SAIK: Full Color Recognition Sensors

Recognize a specic combination of different colors.

Differentiate between very subtle shades of the same color.

Tolerate a range of hues similar to a reference color.

Memorize three different colors with the three-color SA1K sensor!

Specify separate, interchangeable ber optic cords: one sensor head, three sensor heads, and heat-resistant.

Programming is simple: aim the sensor at the target color and push the color preset button. The sensor records the reference color in its memory.

Key features of the SA1K include:

- NPN or PNP outputs
- Multiple outputs (three-color sensor) can be used individually or combined to signal ve variations of the same color hue
- High-speed: 2ms response for one-color sensors and 3ms response for three-color sensors
- Normal speed (average 10 inspections 1 output): 12ms response (1-color) and 13ms response (3-color) — best for detecting uneven color coverage
- DIN rail (35mm) mount (amplier for ber optics) or surface mount
- IP65 protection rating

CE

General Specifications

Power Voltage	12V DC ±5% (ripple 10% maximum)
Current Draw	800mA (maximum)
Dielectric Strength	Between input and output: 1000V AC 50/60Hz, 1 minute
Insulation Resistance	Between input and output: 20MΩ (minimum), with 500V DC megger
Operating Humidity	35 to 85% RH (avoid condensation)
Operating Temperature	Lens style and amplier (only) of ber optic units: –10 to +40C Fiber optic cord (only): –30 to +80C Heat-resistant ber optic cord: –30 to +350C — rating applies to the 66.93" (1.7m) length of cord closest to the sensor head. The full cord is 78.74" (2m) long. (performance will be adversely affected if the sensor becomes coated with ice)
Storage Temperature	Lens style and amplier (only) of ber optic units: –30 to +70C Fiber optic cord (only) (standard and heat-resistant): –30 to +80C
Vibration Resistance	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes
Shock Resistance	Damage limits: 300m/sec^2 (approximately 30G), 3 shocks in each of 3 axes
Extraneous Light Immu-nity	Lens style, integrated amplier/ber optic cord: 500 lux (maximum) from halogen lamp Separate, interchangeable amplier and cords: 1000 lux (maximum) from halogen lamp — dened as incident or unwanted light received by a sensor , unrelated to the pres-ence or absence of the intended object
Material	Amplier housing: aluminum with polyarylate rear cover Lens: glass Standard ber optic: glass ber with PVC spiral tube and nickel-plated brass sensor head Heat-resistant ber optic: glass ber with SUS spiral tube and SUS 303 sensor head
Degree of Protection	IP65 — IEC Pub 529, sensors rated IP65 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts
Cable	Cable type: 7-core (one-color sensor) or 9-core (three-color sensor) oiltight vinyl cabtyre, 9' 10 1/8" (3m) long
Weight	Lens style, interchangeable amplier: 550g Integrated amplier/ber cord: 750g
Dimensions	Housing, lens style: 2.95"H x 1.33"W x 3.43"D (75mm x 34mm x 87.3mm) Housing, ber optic: 3.35"H x 1.65"W x 5.12"D (85mm x 42mm x 130mm) Fiber optic cord (only): 3' 3 1/3" (1m); Heat-resistant cord (only): 6' 6 3/4" (2m) long

Part Numbers: Self-Contained (Lens) Style

One-Color	Three-Color	Input	Output	Inspection Spot	Stand-Off	Ordering
SA1K-C1N3 **SA1K-C1P3**	**SA1K-C1N7** **SA1K-C1P7**	NPN PNP	NPN PNP	Ø 0.394" (Ø 10mm)	1.38" (35mm)	Lens style: Amplier and lens are integrated in the same housing; one part number = complete sensor (no mounting bracket included)
SA1K-C2N3 **SA1K-C2P3**	**SA1K-C2N7** **SA1K-C2P7**	NPN PNP	NPN PNP	Ø 0.196" (Ø 5mm)	0.59" (15mm)	

Part Numbers: Integrated Amplier/Fiber Optic Units

One-Color	Three-Color	Input	Output	Inspection Spot	Stand-Off	Ordering
SA1K-F1N3 **SA1K-F1P3**	**SA1K-F1N7** **SA1K-F1P7**	NPN PNP	NPN PNP	Ø 0.196" (Ø 5mm)	0.196" (5mm)	Amplier/ber optic cord (calibrated); one part number = complete sensor (includes **SA9Z-KF1** and **-KF2** brackets)

Part Numbers: Separate, Interchangeable Amplier and Fiber Optic Cor ds

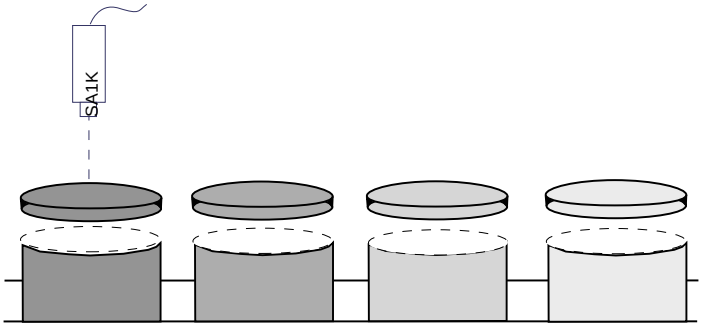
One-Color	Three-Color	Input	Output	Inspection Spot	Stand-Off	Ordering
SA1K-FAN3 **SA1K-FAP3**	**SA1K-FAN7** **SA1K-FAP7**	NPN PNP	NPN PNP	Depends on ber optic cord used (see below)		Amplier only (order separately) — used with separate ber optic cords only (shown below)
SA1K-TF1 **SA1K-TF2**		Standard ber optic cord Heat-resistant (–30 to +350C)		Ø 0.196" (5mm) Ø 0.276" (7mm) Ø 0.394" (10mm)	0.157" (4mm) 0.276" (7mm) 0.394" (10mm)	Separate, interchangeable ber optic cords (order separately) — used with 1-color or 3-color amplier only (above) (SA1K-TF1 and-TF2 come with **SA9Z-KF1** and **-KF3** brackets; SA1K-TF3 comes with (3) **SA9Z-KF1** and (3) **SA9Z-KF4** brackets)
SA1K-TF3		Fiber optic cord with three sensor heads (standard high-resolution)		Ø 0.118" (3mm) Ø 0.196" (5mm) Ø 0.276" (7mm)	0.118" (3mm) 0.236" (6mm) 0.354" (9mm)	

