Smart Interlock System
The Complete Solution for Safe Switching Operations
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Unitech specializes in computer-based interlocking system that prevents human errors in substation operations. Since our development of the first generation of Smart Interlock System in 1987, Unitech products and services have been widely used in more than 24,500 power plants and substations worldwide to prevent power interruptions, equipment damage, and loss of human life.

Unitech serves as a key power industry resource for research, development, and power automation services worldwide.

Unitech Smart Interlock System products, services, and expertise ensure power plant and substation safety. Our systems are proven in the field.

This catalog will provide a thorough introduction to Smart Interlock System. Further information is available at http://www.ut-power.com.
Introduction

What is the Cost of Switching Errors?

- Interruption of power
- Equipment damage
- Loss of human life

What are the Causes of Switching Errors?

- Equipment failure
- Control system faults, EMS/SCADA Faults
- Human errors, switching personnel operating on the wrong piece of equipment
Do Conventional Interlocking Solutions Work as Intended?

Conventional Interlocking Methods

Different interlocking devices are used to prevent switching errors:

- Trapped Key Interlock
- Electrical Interlock
- Mechanical Interlock
- Solenoid Interlock

These conventional methods can prevent switching errors in a number of applications, yet none covers all aspects of the problem. Switching personnel operating on a wrong piece of equipment can still cause a switching error even though an interlock device is installed on the equipment. A similar problem can be found during remote operation at a dispatching center where an incorrect mouse click by the operator on an EMS/SCADA system may cause a switching error.

The Need for a Comprehensive Safety Solution

Statistical studies show most switching errors are caused by human error which can be minimized with proper interlocking design. Taking a more comprehensive interlocking design approach raises protection and safety levels of the switching process.
Comprehensive Protection Attributes

Breaker Bay Interlocking Across Wider Areas

It is essential that interlocking capability spans the entire switching apparatus including all switches and breakers within the same substation or substation systems. This requirement recognizes that opening or closing a breaker or switch can be dependent on the equipment status in a different breaker bay.

Sequence and Location Validation

Switching personnel must be fully aware of the impact of each switching step and have the assurance that the next step is proven safe before switching actually takes place. This would require a simulation system that accurately models the connectivity of substation and logic of switching sequences.

Surveillance Function for EMS/SCADA Remote Operation

Switching error can be caused by an incorrect remote operation on the EMS/SCADA system. A surveillance function for EMS/SCADA remote operation is an indispensable attribute of an outstanding interlocking system.
UNITECH Smart Interlock System

Remote Operation Surveillance
Serial Port Communication
Ethernet Communication

Operation Request
SCADA → SIS Host

Device Status

Switching/Dispatching Center

CDMA
ZigBee

Switching order / Operation Permission

Smart Key
Field Switching

Control Room
Dispatchers/Job Supervisor

Substation Relay Room
Field Staff

Padlock
Circuit Lock
Fixed Lock

Other Locks
Why Use Unitech Smart Interlock System?

The Unitech Smart Interlock System (SIS) has been designed to fulfill the safety requirements of substations and switching/dispatching centers. SIS has inherent advantages over conventional interlocking product solutions. SIS combines the reliability of mechanical interlocking and the flexibility of electrical interlocking. More importantly, the Unitech Smart Interlock System uses the following revolutionary design concepts:

Simulation Before Switching

Unitech SIS uses a Five Step Method that incorporates a Simulation Before Switching process that prevents incorrect switching sequences from occurring.

To ensure that switching personnel operating on the correct device, device identity and operation permissions are validated before switching.
Comprehensive Switching Coordination

The Smart Interlock System collects and models switching interlocking logic and rules differently from conventional methods. SIS uses AMEO programming language to express switching interlocking logic and rules of substation equipment. As a result, SIS interlocking coverage is no longer limited to specific devices within a breaker bay. SIS can encompass an entire substation or several substation systems controlled by a switching/dispatching center. The SIS capability to handle larger substation systems results in a comprehensive solution for switching protection and safety.

User Friendly Operation

Smart Key technology with its unified, standardized lock cylinder makes the switching process simple. Switching personnel only need to carry one key to open all locks. There is no need for multiple keys.

By following the operating procedure displayed on the Smart Key screen, switching personnel can avoid switching errors and ensure that correct sequences are followed during the entire switching process.

