Application Note

Key Voltage Considerations for Replacing a Photorelay With an Analog Switch

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ABSTRACT

When designing or updating an electronic system, replacing components for more efficient and smaller alternatives often leads to performance improvements and cost savings. An example of this is the shift away from larger and more expensive photorelays in favor of smaller and cheaper analog multiplexers in automated test and measurement and factory automation systems. Furthermore, historically photorelays were the only option for switching up to 100V, but TI's new high voltage analog switches now provide options for up to 220V. While TI's *When to Replace a Relay With a Multiplexer* application note provides great context into the differences between switching options and when to utilize an analog multiplexer, this application note includes the key specs to look into when deciding whether a particular analog switch is a proper design for replacing a particular photorelay.

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Trademarks

1 Introduction

While both photorelays and analog switches can be used for similar functionality, their data sheets do vary widely, so knowing and understanding the specifications is crucial for making sure of compatibility when replacing a photorelay with an analog switch. Replacing photorelays with one of TI's high-voltage analog switches can provide substantial improvements in system size, cost, and performance, especially in applications like automated test and measurement systems.

2 Parameter Considerations for Replacing a Photorelay With a High Voltage Analog Switch

When making the transition from photo relays to analog switches, making sure compatibility and functionality needs to be taken into consideration from a specification stand point. The important step in this process is examining the key photorelay data sheet parameters Isolation Voltage (V_{iso}) and Switch Voltage (often denoted as V_{switch} or OFF-state output terminal voltage). V_{iso} describes the max voltage between the LED input and the MOSFET output of the photorelay before the dielectric breaks down. Conversely, the V_{switch} is the max voltage that Photorelay output can handle across the switch. While the naming conventions can change between data sheets, Figure 2-1 shows the relationships between the specifications and the location of the voltage differential used to define the specification.

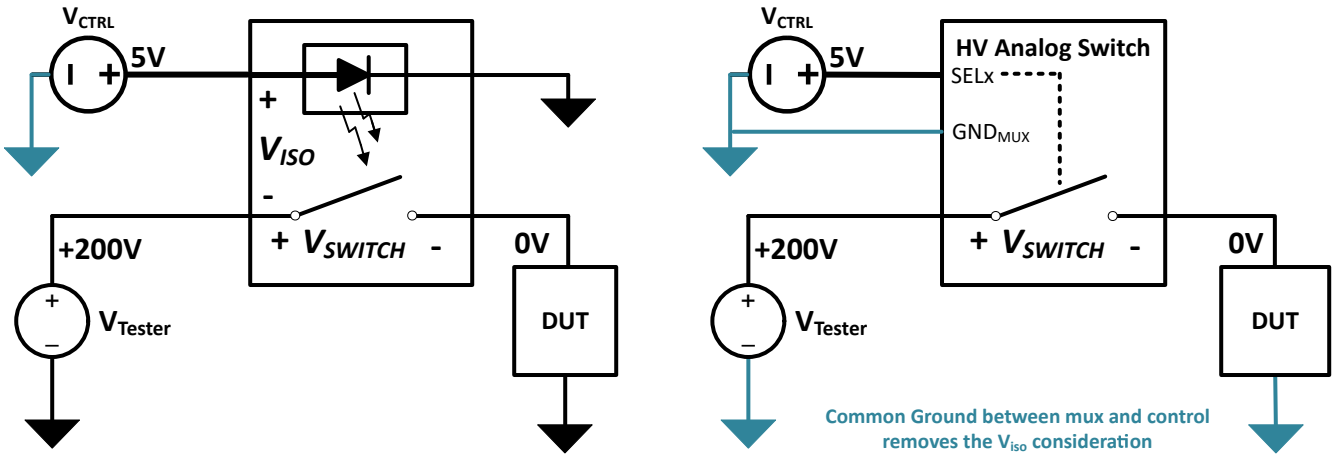

Figure 2-1. High Voltage Analog Multiplexer Replacement for Photo Relay

When looking at an analog switch to replace the photorelay, the key parameter to compare to from the switch data sheet is the Analog I/O voltage. If the analog I/O voltage rating is limited to at most the V_{switch} rating of the photomos, in most instances the analog switch or multiplexer can be a viable replacement for the photomos relay. Note that the supply of the switch still needs to encompass the maximum switch voltage (for example, a 200V analog i/o voltage can require a 200V supply). The exception can be in instances where the photorelay input ground (LED side) is not shared with the output (MOSFET side) ground. In these instances, the voltage seen on the analog switch can have the potential to exceed the maximum conditions and can cause damage. Additionally, a shifted GPIO input can cause inconsistencies with the V_{IH}/V_{IL} control levels on the switch.

