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POWERING THE FUTURE OF FARMING WITH AUTONOMOUS ELECTRIC TRACTORS

Using Standex Reed Relays for Safety and Efficiency

Standex Electronics

Electrification Demands Reliable High-Voltage Switching

The agricultural industry is poised for a revolution with autonomous electric tractors. A leading tractor manufacturer leads this innovation with its electric, driver-optional, smart tractor technology. However, this advancement brings significant engineering challenges, particularly in electrical systems management.

Check out the full list of Standex's testing and certifications:

- AS9100 Certified
- ISO9001 Certified
- IATF16949 Certified
- ITAR & NIST Compliant
- AEC-Q200 Qualified
- UL-Recognized

These tractors rely on complex circuitry to manage functions from navigation to power distribution. A critical aspect is safely connecting and disconnecting high-voltage circuits, isolating unused systems, and ensuring safety during maintenance.

Standex Electronics, a leader in custom magnetics and sensor solutions, partnered with the customer to address these challenges using our KT Series Reed Relays. The collaboration aimed to develop a robust solution for harsh agricultural environments while providing precise control for high-voltage systems.

Standex KT Series Reed Relays: The Ideal Solution

When you implement the KT Series high-voltage reed relay, you're meeting the customer's exacting requirements with these key features:

1. **High breakdown voltage:** Withstanding up to 4.5 kV DC, these relays will handle systems with a significant factor of safety. This capability ensures the system's reliable operation even with transient voltage spikes common in vehicular electrical systems. The safety factor, typically 1.5 to 2 times the maximum expected voltage, provides a crucial buffer against unexpected surges.
2. **Excellent isolation:** A coil-to-contact isolation voltage of 7 kV DC protects control and power circuits. This high isolation maintains the integrity of sensitive electronic systems, creating a robust barrier between low-voltage control signals and high-voltage power circuits.
3. **Low leakage current:** Insulation resistance exceeding 10^13 ohms minimizes unwanted current flow between isolated circuits, which is crucial for preserving battery life. This high resistance ensures negligible power loss due to leakage, enhancing the tractor's electrical system efficiency.
4. **Compact, rugged design:** Available in through-hole and surface mount options, these relays feature a thermoset over-molded package for durability. The design allows for high-density circuit board placement while protecting against vibration, dust, and moisture.

To meet the customer's needs, Standex implemented a specialized sorting process ensuring each relay met the 4.5 kV minimum breakdown voltage specification, guaranteeing consistent performance across the tractor fleet.

Enabling Efficient EV Battery Precharging

The KT Series reed relays are crucial in electric vehicle and machinery battery management systems, specifically in the precharge circuit. This circuit safely energizes the tractor's high-voltage systems, preventing damage to sensitive components.

The precharge circuit works as follows:

1. **Initial state:** Main contactor open, high-voltage capacitors discharged.
2. **Precharge initiation:** KT Series relay closes, connecting a current-limiting resistor parallel to the main contactor.
3. **Controlled charging:** Current flows through the resistor and relay, slowly charging system capacitors, preventing large inrush current.
4. **Voltage monitoring:** The system monitors capacitor voltage until reaching a preset threshold (typically 90% of battery voltage).
5. **Main contactor engagement:** Once capacitors are sufficiently charged, the main contactor closes, and the KT relay opens, allowing full power flow.

This process prevents potential damage to the main contactor, extends component life, and ensures smooth charging. The KT Series' precision and reliability are vital, as any failure in the precharge sequence could damage components or cause system malfunctions.

Advantages Over Competing Technologies

Reed technology has several distinct advantages over alternative switching technologies:

1. **Speed:** Achieve faster operation than traditional electromechanical relays, typically under 3 milliseconds. This rapid switching is indispensable for responsive system control and protection, particularly in overcurrent protection or system fault isolation.
2. **Longevity:** With a life expectancy of millions of operations, these reed relays outlast many competing technologies, ensuring reliable operation throughout a tractor's service life. This longevity is vital in agricultural equipment, where downtime during critical farming operations can have significant economic impacts.
3. **No wetting current:** Unlike some electromechanical alternatives, reed relays don't require a minimum current to maintain conductivity, making them ideal for a low-power sensing and control applications. This allows for a more flexible system design and can improve overall energy efficiency.
4. **Inherent isolation:** The hermetically sealed reed switch provides natural galvanic isolation between control and switched circuits, enhancing safety and reducing electromagnetic interference. This isolation is paramount in high-voltage systems to protect sensitive control electronics.

Collaborating for the Future of Autonomous Agriculture

Standex has worked closely with the customer for over a year to develop and refine the relay solution for their next-generation autonomous tractor. This collaboration has tailored the KT Series to meet the customer's specifications while minimizing deviations from the standard part, ensuring cost-effectiveness and reliability.

The use of Standex's reed relays in the customer's tractors is a key enabler in farm equipment electrification. As agriculture moves toward more sustainable practices, reliable operation of these high-voltage switching and protection systems becomes increasingly critical.

Standex's Commitment to Innovation

The customer's project success has spurred further innovation at Standex. We are developing higher-power reed relays to meet evolving electric vehicle market demands, including agricultural applications. These new relays will offer greater voltage and current handling capabilities, paving the way for next-generation electric farm equipment.

By choosing Standex, the customer has secured a reliable solution for current needs and is aligned with a company committed to advancing high-voltage switching and control technology. This approach ensures that as your autonomous tractor technology evolves, Standex will be ready with cutting-edge solutions to meet new challenges.

To learn more about how Standex Electronics can support your innovative electric vehicle projects with custom magnetics and sensor solutions, visit www.standexelectronics.com or contact our engineering team to discuss your specific application needs.

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