Development History

Unitech is committed to providing advanced switching safety solutions to the power industry since the first computer-based interlocking system was invented in 1987. Unitech devotes significant resources to research and innovations in safe switching technology. The Smart Interlock System is Unitech’s third generation switching safety product and incorporates advanced Radio Frequency Identification (RFID).
Proven Power System Solution That Scales

The Unitech Smart Interlock System (SIS) scales from single on-duty substation to the entire substation system that includes hundreds of substations controlled by a switching/dispatching center.

Smart Interlock System Scalability

SIS can be used in single substation environment or large scaled substation systems. SIS has the built-in capability to seamlessly incorporate the changing grid structure and switching equipment of all substations that are controlled by a switching/dispatching center.

Smart Key Communication Methods

SIS uses the ZigBee low cost, low power, wireless mesh networking standard as the primary data exchange solution in a single on-duty substation environment.

SIS uses CDMA or GPRS mobile connectivity with larger projects that have a switching/dispatching center that controls multiple remote substations.
## Specifications

### Smart Interlock System Host

<table>
<thead>
<tr>
<th>Type</th>
<th>Computer</th>
<th>All-in-one Computer</th>
<th>Mimic Board</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Applicable Scope</strong></td>
<td>On-duty substation</td>
<td>On-duty substation</td>
<td>On-duty substation</td>
</tr>
<tr>
<td></td>
<td>Switching center</td>
<td>Switching center</td>
<td>Switching center</td>
</tr>
<tr>
<td></td>
<td>Dispatching center</td>
<td>Dispatching center</td>
<td>Dispatching center</td>
</tr>
<tr>
<td><strong>Operating System</strong></td>
<td>Windows</td>
<td>Vxworks</td>
<td>Vxworks</td>
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<tr>
<td><strong>Communication</strong></td>
<td>CDMA</td>
<td>CDMA</td>
<td>CDMA</td>
</tr>
<tr>
<td>Methods</td>
<td>GPRS</td>
<td>GPRS</td>
<td>GPRS</td>
</tr>
<tr>
<td></td>
<td>ZigBee</td>
<td>ZigBee</td>
<td>ZigBee</td>
</tr>
<tr>
<td></td>
<td>Ethernet</td>
<td>Ethernet</td>
<td>Ethernet</td>
</tr>
<tr>
<td></td>
<td>Serial port RS485/RS232</td>
<td>Serial port RS485/RS232</td>
<td>Serial port RS485/RS232</td>
</tr>
<tr>
<td><strong>Maximum Number of</strong></td>
<td>16</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td><strong>Parallel Operation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interlocking Points</strong></td>
<td>10000</td>
<td>3000</td>
<td>10000</td>
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<tr>
<td><strong>MTBF</strong></td>
<td>Depends on computer</td>
<td>20000 hours</td>
<td>50000 hours</td>
</tr>
<tr>
<td><strong>Voltage Range</strong></td>
<td>110V AC to 220V AC</td>
<td>110V AC to 220V AC</td>
<td>110V AC to 220V AC</td>
</tr>
<tr>
<td></td>
<td>110V DC to 220V DC</td>
<td>110V DC to 220V DC</td>
<td>110V DC to 220V DC</td>
</tr>
<tr>
<td><strong>Temperature Range</strong></td>
<td>Depends on computer</td>
<td>-40°C to +70°C</td>
<td>-40°C to +70°C</td>
</tr>
</tbody>
</table>
Smart Key

- One Smart Key for all locks
- User friendly interface
- Various communication options: CDMA, GPRS, ZigBee, IRDA
- Low power consumption
- Voice guidance instruction
- Mechanical rotate unlocking mode
- Power-down memory function

<table>
<thead>
<tr>
<th></th>
<th>iKey-s</th>
<th>iKey-M</th>
</tr>
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<tbody>
<tr>
<td>Temperature Range</td>
<td>-40°C to +70°C</td>
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</tr>
<tr>
<td>IP CODE</td>
<td>IP51</td>
<td>IP62</td>
</tr>
<tr>
<td>MTBF(hours)</td>
<td>≥ 50000</td>
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</tr>
<tr>
<td>Maximum Steps per Switching Order</td>
<td>≤ 4096</td>
<td></td>
</tr>
<tr>
<td>Switching Order Storage Capacity</td>
<td>≥ 400</td>
<td>≥ 2048</td>
</tr>
<tr>
<td>Maximum RFID detection number</td>
<td>≥ 65535</td>
<td></td>
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<tr>
<td>Continuous Operating Time</td>
<td>≥ 8</td>
<td>≥ 10</td>
</tr>
<tr>
<td>Screen Resolution</td>
<td>160×128</td>
<td>320×240</td>
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</tbody>
</table>
## Locks and Accessories