1. *Integrated amplier/ber optic units ar e calibrated in pairs — use the same serial numbers together. A separate ber optic c ord cannot be used with an amplier fr om an integrated amplier/ber optic set. A separate ber optic cor d can be used with an "amplier only" unit (SA 1K-FA ■■).*
2. *Order SA9Z-L01 separately for one replacement halogen lamp (one spare bulb is included with each unit). All ber optic units come with a mounting bracket and nut (SA9Z-KF1). Each ber optic unit also includes the corr esponding mounting bracket as noted.*

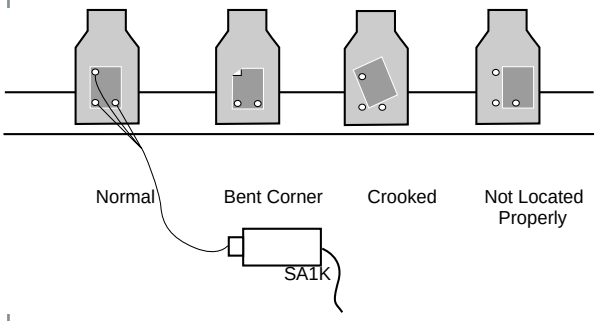
Function Specifications

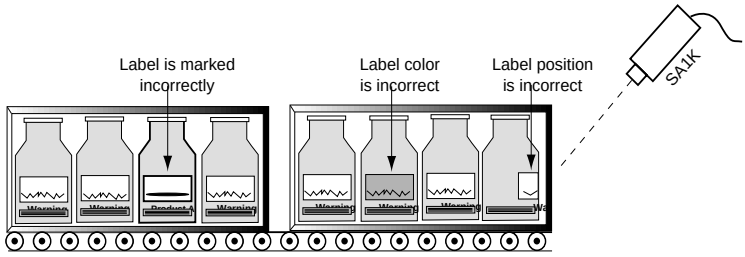
	One-Color Sensors	Three-Color Sensors
Reference Color Registration	Push color preset button (sensor aimed at color target), sensor records reference color in EEPROM memory	**Set dial to A:** push preset button (sensor aimed at color target A); sensor records reference color A in EEPROM memory **Set dial to B:** push preset button (sensor aimed at color target B); sensor records reference color B in EEPROM memory **Set dial to C**: push preset button (sensor aimed at color target C); sensor records reference color C in EEPROM memory
Tolerance	Digital setting for nine degrees of inspection sensitivity	
Inspection Mode	Selectable: color component only or color component plus intensity (depth of color)	
Synchronous Mode	Selectable: internal response mode or synchronize with an external signal	
Operation Mode	Selectable: **Equivalent (=):** output on when detected color matches target color **Different (≠):** output on when detected color differs from target color	Selectable: **S:** auto select, sensor determines tolerance (no need to set tolerance, see explanation under *Three-Color Sensors* on page 17.) **N:** normal mode, match one of three reference colors — set tolerance LMT: conrm or change tolerance setting for each target color
Response Mode	High-speed (F): 2ms (each inspection = 1 output) Normal speed (S): 12ms (10 inspections averaged = 1 output)	High-speed (F): 3ms (each inspection = 1 output) Normal speed (S): 13ms (10 inspections averaged = 1 output)
Control Output	On: detected color matches target color or differs from target color dened by the operation mode set-ting NPN or PNP transistor open collector 28V DC, 100mA (maximum); Residual: 2V (maximum); Short circuit protection	Control output A on: detected color corresponds* to target color A Control output B on: detected color corresponds* to target color B Control output C on: detected color corresponds* to target color C (*dened by operation mode setting) NPN or PNP transistor open collector 28V DC, 100mA (maximum); Residual: 2V (maximum); Short circuit protection
Alarm Output	On: when halogen lamp is burned out NPN or PNP transistor open collector 28V DC, 100mA (maximum); Residual voltage 2V (maximum); Short circuit protection	
Set Input	12V DC, 10mA, 12V supply (input is not isolated due to common ground connection — photocoupler used)	
Synchronous Input	12V DC, 10mA, 12V supply (input is not isolated due to common ground connection — photocoupler used)	
Operation LED	On: when control output is on (red LED)	
Light Source	Halogen lamp 12V, 5W, life: 2,000 hours; Order SA9Z-L01 separately for one replacement halogen lamp (one spare bulb is included with each unit)	
Receiver Element	RGB color recognition element	
Minimum Bending Radius	Integrated amplier/ber optic units: 1.38" (35mm); Separate ber optic cords: 1" (25mm)	
Detectable Color Difference	Lens style and separate ber optic cords: $\Delta E \geq 10$; Integrated amplier/ber optic units: $\Delta E \geq 15$ — while online, dened by CIE as measurement of color difference (3-variable function: values for light, hue, and chroma, plotted on XYZ axis)	

Applications

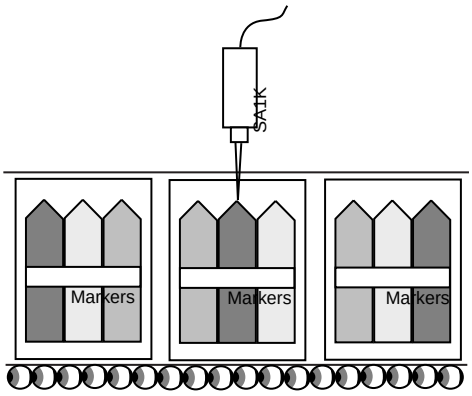


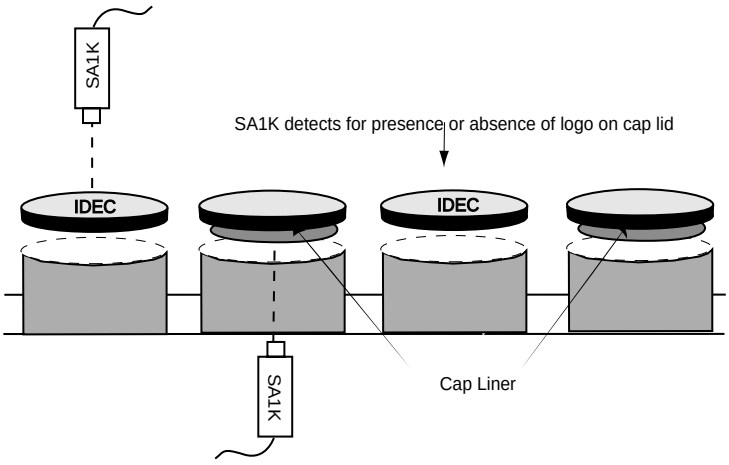
Differentiate subtle variations in shades of color for quality control

