

# Next-Generation AI Load Smoothing Controller



# IT-SSO-5/55

Controller

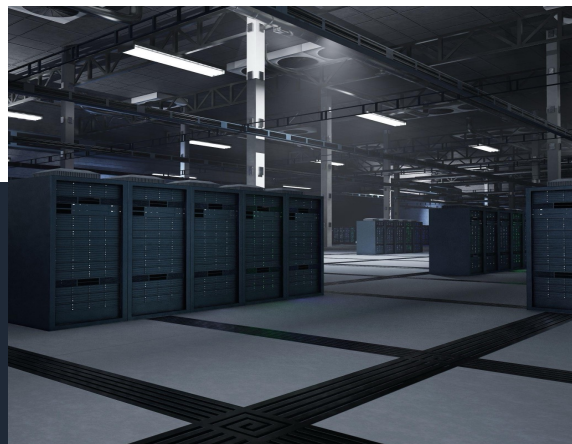
# AI Load Smoothing Controller

## ETP IT-SSO-5/55

The IT\_SST\_5/55 is ETP's next-generation patented controller technology designed specifically to address one of the most critical emerging challenges in AI-driven power systems: torsional interaction between fast-varying AI loads and generator shaft torque dynamics.

As hyperscale AI data centers continue to scale beyond hundreds of megawatts, the industry is now facing a new class of stability and mechanical reliability concerns. Unlike traditional industrial loads, **AI training workloads** introduce highly dynamic and continuously changing power swing characteristics.

These oscillations can propagate into nearby **synchronous generators**, reciprocating engines, and rotating equipment, potentially accelerating fatigue on **generator shafts**, turbine couplings, and reciprocating engine crankshafts.



Conventional mitigation approaches using Battery Energy Storage Systems (BESS), flywheels, E-STATCOMs, and supercapacitors are often limited by two major challenges:

First, the **AI load profile itself is largely unknown** and continuously evolving. Traditional smoothing algorithms are typically designed around fixed or predictable oscillatory modes, making them less effective when exposed to rapidly changing AI training patterns.

Second, existing measurement and control techniques commonly introduce **delays ranging from 5 ms to 30 ms**.

At the oscillation frequencies associated with torsional interactions, these delays can significantly reduce mitigation effectiveness and, in some cases, amplify the problem rather than damp it.

The IT\_SST\_5/55 was specifically developed to overcome both limitations. Leveraging ETP's patented ultra-low-latency control architecture, the IT\_SST\_5/55 enables mitigation devices to dynamically identify and target the exact oscillatory frequencies that adversely impact generator shafts and reciprocating engine crank mechanisms. The controller acts as an advanced ancillary control layer for BESS, flywheels, E-STATCOMs, and supercapacitor systems, allowing these technologies to respond with significantly higher precision and speed than conventional load smoothing methods.



# Key Features

## Up to 60% Reduction in Required BESS Size

Advanced torsional mitigation capability significantly reduces the MW/MWh requirement of conventional mitigation solutions.

## Full SSO Frequency Coverage (5–55 Hz)

Designed to target and mitigate the complete range of sub-synchronous and low-frequency oscillation modes associated with AI-driven loads and rotating machines.

## Ultra-Low Latency Operation

Patented architecture minimizes response delay, enabling fast mitigation of high-speed power swings and torsional interactions.

## Immune to Communication Delays

Controller performance is not degraded by SCADA or communication latency typically observed in conventional smoothing and damping solutions.

## Parallel Operation with Existing Plant Functions

Operates seamlessly alongside LVRT, HVRT, ramp-rate limiters, PPC functions, frequency support, and other existing plant-level controls.

## Compatible with GFL and GFM Technologies

Supports Grid-Following and Grid-Forming inverter architectures without requiring major control redesign.

## OEM Agnostic Integration

Compatible with all major BESS, E-STATCOM, flywheel, and supercapacitor manufacturers.

## Retrofit and Greenfield Deployment Capability

Can be implemented in both new and existing plants with minimal engineering modifications and limited operational disruption.

## Fast Deployment and Minimum Lead Time

Straightforward architecture and simplified integration process enable rapid deployment timelines.

## Simple and Practical Control Design

Easy-to-configure control structure reduces engineering complexity while maintaining high-performance damping and stabilization capability.

# Real-Time Power System Testing with iT-SSO-5/55

The product has been extensively tested and validated within ETP's Hardware-in-the-Loop (HIL) laboratory in Vancouver, British Columbia, where real-time simulations and controller interactions were evaluated under realistic AI load scenarios and generator dynamic conditions.

Data exchange between the simulator and Device Under Test (DuT) occurs via:

- Industrial Communication Protocols (e.g., IEC-61850)
- Analog and Digital I/O
- Fiber Optic connections.

SEL - RTAC



IBR and DER Controllers

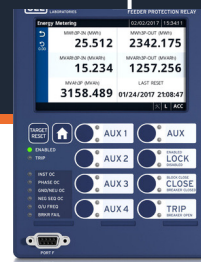


iT-SSO-5/55



The control commands (or setpoints) and protection trip signals, issued by the DuT, are sent back to the real-time simulator

Protection Relays



The dynamic performance of a wide range of embedded control and protection components (i.e., DuT) is verified

Real-Time Simulator:

A real-time simulation shows a complete power system model, including DERs, electrical machines, loads, and transmission and distribution equipment.

