

KOBOLD KAL-K (KAL-4000 Series) Thermal Flow Switch User Instructions



KOBOLD Instruments Inc. 1801 Parkway View Drive Pittsburgh PA 15205

Phone (412) 788-2830 • Fax (412)-788-4890

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CAUTION: For safety reasons, please read the cautionary information located at the end of the manual, before attempting installation.

1.0 General

The KOBOLD KAL-K (a.k.a. KAL-4000 Series) flow switch is intended for use in monitoring and control applications involving moderate flowrates of non-viscous or dirty liquids. The KAL-K flow switch uses the proven thermal dispersion principle and operates as follows:

1. The probe is heated internally to a few degrees above the temperature of the medium into which it extends.
2. As the medium flows past the probe it removes heat from the probe tip. The rate at which heat is removed is proportional to the flowrate.
3. The measured flowrate is compared to the setpoint value selected by the user. If the setpoint is reached, the electronic circuitry activates a transistor switch and bi-colored alarm LED. The electronic circuitry also controls an LED trend indicator which can be used to indicate relative system flow.

The microprocessor-controlled design permits simple calibration and setup. The compact probe design permits monitoring of flowrate with minimal head loss.

2.0 Specifications

Measuring Range:	0.13-6.6 feet/sec. (0.05 - 2 meter/sec.)
Fitting Size:	1/2" NPT
Optional:	1-1/2" Tri-Clamp® 3/4" NPT
Maximum Pressure:	
NPT:	1450 PSIG
Tri-Clamp®:	Per users' clamp rating up to 1450 PSIG
Maximum Temperature:	
Medium:	0 to 250°F
Ambient:	0 to 250°F
CIP (Clean In Place):	290°F max. up to 10 min. (unit is non-operational)
Supply Power:	
Standard:	24 VDC ± 10%, 300 mA Max.
Suffix P03R	110 VAC
Wetted Parts:	
KAL-4215:	304 Stainless Steel
KAL-4315:	316-Ti Stainless Steel
KAL-4320:	316-Ti Stainless Steel
KAL-4340-S	316-Ti Stainless Steel

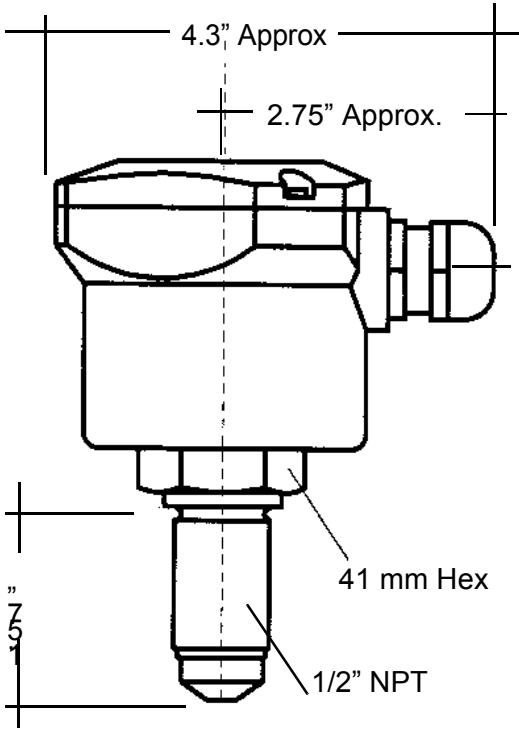
Housing:	PA6
Switching Characteristics:	
Switchpoint Adjustment:	By internal potentiometer
Switch Type:	
Standard:	NPN or PNP transistor (selectable) Max. 24 VDC, 400mA
Suffix P03R:	SPST relay 5 amp @250 VAC
Calibration Data:	Stored in non-volatile memory, data retained for at least 10 years in the event of power failure

