

SA1W: Water Detection Sensors

The SA1W is the fastest, most reliable liquid detection sensor on the market. Using a laser beam tuned to the resonant frequency of an H₂O molecule, the SA1W is able to detect any liquid containing water molecules — without contact! This allows the SA1W to eliminate many of the problems associated with other photoelectric sensors, capacitive sensors, ultrasonic sensors, vision systems, or moisture meters.

The SA1W easily detects liquid in any translucent container — even clear or dark colored containers. Operation is as simple as a photoelectric switch. Just position the fiber optic cable to the proper level, and apply power to the sensor .

Key features of the SA1W include:

- High-speed response time (0.5ms)
- Long sensing range: up to 31.5" (800mm)
- Small diameter laser beam for precise level detection
- Visible red spot for easy targeting and alignment
- Easy to mount in restricted spaces due to fiber optic cables
- Choice of either through-beam or diffuse-reflecting fiber cables
- Capable of detecting liquid levels (including clear water) through clear or translucent colored containers



	SA1W-FN1	SA1W-FN2	SA1W-FP1	SA1W-FP2
Detectable Object	Water or water content			
Power Voltage	12 to 24V DC (operating voltage: 12 to 24V DC ± 10%)			
Current Draw	100mA			
Control Output	NPN open collector 30V DC, 100mA (maximum) Voltage drop: 1.5V (maximum) protected against short circuit		PNP open collector 30V DC, 100mA (maximum) Voltage drop: 1.5V (maximum) protected against short circuit	
Operation Mode	Light ON or Dark ON (selectable by DIP switch on amplifier)			
Response Time	0.5ms			
Indicator	Operation indicator: Yellow LED Stable level indicator: Green LED			
Off-Delay Timer	40ms (ON/OFF selectable by DIP switch on amplifier)			
Hysteresis	20% (maximum) (using reflex fiber unit, SA9W -DD81)			
Sensitivity Adjustment Control	1 rotation (COARSE + FINE)			
Light Source Element	For detecting: Infrared laser diode (Class I laser); For alignment: Red LED			
Receiver Element	Photo diode			
Operating Temperature	0 to +45C (avoid freezing)			
Storage Temperature	-20 to +70C			
Operating Humidity	35 to 85% RH (avoid condensation)			
Extraneous Light Immunity	Sunlight: 10,000 lux (maximum); Incandescent light: 3,000 lux (maximum) on the receiver surface			
Insulation Resistance	Between live and dead parts: 20MΩ minimum (500V DC megger)			
Dielectric Strength	Between live and dead parts: 500V AC, 1 minute			
Vibration Resistance	Damage limits: 10 to 55Hz Single amplitude: 0.75mm 2 hours in each of 3 axes (when de-energized)			
Shock Resistance	Damage limits: 100 m/s ² (approximately 10G) 5 times in each of 3 axes (when de-energized)			
Degree of Protection	IP66 IEC Pub 529			
Cable	Cable type: Ø 5.4mm 3-core vinyl cable, 6' 6-3/4" (2m) long			
Material	Housing: PBT; Cover: Polyarylate			
Interference Prevention	2 units can be installed in close proximity			
Accessories	Adjusting screwdriver, mounting bracket			
Dimensions (WxHxD)	1.10" x 1.89" x 3.70" (28 x 48 x 94mm)			
Weight	Approximately 200g			

General Specifications

Assembled Part Number List


Part Numbers: Assembled Units

Part Number	Control Output Description
SA1W-FN1	NPN open collector amplifier + Diffuse-reex
SA1W-FN2	NPN open collector amplifier + Through-beam
SA1W-FP1	PNP open collector amplifier + Diffuse-reex
SA1W-FP2	PNP open collector amplifier + Through-beam

Sub-Assembled Part Number List

Part Numbers: Fiber Optic Units

Part Number	Description	Sensing Distance
SA9W-TS31	Through-beam	3.94" (100 mm)
SA9W-DD81	Diffuse-Reex	1.18" (30 mm)
SA9Z-F21	Lens attachment	31.50" (800 mm)

 Lens attachment is for through-beam type only.


