APPLICATIONS OF SMALL SIGNAL RELAYS IN PHOTOVOLTAIC INVERTERS

Solar arrays using transformer-less inverters with ungrounded photovoltaic (PV) panel arrays are becoming increasingly popular for many reasons, including safer installation and maintenance, reduced system costs, and higher efficiency. North American and International regulations require that all such installations be equipped with a ground fault detection and interruption (GFDI) device that will interrupt the flow of DC current from the solar array and indicate a problem, should leakage between any of the DC conductors to ground occur.

Photovoltaic Panel Ground Fault Monitoring Requirements

In order for a PV inverter to be certified under US and International safety standards, it must include automatic measurements of the insulation resistance of each PV array leg with respect to ground. These measurements must be made prior to the start of inverter operation, and at least once per day, and must inhibit inverter startup if the isolation resistance does not exceed a predefined level.

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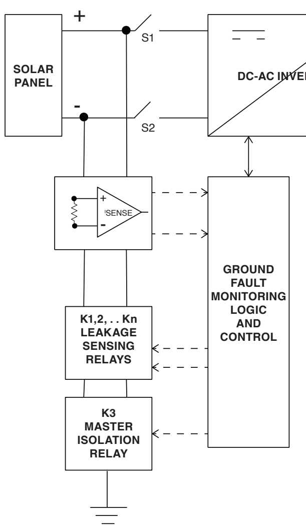
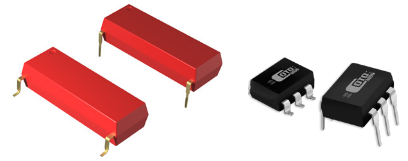
Circuit Operation

The diagram below shows a simplified block diagram of a suitable PV insulation resistance test circuit for a single solar panel or array that may be developing more than 600 VDC in full sunlight. The circuit uses a hybrid combination of small, surface-mount high voltage MOSFET relays to switch in sense resistors from different panel arrays and current feeds, and an extremely high isolation reed relay to isolate the entire sensing array from ground when the inverter is operating. Before the inverter is started up, the high voltage reed relay K3 switches in the MOSFET sensing matrix, here shown for a simple single panel array. By sequencing K1 and K2, any ground leakage from the positive and negative panel feeds is detected by current sensors monitored by the inverter's logic and control circuits. Clearly this scheme is extendable to multiple panel arrays by monitoring the sensed leakage currents from multiple array legs using an extended MOSFET relay matrix K1, K2 . . . .Kn. This scheme allows individual array monitoring, simplifying the task of tracking down a fault in a particular array compared to a system that simply measures the insulation resistance of the entire array system.





K3 = COTO 9105 K1,2 = CotoMOS® S117X

Images not to scale

Benefits of a hybrid solid state/reed relay GFDI sensing circuit

The hybrid switching circuit shown in the diagram combines the benefits of surface-mounted CotoMOS® S117X MOSFET solid state relays with the ruggedness and extremely high isolation of a Coto 9105 HV reed relay that isolates the entire sensing array. The 100 giga-ohm off-resistance of the 9105 isolation relay ensures that the MOSFET sensing array is completely isolated from ground before the inverter starts up, while the small size, extremely low power consumption and 1500 VDC peak load voltage capability of the CotoMOS® S117X MOSFET relays allows the design of a compact, highly reliable ground fault sensing array.

For further information on Coto Technology's 9105 high voltage reed relay and CotoMOS® S117X solid state relays, visit ***cototechnology.com****.*