

# GEIS

## RelGuard

# Trapped Key Interlocks

GEIS Electrical Protection

Safer Smarter Greener



## About GEIS

GEIS was established in 2019 following the spin-off of several businesses and assets that ABB had acquired from GE on July 1, 2018, including 3 manufacturing centers, Warehousing & Trading business at FTZ, China Technology Center.

- Components: Full range of circuit breakers up to 40.5kV: Medium voltage vacuum circuit breakers, LV circuit breakers: ACB, MCCB, MCB, RCD, RCBO: Control components.
- Equipment: MV switchgear (Air insulation and Gas Insulation Technology), LV switchgear, switchboard.
- Medium voltage distribution transformer.
- Medium voltage ATS system (Paralleling Switchgear).

After the separation, all the above product lines were rebranded as AEG for selected markets and GEIS for global markets. Moreover, GEIS has expanded its technological portfolio to include medium-voltage controls such as VFDs and soft starters, as well as ATS systems and EV chargers.



## Quality is Built-in

### Where Technology Meets Manufacturing Excellence for Customers

- Since 2000, we have been specializing in localizing world-class products and manufacturing technologies, developing strong expertise and a highly capable team.
- Vertical integrated Shanghai Manufacturing Center brought key manufacturing processes into a 75,000 m<sup>2</sup> facility, enabling high-quality, high-efficiency production and fostering innovation. A dedicated R&D team committed to developing products that meet global standards and serve diverse applications.
- Global expansion: GEIS's first Thailand facility makes it easier to serve customers worldwide.



### GEIS deliver complete range of products for the evolving electrification needs:



**SecoVac** VCB



**M-PACT Plus** ACB



**Elfa** Series MCB/RCBO



**SolidDrive** MV VFD



**SecoGear** MV Switchgear



**RMU** Gas Insulated Switchgear



**WaveCast** Transformer



**MLS** LV Switchgear

# RelGuard Trapped Key Interlocks

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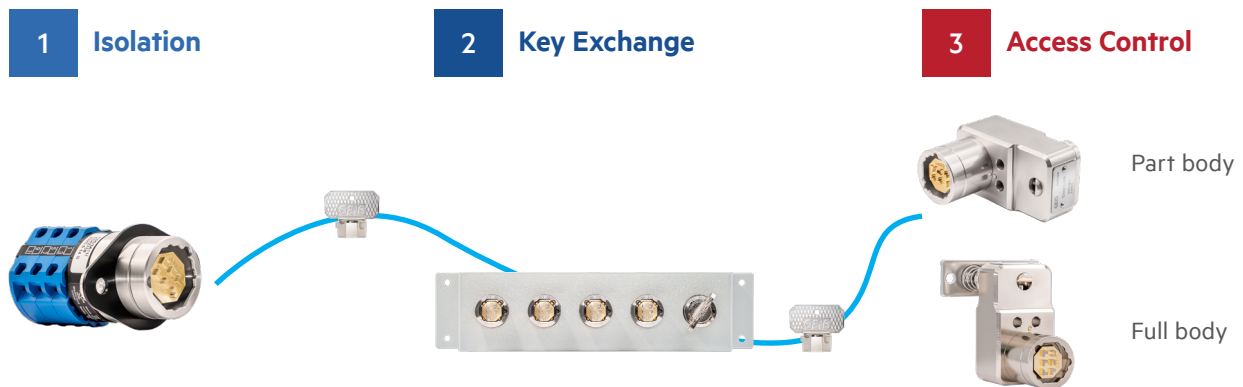
## Description

Trapped Key Interlocking is a proven mechanical safety system that ensures safe operation of electrical equipment by enforcing a pre-defined operating sequence. Through the controlled release and transfer of uniquely coded keys, the system makes unsafe operations physically impossible.

Engineered to perform in the harshest conditions, the system delivers exceptional environmental resilience from -55°C to +85°C, withstanding high humidity, salt mist, dust, vibration, and solar radiation in full compliance with international standards.

GEIS RelGuard Interlocking System Built for Extremes. It converts safety procedures into physical safeguards—delivering confidence, consistency, and protection for both personnel and equipment.

