

# OPERATION MANUAL

## **EARTHING RELAY**

**VEHICLE STATIC GROUNDING SYSTEM**

**RESISTANCE + CAPACITANCE MONITORED**

**SPS-600**

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# **EARTHING RELAY**

## **VEHICLE STATIC GROUNDING SYSTEM**

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### **SPS-600**

#### **GENERAL**

Static Electricity is a phenomenon of electrification of surfaces of objects through relative motion and continuous physical contact and forceful separation of like or unlike materials, resulting in positive and negative charges formed on the surface. In industrial processes where there is any form of physical movement, the separation of materials generates a high degree of static charge. If the object or container is insulated from earth, this charge will start to accumulate and can reach dangerous potential levels, to the tune of 30 kV. Non-conducting materials like rubber tyres in vehicles, paints, gaskets and seals provide insulation to this charge and prevent its safe dissipation.

Since the tyres of vehicles are non-conductive, there is no path available for the discharge of this developed static-charge. Hence, during the process of loading or unloading fuels or any inflammable, explosive or hazardous chemicals in transport vehicles such as Tankers and Railway Tank Wagons, it is essential to ground the vehicles or wagons before commencement of the loading/unloading operation and ensure that the grounding links are in place during the entire operation. This effectively diverts the surface residual electrostatic charges to ground and will prevent possible generation of sparks between the vehicle and any conductive objects in proximity.

#### **PRINCIPLE OF OPERATION**

The Vehicle Static Grounding Relay SPS-600 is an advanced protection system that provides safe and secure grounding of static charge to Earth in hazardous area applications during tanker loading and unloading operations. The instrument is a certified intrinsically safe product mounted in an explosion-proof enclosure. The instrument detects the presence of a Tanker vehicle and interlocks the loading and unloading operations allowing the process to initiate only after satisfactory grounding of the Tanker body or Loading Arm and healthy physical condition of the interconnecting Cables. The charge is thus safely dissipated to earth via a low impedance path through an intrinsically safe module housed in a flameproof enclosure in the vicinity of the operation.

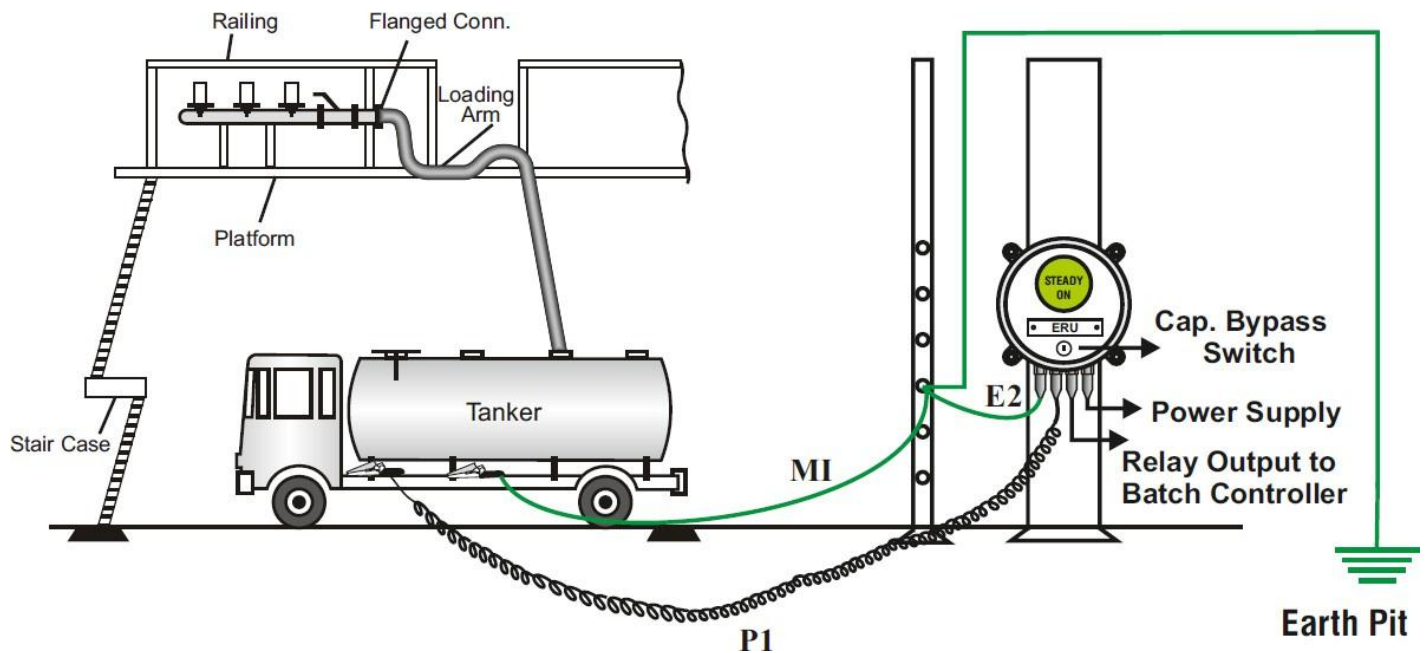
The Earthing Relay assumes "intelligence" by the fact that it can discern connection of the probe to a Tanker vehicle as against a metallic structure, and will permit operations only when the Probes are connected in the recommended configuration. Any attempt by the operator to bypass the Earthing Device is effectively foiled, thus guaranteeing a safe operation. The instrument has a large high-bright and bi-colour LED display window with Red and Green colours prominently visible to indicate the status of the grounding operation. When the monitoring and grounding cycle is complete, the Earthing Relay provides potential free Relay change-over contacts, which may be interlocked to control the operation of the line Pumps, Batch Controllers, auxiliary instruments and any remote lamps or alarms. The operator thus receives absolute confirmation that the Vehicle is properly earthed, signaling it safe for loading or unloading operations.

