting up the SpotScan power supply (see p. 11), orient SpotScan in its mounting so that the desired line of temperature measurement can be formed on the target object (see Figure 5, below).
5. To check the SpotScan positioning and to adjust its aim, press the button on the SpotScan control panel (see p. 13) to cycle through the mirror positions as follows.
 - a) One end-point position.
 - b) Center position.

- c) Other end-point position. 

At each position in turn, use either the laser, the video camera, or the through-the-lens sighting options of the temperature sensor in order to see the position of the spot.

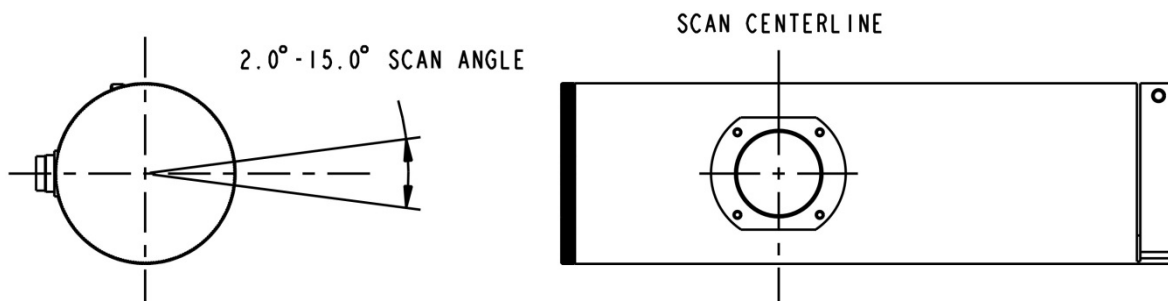



Figure 5: Scanning direction and scan angle of the SpotScan.

6. Return the mirror-position control to scanning mode. 
7. Adjust scan frequency as necessary for your application.
8. Screw the end-plate back into place over the control panel.

4.3 Electrical Installation

SpotScan must be attached to a suitable power supply. This will normally be the same power-supply unit being used for the existing temperature sensor.



Power-supply units which are sold by Fluke Process Instruments, and which are suitable for compatible temperature sensors, provide adequate power to operate both the sensor and SpotScan. The use of these power-supply units is recommended.



Although Endurance temperature sensors can accept input voltage up to 48 V DC, the maximum input voltage for SpotScan is 32 V DC. Power supplies sold by Fluke Process Instruments provide 24 V DC and are thus compatible with SpotScan.

The power-supply socket is a standard 3-pin connector, located on the side of the unit near the control panel and opposite the scanning window. Details of the socket and power requirements are as shown below.

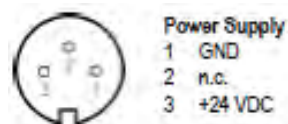


Figure 6: Power-supply socket, 3-pin.

Pin		Description	Color (6 wires)
1	GND	Power ground	Brown
2	Not connected		-
3	+ 24 V DC	Input for +24 V DC power supply	White
		Shield	Black

Table 1: Power-supply connections, 3-pin.

Installation

4.3.1 Power-supply Cable

The standard power-supply cable is 7.5 m (24.6 ft.) long. If a longer cable is required, use Table 2 (below) to determine the required cable gauge from the cable length needed.

Max. cable length (m)	Cable gauge (mm ²)	Resistance per m (1 wire) (Ω /m)	Voltage drop per m at 0.5 A (2 wire) (V/m)
100	0.5	0.04	0.04
118	0.56 (AWG 20)	0.034	0.034
148	0.75	0.027	0.027
174	0.82 (AWG 18)	0.023	0.023
200	1	0.02	0.02
267	1.31 (AWG 16)	0.015	0.015
286	1.5	0.014	0.014
444	2.08 (AWG 14)	0.009	0.009

Table 2: Typical parameters for shielded 2-wire copper cables.

