Single-Rail and Double-Rail Power Frequency Track Circuits

ASTS USA Power Frequency PF track circuits have provided dependable train detection service at thousands of railway interlocking turnouts and crossovers for many decades. These circuits feature robust and reliable electrical designs and apparatus such as ASTS USA’s PV-250 AC Vane Relay, W-400 Transformers and impedance bonds. PF track circuits continue to play a key role in ASTS USA’s latest transit ATC applications such as the driverless Copenhagen Metro.

**General Description**

Single-Rail PF track circuits are employed where a single rail is available for installation of insulated joints in order to define track circuit boundaries (the other “common” or “return” rail carries traction return current and has no insulated joints). This type of track circuit uses both rails to conduct the track signaling current, thus the common rail is carrying both traction return and track signaling currents.

Systems that do not employ a separate signal rail with insulated joints make use of Double-Rail PF Track Circuits. This type of track circuit incorporates insulated rail joints (for track circuit boundaries) in both rails which, in turn, will carry both propulsion and signal currents. Impedance bonds are used to ensure proper isolation of these currents from one another.

PF track circuit basic operating characteristics include:

- Broken-rail protection provided for both rails on normal routes and single rail circuits on the crossover portion of turnouts
- Detects the failure of any insulated joint.
- Operation not be affected by traction electrification return-current imbalances.
- Operates correctly with ballast resistance as low as 3 ohms per 1000 feet (304.9 m), and detect a train shunt of 0.25 ohm DC (typical) anywhere within the circuit.
- Five-second loss of shunt protection included within interlockings to prevent any switch movement within this time period.

Basic functions of ASTS USA PF track circuit components include:

- **Track Transformer** - Supplies current to the rails.
- **Relay Transformer (single-rail only)** - Prevents dc propulsion current from passing through the PV-250 Track Relay, where it could cause undesirable magnetic saturation of the relay structure.
- **Limiting Resistors** - Prevents serious heat or burn up of the track transformer due to short circuit current when a train is on the track circuit.
- **Track Relay (PV-250)** – Provides the train detection indication to external circuits and indicates broken insulated joint condition
- **Fuses** – Protects track and relay transformers from propulsion current increase from defective rail joint or possible full propulsion current.
- **Insulated Joints** - Defines boundar track circuit boundary and isolates adjacent track circuits.
- **Lightning Arresters (double-rail only)** - Limits voltage impressed on any component of the track circuit and minimizes surge currents
- **Impedance Bonds (double-rail only)** - Provides low DC resistance connection between adjacent track circuits, and impedance to the flow of AC signaling current from one rail to the other of its track circuit
Advantages

- Sharp definition: No pre/post shunt effects
- Compatible with shunt fouling circuits
- No length ratio limitations between adjoining track circuits.
- No risk of crosstalk between parallel tracks or bondlines
- Readily compatible with AFO overlay
- No tuning adjustments or measurements required when installing or replacing PF equipment.
- Robust, immune to lightning and propulsion surges without supplemental protection.
- Relatively simple EMC and safety analysis

Additional Information

- For additional information on PF Track Circuit applications, request ASTS USA Service Manual SM-6087 or contact your ASTS USA Account Executive.
- Request SM-6087 for PF Track Circuit component part numbers.
- For additional information on PF Track Circuit key components, refer to these RSE catalog sections:
  - PV-250 2-Element AC Vane Relay: RSE-4J1
  - W-400 Transformers: RSE-3E1
  - USG-A Lightning Arresters: RSE-3H2

Basic Single-Rail Power Frequency Track Circuit
Basic Double-Rail Power Frequency Track Circuit

- Traction Power
- Insul. Joint
- Limiting Resistor
- Track Transformer
- Fuse
- 115 VAC*
- *MUST BE SAME SOURCE FOR BOTH FEEDS
- Lightning Arrester
- Track Relay (PV-250)
- IMPEDANCE BONDS
- Tractive Power

*[MUST BE SAME SOURCE FOR BOTH FEEDS]