The Earthing Relay ensures:

1. Positive and verified connection of Probe to a tanker vehicle only – and not to a metal structure in gantry.
2. Verified Capacitance measurement and verification of vehicle.
3. Verified low Resistance measurement and verification of Cable interconnections.
4. A continuously earthed Tanker vehicle with monitoring of Cable integrity and impedance below 8 ohms (configurable upto 16 Ohms) for the duration of the product transfer process.

When these parameters are confirmed, the Earthing Relay permits the transfer of product. Any static charge generated on the tanker truck during the transfer process is instantly transferred to the Earth Pit grounding point.

The wiring configuration of the Vehicle Static Grounding System SPS-600 is as below:-



In essence, there are three inputs to the Earthing Relay:

1. Probe from ERU to Vehicle Chassis : P1
2. True Earth point from Earth-Pit : E2
3. Probe from Earth-Pit point to Vehicle Chassis : MI

When the Tanker vehicle comes to the loading area, the spiral Dual-core Cable is first connected to the Vehicle Chassis (P1) and the regular non-spiral Cable to the Earth Pit (E2).

The line resistance for the complete loop between the Earthing Relay, the Vehicle and the Earth Pit through the length of the interconnecting Cables must be less than the programmed Resistance Value (in any case not over 16 Ohms) at all times for correct operation.

The instrument will not be able to build up or sustain Capacitance charge when the vehicle is in wet condition. As such, during monsoon season, it must be ensured that the tyres of the vehicle are dry before attempting to ground the vehicle.

**The P1 Cable will distinguish between its connection to a Vehicle body and its connection to any other metallic structure.**

**The Vehicle Capacitance is measured and verified that it falls within acceptable limits.**

**The Line Impedance is measured and verified that it falls within acceptable limits.**

**If the P1 cable is shorted to E2 cable – or if the P1 & E2 Cables are clamped to a common metal railing, the Relay will NOT operate.**

The SPS-600 is an intrinsically safe (Exi) certified design and housed in an explosion proof (Exd) execution. The instrument acts as an interlock during loading / unloading operations, allowing the process to initiate only after satisfactory grounding of the static charge on the Tanker vehicle and/or the Loading Arm. The instrument provides a control output for required process interlocking along with visual indication to indicate safe earthing.