5 Operation

5.1 Control Panel

The control panel is on the end of the SpotScan. In normal operation, the control panel must be covered by the screw-on end-plate (Figure 3, p. 9), sealed by its O-ring. To adjust the unit's rotating mirror, remove the end-plate (which will be tight, because of the O-ring seal) and proceed as follows.



Figure 7: Control panel of the SpotScan.

5.1.1 Scan Angle



With mirror position set to scanning (see below), rotate the knob to set the angle over which the sensor spot will move.

5.1.2 Scan Frequency



With mirror position set to scanning (see below), rotate the knob to set the oscillation-frequency of the measurement spot. As the oscillation-frequency changes, the flashing-frequency of the LED changes to match it.

Choice of scan frequency is a trade-off between process speed and feature size; see 'Geometry of Measurement Spot' (p. 14) for further information.

5.1.3 Mirror Position



Change the mirror position (mode) in order to set up the unit to suit the current application (see 'Mechanical Installation', p. 9). Press the button repeatedly to cycle between the four possible mirror modes in the sequence shown on the control panel. The modes are as follows.



Scanning (normal operation): *LED flashes at oscillation-frequency.*



Mirror at end-point positions (extreme range of travel): *LED off.*



Mirror at center position: *LED on constantly.*

Operation

5.2 Status Indicator

Current status of the SpotScan is shown by its LED (next to the power socket) as follows.

LED	Meaning	Notes
Off	Power off, or power on with mirror set at end-point position	Check mirror-position control (see above)
On	Power on, not scanning, with mirror in center position	
Flashing	Scanning	

Table 3: Status LED indications.

5.3 Temperature-sensor Settings

5.3.1 Correction Factor

Before using SpotScan to collect data, apply to your temperature sensor the appropriate **correction factor** for the sensor model in use (see Table 5 and Table 6, p. 17, for correction-factor data, and see your temperature sensor's *Operating Instructions* for the correct procedure).

5.3.2 Peak-picking Function

Enable or disable the temperature sensor's **peak-picking function**, as required. This function permits scanning to take place over a larger area while still picking the peak temperatures. If the aim is to monitor, archive or control maximum temperature, the peak-picking function may well be appropriate. See your temperature sensor's *Operating Instructions* for the procedure.

5.4 Geometry of Measurement Spot

A spot pyrometer by itself measures the infrared energy it receives from a roughly-circular 'measurement spot' on the target in order to determine the target's temperature. The pyrometer needs a minimum amount of time looking at the target in order to get an accurate reading: this is the 'response time' of the pyrometer.

When SpotScan is attached to a spot pyrometer, the measurement spot is *stretched* due to the motion of the mirror (see Figure 8). The width of the stretched spot can be determined from the speed of the measurement spot on the target and the response time of the pyrometer:

$W = S \times T$ – where:

- W width of stretched spot
- S linear speed of spot on the target
- T pyrometer response time

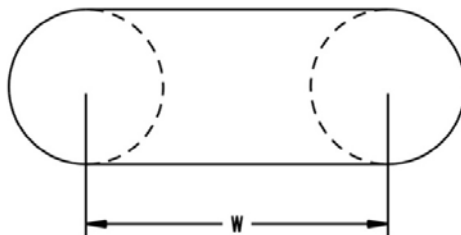


Figure 8: Diagram of 'stetched spot', showing meaning of 'W'.

