


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.


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.

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.

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SAFETY MODE DESCRIPTIONS

Figure 1. Limit Switch Operation Modes

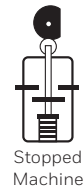
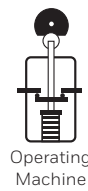
Limit switches normally operate in one or two modes, positive or negative mode.

- 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.

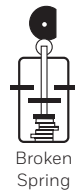
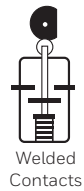
Operation in Positive Mode

(Recommended Method)

Normal Operation



Abnormal Operation

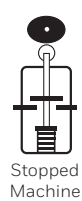
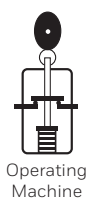


The contact is still open and the **machine stops safely**

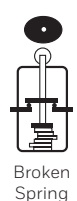
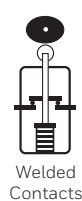
Operation in Negative Mode

(Not recommended method for stand-alone only)

Normal Operation



Abnormal Operation



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

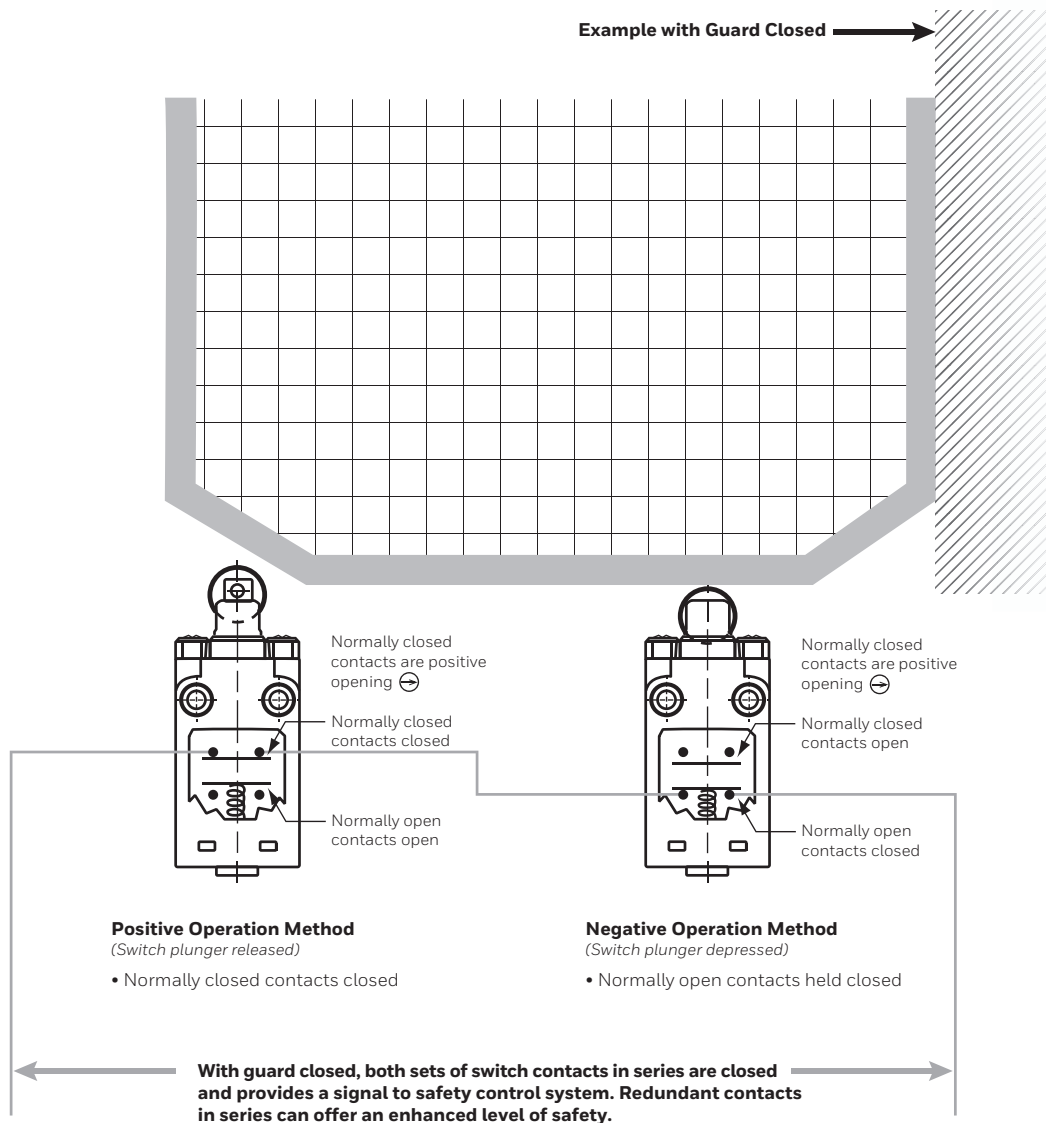


