KAMAN APPLICATION NOTE

KD-2446 Switched Output

OVERVIEW

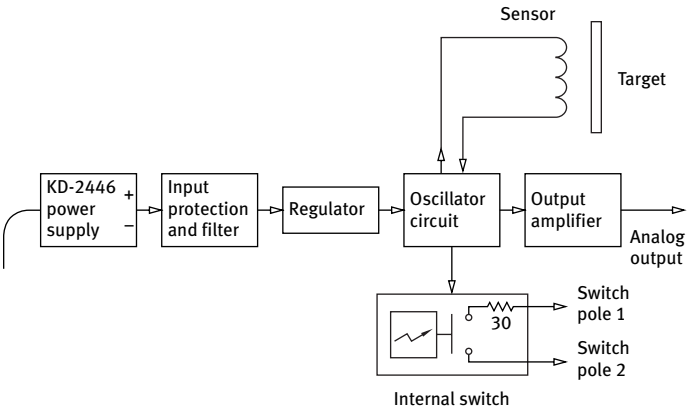
The KD-2446 is a high-end proximity sensor providing both an analog output and a switched output utilizing Colpitts oscillator technology (See Figure 1).

The switched output is a simple open/closed solid state relay using MOSFET technology. When the target is within the setpoint range of the sensor, the switch is normally open. When the target is out of view of this range, the switch is in a closed or shorted condition, and a series resistance of about 30 Ω is measured between pins 2 and 3 (See Figures 2 and 3). The trip point of the switch is adjustable anywhere throughout the sensor range, depending on target material, target size, and the gain setting of the output amplifier.

TECHNOLOGY

MOSFET technology is ideal for switching analog signals. FETs behave in many ways as an ordinary bipolar transistor. Apart from a bipolar transistor, however, an FET has some unique properties: The gate draws no current except for leakage current. Because of this, extremely high input impedances are obtainable, limited only by capacitance and leakage effects.

Figure 1. KD-2446 schematic block diagram



The MOSFETs low 'on' resistance, extremely high 'off' resistance, low leakage currents, and low capacitance make them ideal as voltage-controlled switch elements for analog signals. The FET passes a signal through to a load without attenuation or nonlinearity in the 'on' position, and acts as an open circuit in the 'off' position.

APPLICATIONS

The KD-2446's switched output may be configured and used in a variety of applications to directly control external equipment, or provide logic voltage levels that can be interfaced directly to a computer or PLC device.

Figure 2. When the target is within range, the switch is open.

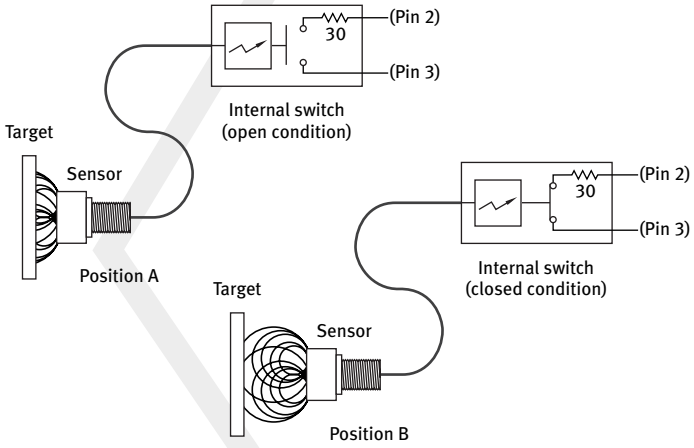
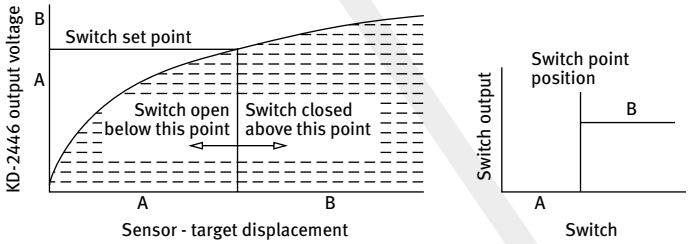


Figure 3. The switch closes and completes the circuit when the sensor-target displacement reaches point B.



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KAMAN PRECISION PRODUCTS

PROX SWITCH CONFIGURATION

Figure 4 shows a simple configuration in which an external power supply is used to trigger an alarm when the target-sensor distance reaches a preset range, tripping the photo switch, and completing the circuit. In this case, an R load is added to limit the current and prevents the photo switch from being overloaded. (Refer to switched output electrical specifications before configuring.) Although the internal opto-switch is configured as (normally open), external circuitry may be configured to simulate a normally open or normally closed condition.

Figure 4. A simple prox configuration. When the target is out of range, the alarm triggers.

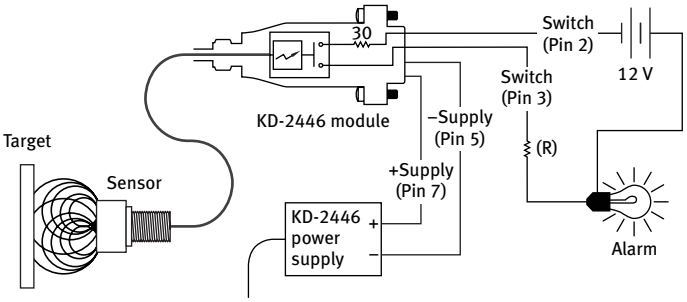


Figure 5. Output is +5V when a gear tooth is seen by the sensor.