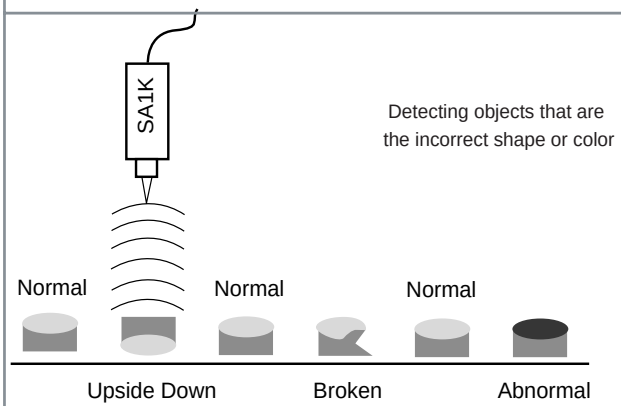




Detects packaging labels for correctness of position, color, and content.
The SA1K can either detect a precise color or a combination of colors.







Beam must be aimed within 12˚ to target surface.

TREICHL-ATM Electronic Auf der Bült 10 - 12 D 41189 Mönchengladbach

Tel. 02166 958545 Fax 02166 958547 eMail: atm@treichl.de internet: www.lichtschranke.de

Operation Principle

Using a true light source (the halogen lamp) reected light is collected into a precise color recognition element. Detected color is separated into RGB components, and the signal is converted (internally) from analog to digital. The digital value is compared to the reference value(s) stored in memory.

Distinguish or Tolerate Variations

Select from nine degrees of sensitivity. Low tolerance distinguishes between slight differences in the shade of a color ("N" = narrow). High tolerance accepts a wide range of similar colors ("W" = wide).

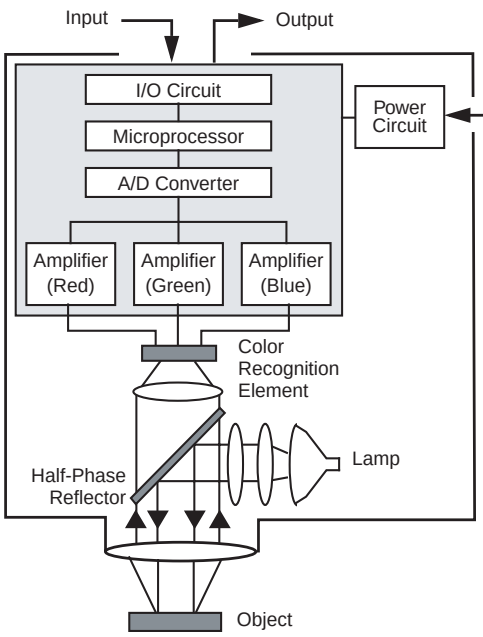
Three-Color Sensors

Set different tolerances for each of the three colors, or let the sensor determine the tolerance! Using auto select, the SA1K denes the color differences existing between the three reference colors. The sensor will detect object color and produce an output, corresponding to the most similar reference color.

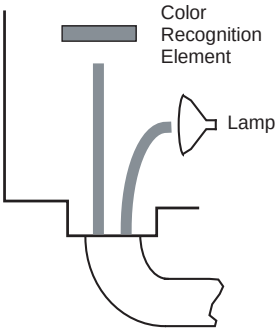
Example:

When each reference color is a different shade of red, the sensor sees subtle differences and picks the most similar reference red. Alternatively, when reference colors are red, green, and blue, the sensor will accept similar shades of red and output according to the reference red.

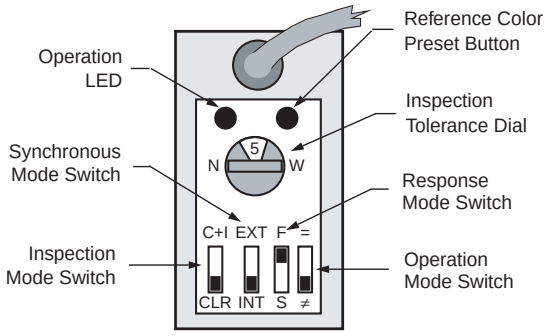
Self-Contained (Lens) Style



Fiber Optic Units



Operation: One-Color Sensors

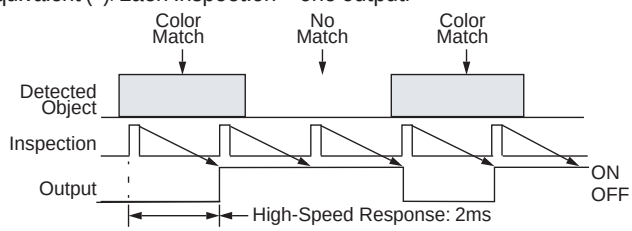


After turning the power on, allow approximately one second for output. The sensor does not instantly emit light upon powering on.

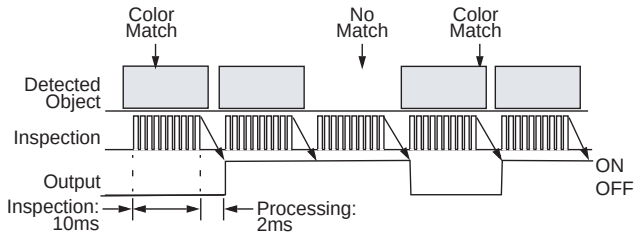
Reference color preset button: Press to memorize the reference color when sensor is aimed at color target. Reference color can also be registered using an external signal and the set input wire (SET). In either case, a reference color existing in memory is replaced by the new reference color.

Response mode switch: Select high-speed ("F" = 2ms response) or normal speed ("S" = 12ms response).

High-speed (F): Set synchronous mode to internal; set operation mode to equivalent (=). Each inspection = one output.



Normal Speed (S): Ten inspections averaged ➜ one output (best for detecting uneven color coverage). Set synchronous mode to internal; set operation mode to equivalent (=).



Operation mode switch: Select output on when the detected color is equivalent or different. For equivalent (=), the output turns on when the inspected color is the same as the reference color. For different (≠), the output turns on when the inspected color differs from the reference color.