Figure 3. Positive Negative Operation – Guard Open

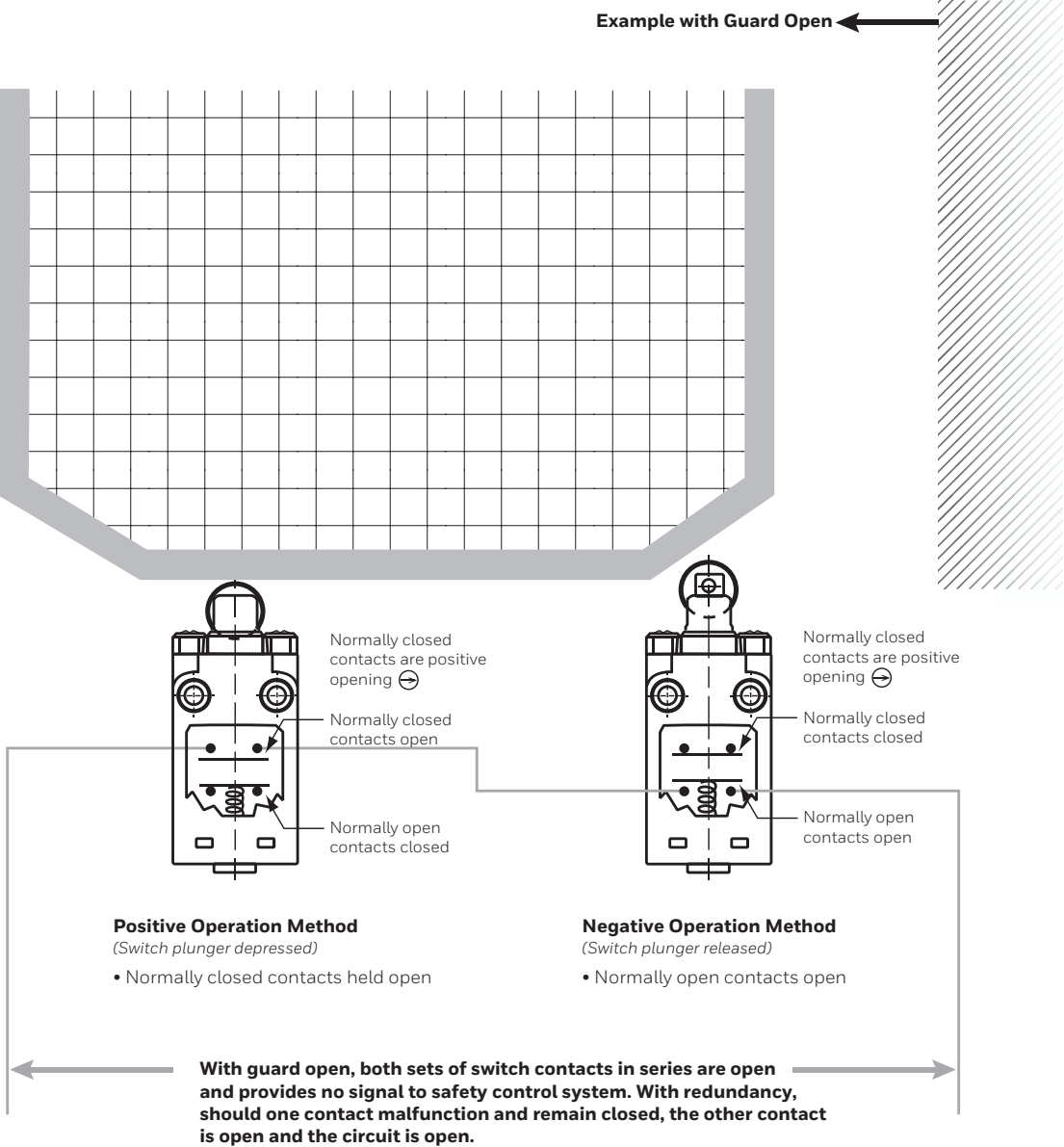









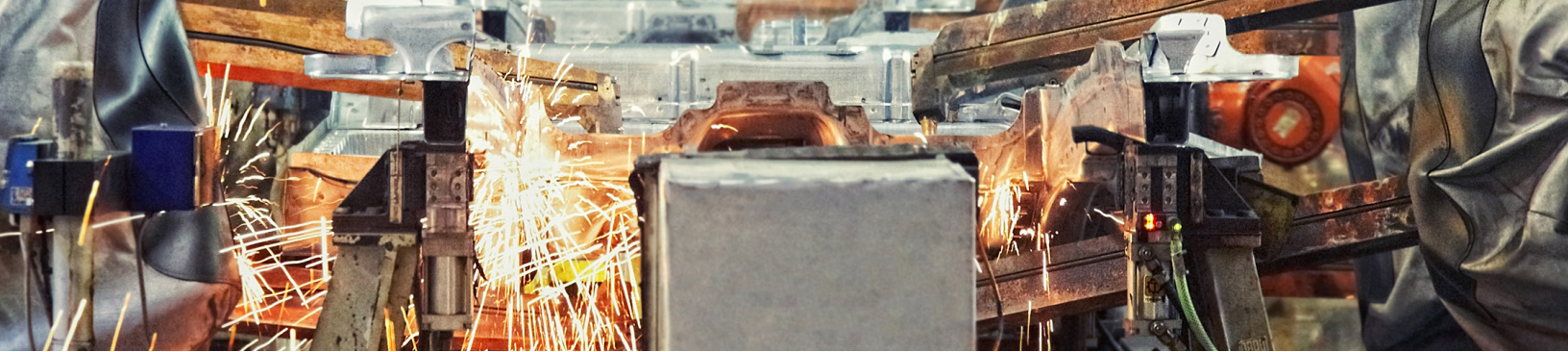
Table 1. Honeywell MICRO SWITCH Limit Switch Series with Positive-Opening, Normally Closed (NC) Contacts



THIS APPLICATION NOTE CONTAINS CLICKABLE LINKS...

To review the datasheet for a particular series of limit switches with positive-opening contacts, click on the Series name below.

EN50041 Global Limit Switches	
	<p>GLA Series, metal housing, non-plug-in</p> <p>GLB Series, metal housing, plug-in</p> <p>GLF Series, metal housing, non-plug-in, 1 LED</p> <p>GLG Series, metal housing, plug-in, 1 LED</p> <p>GLH Series, metal housing, non-plug-in, 2 LEDs</p>
EN50047 Global Limit Switches	
	<p>GLC Series, metal housing, non-plug-in</p> <p>GLD Series, plastic housing, non-plug-in</p> <p>GLE Series, plastic housing, non-plug-in</p> <p>GLL Series, plastic housing, non-plug-in</p>
EN50041 Safety Series Limit Switches	
	<p>GSA Series, metal housing, non-plug-in</p>
Miniature Limit Switch Series	
	<p>NGC Series, metal or plastic housing</p> <p>SZL-VL-S Series, with side rotary actuator</p> <p>24CE Series, safety switch with metal housing</p> <p>924CE Series, safety switch with metal housing</p>
Hazardous Location Safety Switch Series	
	<p>GSX Series, hazardous location switch with metal housing</p>
Cable- and Rope Pull Switches	
	<p>2CCP Series, designed dual-head cable/rope pull with metal housing</p> <p>1CPS Series, single head cable/rope pull with metal housing</p> <p>2CPS Series, dual head cable/rope pull with metal housing</p> <p>CLSX Series, single head cable/rope pull with metal housing for hazardous locations</p>
Key Interlock Safety Switches	
	<p>GK Series, EN50041 mounting, metal housing</p> <p>GKE Series, EN50047 mounting, plastic housing</p> <p>GKM Series, miniature with metal housing</p> <p>GKN Series, plastic housing</p>



⚠ 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

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship during the applicable warranty period. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items that Honeywell, in its sole discretion, finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

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