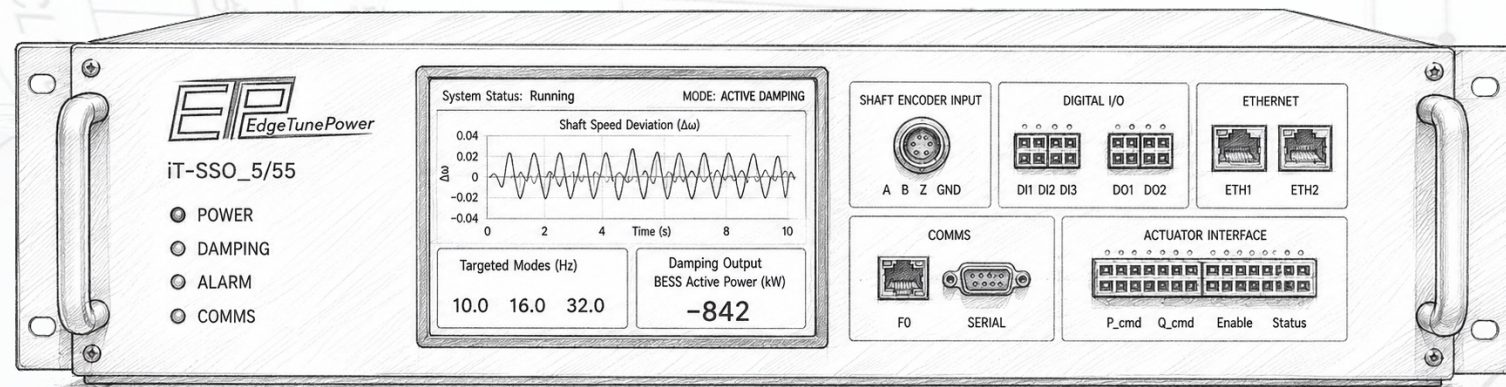
A wide range of electric grid signals, such as voltage, current, and breaker status, is sent to the DuT.

Monitoring Devices



# Specifications

iT-SSO-5/55



## Specifications | Physical Features

<b>High-definition HMI panel</b>	<ul style="list-style-type: none"> <li>• 12.1" (30.7 cm) TFT Display, 1024 x 768 pixels (XGA)</li> <li>• Arm® Cortex®-A72, Dual-core 1.8 GHz</li> <li>• 1x USB 3.0 Host Port, 2x Ethernet (10/100/1000 Mbps), RJ45, Debian/Linux OS, Firefox Browser</li> </ul>
<b>HVAC System</b>	<ul style="list-style-type: none"> <li>• Condensation prevention</li> <li>• Temperature range: -18°C to +65°C (0°F to +149°F)</li> <li>• Fan Auto/On switch with pilot light, aluminum alloy casing</li> </ul>
<b>SEL-RTAC or PLCnext Technology</b>	<ul style="list-style-type: none"> <li>• Dual Ethernet Ports: 2x Ethernet (10/100 Mbps) for communication and networking</li> <li>• High-speed data exchange and protocol conversion</li> <li>• Rugged Design for Industrial Environments</li> <li>• Supports Multiple Protocols including IEC</li> <li>• 61850, DNP3, and Modbus</li> <li>• Secure Remote Access with integrated firewall and VPN support</li> </ul>
<b>Power-supply System</b>	<ul style="list-style-type: none"> <li>• QUINT POWER, 24 V DC / 10 A, DIN rail mounting</li> </ul>
<b>Input-Output Modules</b>	<ul style="list-style-type: none"> <li>• 64 DI-DO, 32 AI-AO, +-TTL voltage range, resolution +-5 µVoltage</li> </ul>
<b>Cabinet Rating</b>	<ul style="list-style-type: none"> <li>• NEMA 4 / IP65</li> </ul>
<b>Cellular-based Module</b>	<ul style="list-style-type: none"> <li>• Industrial 5G router with fallback to 4G, 3G, and 2G networks, and features two Ethernet ports (10/100/1000 Mbps) for high-speed connectivity.</li> </ul>
<b>Single Cabinet Dimensions</b>	<ul style="list-style-type: none"> <li>• 800 mm (W) x 1200 mm (H) x 400 mm (D)</li> <li>• 31.5" (W) x 47.2" (H) x 15.7" (D)</li> </ul>
<b>Performance &amp; Compliance Data</b>	
<b>Grid Code Compliance</b>	<ul style="list-style-type: none"> <li>• IEEE-2800, CSA 22.3, UL 1741, NERC, FERC, RFC (ReliabilityFirst), SERC, WECC</li> </ul>
<b>Warranty</b>	<ul style="list-style-type: none"> <li>• Standard: 3 years, Extended: 4-10 years</li> </ul>
<b>Certifications</b>	<ul style="list-style-type: none"> <li>• UL and CSA</li> </ul>
<b>Compliance</b>	<ul style="list-style-type: none"> <li>• IEC-61850, IEC 60870-5-101/104, Modbus (IEC 61158), IEC 62351, NERC-CIP</li> </ul>
<b>Advanced Features</b>	<ul style="list-style-type: none"> <li>• Modular and scalable design ensures future readiness, with built-in cybersecurity features for operation in challenging environments</li> </ul>



# CONTACT US

GET YOUR FREE DEMO TODAY  
AND EXPLORE OUR ENERGY  
SOLUTIONS!

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