Table 2.1 Switching Ranges Vs. Pipe Diameter

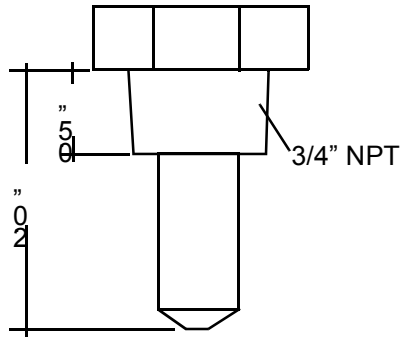
Nominal I.D Inches	Range GPM Water	Nominal I.D Inches	Range GPM Water
1/2	0.3-5.0	4	12-220
3/4	0.5-8.9	6	28-500
1	0.8-14	8	50-900
1-1/4	1.1-20	10	78-1400
1-1/2	2.0-35	12	110-2000
2	3.1-55	16	200-3600
3	7.9-140	20	310-5600

Note: The flow ranges specified in the table above have been calculated for each pipe diameter based on the known velocity range of the KAL-K. It must be noted that flow in pipes is non-uniform across the pipe cross section, and approaches zero at the pipe wall. This means that, in practice, the depth of installation of the probe, the internal pipe diameter, and the flow profile of the liquid in the pipe can interact to produce significant deviations from the flow ranges in the above table.

