

PHASE-SHIFTING TRANSFORMER (PST) PROTECTION AND CONTROL SYSTEMS



Protect and control PSTs, also known as phase-angle regulating (PAR) transformers, with purpose-engineered solutions.

- Gain comprehensive PST protection with a single SEL-487E Transformer Protection Relay or complete protection redundancy with only two relays.
- Mitigate equipment damage by quickly detecting and tripping for all in-zone fault types, including turn-to-turn faults.
- Automatically control the on-load tap changers (OLTCs) that regulate power flow through a PST.



Comprehensive Protection in a Single Relay

SEL provides a pre-engineered PST protection system using a single SEL-487E Transformer Protection Relay. Traditional protection for conventional, two-core PSTs requires separate differential relays to cover the primary windings (87P) and the secondary windings (87S) of the series and excitation transformers, meaning four relays are required to provide a redundant protection system. As both sets of differential elements are provided in a single SEL-487E, only two relays are necessary to provide fully redundant electrical protection.

Traditional 87P and 87S elements are unable to detect turn-to-turn faults in the regulating windings of a PST, where partial winding faults are most likely to occur. The SEL solution supplements 87P and 87S elements with patented positive- and negative-sequence differential elements (87-1 and 87-2) that compensate for the variable phase shift introduced by the PST. These elements are sensitive to all in-zone fault types, including turn-to-turn faults in the regulating winding of the PST—a significant advancement in PST protection that is highlighted in IEEE C37.245-2018.

Rather than requiring CTs be embedded within the PST, as conventional protection does, these patented elements only need CTs at the zone boundaries (source and load sides). This unique capability also makes the SEL PST protection system suitable for modernizing the protection of PSTs without CTs in the correct locations to implement conventional protection.

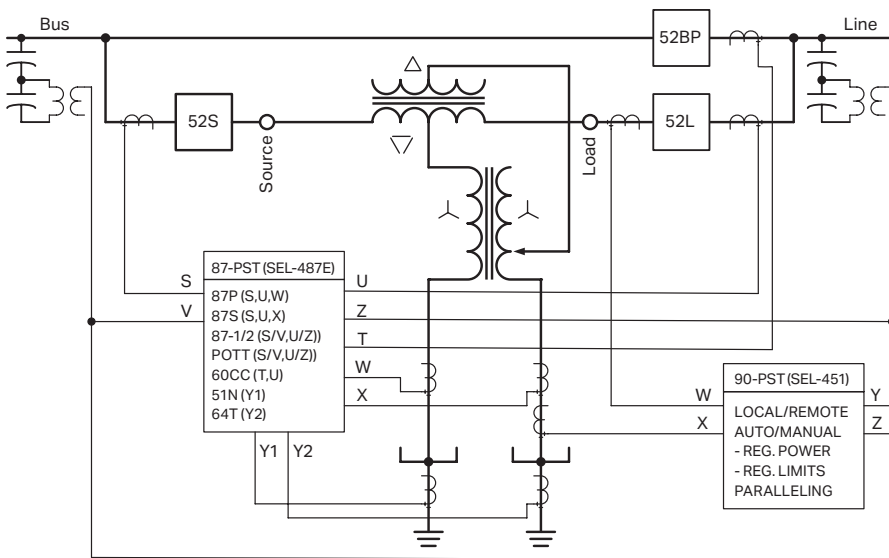
Additionally, this comprehensive solution provides bypass-off-neutral protection (60CC), system ground backup (51N), primary winding restricted earth fault (REF), and secondary winding ground protection (64T).

Pre-Engineered and Custom OLTC Control Systems

PSTs have traditionally been limited to manual control due to the complexities of automatically regulating real power flow on the grid. By adapting an extensive library of solutions to the unique needs of your power flow control applications, SEL solutions can automatically control the OLTCs that regulate power flow through a PST, operate PSTs in parallel, and manage redundant hot-standby automatic control systems.

Support

SEL Engineering Services has decades of experience designing and implementing PST protection and control systems. Our support teams are stationed in regional offices around the globe and staffed with application engineers who are experts in our products and in power system applications. We offer free, 24/7 emergency technical support for the life of SEL products, even if they're outside of our ten-year warranty.



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