- Unified cylinder interface
- High mechanical strength
- Anticorrosive, rust resistant material
- Anti-jamming structure
- High reliability RFID identification

<table>
<thead>
<tr>
<th>Type</th>
<th>Applications</th>
<th>Materials</th>
<th>Temperature Range</th>
<th>IP code</th>
<th>Service Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Padlock</td>
<td>Breaker Disconnect Ground switch</td>
<td>Stainless steel, Brass, Zinc alloy</td>
<td>-40°C to +60°C</td>
<td>IP56</td>
<td>≥ 10000 times</td>
</tr>
<tr>
<td>Fixed lock</td>
<td>Breaker Disconnect Ground switch</td>
<td>Stainless steel, Brass</td>
<td>-40°C to +60°C</td>
<td>IP56</td>
<td>≥ 50000 times</td>
</tr>
<tr>
<td>Circuit lock</td>
<td>Buttons on the control panel</td>
<td>Engineering plastic AES</td>
<td>-25°C to +60°C</td>
<td>IP62</td>
<td>≥ 10000 times</td>
</tr>
<tr>
<td>Lock box</td>
<td>Buttons on the control panel</td>
<td>Engineering plastic AES</td>
<td>-25°C to +60°C</td>
<td>IP62</td>
<td>≥ 10000 times</td>
</tr>
<tr>
<td>Cabinet door lock</td>
<td>Cabinet door</td>
<td>Stainless steel</td>
<td>-40°C to +60°C</td>
<td>IP56</td>
<td>≥ 10000 times</td>
</tr>
<tr>
<td>Ground wire lock</td>
<td>Ground wire</td>
<td>Brass</td>
<td>-40°C to +60°C</td>
<td>IP56</td>
<td>≥ 10000 times</td>
</tr>
</tbody>
</table>

Unitech stocks hundreds of locks and accessories that fulfill the different interlocking requirements of substation equipment.
Ground Wire Management System

The Ground Wire Management System (GWMS) is an intelligent electronic device (IDE) that manages temporary ground wires in substations and power plants. GWMS can be operated in a standalone mode or integrated with SIS.

The Ground Wire Management helps ensure safe power system operation. GWMS can identify ground wires and their assigned positions in real-time. Use of GWMS reinforces the rules and standards of safe management of ground wires.
**Key Features**

**Ground Wire Management**
- Unique ID for each ground wire
- Detailed records of ground wire usage.
- Ground wires with different voltage levels simultaneously managed
- Tracking of storage position for each ground wire
- Management of up to 64 ground wire sets.

**Ground Wire Operation**
- Ground wire usage only after unlocking
- Intelligent voice guidance to enhance operation safety
- Two modes of operation (SIS integration or standalone)
- Integrate ground wire operations into procedures defined by SIS

**Real-Time Status**
- Real-time display of ground wires connection and position status

**Other Features**
- Save up to 1000 operation records
- No data loss for 10 years even under a power-off condition
- Large 3.5 inch LCD display
- Rust-proof all-metal cover
- Mechanical unlocking available in an emergency
- Easy and flexible integration with the Smart Key Cabinet or other tool chambers
Smart Key Cabinet

Smart Key Cabinets can manage both Smart Keys and regular keys. Access to stored keys can be authorized by means of Radio Frequency Identification (RFID) card, computer network log-ins, or mobile phone SMS. Smart Key Cabinet precisely records the date and time when the user borrows or returns a key. Smart Key Cabinets greatly reduce complexity and improve key management within substations and power plants.
Key Features

Key Management
Various types of keys can be securely and safely stored in Smart Key Cabinet, including Smart Keys, electric unlocking keys, mechanical unlocking keys, step-skipping keys, and drive-by-wire keys. With a Smart Key Cabinet solution, only authorized personnel are allowed to have access to master keys.

Key Usage Automatically Recorded
Key usage and status records are automatically saved. Records include key description, usage information, authorizer data, and date and time. Up to 10000 records can be saved in memory.

Single Key Authorization Mode
Authorization can be designated to a single key. All other keys remain in a locked state.

Cabinet Extension
Up to 128 Smart Key Cabinets can be connected using a RS485 bus. One of the Smart Key Cabinet can be configured to control all others within the system.

Data Communication Methods
Smart Key Cabinet has a built-in serial port, Ethernet port and USB port. Data can be imported or exported using an USB device or remotely managed by mobile phone SMS and internet browser.
The Complete Solution for Safe Switching

25 years of experience
Operations

with more than 25,000 installed Smart Interlock Systems.