3 What to do if the Control Ground and Switch Grounds are Different

In the cases where Control source ground and mux ground are shifted, TI's new TXG-family of ground-leveling translators can be used to shift ground levels to make the signal compatible with the mux logic levels. The TXG8041 and TXG8042 can level ground differences of up to +/-80V. This can enable the V_{switch} of the mux and the $V_{control}$ from the source to be at different ground references and still achieve the functionality required to replace a relay switch with different ground levels. This way an engineer can still get the benefits of a small design size with quicker switching times that the analog switch provides even with shifted ground levels.

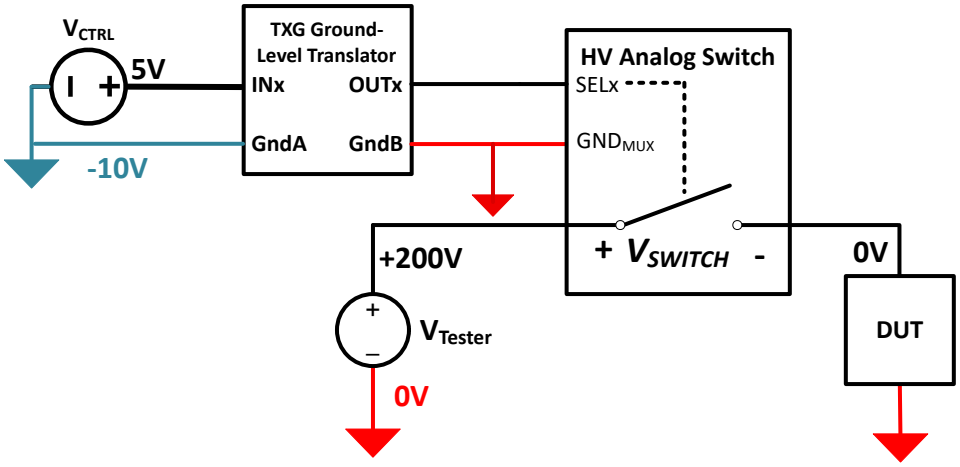

Figure 3-1. TXG Ground-Leveling Translator for Device Interface

4 Summary and Part Recommendations

Replacing photorelays with analog switches can offer significant benefits in terms of size, cost and switching speed, especially in automated test and measurement systems. However, careful attention much be paid to key specifications such as isolation voltage, switch voltage and ground reference compatibility to make sure proper functionality and avoid damage to the system. By comparing these relevant parameters and using a ground-level translator in necessary applications TI provides a variety of designs for an engineer to successfully replace photomos relays, achieving enhanced performance and efficiency in designs.

	Channel Count	Signal Range	Package Channel Density	On-Resistance	Off-Capacitance
TMUXS7614DZEMR	1:1, 8-ch	4.5V to 42V ±4.5V to ±25V	2.5mm ^{2} /ch	1Ω	27pF
TMUX7612RUMR	1:1, 4-ch	4.5V to 50V ±4.5V to ±25V	4.0mm ^{2} /ch	1.1Ω	27pF
TMUX8212RUMR	1:1, 4-ch	10V to 100V ±10V to ±50V	4.0mm ^{2} /ch	5Ω	12pF
TMUX8612RUMR	1:1, 4-ch	10V to 100V ±10V to ±50V	4.0mm ^{2} /ch	14Ω	5pF
TMUX9612RUMR	1:1, 4-ch	10V to 220V ±10V to ±110V	4.0mm ^{2} /ch	14Ω	5pF

5 References

- Texas Instruments, *When to Replace a Relay With a Multiplexer*, application note.
- Texas Instruments, *TMUX961x 220-V, Flat Ron, 1:1 (SPST), 4-Channel Switches with Latch-Up Immunity and 1.8-V Logic* data sheet.
- Texas Instruments, *TMUX861x 100-V, Flat Ron, 1:1 (SPST), 4-channel Switches with Latch-Immunisty and 1.8-V Logic* data sheet.
- Texas Instruments, *TMUX821x 100-V, Flat Ron, 1:1 (SPST), 4-Channel Switches with Latch-Up Immunity and 1.8-V Logic* data sheet.
- Texas Instruments, *TMUX7612 50V, Low-RON, 1:1 (SPST), 4-Channel Precision Switches with 1.8V Logic* data sheet.
- Texas Instruments, *TMUXS7614D 50V, SPI Controlled, Low-RON, High Density, 1:1 (SPST), 8-Channel Precision Switches with 1.8V Logic* data sheet.

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