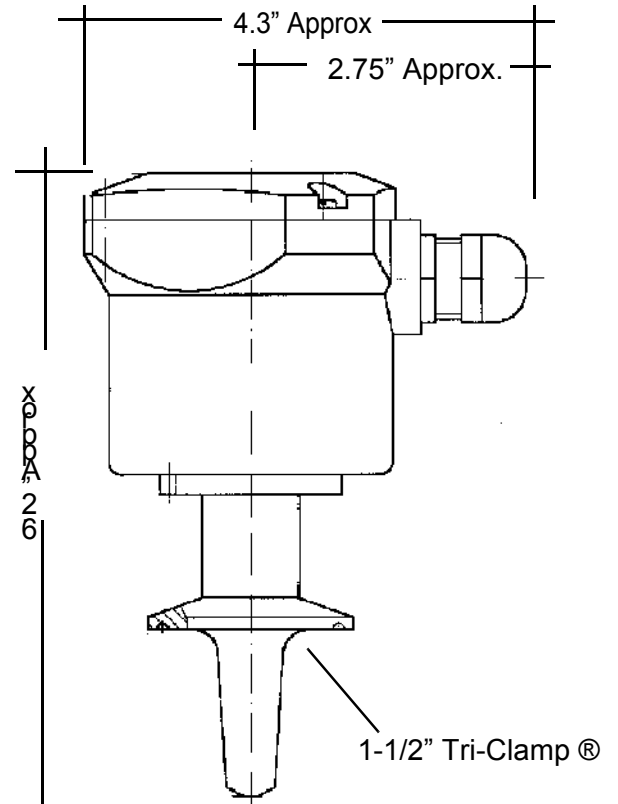
Diagram 2.1 Dimensions



KAL-4215/KAL-4315



**KAL-4320 3/4" NPT
(Probe Only)**



KAL-4340S

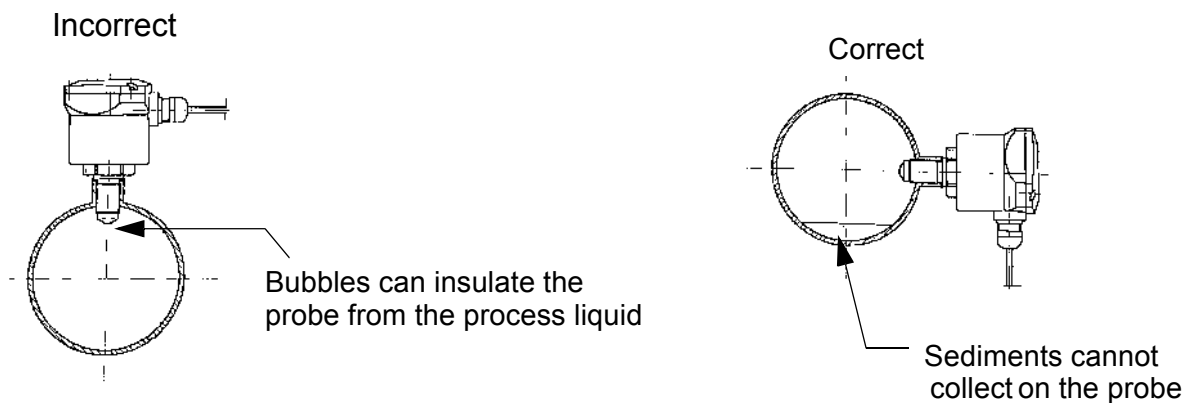
1-1/2" Tri-Clamp ®

3.0 Mechanical Installation

To install the KAL-K flow switch into your piping system, proceed as follows:

- 3.0.1 The KAL-K flow switch can be mounted in virtually any orientation as long as the piping is completely filled with fluid. It is recommended that the unit be installed in the upper hemisphere of the pipe when being used in horizontal piping runs. This ensures that sediments do not deposit on the probe. It is also recommended that the unit not be installed in the top of the pipe on horizontal runs. This ensures that air pockets which collect in the top of the pipe do not cause false switching

Diagram 3.1 Mechanical Installation



- 3.0.2 For optimal measuring accuracy, allow for 5 pipe diameters of straight-run piping both upstream and downstream of the flow switch. This ensures that flow profile at the sensing probe is uniform and fully developed.
- 3.0.3 Prior to installation, ensure that the desired flow alarm setpoint is within the switching range of the KAL-K. Additionally, ensure that the maximum system temperature and pressure are within the limits specified per Section 2.0, Specifications.
- 3.0.4 It is recommended that a thread sealant such as PTFE tape be applied to the probe threads to ensure a leaktight seal.
- 3.0.5 Using an appropriate sized wrench, carefully thread the sensor probe into the piping system. The probe must be installed such that at a minimum, the probe tip extends beyond the inner diameter of the piping and into the fluid stream.

4.0 Electrical Connections

Diagram 4.1 shows the layout of electrical connections, as well as other controls for the 24 VDC KAL-K. Diagram 4.2 shows the layout for 110 VAC versions.