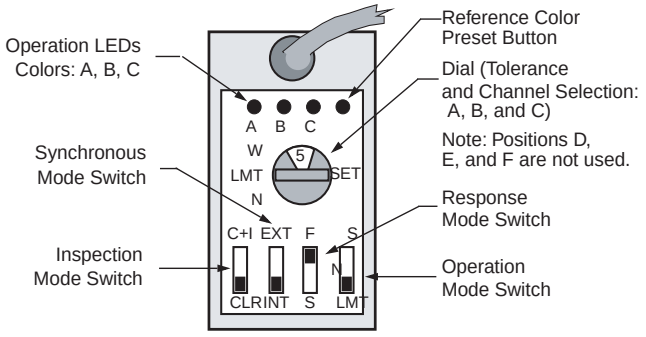
Inspection tolerance selection dial: Turn the dial to program one of nine different degrees of sensitivity. Set the dial to 1 to distinguish the slightest variation in the reference color ("N" = narrow range of tolerance). Set dial to 9 to tolerate considerable variations in the reference color ("W" = wide range of tolerance).

Inspection mode switch: Select color only (CLR) or color plus intensity (C + I). Color only is used to inspect on the basis of color alone, when surrounding lights inuence intensity , or when inspection spot varies. Color plus intensity is used to inspect color *and* depth of color when necessary to distinguish between slight variations in shade.

Control output: Turns on, along with operation LED, when inspected color matches or doesn't match reference color, depending on operation mode setting.

Alarm output: Turns on when the lamp is burned out

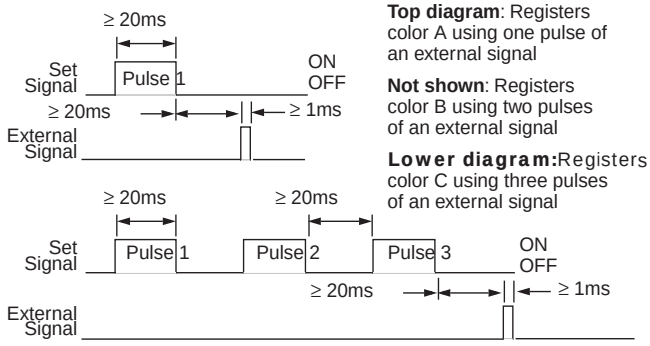
Operation: Three-Color Sensors



After turning the power on, allow approximately one second for output. The sensor does not instantly emit light upon powering on.

IMPORTANT: If it is necessary to change one or more target color(s) along with tolerance setting(s) and/or inspection mode(s), for best results it is recommended to clear the memory of all tolerance settings and inspection modes and to enter all settings for each color starting with cleared settings.

Reference color preset button: With the operation mode switch set to the S or N mode and the tolerance/color dial set to A, press this button to memorize color A when sensor is aimed at color target A. Repeat this procedure to memorize reference colors B and C.
Reference colors can also be registered when an external signal is input using the set input wire (SET) and the external input wire (EXT). Existing reference colors can be replaced by new reference colors.



Top diagram: Registers color A using one pulse of an external signal

Not shown: Registers color B using two pulses of an external signal

Lower diagram: Registers color C using three pulses of an external signal

Response mode switch: Select high-speed ("F" = 3ms response) or normal speed ("S" = 13ms response). For high-speed (F), each inspection ➜ one output. For normal speed (S), ten inspections averaged ➜ one output (best for detecting uneven color coverage).

Operation mode switch: Select one of two operation (RUN) modes — auto select (S) or normal (N) mode. Or use LMT to conrm or change the tolerance setting and/or inspection mode. (The sensor does not operate when LMT is selected.)

Auto select (S): This mode allows the sensor to dene the best tolerance. (No need to set tolerance.) Low tolerance is used to distinguish shades of color that are similar to the reference color. High tolerance is used to distinguish shades of color that vary from the reference color. The output corresponds to the reference color that is most similar to the object detected.

Normal (N): Matches any one of the three reference colors and ignores all other colors. A unique setting for the tolerance and inspection mode can be used for each reference color.

LMT: Sets a unique tolerance level for each color (see *Inspection tolerance selection dial*), or selects color only (CLR) or color plus intensity (C + I) for each color (see *Inspection mode switch*).

Individual tolerances and inspection modes: Setting the inspection tolerance and inspection mode individually for each of the three reference colors is a three-step procedure —

For each color:
(1) Clear the memory for the inspection tolerance and mode (not target color memory)
(2a) Set the inspection tolerance
(2b) Set the inspection mode

IMPORTANT: The individual inspection tolerance and inspection mode must be set at the same time for each color, in the order described below (steps 2a and 2b together). To use the individual tolerance settings, the operation mode must be set to LMT.

1. *If individual tolerance and inspection mode settings are not required for each color, then skip the three-step procedure below. Make sure that the memory is cleared of the individual settings for each color, and then set the tolerance and inspection mode as described for a one-color sensor.*
2. *Individual tolerance and inspection mode settings are not required when using auto select (S) for the operation mode.*

(1) Clear memory for tolerance and inspection mode:
(This procedure will not clear the reference color(s) from memory.)
With operation mode set to LMT, turn the dial to A and press the preset button (doesn't change the reference color). Turn the dial to zero (0), and press the preset button again to program zero tolerance for reference color A. This erases previous presets. Repeat this clearing procedure for colors B and C.

3. *Make sure all settings are cleared by selecting LMT using the operation mode switch. All operation LEDs (A, B, and C) should stay lit. If the LEDs are not lit, repeat the clearing procedure.*
4. *To use one reference color only on the three-color sensor, clear the other two colors (along with tolerance and mode settings) from memory. To use two reference colors, clear the third reference color from memory.*

(2a) Inspection tolerance selection dial: With the operation mode set to LMT, turn the dial to A, and press the color preset button (doesn't change the reference color). Now, program one of nine different degrees of sensitivity for reference color A.

Set the dial to 1 to distinguish the slightest variation in the reference color ("N" = narrow range of tolerance). Set the dial to 9 to tolerate considerable variations in the reference color ("W" = wide range of tolerance). With the dial set to the desired tolerance, press the preset button again (doesn't change the reference color).

IMPORTANT: Continue setting the inspection mode for color A (described below in step 2b) before repeating the entire three-step procedure for colors B and C.

(2b) Inspection mode switch: Set the desired tolerance for color A, as described above; then, select color (CLR) only or color plus intensity (C+I) for reference color A. Press preset again.