Part Numbers: Amplifier Units

Part Number	Control Output
SA1W-FN3F	NPN open collector: 30V DC
SA1W-FP3F	PNP open collector: 30V DC

Specifications

Fiber Optic Units

	SA9W-TS31	SA9W-DD81	
Specifications	Detection Method	Through-beam	Diffuse reex
	Sensing Range	3.94" (100mm)	1.18" (30mm)*
	Material	Fiber head: Stainless steel; Fiber: Glass ber; Housing: Stainless steel	
	Operating Temperature	-30 to +80C (avoid freezing)	
	Operating Humidity	35 to 85% RH (avoid condensation)	
	Allowable Bending Radius	Armored tube: R25 or more	
	Weight	Approximately 200g	Approximately 100g

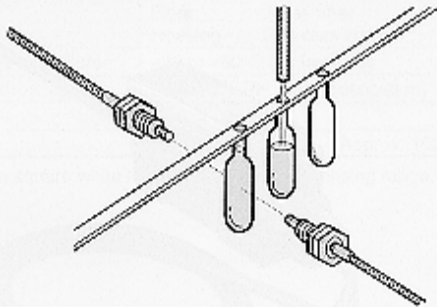
 *1.97" (50 mm) square white mat paper is used for sensing range.

Lens Attachments (for through-beam type ber units)

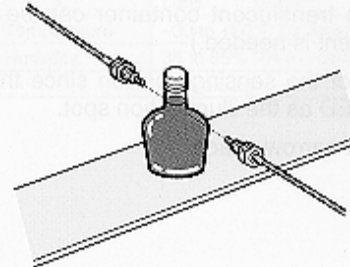
	SA9Z-F21	
Specifications	Applicable Fiber Optics	SA9W-TS31 (through-beam type)
	Sensing Range	31.50" (800mm)
	Material	Housing: Aluminum; Lens: Optical glass
	Operating Temperature	-30 to +80C (avoid freezing)
	Operating Humidity	35 to 85% RH (avoid condensation)
	Weight	Approximately 2g

Applications

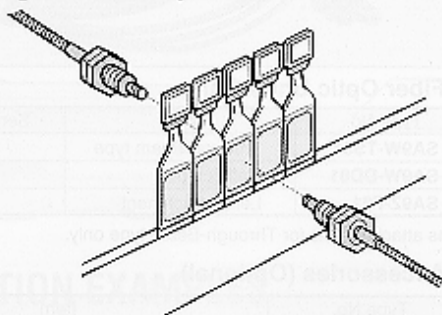
- Checking the Level of Chemicals.



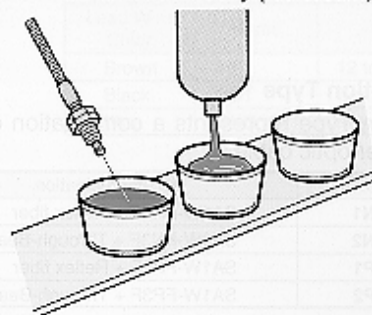
- Checking the Level of Spirits.
Detection can be performed irrespective of bottle shapes.



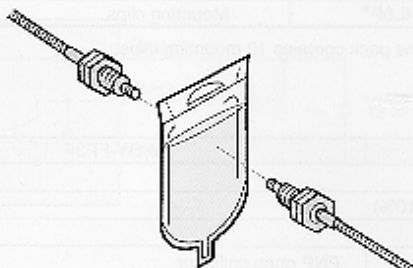
- Checking the Level of Eyewash.



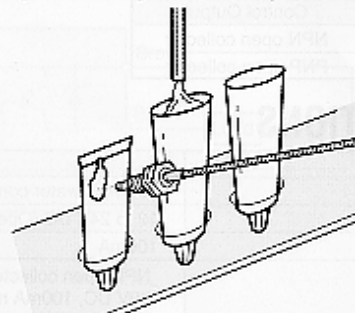
- Checking for the Presence of Jelly (ice cream, pudding, etc).



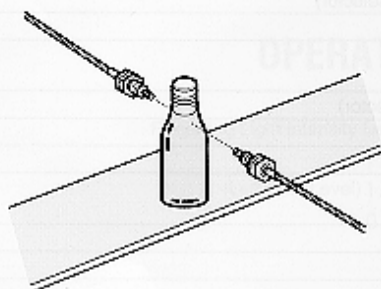
- Checking the Level of Intravenous Drip.