Diagram 4.1 Interior Controls Layout for 24VDC Versions

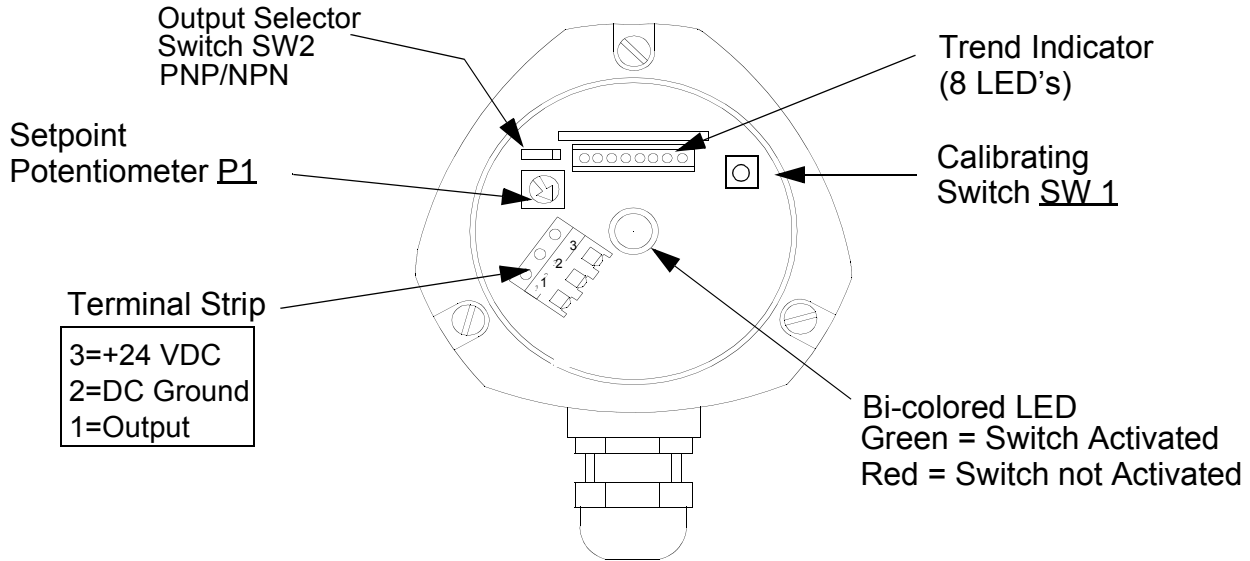


Diagram 4.2 Interior Controls Layout for 110 VAC Versions

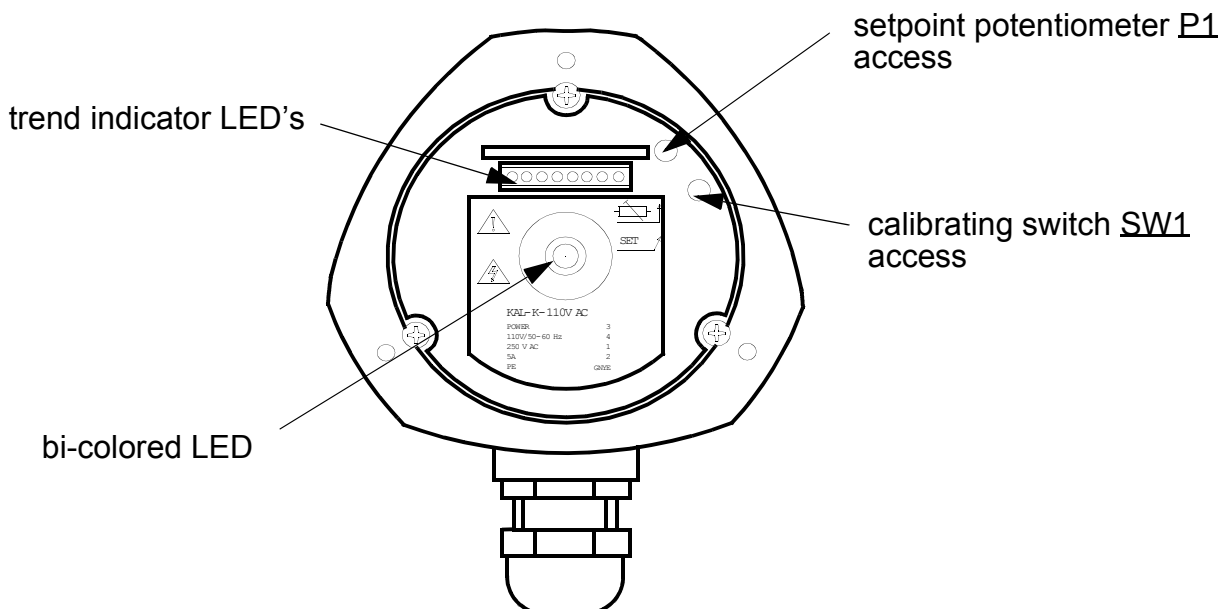


Diagram 4.3 shows typical electrical wiring for the KAL-K 24 VDC versions configured as either a NPN or PNP transistor switch. Instructions for selecting between the PNP or NPN output is provided in section 5.3, Setting the KAL-K Output Type. The KAL-K requires a 24 VDC, 300 mA power supply regulated to within $\pm 10\%$. If the same power supply will be used to provide current to devices being switched by the KAL-K (e.g. relays), sufficient additional current must be available to power these devices. Diagram 4.4 shows the wiring for the 110 VAC versions of the KAL-K (suffix P03R).