CLR inspects on the basis of color alone, when surrounding lights inuence intensity or when the inspection spot varies. C+I inspects color *and* depth of color to distinguish between slight variations in shade.

5. *Check the inspection mode setting by selecting LMT using the operation mode switch after tolerance is set (not cleared). The operation LED (corresponding to color A, B, or C) is lit continuously for color only (CLR) or and blinks for color plus intensity (C + I).*
6. *Although the color only (CLR) setting is designed to minimize the inuence of surr ounding incident light, it may also be necessary to shield the sensor from extraneous light.*

Set the desired tolerance for color B as described above; then select CLR or C+I for reference color B. Press preset again. Repeat this procedure for color C.

Control output: Turns on along with the corresponding operation LED (A, B, or C) when the inspected color corresponds to one of three reference colors, as specied by the operation mode setting.

Alarm output: Turns on when the lamp is burned out (see the following page for more details).

Operation: One- and Three-Color Sensors

Operation LED: The LED turns on when the control output turns on, according to the inspection results (one-color sensors). The LED turns on when the A, B, or C control output turns on (three-color sensors).

1. Check inspection mode setting by selecting LMT using the operation mode switch after tolerance is set (not cleared). Operation LED corresponding to color A, B, or C will be blinking for color plus intensity (C + I) or will be lit continuously for color only (CLR).

Alarm output: Turns on when lamp is burned out.

2. The lamp does not turn on immediately upon power-up; the output is delayed for one second. When the lamp is burned out, the alarm output goes on, and operation is stopped.

Replacing a halogen lamp: When the lamp is burned out, the alarm output goes on and operation is stopped. Be sure to turn the power off before replacing lamp.

Remove two screws; open the cover.

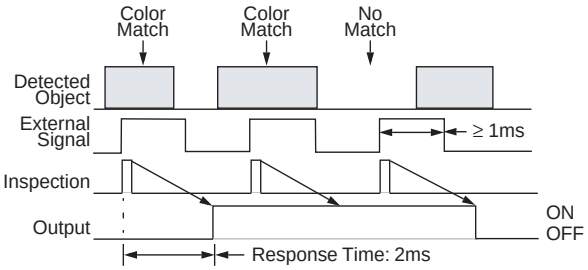
Pull the lamp, together with the lamp holder, straight out through the back of sensor.

Insert the lamp along the guides.

3. Avoid touching the lamp directly. Remove all ng erprints and smudges from the lamp using alcohol (isopropyl) and a clean cloth. To avoid damaging the sensor, do not use organic solvents for cleaning.

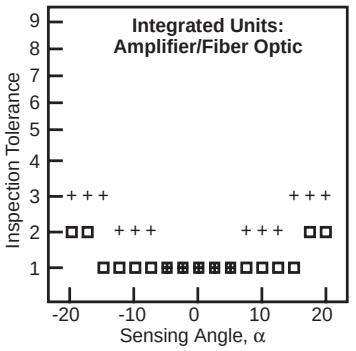
Synchronous mode switch: Select external (EXT) or internal (INT). EXT is used to synchronize the inspection with an external signal. INT is used to perform inspections continuously corresponding to the response mode selection. The internal response is activated when INT is selected *and* the reference color preset button has been pressed.

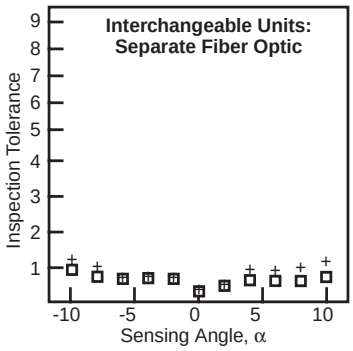
External synchronous input: Receives synchronous inputs from an external source (synchronous mode = EXT), used to synchronize inspection with an external signal.
Example below: one-color sensor with operation mode set to equivalent (=).

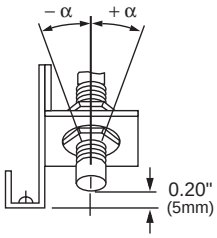


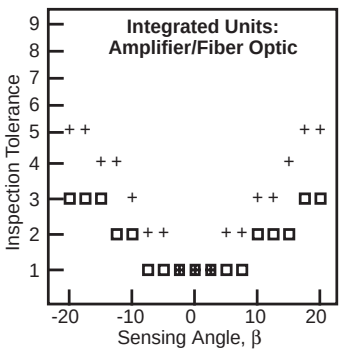
4. The inspection is performed on the rising edge of external signals only. The external signal must be on for 1ms or more.

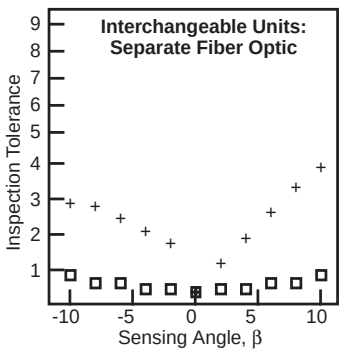
Sensing Angle Characteristics: SA1K-F Fiber Optic Units

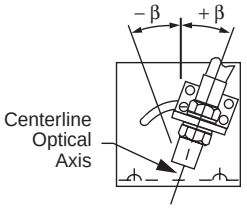


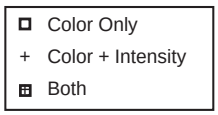








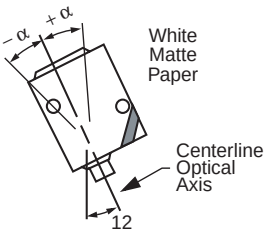


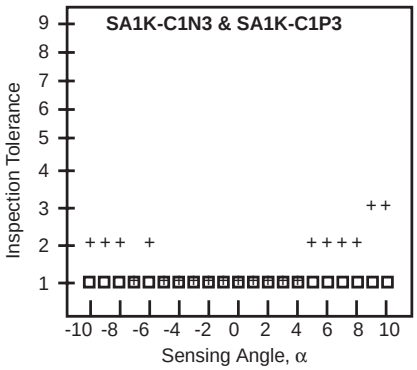


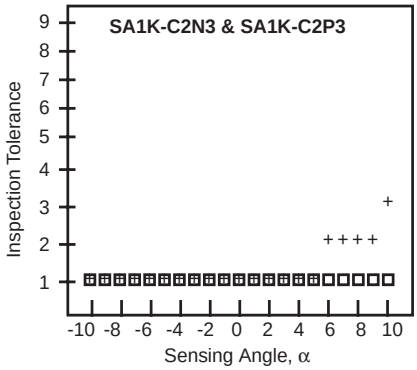
TREICHL-ATM Electronic Auf der Bült 10 - 12 D 41189 Mönchengladbach
Tel. 02166 958545 Fax 02166 958547 eMail: atm@treichl.de internet: www.lichtschranke.de