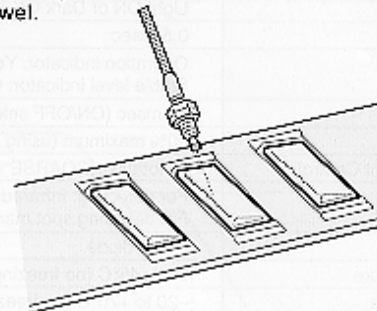
- Checking for Leakage in a Toothpaste Tube.



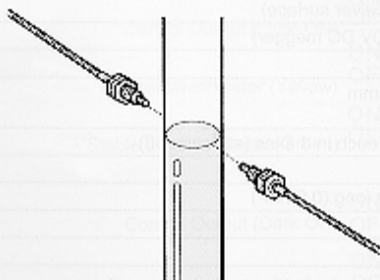
- Checking the Level of Soda or Juice.



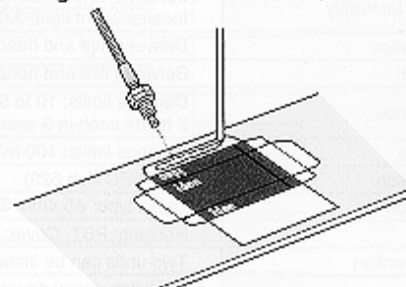
- Checking the Presence of Moisture Content in a Towel.



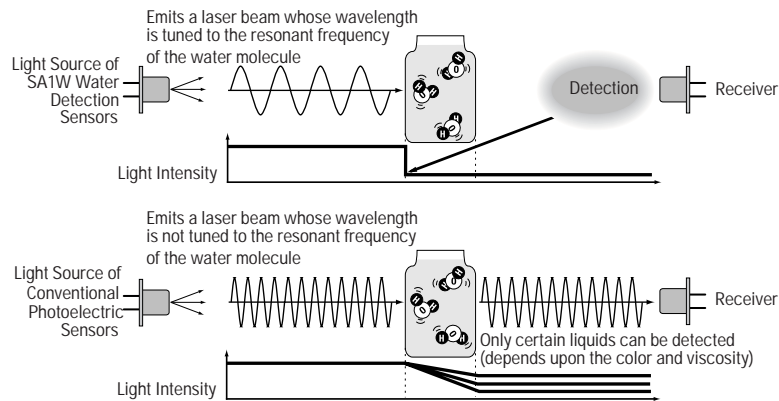
- Checking the Transparency Level in Glass Tube.



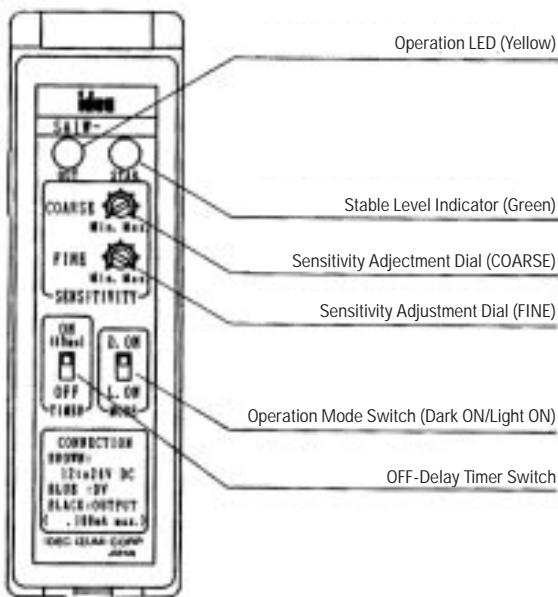
- Checking for the Presence of Glue.



Operation Principle



Operation



Operation LED (yellow) and stable level indicator (green): The operational indicator and stable level indicator operate according to the intensity level of received light described below. Use the sensor in the stable incident or stable interruption mode.

Sensitivity adjustment dial (COARSE and FINE): When the reex type is affected by the background or when the through-beam type detects water in a thin container, adjust the sensitivity using the COARSE control. If the detection is still unstable, adjust the sensitivity using the FINE control. When sensitivity adjustment is not required, set the adjustment control to Max. The adjustment procedures described below are for Light ON. For Dark ON, the lighting status of the operational indicator is reversed.

Operation mode switch (Dark ON/Light ON): This switch is used to select Light ON or Dark ON.

OFF-delay timer switch: This switch is used to select the off-delay timer (40ms).