Diagram 4.3 KAL-K Wiring 24 VDC Versions

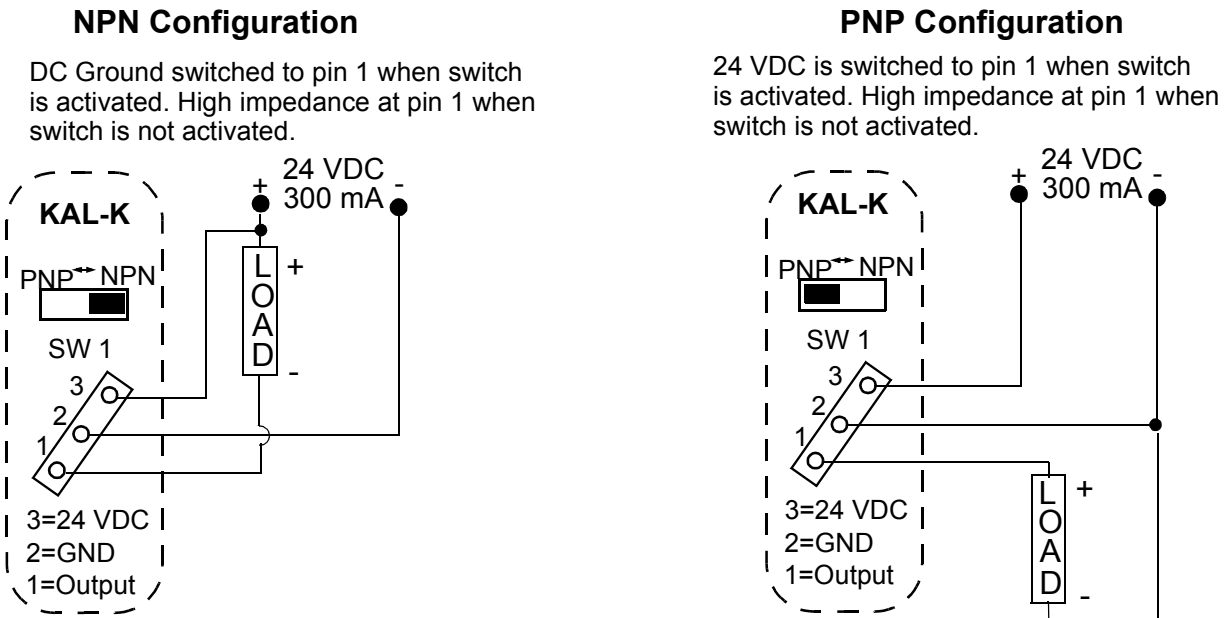


Diagram 4.4 KAL-K Wiring 110 VAC Versions

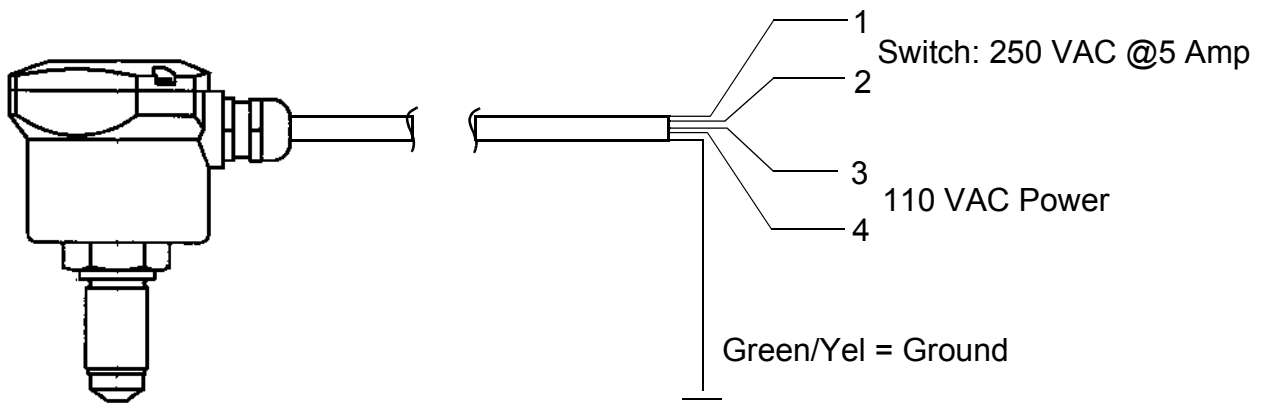
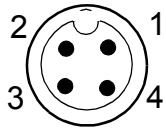