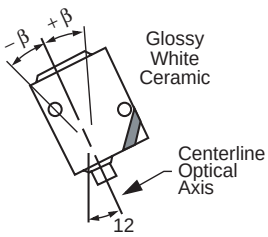
Sensing Angle Characteristics: SA1K Self-Contained (Lens) Type

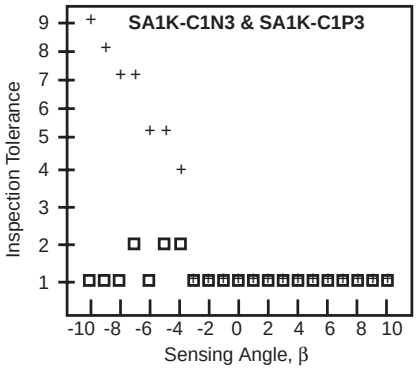
Color Only
\+ Color + Intensity
Both

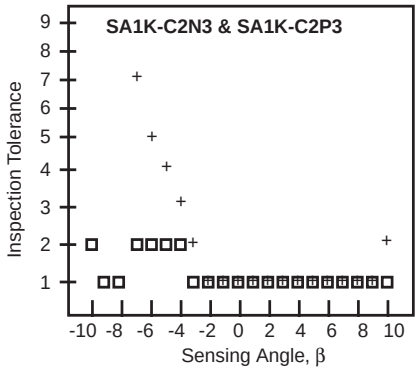


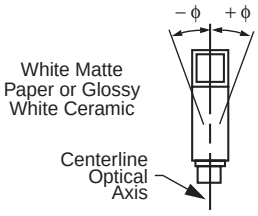


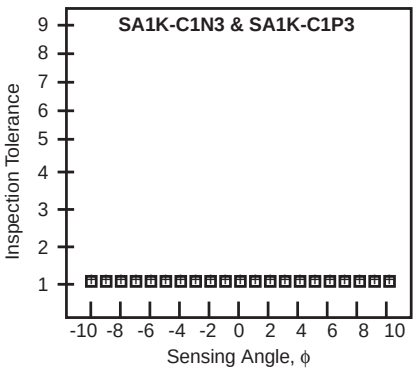


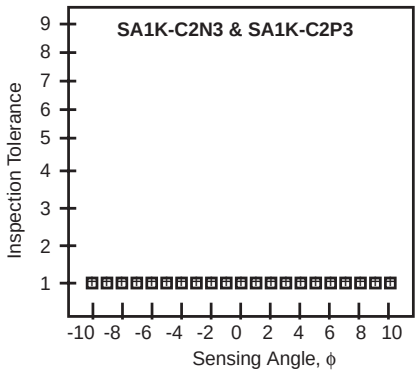






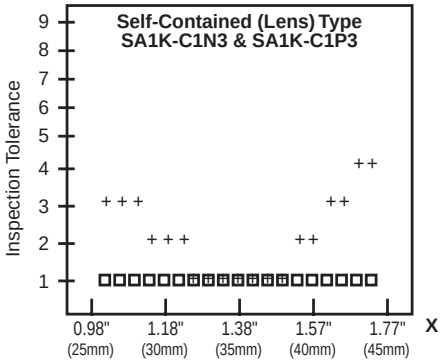


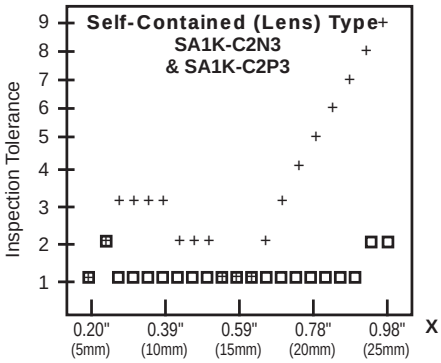


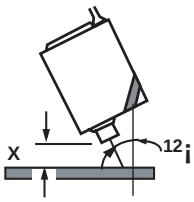


Sensing Range Characteristics: SA1K Self-Contained (Lens) Type

Color Only
\+ Color + Intensity
⊞ Both

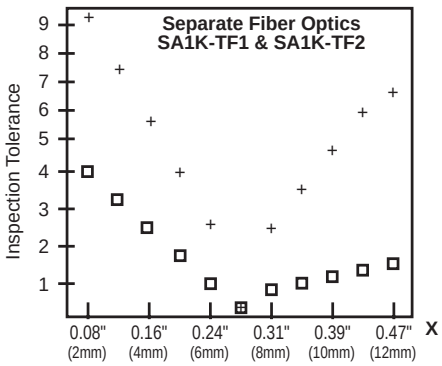


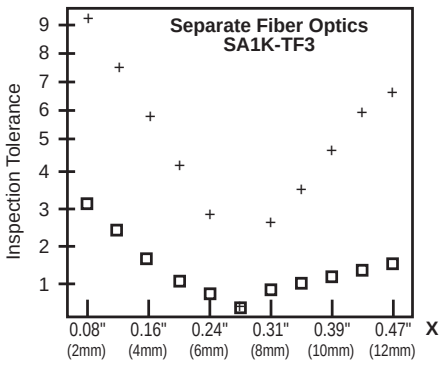


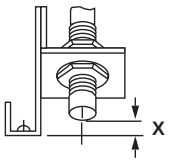


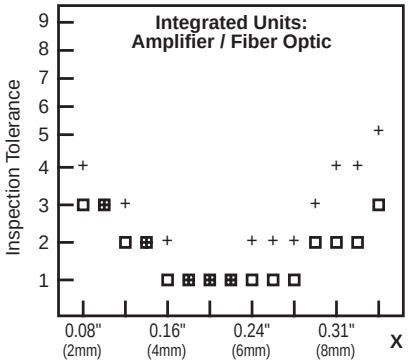
Sensing Range Characteristics: SA1K-F Fiber Optic Units

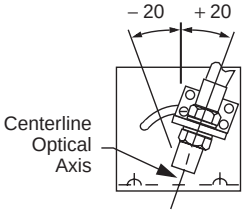
Color Only
\+ Color + Intensity
⊞ Both

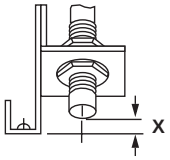








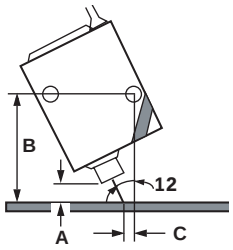




Installation

SA1K Self-Contained (Lens) Style

Mounting Position: Install the sensor so that distance **A** (between the lens and the object) and distance **B** (between the mounting hole and the object) are within parameters shown in the table below.The center of the inspection spot is dimension **C**.