Sensitivity Adjustment Procedures

Sensor Status		Sensitivity Adjustment Control		Adjustment Procedures	Remarks
Course Adjustment	Incident condition Through-beam: without detected object (water) Reex: without detected object (water)	Coarse		First, at incident condition, turn the COARSE control from the Min. position to the Max. position until the operational indicator (yellow) turns ON (Point A).	• When the operational indicator (yellow) turns ON at the Min. position, the Min. position is regarded as Point A.
	Interrupt condition Through-beam: with detected object (water) Reex: with detected object (water)	Coarse		Second, at interrupt condition (operational indicator is OFF), turn the COARSE control to the Max. position until the operational indicator (yellow) turns ON again (Point B). Then set the COARSE control to the middle between Point A and Point B.	• When the operational indicator (yellow) does not turn ON, the Max. position is regarded as Point B. • When there is not enough adjustment range, use the FINE control.
Fine Adjustment	Incident condition Through-beam: without detected object (water) Reex: without detected object (water)	Fine		First, at incident condition, turn the FINE control from the Min. position to the Max. position until the operational indicator (yellow) turns ON (Point A).	• When the operational indicator (yellow) does not turn OFF, the Min. position is regarded as Point A.
	Interrupt condition Through-beam: with detected object (water) Reex: with detected object (water)	Fine		Second, at interrupt condition (operational indicator is OFF), turn the FINE control to the Max. position until the operational indicator (yellow) turns ON again (Point B). Then set the COARSE control to the middle between Point A and Point B.	• When the operational indicator (yellow) does not turn ON, the Max. position is regarded as Point B.

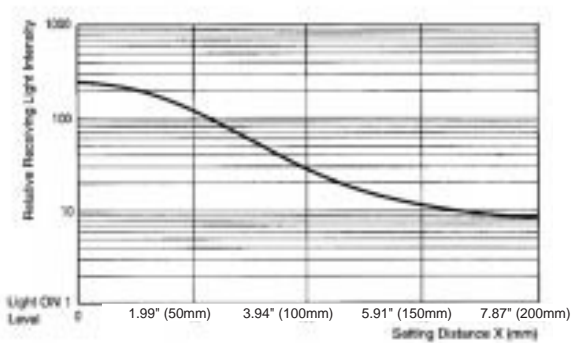
Operation and Stable Level Indicator

			Light ON	Dark On
Receiving Light Intensity Level	Mode	Stable Operation (Green)	Operational (Yellow)	
Light ON Level	1.15 ▶	Stable incident	ON	OFF
	1.00 ▶	Unstable incident		
	0.75 ▶	Unstable interruption	OFF	ON
		Stable interruption		

Sensing Characteristics

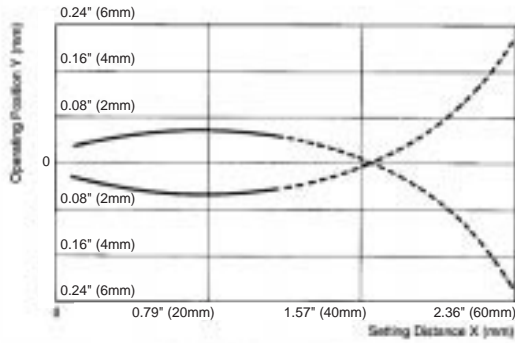
1. Relative Receiving Light Intensity vs. Setting Distance

SA9W-TS31 (through-beam type)

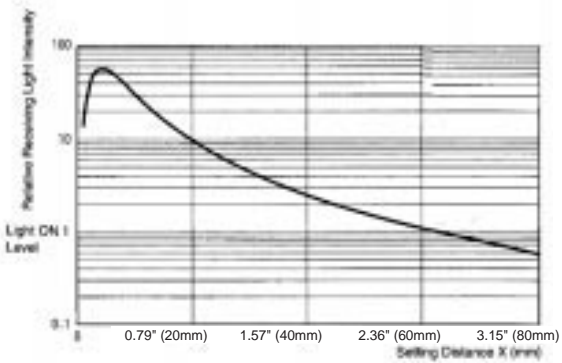


2. Sensing Range Characteristics

SA9W-DD81 (reex type)