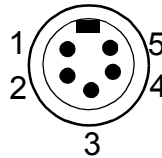
Diagram 4.5 Quick Disconnect (option M-12) wiring

24 VDC Version



- 1 = Brown = 24 VDC
- 2 = White = Output
- 3 = Blue = - DC (Ground)
- 4 = Black = Output

110 VAC Version



- 1 = Black = switch
- 2 = Blue = 110 VAC power (non-polarized)
- 3 = Yel/Green = ground
- 4 = Brown = 110 VAC power (non-polarized)
- 5 = White = switch

5.0 Operation

This section will provide details on the following aspects of KAL-K operation:

- Calibration of the zero-flow reference and trend indicator span.
- Adjustment of the flow switch setpoint.
- Transistor output type selection.
- Computer self monitoring diagnostic routine within the KAL-K software.

5.1 Calibration

5.1.1 Zero Flow Calibration

Calibration of the KAL-K electronics at zero system flow is necessary in order to obtain optimal performance from your KAL-K. This procedure is used to store data pertaining to the thermal characteristics of the fluid being monitored.

To perform the zero flow alignment, refer to Diagram 4.1 for 24 VDC versions, and Diagram 4.2 for 110 VAC versions. Proceed as follows:

- 5.1.1.1 Ensure that the fluid system is in a no-flow condition.
- 5.1.1.2 Ensure that the system is completely filled and that the KAL-K sensing probe is completely immersed in fluid.
- 5.1.1.3 With power connected to the unit, turn setpoint adjustment potentiometer P1 counterclockwise to its far lefthand stop.
- 5.1.1.4 Momentarily depress the calibrating switch SW1 and release. The bi-colored LED will flash green for a brief period while the unit is zeroing.

Note: Do not adjust the setpoint potentiometer P1 while the bi-colored LED is flashing. Doing this will invalidate the zero calibration and the procedure will have to be repeated.

- 5.1.1.5 When the bi-colored LED stops flashing, the zero flow calibration is complete.

5.1.2 Adjustment of the Trend Indicator Span

The KAL-K is factory preset at its maximum possible span. This span corresponds to a water flow velocity of 2 meters/second. This flow velocity will result in the illumination of all eight flow trend indicator LED's. If the flow velocity in your system is significantly less than 2 meters/second, only two or three of the trend indicator LED's may be lit during normal operation. The trend indicator span can be adjusted so that maximum system flow will result in a full span deflection of the flow trend indicator LED's, thereby improving resolution.

To adjust the trend indicator span, refer to Diagram 4.1 for 24 VDC versions, and Diagram 4.2 for 110 VAC versions. Proceed as follows:

- 5.1.2.1 With the system completely filled, adjust flow to its maximum value.
 - 5.1.2.2 With power applied to the KAL-K, turn the setpoint potentiometer P1 clockwise to its far right-hand stop. The far right LED on the trend indicator will be flashing.
 - 5.1.2.3 Momentarily depress the calibrating switch SW1 and release. The bi-colored LED will flash green for a brief period while the unit self-adjusts the span.
- Note:** Do not adjust the setpoint potentiometer P1 while the bi-colored LED is flashing. Doing this will invalidate the span adjustment and the procedure will have to be repeated.
- 5.1.2.4 When the bi-colored LED stops flashing, the span adjustment is complete. One measuring cycle after the bi-colored LED stops flashing (approximately 10 seconds) all, or nearly all eight of the trend indicator LED's should be lit.