Part #	A	B	C	Spot Ø
SA1K-C1N3 **SA1K-C1N7**	1.37" (35mm)	4.33" (110mm)	1.06" (27mm)	Ø 0.39" (10mm)
SA1K-C1P3 **SA1K-C1P7**	1.37" (35mm)	4.33" (110mm)	1.06" (27mm)	Ø 0.39" (10mm)
SA1K-C2N3 **SA1K-C2N7**	0.59" (15mm)	3.34" (85mm)	1.25" (32mm)	Ø 0.19" (5mm)
SA1K-C2P3 **SA1K-C2P7**	0.59" (15mm)	3.34" (85mm)	1.25" (32mm)	Ø 0.19" (5mm)

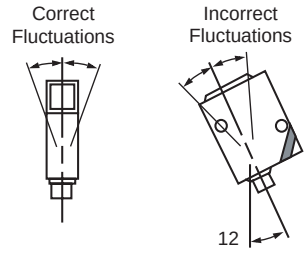
Mount the sensor where vibration and shock will be minimized. Make sure that the sensing range and angle remain reasonably constant.

To minimize the adverse effects of sensing an object with a glossy surface or when the sensing angle uctuates, make sure that the mounting angle is at least 12. When the object surface is not glossy , the mounting angle may be less than 12.

For a 12 mounting angle , draw an imaginary line between the mounting holes, and make sure it is horizontal.

If it is not possible to avoid uctuations in the sensing angle , minimize adverse effects by mounting the sensor so changes in the sensing angle are NOT in the same plane as the 12 mounting angle (see below).

Make sure the illumination spot lands on the object to be sensed, in the desired location (the illumination spot is slightly larger than the inspection spot).



SA1K-F Fiber Optic Units

Since integrated amplier/ber optic units are calibrated in pairs, it is impor - tant to always install the same serial numbers together. A separate ber optic cord cannot be installed with an amplier from an integrated amplier/ber optic set.

A separate interchangeable ber optic cord can be installed with a separate interchangeable amplier of any serial number , but make sure to use an “amplier only” unit (SA1K-F A■ ■).

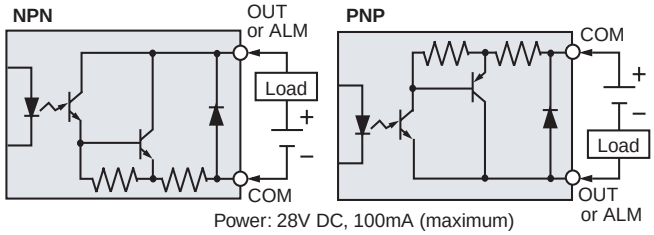
Integrated amplier/ber optic units and separate ber optic cords are shipped with a bracket to easily mount the sensing head with the optical axis at a 20 angle (see diagram on the right). Do not tighten the mounting nut in excess of 8 Nm (80kgfcm).

Wiring

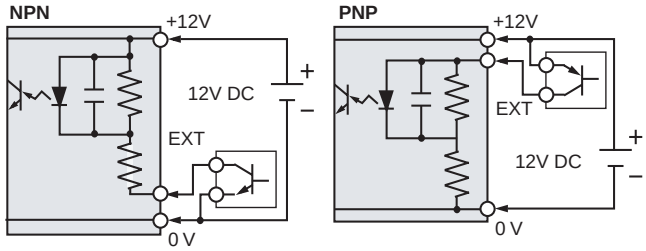
Wire Color	Name	Function
Brown (Thick)	+12V	Power Voltage 12V DC
Blue (Thick)	0V	Power Ground
Pink (Thin)	SET	Set Input
Purple (Thin)	EXT	External Synchronous Input
Black (Thin)	OUT OUT A	Control Output (1-color sensors) Control Output A (3-color sensors)
White (Thin)	OUT B	Control Output B (3-color sensors only)
Gray (Thin)	OUT C	Control Output C (3-color sensors only)
Orange (Thin)	ALM	Alarm Output
Blk/Wht (Thin)	COM	Common Output
Blue (Thin)	GND	Ground (0V)

Schematics

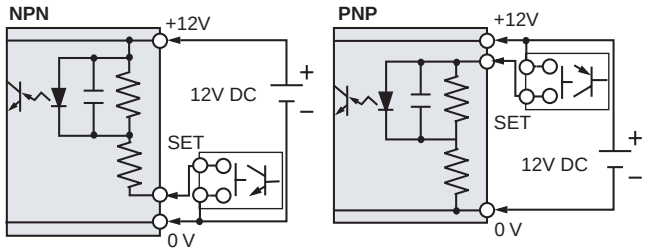
Control and Alarm Outputs



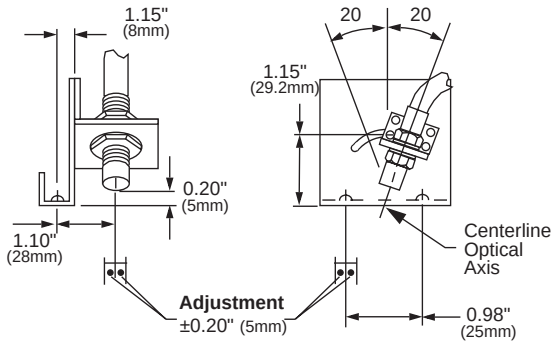
External Synchronous Input



Set Input



Mounting: Fiber Optic Units

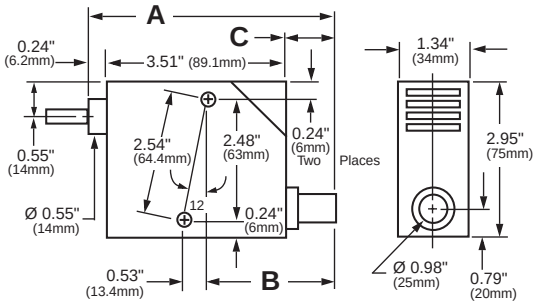


Dimensions

SA1K and SA1K-F (All Styles)