The Earthing Relay's primary function is therefore to determine whether the Tank Trucks at the loading terminals are properly earthed and thereafter, provide a visual indication and a control signal for process initiation. The Earthing Relay senses the static-charge potential of the Tanker and provides a safe grounding path for this charge through a low impedance and intrinsically safe electronic module, which is itself housed in an explosion proof enclosure mounted near the loading terminal.

The integrity of the connections of the Tanker body and the Earth Pit are also continuously verified and if there is any break in the connections or an accidental disconnection of the Probe Clamp, the operation is instantly arrested. The Line Impedance between the Tanker and the Ground point is another critical parameter that is continuously monitored. The Line impedance (after compensating for line and cable impedances) must be maintained below the permissible limit of 8 Ohms for Line Impedance. For any reason (such as a cable-break or poor quality Cable or very long Cables), if this line impedance exceeds the permissible value, the instrument shall arrest operations immediately by switching internal Relays, whose contacts are used as interlocks for filling or pumping operations.

When the static charge is fully grounded and the vehicle is safe for loading/unloading operations, the Earthing Relay SPS-600 displays this by means of a bright Green lamp on the instrument panel. However, the instrument instantly shuts down the loading operation under the conditions when there is either a break in the "grounding", or if electrical grounding is not present at all times during the operation, or even if there is any internal failure within the instrument. The lamp will then glow Red.

The Earthing Relay SPS-600 is certified for intrinsic safety and the enclosures for explosion-proof operations by CIMFR and PESO. The instrument is housed in a certified cast Aluminum Alloy LM6 enclosure and offered with a standard Cable-Clamp assembly set.

## **INTRINSIC SAFETY**

**Intrinsic Safety (IS)** is a protection technique for safe operation of [electrical equipment in hazardous areas](#) by limiting the thermal or electrical energy available for ignition. A device termed intrinsically safe is designed to be incapable of producing heat or spark sufficient to ignite an explosive atmosphere. Elimination of spark potential within components is accomplished by limiting the stored energy in any given circuit and the system as a whole. Temperature, under certain fault conditions such as an internal short in a semiconductor device, becomes an issue as the temperature of a component can rise to a level that can ignite some explosive gases, even in normal use.

Intrinsic Safety design ensures against the release of sufficient energy during normal or abnormal conditions to ignite volatile gases. The excess electrical energy in the form of voltage and current is limited by the effective use of energy-limiting devices known as intrinsically safe barriers, within the circuits.

The design of the SPS-600 Earthing Relay ensures that the total electrical and thermal energy dissipated during the entire sequence of vehicle sensing, dissipation of static charge, monitoring of cable impedances and switching of the Relay, is restricted to extremely low levels. This implies that the energy levels within the instrument are so low, that there is no danger of sparking or flash-over within the instrument during grounding, or at the time of contact of the probes to the tanker-body or the "true-earth" point. This feature makes the Earthing Relay an "Intrinsically Safe" product. The instrument has been certified for Intrinsic Safety by the CIMFR, Dhanbad.

A Red LED indicates the "Earth Open" condition, while the "Earth OK" condition and Relay change-over condition is displayed by a Green LED on the front panel display. The Relay contacts are rated for switching 5 Ampere current @ 230 V AC for Resistive Loads. The Earthing Relay operates on universal AC Power Supply of 90 to 270 V AC, 50/60 Hz supply. Short circuit protection and Barrier protection is provided by means of internal fuses.

## **INSTALLATION**

1. The Earthing Relay SPS-600 should be rigidly mounted near the Truck Grounding Location under cover of a protective canopy. The unit must be kept dry and free from grease and dust.
2. Wiring must be carried out as per local codes and NEC Specifications covering hazardous areas. Make sure to seal the conduits with appropriate explosion proof seal. Include a conduit bushing to protect insulation on wires.
3. The integral pilot bicolour light (red / green) indicate an ungrounded / grounded condition, respectively.
4. Green/Yellow (Earth) wire must be attached to ground screw.
5. Connect the Contact Clamp to the Vehicle by means of the connector provided. Install a hook or bracket at a convenient location near the truck grounding location to hold the Contact Clamp when it is not in use. This will assist in preventing possible damage to the Contact Clamp and Cable assembly.
- 7 The Earthing Relay Model SPS-600 is shipped ready for use and requires no further adjustment.
- 8 Make sure that loading (filling) equipment is separately grounded. The Earthing Relay SPS-600 unit DOES NOT GROUND THE LOADING STRUCTURE OR EQUIPMENT.