5.2 Flow Setpoint adjustment

To adjust the flow setpoint on the KAL-K, refer to Diagram 4.1 for 24 VDC versions, and Diagram 4.2 for 110 VAC versions. Proceed as follows:

- 5.2.0.1 Adjust system flow to the value at which the setpoint is desired.
- 5.2.0.2 Potentiometer P1 adjusts the flow setpoint. the flashing LED on the trend indicator signifies the switch point. You will notice that the flashing LED moves along the trend indicator scale as potentiometer P1 is adjusted.
- 5.2.0.3 With system flow adjusted to the desired value, adjust potentiometer P1 until the KAL-K output switches state and the bi-colored LED changes color.
- 5.2.0.4 The KAL-K flow setpoint is now adjusted and system flow can be restored to normal.

5.3 Setting the KAL-K Output Transistor Type (24 VDC versions Only)

The KAL-K is shipped from the factory as a normally open (N/O) logic, PNP transistor output. The transistor output of the KAL-K can be field switched from PNP to NPN if desired by using SW 2. See Diagram 4.1.

The characteristics of the N/O switch logic, and the PNP and NPN transistor switch outputs are as follows:

N/O Switch:

System flow above the flow setpoint:	Switch = ACTIVATED
	Bi-colored LED = GREEN
	NPN Switch = Pin 1 SWITCHED TO GROUND
	PNP Switch = Pin 1 SWITCHED TO +24VDC

System flow below the flow setpoint:	Switch = DE-ACTIVATED
	Bi-colored LED = RED
	NPN Switch = Pin 1 HIGH RESISTANCE (open switch)
	PNP Switch = Pin 1 HIGH RESISTANCE (open switch)

5.4 KAL-K Diagnostics and Troubleshooting

The KAL-K continuously self-monitors the sensing probe and micro-processor systems. Any fault in these portions of the electronics will be signaled by a flashing red bi-colored LED. Additionally, if any of the calibrations (i.e. zero/span adjustments) are done improperly, the KAL-K bi-colored LED may flash red indicating that an error in the calibration procedure may have occurred. If the bi-colored LED starts to flash red at any time during the calibrating sequence, simply power the unit down for approximately 30 seconds, re-apply power and restart the calibration procedure. If the bi-colored LED flashes red during normal operation, a fault with the unit may have occurred. Contact KOBOLD Instruments for assistance.

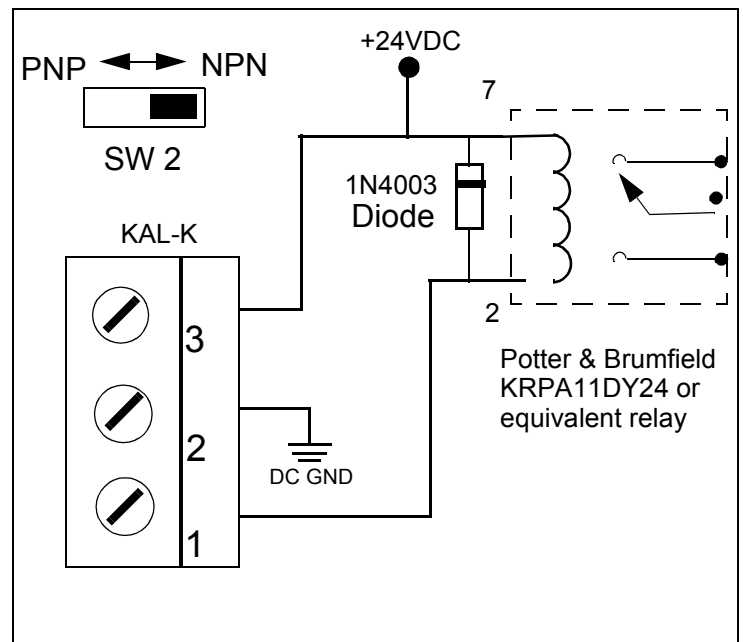
5.5 Applications

5.5.1 Wiring the KAL-K to Activate a Relay

A common application of the transistor type switch is to use it to activate a DC relay. It may be necessary to use the KAL-K to activate a relay if:

1. It is necessary to switch an AC load (transistor switches only switch DC loads).
2. The DC load to be switched exceeds the current rating of the KAL-K transistor switch.
3. It is desirable to protect the KAL transistor output from damage by using an inexpensive relay.