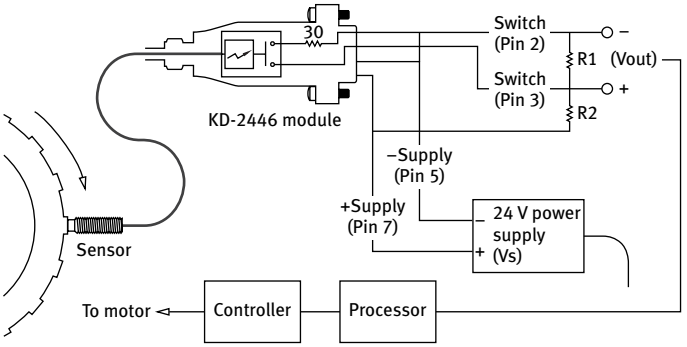
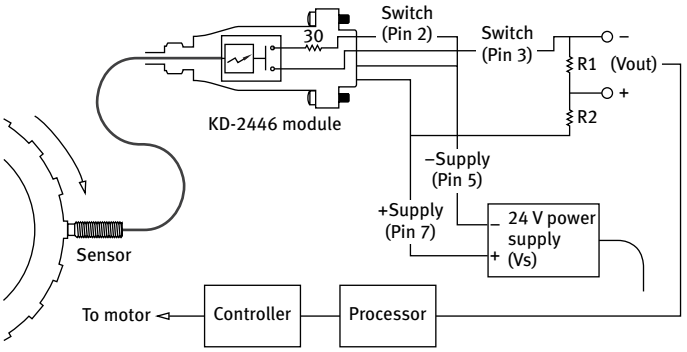


Figure 6. Output is 0V when a gear tooth is seen by the sensor.



The KD-2446 may also be used to obtain specific output voltages across the switched output connections. This may be done using an external power supply or the supply used to power the KD-2446 module. A simple voltage divider network may be used to calculate a specific output voltage, based on the available input power supply voltage as in the following examples.

MOTOR SPEED CONTROL

Figure 5 is an example of how motor speed may be controlled. The sensor sees gear teeth, and sends TTL output voltage levels of between 0 and +5 V to a processor that tracks frequency. The processor then speeds and slows the motor based on the measured frequency.

The output TTL levels are fed directly from the KD-2446 power supply using a simple voltage divider network. The voltage divider resistor R2 is calculated as 190 KΩ by the following relationship:

$R2 = (Vs)\ R1\ /\ (Vout) - R1$

Where:

R2 = Resulting divider network resistor value

R1 = Network divider resistor (chosen to be 50 KΩ in this case)

(Vout) = Desired 'on' output voltage (+5 V in this case)

(Vs) = Power supply voltage (+24 V in this case)

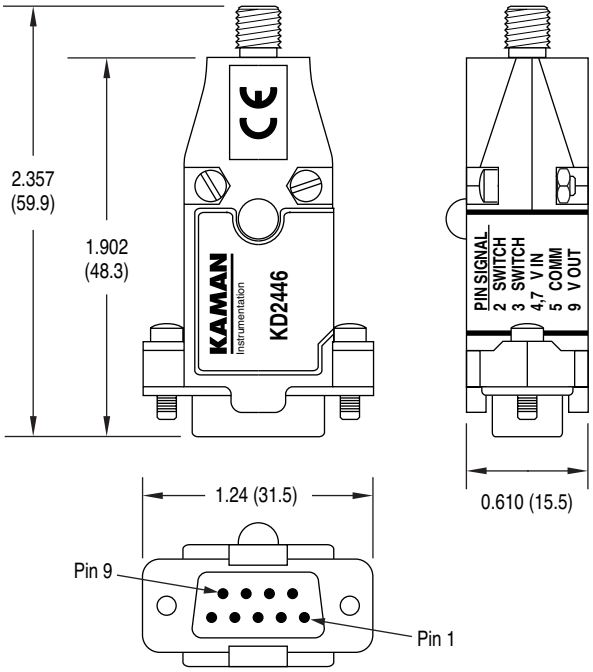
In this configuration, the switch is open when the sensor detects a gear tooth. With the switch open, the output is at a TTL level of +5 V. When a gear tooth is not present, the output is 0 V.

Figure 6 shows how to configure the same system with opposite TTL voltage levels. In this case, a voltage level of 0V is seen across the output when a gear tooth is present, and +5 V when a gear tooth is absent.

SPEEDING THE SWITCH RISE TIME

For high frequency applications, it may be necessary to have a faster rise time on the switched output. To achieve this, an external resistor may be added directly across the switched output terminals as shown in Figure 5. With an external resistor paralleled across the switch, however, a current path is present, and the switch can never achieve a true "open" circuit condition. This may limit the use of some configuration options such as in Figure 6.

KD-2446 SPECIFICATIONS



SWITCH ELECTRICAL CHARACTERISTICS

Load current	100 mA maximum AC or DC
Load voltage	0 V rms, 42.4 V Peak, or 60 V DC
On resistance	30 Ω typical, 50 Ω maximum
Off resistance	51 KΩ typical off state
Leakage current	1 µA maximum
Switch point hysteresis	0.56% FS for 9C sensor, 0.97% FS for 5CM sensor using a 24 Vdc input on a 4130 steel target
Switching speed	Turn on – 0.25 mS typical, Turn off – 0.05 mS typical

Electronics Module Pin #	I/O Cable Wire Color	DIN Rail Mount Terminal #	Function
1	N/C	1	–
2	Blue	2	Switch pole 1
3	White	3	Switch pole 2
4	Green	4	V in (alternate)
5	Black	5	Common
6	N/C	6	–
7	Red	7	V in
8	N/C	8	–
9	Orange	9	V out
–	Clear	E	Cable shield