### The three points of trapped key interlocking



## Description

### Technical Specifications

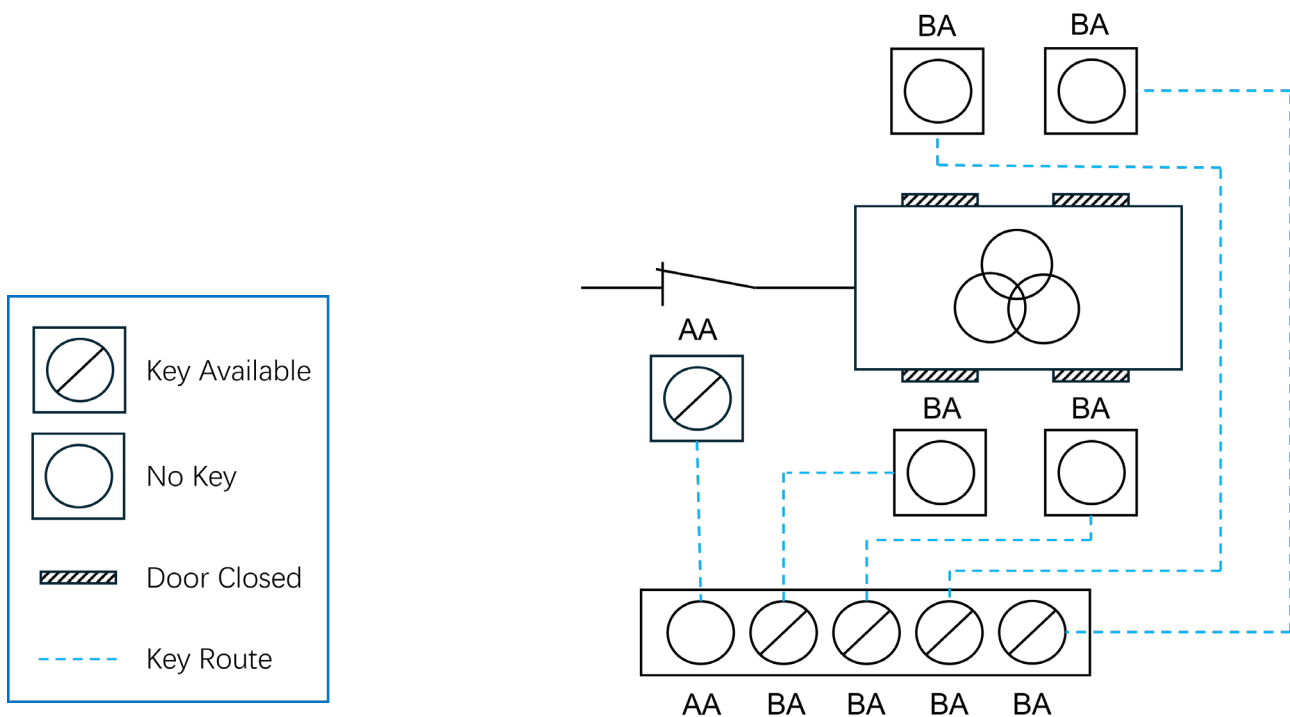
| Environmental performance                  |                                                                                |
|--------------------------------------------|--------------------------------------------------------------------------------|
| Low air temperature                        | -55°C, Compliant with the IEC 60068-2-1 standard                               |
| Atmospheric temperature at high altitude   | 85°C, Compliant with the IEC 60068-2-2 standard                                |
| Temperature change rate                    | -55°C ~ 85°C, Compliant with the IEC 60068-2-14 standard                       |
| High temperature and high humidity         | 25°C ~ 85°C, 99% relative humidity, Compliant with the IEC 60068-2-30 standard |
| Salt spray                                 | 720h, Compliant with the IEC 60068-2-11 standard                               |
| Electrochemical compatibility of materials | Compliant with the MIL-STD-889D                                                |

| Mechanical properties             |                                                               |
|-----------------------------------|---------------------------------------------------------------|
| Impact                            | IK08                                                          |
| Vibration                         | Compliant with the IEC 60068-2-6, IEC 61373 standard          |
| Low pressure                      | Compliant with the IEC 60068-2-13 standard                    |
| Solar radiation                   | Compliant with the IEC 60068-2-5 standard                     |
| Dust and dirt                     | Compliant with the IEC 60068-2-68 standard                    |
| Mechanical safety and reliability | B10d, 1000000 cycles, Compliant with the ISO 13849-1 standard |
| PL Level                          | PLd                                                           |
| Protection level                  | IP40                                                          |
| Mechanical tolerance              | ≥60daN                                                        |

| Environmental protection and chemical compliance                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------|
| Compliant with the requirements for restricted substances as stipulated in RoHS, REACH, TSCA, PFAS, SCIP, CMRT, EMRT and Prop 65 |

**Applications****Maintenance Interlock for Low-Voltage Switchgear in Wind Farms****Transfer Switch + 4 Doors**

1. Turn off the power supply of the electrical cabinet by unlock the switch and obtain free key AA;
2. Insert mentioned free key AA into the exchange box and unlock to free four keys BA.
3. Use key BA to open the cabinet door and begin maintenance; in this process AA key remain captured in exchange box to prevent any mistake operation to energize the cabinet
4. After completing the task, return the four keys BA in sequence. Reverse the previous steps to free AA key from exchange box then use the AA key to restore power of cabinet.