5.4.1 Determine Stationary Spot Size

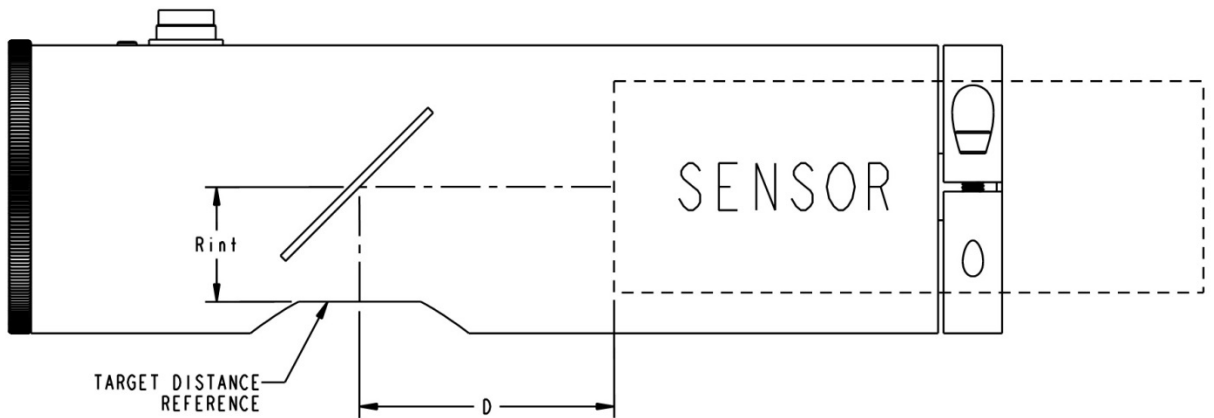


Figure 9: Diagram showing the internal optical path ($D + R_{int}$), i.e. the distance from the sensor to the SpotScan's target distance reference.

Temperature sensor	Internal optical path
Endurance EN1R	31.9 mm (1.25 in.)
Marathon MR	31.9 mm (1.25 in.)
Marathon MM	91.0 mm (3.58 in.)
Modline 5	99.1 mm (3.90 in.)
Modline 7	91.0 mm (3.58 in.)

Table 4: Internal optical path distance when using different temperature sensors (see Figure 9).

Measure the distance from SpotScan's target distance reference (the flat surface surrounding the scanning window) to the target object, and add to this the internal optical path distance for your temperature sensor (see Table 4). The sum of these two distances is the total 'distance to target'. Then refer to the sensor's *Operating Instructions* for spot-size calculation.

5.4.2 Determine Stretched Spot Width

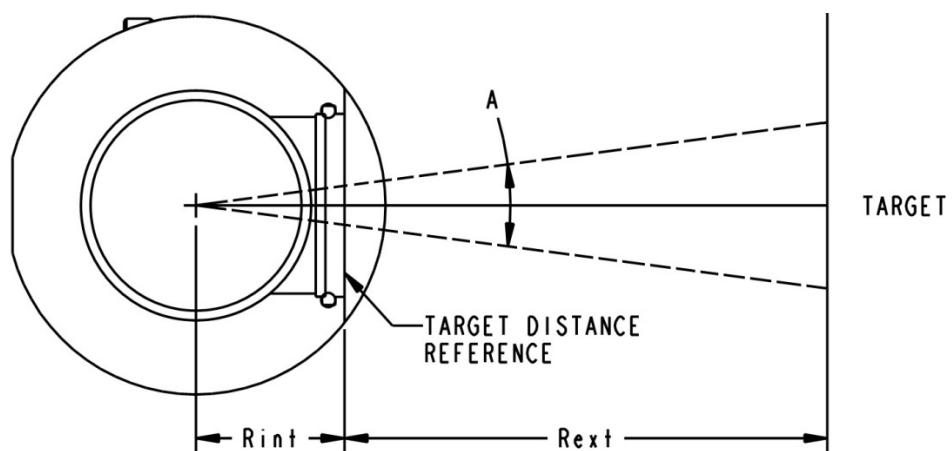


Figure 10: Diagram showing A, R_{int} and R_{ext} .