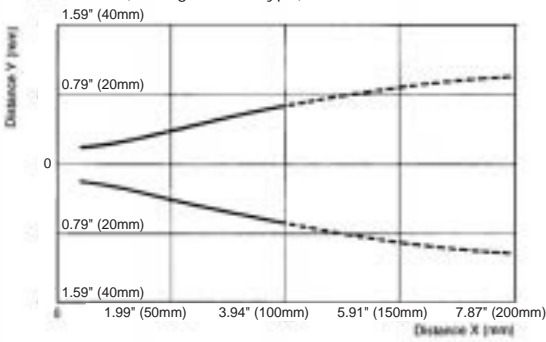


SA9W-DD81 (reex type)

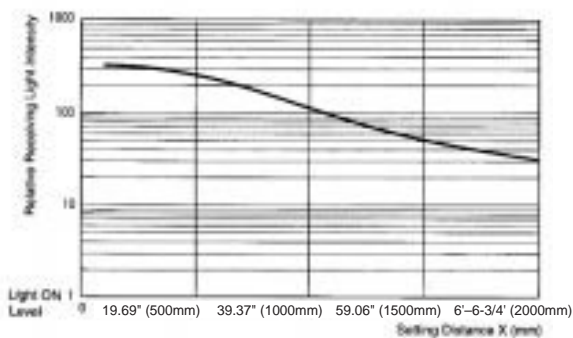


3. Horizontal Transfer Characteristics

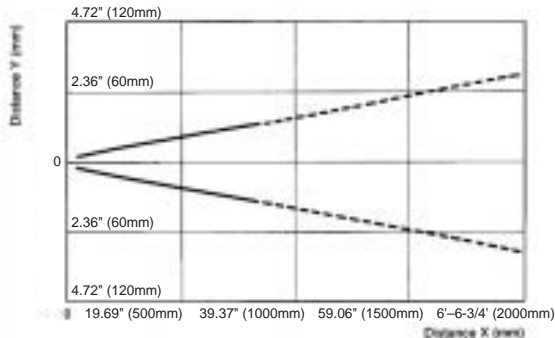
SA9W-TS31 (through-beam type)



SA9W-TS31 (through-beam type) and SA9Z-F21 (lens attachment)



SA9W-TS31 (through-beam type) and SA9Z-F21 (lens attachment)



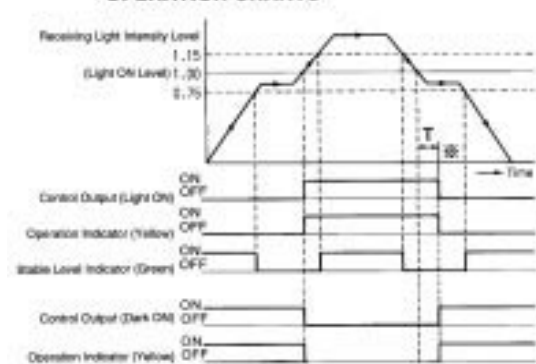
Installation

Notes

Operation at power ON: The light source does not go on immediately when the power is turned on. The sensor contains a circuit to keep the output off for 20ms.

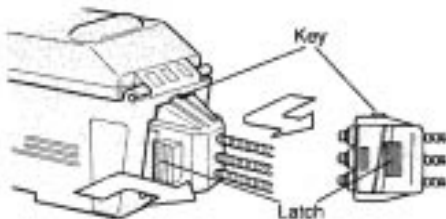
To ensure stable sensing, run a test operation for approximately 15 minutes.

Operation Charts



Connecting bers to the amplifier: Insert the bers into the amplifier with the key connector facing up until the head clicks into the body.

For removal, pinch the latches on both sides of the ber connector and pull the connector toward you.

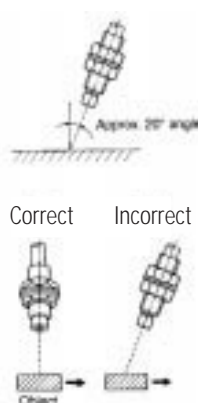


Installing the ber optics: Tighten the bers with tightening torque less than 2Nm (20kgfcm) by using the nut on the tip of the ber cable.

When using the reex ber cable, mount the sensing head with the optical axis angled at 20° from the sensing surface to avoid direct reactive light.

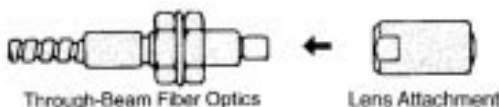
When the surface of the object is not glossy, the mounting angle may be less than 20°.

