FUNDAMENTALS OF LIMIT SWITCHES WITH POSITIVE-OPENING CONTACTS

Application Note

Honeywell designs and manufactures a wide range of limit switches for monitoring a variety of applications. This document will focus on limit switches with positive opening contacts that can be applied in safety-related installations. Limit switches with positive opening contacts are identified with the following symbol ⊖ and the positive opening contacts are typically normally closed by design.

LIMITS
WITH POSITIVE OPENING CONTACTS

Typical applications include monitoring positions of gates or guards on factory floor equipment, door and access panels for railroad equipment, rail passenger car doors, positions of linkage on machinery for off-road wheeled or track equipment such as scissor lifts, equipment that extends or retracts, or equipment with limited radial movement.

BACKGROUND

MICRO SWITCH limit switches for safety-related applications include traditional limit switches with plunger or lever actuation, as well as key-interlock limit switches, hinge-lever limit switches, and cable/rope pull limit switches. These industrial limit switch series incorporate NEMA and/or IP environmental sealing and a number of these series have been certified to a SIL (Safety Integrity Level) category from an independent certifying agency.

For an overview of Honeywell's extensive line of limit switch series with positive-opening normally closed contacts refer to Table 1.

SOLUTIONS

COMMON SAFETY TECHNIQUES

By design, a limit switch with positive-opening contacts ⊖ has direct mechanical linkage within the limit switch which force the normally closed contacts open when the switch is actuated. In the case of a weld of the contacts, the action of the actuator will mechanically break the weld, opening the switch contacts. The normally closed contacts of these limit switches can not rely solely on a spring member to open the contacts per IEC 60947-5-1 Annex K.

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Figure 1. Limit Switch Operation Modes

Limit switches normally operate in one or two modes, positive or negative mode.

- **In positive mode,** the switch contact(s) are closed when the limit switch is not actuated. When the limit switch is actuated the closed contacts are opened or forced open if a contact weld occurs. These contacts are typically referred to as "normally closed" contacts.

- **In negative mode,** the switch contact(s) are closed when the limit switch is actuated. When the limit switch is no longer actuated, the contacts are opened by an internal spring within the limit switch. These contacts are typically referred to as "normally open" contacts.
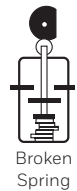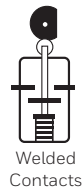
Operation in Positive Mode
(Recommended Method)

Normal Operation

Operating Machine

Stopped Machine

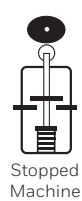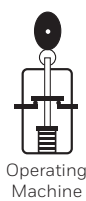**Abnormal Operation**

Welded Contacts

Broken Spring
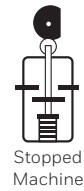
The contact is still open and the **machine stops safely**

Operation in Negative Mode
(Not recommended method for stand-alone only)

Normal Operation

Operating Machine

Stopped Machine

Abnormal Operation

Welded Contacts

Broken Spring
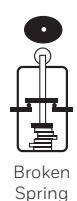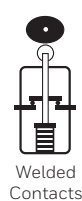
Dangerous situation: the machine is still operating (this can be avoided by using redundancy)

Based on Figure 1, it is **never recommended** to install the limit switch or limit switches in the negative mode only. In a negative-mode-only installation, should the normally open contacts weld or the return spring of the switch break, the switch contacts may not open, resulting in a dangerous situation.

Therefore, limit switches installed with **positive mode operation** (normally closed contacts) offer a greater assurance of safety since the normally closed contacts are forced open with direct mechanical linkage when actuated.

Another consideration when specifying limit switches for a safety-related application is whether **redundancy** (two or more limit switches with contacts in series) can be incorporated into the

control/safety circuit. When redundancy is designed into the control/safety circuit, any contact that opens, results in the circuit being opened. With redundancy, it is unlikely that the components (see Figure 2) would malfunction at the same time. In addition to adding **redundancy** to the functional circuit, installing one limit switch in the **positive mode** and the other limit switch in the **negative mode** may offer an enhanced level of safety. This positive mode and negative installation combination with redundancy eliminates the disadvantages of either mode. Figures 2 and 3 illustrate the limit switches installed in a positive and negative mode with redundancy.

Figure 2. Positive Negative Operation – Guard Closed

Example with Guard Closed ⟶

Normally closed contacts are positive opening ⊖

Normally closed contacts closed

Normally open contacts open

Normally closed contacts are positive opening ⊖

Normally closed contacts open

Normally open contacts closed

Positive Operation Method
(Switch plunger released)

• Normally closed contacts closed

Negative Operation Method
(Switch plunger depressed)