Operation

The linear speed of the spot on the target, S , can be calculated as follows.

$$S = \omega \times R$$

$$R = R_{int} + R_{ext}$$

$$\omega = a \times F$$

$$a = \left(\frac{2\pi}{360}\right) \times A$$

where:

ω	angular speed of spot (rad/sec)
R	distance from center of mirror to target (meters) (see Figure 10)
a	angular distance covered in one mirror cycle (rad)
F	scan frequency (Hz) (1–10 Hz; to set, see p. 13)
A	scan angle (degrees) (2–15°; to set, see p. 13)

The stretched spot width can then be calculated.

$$W = S \times T$$

where:

S	linear speed of spot (m/s)
T	sensor response time (ms)
W	stretched spot width (mm)

Be careful to use consistent units. Using metric units as shown, W is calculated in millimetres.

5.4.3 Only an Estimation

The procedure described should be used to provide an *approximation* of the performance of the sensor + SpotScan system. There are a number of non-idealities that prevent precise determination of the measurement-spot geometry.

- Control-panel knobs provide only approximate setting of scan angle and scan frequency parameters.
- Mirror does not move at constant velocity; there is acceleration near the ends.
- Mirror does not move with perfect smoothness.

For these and other reasons, do not expect sensor + SpotScan system performance to match exactly the mathematical results derived above.

6 SpotScan Models

Two models of SpotScan are available, using different materials for the scanning window:

- **SSA** – NBK-7 borosilicate glass, window; used for short-wavelength sensors.
A high-quality crown glass suitable for most infrared measurement purposes and environments.
- **SSB** – Zinc sulfide (ZnS), window; used for mid- and long-wavelength sensors.
A harder and more scratch-resistant window material, suitable for harsh environments and vacuum applications.



The two SpotScan models are compatible with different series/models of temperature sensor, determined primarily by the operating wavelength of the sensor. See Table 5 and Table 6, below.



The various SpotScan models require different correction factors to be applied to the temperature sensor. See Table 5 and Table 6, below.

SpotScan model	Spectral range (µm)	Temperature sensor			Emissivity correction factor
		Endurance	Marathon	Modline	
SSA (NBK-7 window material)	1	EN1R	MR1S, MM1M	5R, 52, 72	0.90±0.05
	1.6	–	MM2M	5G, 7G	
	2.1–2.5	–	MM3M	56, 76	
SSB (ZnS window material)	3.9	–	MMMT	75	0.75±0.10
	5	–	MMG5	77	0.93±0.05
	7.9	–	MMG7	78	0.77±0.10
	8–14	–	MMLT	74	0.73±0.10

Table 5: Temperature-sensor compatibility and emissivity correction factors: single-color sensors (and two-color sensors in one-color mode).

SpotScan model	Spectral range (µm)	Temperature sensor			E-slope correction factor *
		Endurance	Marathon	Modline	
SSA (NBK-7 window material)	1	EN1R	MR1S	5R	0.98±0.02

* Depends on measured temperature.

Table 6: Temperature-sensor compatibility and E-slope correction factor: two-color sensor in two-color mode.

For the means of applying the correction factor, see p. 14.

Accessories

7 Accessories

A full range of accessories for various applications and industrial environments is available. Accessories include items that may be ordered at any time and added on-site.

- SSUAA – SpotScan Universal Adapter Accessory
- SSRAM – SpotScan Right-angle Mount
- SSAP – SpotScan Air-purge

7.1 SSUAA – SpotScan Universal Adapter Accessory

The Universal Adapter Accessory permits rigid but readily-adjustable mounting of the SpotScan in combination with the temperature sensor.

The SSUAA is a circular aluminum ring that clamps around the SpotScan, tightened by an M6 screw (5-mm hex key required). Holes on the flat mounting surface of the ring’s circumference allow fastening of the SpotScan to the Right-angle Mount (SSRAM, see below), to a tripod, or to other user-designed mounting surface. See Figure 16 (p. 21) for the accessory in place. Weight of SSUAA 0.50 kg (1.1 lb).

To fit the SSUAA, first remove the M6 screw from the clamping ring on the end of the SpotScan body; this enables the SSUAA to be slid into place from that end of the SpotScan. Then replace the screw.