When the surface of the object is glossy and the changes in the sensing angle are significant, increase the mounting angle to reduce the influence of the changes in the sensing angle.



Connecting the Lens Attachment

Fasten the lens attachment securely to the screw on the tip of the ber cable. The tightening torque should not exceed 1Nm (10kgfcm).



Installing the Amplifier Unit

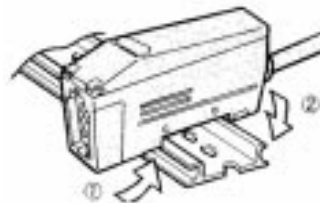
Amplifier units can be snap-mounted onto a 35mm-wide DIN rail or mounted using an attached mounting bracket.

Installation

1. Insert the front of the sensor unit onto the DIN rail or attached mounting bracket.
2. Press the rear of the sensor unit down onto the DIN rail or attached mounting bracket.



1. Do not reverse the above procedures.
2. Do not install the ber optics onto the amplifier unit before the amplifier is installed onto the DIN rail.



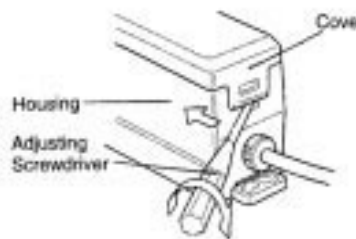
Removal: Insert a screwdriver into the hole on the hook and pull the screwdriver toward you. When using a hole for screw mounting, the tightening torque should range from 0.5 to 0.8Nm (5 to 8kgfcm).

Cover Opening and Closing

Opening: As shown in the figure at right, insert a screwdriver into the clearance between the cover and the sensor unit. Press the screwdriver toward the sensor unit, and turn the screwdriver clockwise. The cover then can be easily opened.

Caution: To avoid injury, do not use your fingernail to open the cover.

Closing: Press the cover onto the sensor unit until it snaps into place.



Optical alignment: The optical alignment described below is for the Light ON mode.

Through-beam type: Face the projector and receiver ber optics toward each other. Move the emitter or receiver up, down, left, and right. Then mount them in the middle of the range where the operational indicator (yellow) turns ON. Make sure that the stable level indicator (green) turns on at the incident or interruption.

For Dark ON mode, ON and OFF described above are reversed.

Installation

Do not use sensors near an inductive heat source or where they are subject to strong shocks or vibrations, large amounts of dust, corrosive gasses, water for long periods of time, oil, or chemicals.

When the lens of the ber cable is dusty, dirty, or wet, clean it with a soft cloth dipped in alcohol.

Note that the temperature of the sensor unit may rise depending on the operating environment.

Do not expose the lens to excessive extraneous light.

Do not extend the ber unit cable.

Do not apply excessive tensile strength to the ber unit cable; otherwise, malfunction or damage may occur.

Wiring and Power Supplies

Connect according to the output circuit diagram, as miswiring will cause damage.

The power voltage should not exceed the rated range.

When using a switching power supply, be sure to ground the FG (frame ground) terminal.

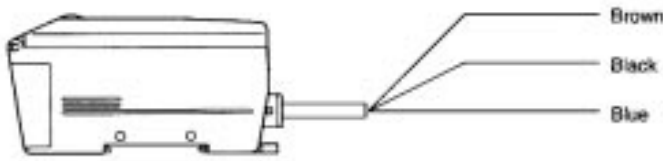
Do not install high-voltages and power lines in the same conduit with input and output lines. Use separate conduits.

When wiring is long or when the influence of the power line and electromagnetic equipment may occur, use a separate conduit for wiring.

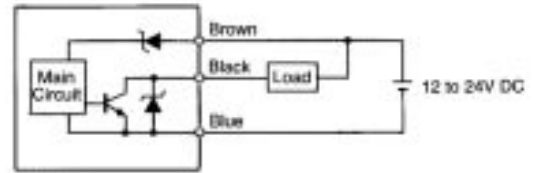
Power cable extension is allowed up to 327' (100m) using a cable with core wires of #22 AWG (0.3mm²) or more.