• Normally open contacts held closed

With guard closed, both sets of switch contacts in series are closed and provides a signal to safety control system. Redundant contacts in series can offer an enhanced level of safety.
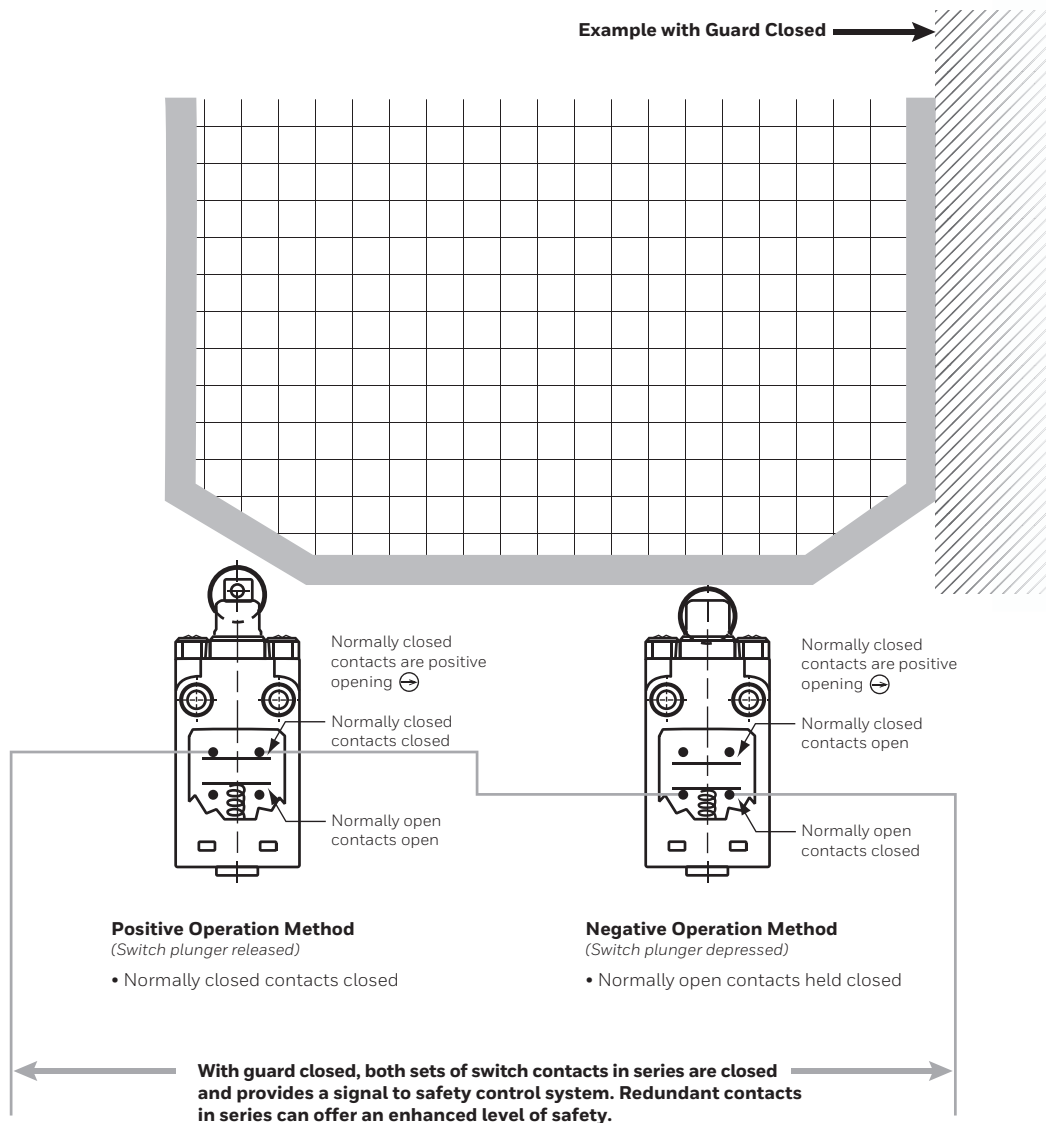
Figure 3. Positive Negative Operation – Guard Open

Example with Guard Open ←

Normally closed contacts are positive opening ⊖

Normally closed contacts open

Normally open contacts closed

Normally closed contacts are positive opening ⊖

Normally closed contacts closed

Normally open contacts open

Positive Operation Method
(Switch plunger depressed)

• Normally closed contacts held open

Negative Operation Method
(Switch plunger released)

• Normally open contacts open

With guard open, both sets of switch contacts in series are open and provides no signal to safety control system. With redundancy, should one contact malfunction and remain closed, the other contact is open and the circuit is open.

Table 1. Honeywell MICRO SWITCH Limit Switch Series with Positive-Opening, Normally Closed (NC) Contacts

EN50041 Global Limit Switches

GLA Series, metal housing, non-plug-in
GLB Series, metal housing, plug-in
GLF Series, metal housing, non-plug-in, 1 LED
GLG Series, metal housing, plug-in, 1 LED
GLH Series, metal housing, non-plug-in, 2 LEDs

EN50047 Global Limit Switches

GLC Series, metal housing, non-plug-in
GLD Series, plastic housing, non-plug-in
GLE Series, plastic housing, non-plug-in
GLL Series, plastic housing, non-plug-in

EN50041 Safety Series Limit Switches

GSA Series, metal housing, non-plug-in

Miniature Limit Switch Series

NGC Series, metal or plastic housing
SZL-VL-S Series, with side rotary actuator
24CE Series, safety switch with metal housing
924CE Series, safety switch with metal housing

Hazardous Location Safety Switch Series

GSX Series, hazardous location switch with metal housing

Cable- and Rope Pull Switches

2CCP Series, designed dual-head cable/rope pull with metal housing
1CPS Series, single head cable/rope pull with metal housing
2CPS Series, dual head cable/rope pull with metal housing
CLSX Series, single head cable/rope pull with metal housing for hazardous locations

Key Interlock Safety Switches

GK Series, EN50041 mounting, metal housing
GKE Series, EN50047 mounting, plastic housing
GKM Series, miniature with metal housing
GKN Series, plastic housing

⚠ WARNING
IMPROPER
INSTALLATION

- Consult with local safety agencies and their requirements when designing a machine control link, interface and all control elements that affect safety.
- Strictly adhere to all installation instructions.

Failure to comply with these instructions could result in death or serious injury.

WARRANTY/REMEDY

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