The circuit to the right demonstrates how a relay should be connected to the KAL-K. The relay shown is a Potter & Brumfield, but any 24 VDC relay will work as long as the coil current does not exceed 400 mA. SW 2 should be switched to the right for an NPN output. The diode connected across the relay coil protects the KAL-K output against voltage spikes which can occur when the relay activates.



6.0 Maintenance

The KAL-K thermal flow switch is an electronically-controlled device with no moving parts. As a result the unit is virtually maintenance free. Occasional cleaning of the immersed probe may be required if the liquid media and/or process conditions are such that they tend to coat or build up an insulating film layer on the probe, affecting the functionality of the device. If this occurs, the unit should be removed from the system and any deposits or coatings on the probe removed using an appropriate method (such as a clean cloth) so as not to cause any damage to the probe surface. If, after cleaning, surface damage such as scratches, corrosion or pitting is noted, replace the device.

7.0 Arrival of Damaged Equipment

Your instrument was inspected prior to shipment and found to be defect-free. If damage is visible on the unit, we advise that you carefully inspect the packing in which it was delivered. If damage is visible, notify your local carrier at once. The carrier is liable for a replacement under these circumstances. If your claim is refused, please contact KOBOLD Instruments.

8.0 Need Help With Your KAL-K

Call one of our friendly engineers at 412-788-2830

CAUTION

PLEASE READ THE FOLLOWING WARNINGS BEFORE ATTEMPTING
INSTALLATION OF YOUR NEW DEVICE. FAILURE TO HEED THE
INFORMATION HEREIN MAY RESULT IN EQUIPMENT FAILURE AND
POSSIBLE SUBSEQUENT PERSONAL INJURY.

- **User's Responsibility for Safety:** KOBOLD manufactures a wide range of process sensors and technologies. While each of these technologies are designed to operate in a wide variety of applications, it is the user's responsibility to select a technology that is appropriate for the application, to install it per these installation instructions, to perform tests of the installed system, and to maintain all components. The failure to do so could result in property damage or serious injury.
- **Proper Installation and Handling:** Use a proper sealant with all installations. Never overtighten the unit within the fitting. **Never use the housing to thread the unit into its fitting.** Always use only an appropriate sized wrench on the hex portion of the probe. Always check for leaks prior to system startup.
- **Wiring and Electrical:** Depending on the model, a supply voltage of 24 VDC $\pm 10\%$ or 110 VAC is used to power the KAL-K. The sensor systems should never exceed this rating. Electrical wiring of the sensor should be performed in accordance with all applicable national, state, and local codes.
- **Temperature and Pressure:** The KAL-K is designed for use in normal operating temperatures from 0 to 250°F, and for use at pressures up to 1450 PSIG for threaded probes. Tri-Clamp® probes are rated to the pressure rating of the user supplied clamp. Normal operation outside these limitations will cause damage to the unit and possible personnel injury.
- **Material Compatibility:** The KAL-K sensor probe is made of either 304 or 316-Ti stainless steel. The housing is either PA6 or epoxy coated aluminum. Check your model number with the wetted materials specification in Section 2.0, "Specifications", on page 1 of this manual. Make sure that the model which you have selected is chemically compatible with the application liquids. While the switch housing is liquid resistant when installed properly, it is not designed to be immersed. It should be mounted in such a way that it does not normally come into contact with fluid.
- **Flammable, Explosive and Hazardous Applications:** KAL models should not be used in areas where an explosion-proof design is required.
- **Make a Fail-Safe System:** Design a fail-safe system that accommodates the possibility of switch or power failure as well as operator error. In critical applications, KOBOLD recommends the use of redundant backup systems and alarms in addition to the primary system.