Figure 11: SpotScan Universal Adapter Accessory.

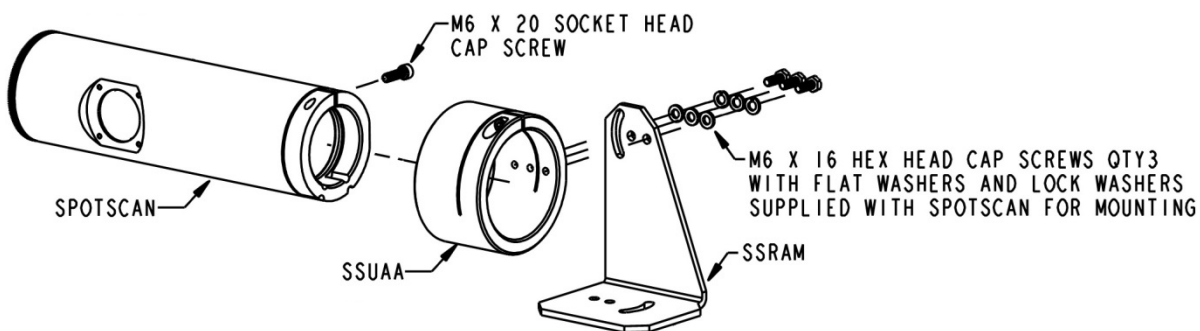


Figure 12: Assembly of SpotScan Right-angle Mount (SSRAM), SpotScan Universal Adapter Accessory (SSUAA) and SpotScan.