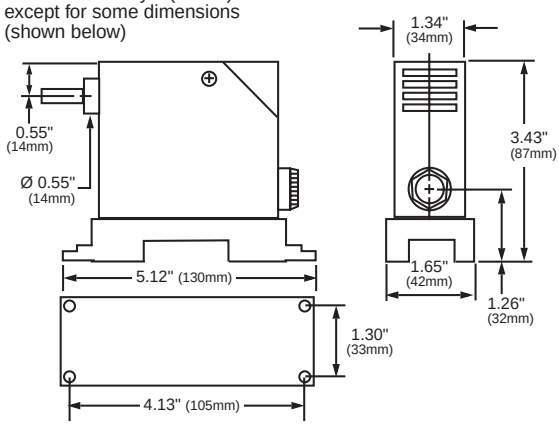
Dimensions	A	B	C
SA1K-C2N3, 7 SA1K-C2P3, 7	4.81" (122.3mm)	2.30" (58.5mm)	1.06" (27mm)
All Other Units (Lens and Fiber)	5.01" (127.3mm)	2.50" (63.5mm)	1.26" (32mm)

Self-Contained (Lens) Style

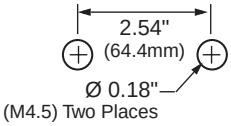


Fiber Optic Amplifiers

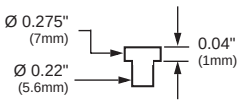
Same as lens style (above) except for some dimensions (shown below)



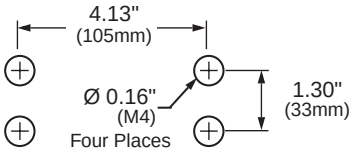
Panel Cut-Out: Lens Style



Typical Countersink: Two Holes



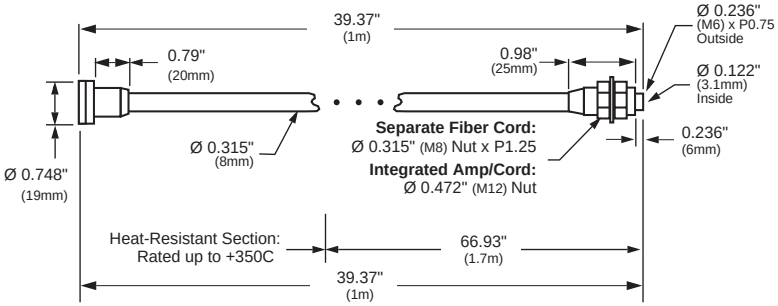
Panel Cut-Out: Fiber Optic



Fiber Optic Cords

Minimum bending radius =
1.38" (35mm) for integrated amplier/ber optic units
1" (25mm) for separate ber optic cor ds

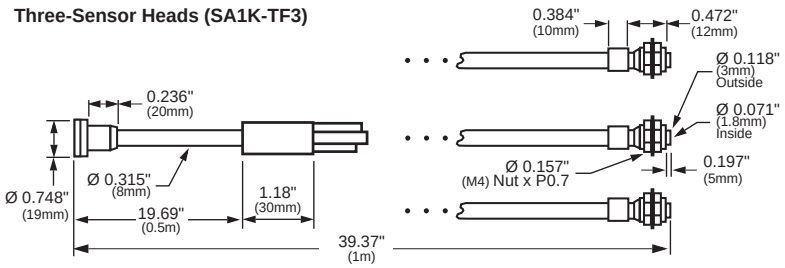
Standard (SA1K-TF1)



Heat-Resistant (SA1K-TF2)

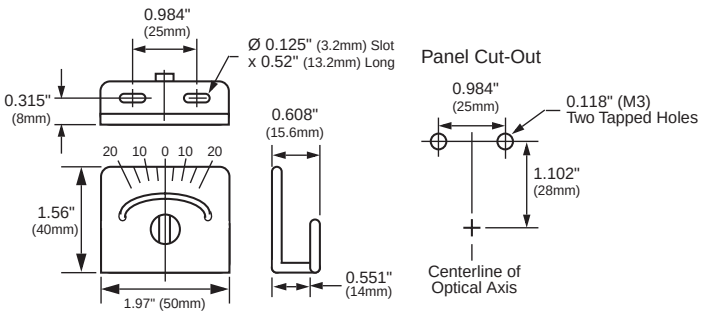
Same as standard (SA1K-TF1) except length = 78.74" (2m).

Three-Sensor Heads (SA1K-TF3)

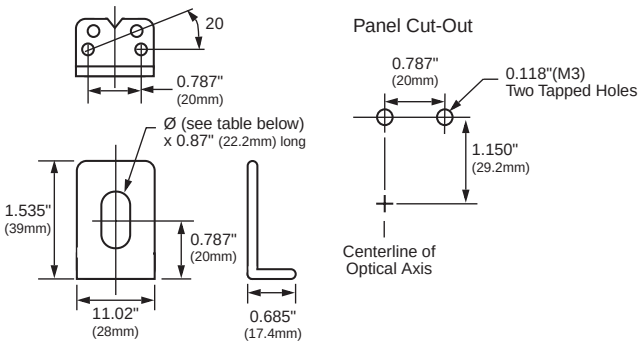


Accessories

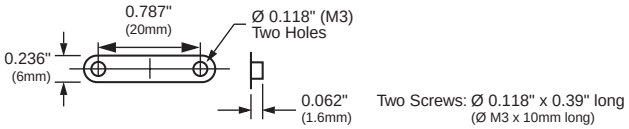
SA9Z-KF1: Fiber Optic Mounting Bracket
Comes with all fiber optic units (integrated amplifier/fiber optic and separate fiber optics). Can be ordered separately. Comes with nut (below).



SA9Z-KF2, -KF3, and -KF4: Fiber Optic Mounting Bracket
Comes with corresponding fiber optic unit (see table below). Also can be ordered separately.



Mounting Nut (comes with SA9Z-KF1)



Accessories

Part #	Comes With	Slot Ø
SA9Z-KF2	Integrated Amplier/Fiber Optic Units	Ø 0.48" (12.2mm)
SA9Z-KF3	Separate Fiber Optics SA1K-TF1, -TF2	Ø 0.32" (8.2mm)
SA9Z-KF4	Separate Fiber Optics SA1K-TF3	Ø 0.17" (4.2mm)