## OPERATION PROCEDURE

### A summary of the sequence of operations of the SPS-600 is as follows:-

- The explosion-proof enclosure of the Earthing Relay must be connected to the Earth-Pit (at the marked Earth Point on the enclosure body), thereby establishing the reference point for the potential levels measured on the tanker body / other appliances to be discharged.
- The Probe **P1** is required to be connected to the chassis of the vehicle to be grounded. The discharge path **E2** must be connected to the Earth Pit.
- The probe **MI** must be connected to Earth Pit.
- As a safety measure, the power supply to the instrument must be switched off while making the connections to the instrument (although there is no danger if the Earthing Relay clamps are connected while the instrument is powered). The instrument should be electrically earthed for safety and operational reasons – however, it may be noted that the Electrical Earth is in no way linked with the discharge path of the static charge and remains isolated from the charge grounding circuit.
- In the normal (dormant) state, the Red light will glow indicating EARTH OPEN condition.
- Attach the Earthing Clamp (**P1**) on to the tanker body at a suitable conductive location by gripping the jaws of the Clamp firmly on the cleaned metallic portion of the chassis.
- If the connection is healthy, then the Earthing Relay will instantly initiate a sequence of verification of Capacitance with Red and Green LED toggling indication on front panel.
- Now, connect **MI** to the tanker body. If loop resistance is within limit then Earthing Relay will give Green LED steady ON indication on front panel.
- Both parameters are continuously monitored during the loading/unloading operation.
- The intrinsically safe grounding circuit of the Earthing Relay is designed to provide a safe path to Ground for the static charge generated during the operation. When the parameters are verified successfully, the control Relay will change state and the loading or unloading operations may be commenced. The Green light indicating EARTH OK will instantly illuminate and the interlock contacts will close.
- Ensure that the Earthing Clamp is attached to the Tanker and the lamp is glowing Green before opening hatches, attaching hoses, positioning Loading Arm, etc.
- Ensure that both pins of the Earthing Clamp are in contact with bare metal on the tanker's chassis.
- If the Earth connection is accidentally broken during the transfer, then the Earth Open lamp will light up and the interlock contacts will open. Also, if the Probe is clamped at an insulated section, or if proper contact with the vehicle chassis is not made because of layers of paint, then the instrument will interpret this fault as an Open Circuit and arrest further operations.
- On completion of the operation, the Earthing Clamp may be removed from the Tanker chassis and stowed on the insulated Clamp-holder near the junction box.
- The Red "Earth Open" lamp will light again.

*It must be expressly noted that the chamber of the Earthing Relay instrument must not be opened by the user, nor any attempt be made to repair or replace any of the fuses in the event of a fault. The physical characteristics including creepage distances between components within the instrument are an inherent and important part of the intrinsic safety design of the Earthing Relay. Any disturbance in this aspect would render the instrument ineffective in intrinsic safety protection and make it potentially dangerous in the event of a genuine fault. The manufacturers must be contacted immediately and the instrument sent for repair / fuse replacement. This is a CIMFR directive.*

## **SERVICE GUIDE**

1. Check fuse in power supply line to unit.
2. Check grounding of Enclosure to confirmed ground point.
3. Check continuity of Cable-Clamp Assembly periodically. The Cord can "open" If stretched too much or run over frequently by the tankers.
4. Shut off the power to the SPS-600 and disconnect the unit from the power supply circuit before opening the cover. Remove the cover and check the internal fuses.
5. If the above steps do not correct the problem, the instrument can be removed as follows:
  - a. Disconnect all field wiring.
  - b. Remove the front cover of the enclosure.
  - c. The Earthing Relay electronics is mounted within the enclosure. Carefully disconnect the electronic hardware and detach the electronic assembly. Be careful not to break any internal wiring.

Return the entire chassis to the factory for repair and recalibration. Include a note describing the nature of the problem.