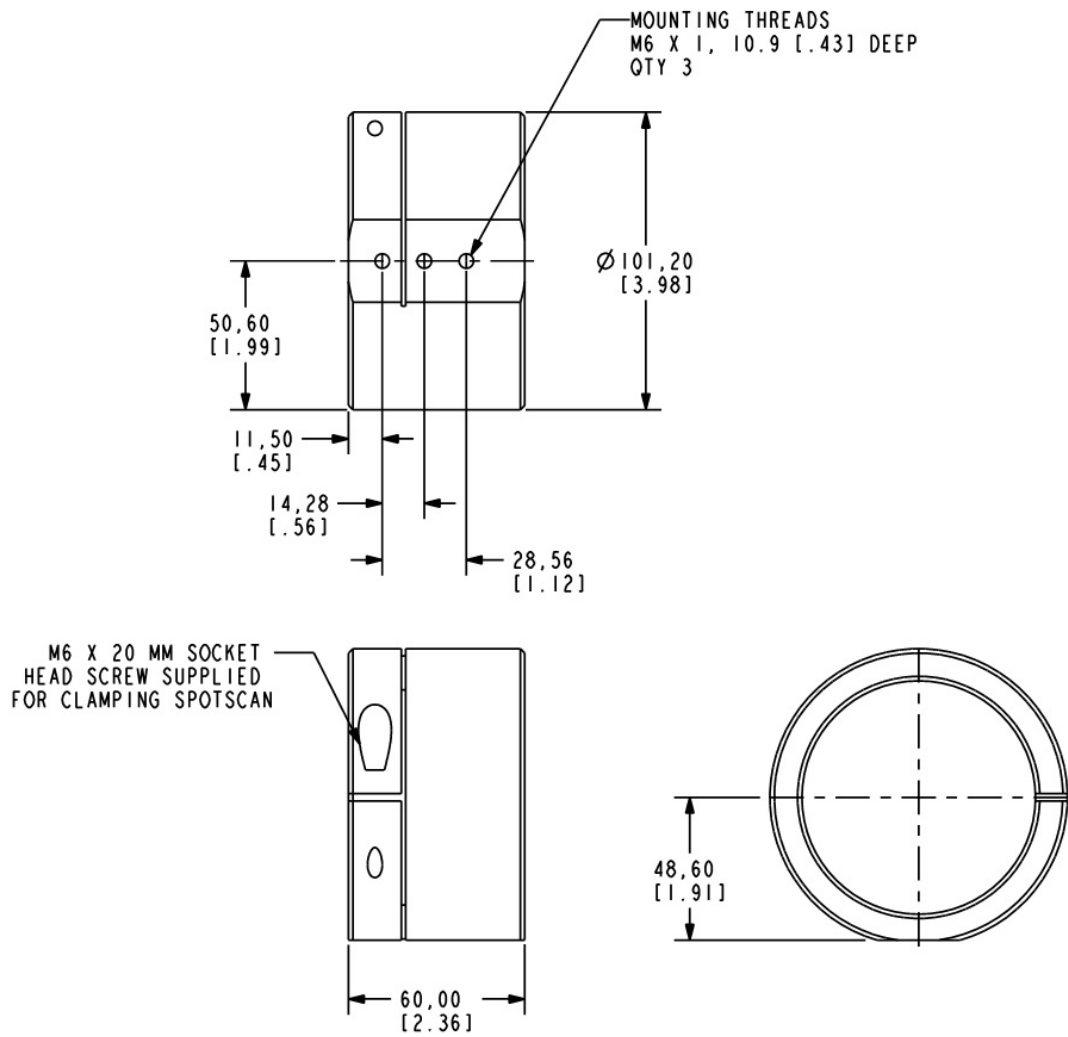


Figure 13: Dimensions and use of the SpotScan Universal Adapter Accessory; dimensions in mm (and inches).

Accessories

7.2 SSRAM – SpotScan Right-angle Mount

Especially when used with the Universal Adapter Accessory (SSUAA, see above), the Right-angle Mount provides convenience, strength and flexibility in mounting the SpotScan.

On the upright side of the mount, two holes and curved slot are for mounting the SpotScan when held in the SSUAA or for attaching directly to the SpotScan.

On the base of the mount, two holes and a curved slot permit attachment to a tripod or to other mounting surface. See Figure 16 (p. 21) for the accessory in place.



Figure 14: SpotScan Right-angle Mount.