Schematics

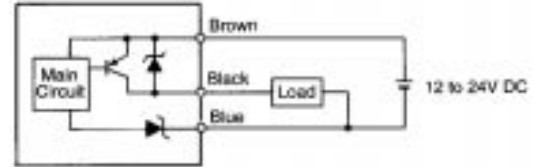
Connection Diagram



Connection Examples
NPN Output



PNP Output

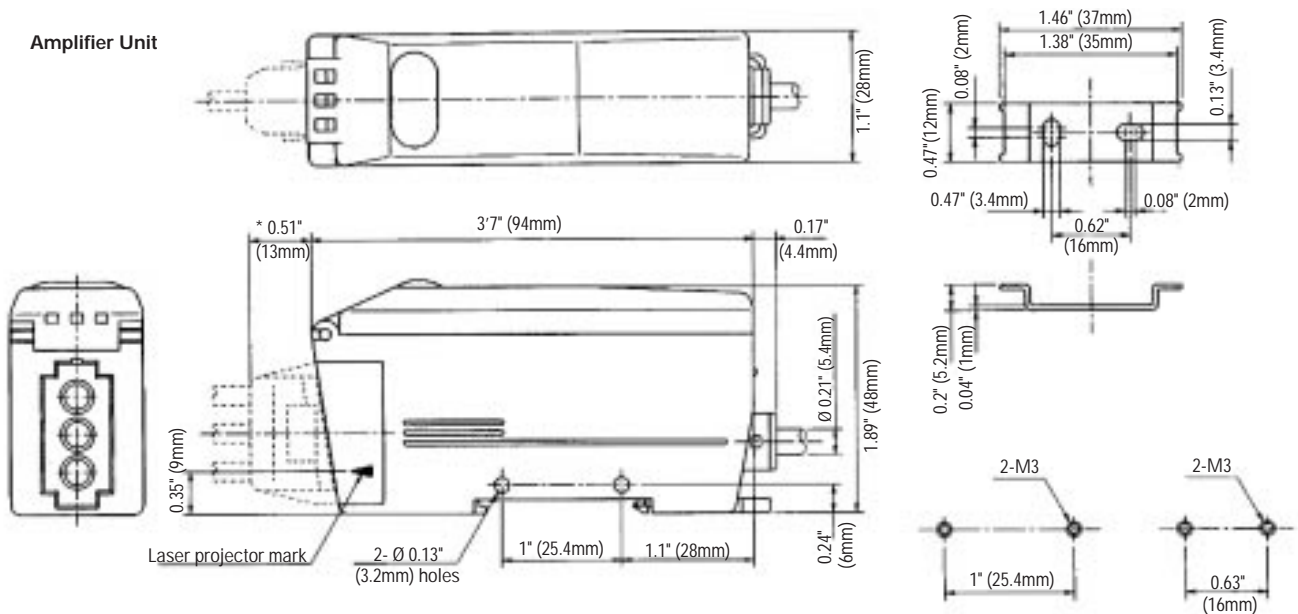


Wiring

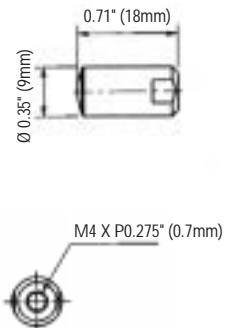
Lead Wire Color	Name	Function
Brown	+V	12 to 24V DC
Black	OUT	Control Output
Blue	GND (0V)	Power Voltage 0V

Dimensions

Amplifier Unit

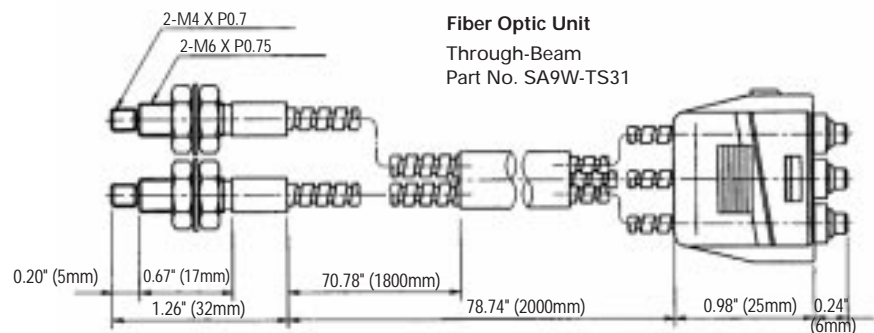


Lens Attachment
Through-Beam
Part No. SA9Z-F21



Fiber Optic Unit

Through-Beam
Part No. SA9W-TS31



Fiber Optic Unit

Diffuse Reflex
Part No. SA9W-DD81