**DO NOT SUBSTITUTE COMPONENTS.  
DO NOT ADJUST RESISTORS.**

6. Replace Cable Clamp assembly when spring contacts become worn.

## TROUBLESHOOTING

SR	SYMPTOM	POSSIBLE EXPLANATION
1.	Red EARTH OPEN lamp or Green EARTH OK lamp is not glowing	<ul style="list-style-type: none"> <li>✓ Check whether instrument is installed as prescribed in the Manual.</li> <li>✓ Check whether the AC Power Supply to the instrument is in order.</li> <li>✓ Check whether line Fuse has blown.</li> </ul>
2.	Earthing Relay is not switching to permissive Green (EARTH OK) state when Clamp is fitted to Tanker chassis (Red EARTH OPEN state continues to glow).	<ul style="list-style-type: none"> <li>✓ Check whether instrument is installed as prescribed in the Manual.</li> <li>✓ Check whether the grounding clamp is in good condition.</li> <li>✓ Check whether grounding Clamp has been fixed to a metallic portion of the chassis, which is devoid of paint/corrosion.</li> <li>✓ Check wiring connection between Earthing Relay module and Terminal Block within the instrument.</li> </ul>
3.	EARTH OK green lamp is glowing - however, Relay contacts do not change over.	<ul style="list-style-type: none"> <li>✓ Check whether Fuse has blown.</li> <li>✓ Check contact wiring of Relay and ensure proper connections.</li> </ul>
4.	Relay contacts are operational - however, EARTH OK lamp does not glow.	<ul style="list-style-type: none"> <li>✓ Check whether Fuse has blown.</li> <li>✓ Check wiring connection between Earthing Relay module and Terminal Block within the instrument.</li> </ul>

## TERMINAL DETAILS

### TERMINAL BLOCK FOR ELECTRONIC MODULE

#### On Bottom PCB:

L	N	E		NO	C	NC	NO	C	NC		P1A	P1B	E2
90-270 VAC, 50/60 Hz			X	Relay-1			Relay-2			X	Probe To Tanker		Earth Pit

#### On Top PCB:

G	B	A
RS-485 (Modbus RTU)		

+	-
Cap.Bypass Switch	



## TECHNICAL SPECIFICATIONS

### EARTHING RELAY VEHICLE STATIC GROUNDING SYSTEM

Model Number	:	SPS-600.
Type	:	Micro-controller based.
Principle	:	Intrinsically Safe Intelligent Static Charge Grounding System of Tankers in Loading Terminals. [Vehicle Static Grounding System].
Inputs	:	1. True-Earth point at loading area to ERU. 2. Probe from body of Tanker to ERU. 3. External Manual Earth from Earth Pit to Tanker Truck
Loop Resistance	:	0 to 16 Ohms (Factory configurable)
Capacitance Limits	:	2000 pF to 100000 pF (2 nF to 100 nF)
Design	:	Intrinsically Safe Exi [CIMFR certified].
Control Outputs	:	Control Relays.
Relay Contacts	:	Two potential-free change-over contacts.
Contact Rating	:	5 Ampere @ 230 V AC (Resistive Loads)
Control action	:	Relays will get energized when Tanker body is safely grounded.
Indication	:	1. Green LED lamps indicating EARTH OK 2. Red LED lamps indicating EARTH OPEN (FAULTY).
Communication	:	RS-485 on Modbus RTU.
Power supply	:	90 to 270 V AC, 50/60 Hz Universal AC power Supply.
Protections	:	Fuses.
Enclosure Execution	:	Explosion-proof Exd, Weather-proof.
Ingress Protection	:	IP65.
Dimensions	:	200 x 200 x 120 mm
Enclosure MOC	:	Aluminum Alloy LM6 Die cast enclosure suitable for use in Zone 1 and 2, Gas Groups IIA/IIB.
Certifications	:	CIMFR and PESO
Cable Entries	:	Bottom of enclosure.
Max. Ambient Temp	:	50 °C.
Cable type	:	Dual-core, industrial grade chemical and abrasive resistant spiral cable.
Cable Length	:	5 metres extended.