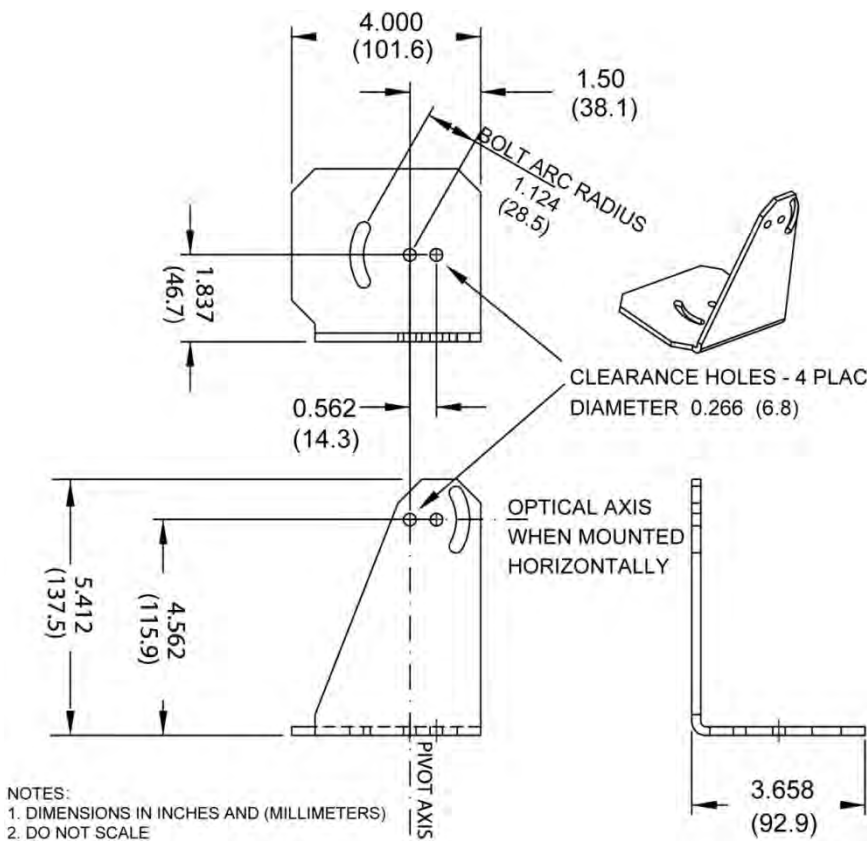


Figure 15: Dimensions and use of the SpotScan Right-angle Mount; dimensions in mm (and inches). All three axes of rotation (including optical axis) intersect at a common point, avoiding parallax during target alignment.

7.3 SSAP – SpotScan Air-purge

Clean oil-free air is recommended for effective operation of SpotScan. By producing an air flow near the scanning window, the Air-purge keeps dust, moisture, airborne particles and vapors away from the sensing head. Recommended minimum air-flow rate 56.6 litre/min (2 cu. ft/min).



Do not use air chilled to below 10°C (50°F).



Figure 16: SpotScan fitted to Endurance temperature sensor (at right), mounted using Universal Adapter Accessory (p. 18) and Right-angle Mount (p. 20), with Air-purge in place.



Figure 17: SpotScan Air-purge.

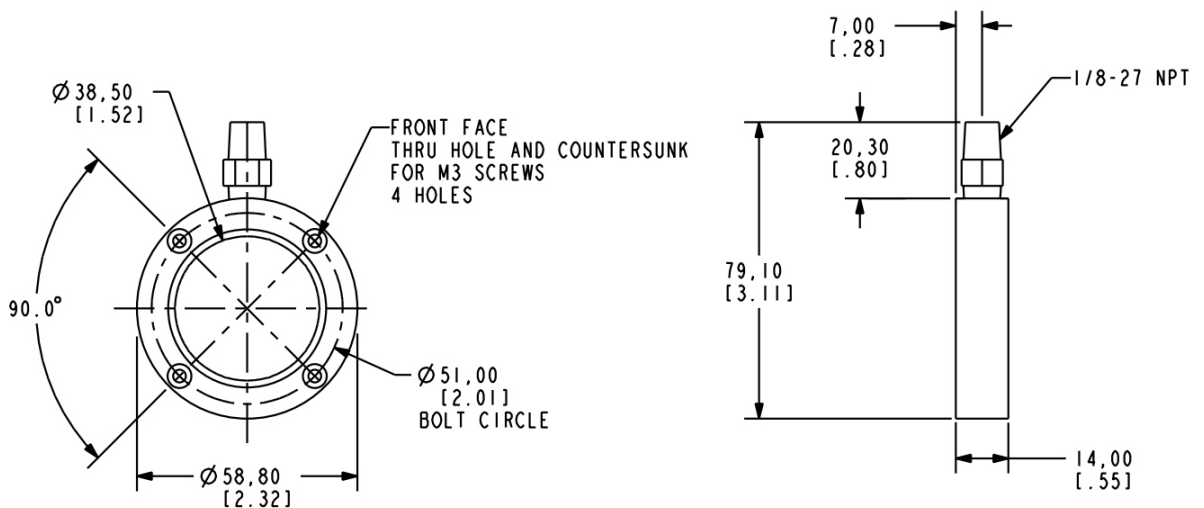


Figure 18: Dimensions of the SpotScan Air-purge (SSAP), in mm (and inches).

Accessories

7.3.1 Mounting

Attach the Air-purge to the recessed surround of the scanning window using four screws, and connect the fitting on top of the Air-purge to a suitable air supply (see data for appropriate air flow, above). See below, and Figure 16 (p. 21), for the accessory in place.



Air-purge can be mounted with fitting oriented either up or down.

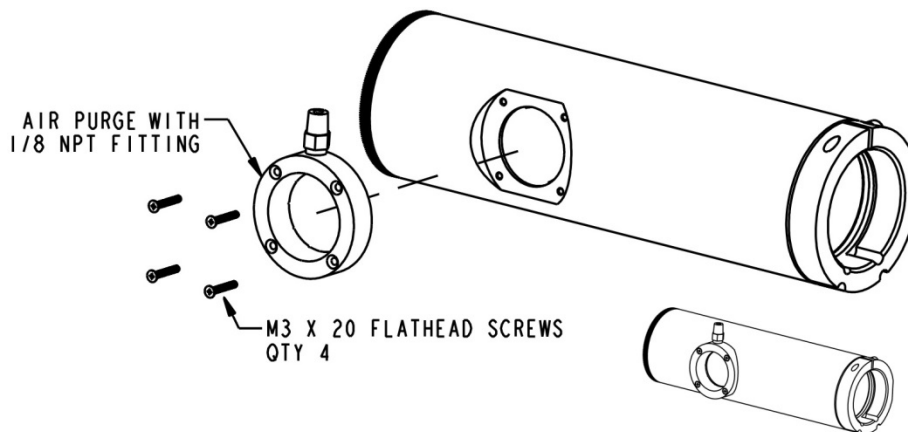


Figure 19: Attachment of Air-purge to SpotScan (and, at smaller size, SpotScan with Air-purge fitted).

8 Maintenance

Our sales representatives are always at your disposal for questions regarding application assistance, calibration, repair, and solutions to specific problems. Please contact your local sales representative if you need assistance. In many cases, problems can be solved over the telephone. If you need to return equipment for servicing, calibration, or repair, please call our Service Department for authorization prior to return. Phone numbers are listed at the beginning of this document.

Users should not attempt to perform maintenance not described in this section.

There are no user-serviceable parts within the unit. Units must be returned to the factory for servicing and adjustments. Do not disassemble the unit!



To prevent possible electrical shock, fire, or personal injury have an approved technician repair the product.

8.1 Removing Temperature Sensor for Calibration or Repair

1. At the sensor-end of the SpotScan, use a 5-mm hex key to undo the clamping ring on the end of the unit.
2. At the opposite end of the SpotScan, unscrew the end-plate which covers the unit's control panel (the end-plate is sealed by an O-ring, so will be tight). This relieves the air pressure in the unit and should be done whenever the sensor is being installed or removed.
3. Slide the temperature sensor out of the SpotScan body.
4. Install the protective cap into the end of the SpotScan in place of the sensor.



SpotScan is not IP-65 sealed with protective cap in place.



For reinstalling of the temperature sensor into the SpotScan, see p. 9.

8.2 Cleaning the Scanning Window

Clean the front surface of the window as often as necessary, depending on the environment at the point of installation. Air-purging (p. 21) will reduce the necessity of frequent cleaning in dusty, dirty areas.

Take care when cleaning the window, as follows:

1. Lightly **blow off** loose particles with 'canned' air (used for cleaning computer equipment) or a small squeeze bellows (used for cleaning camera lenses).
2. Gently **brush off** any remaining particles with a soft camel-hair brush or a soft lens tissue (available from camera supply stores).
3. Clean remaining dirt using a cotton swab or soft lens tissue dampened in **distilled water**. Do not scratch the surface.

For **fingerprints or other grease**, apply any of the following to the window:

- Denatured alcohol (methylated spirit).

Maintenance

- Ethanol.
- Isopropyl alcohol.

Wipe gently with a soft, clean cloth until you see colors on the surface, then allow to air dry. Do not wipe the surface dry, as this may scratch it.

If **silicones** (used in hand creams) get on the window, gently wipe with hexane and allow to air-dry.



Do not use ammonia or any cleaners containing ammonia.