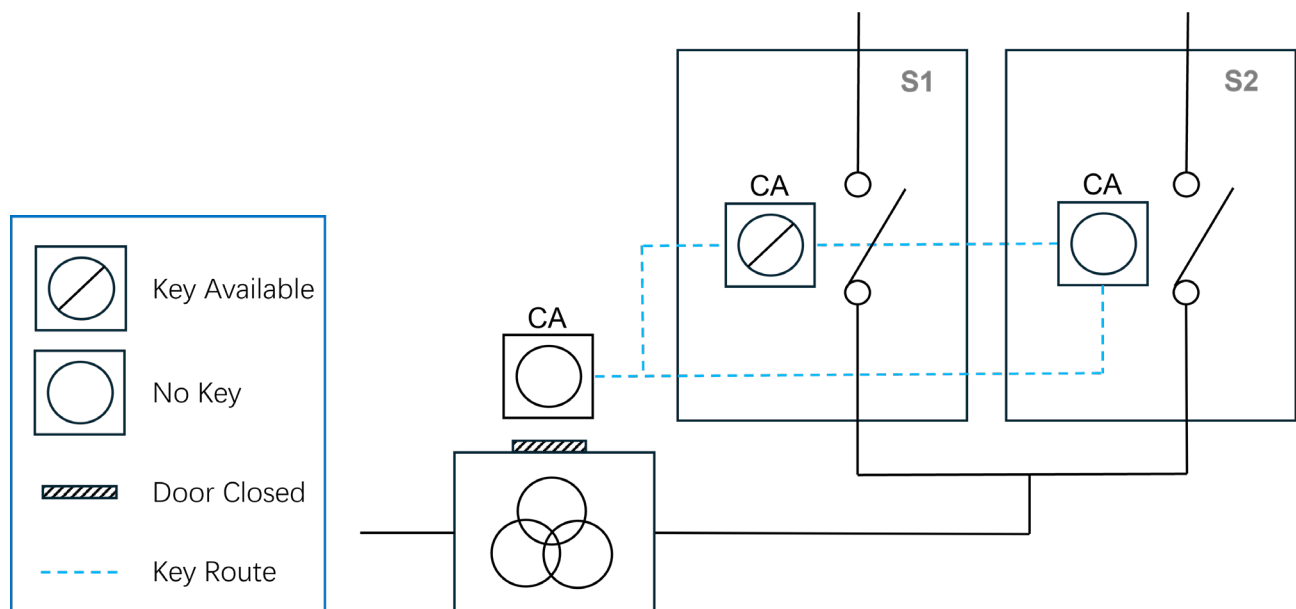


## Description

### Interlocking System for Dual Incoming Line Switchgear

#### Two Switches + One Door

1. Power off the circuit breaker S1 for line 1 by locking the switch lock to secure it in the open position and retrieve free key CA; (this operation may apply to line 2 if certain line is energized.)
2. Insert the key into cabinet door lock CA to open the door for maintenance task;
3. After maintenance is completed, close the door and retrieve key CA, then unlock the switch lock of S1 or S2 and close the circuit breaker to restore operation.

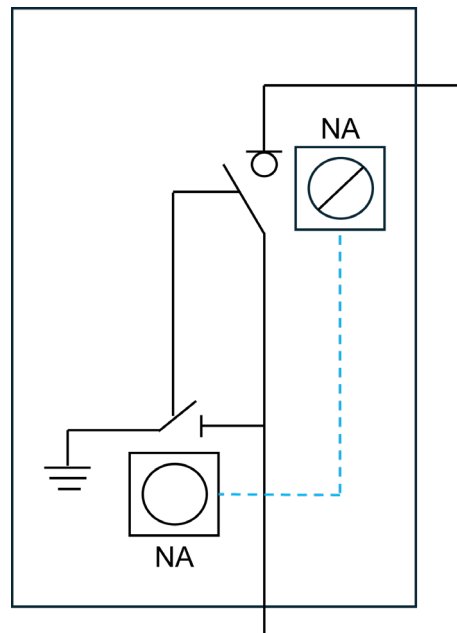
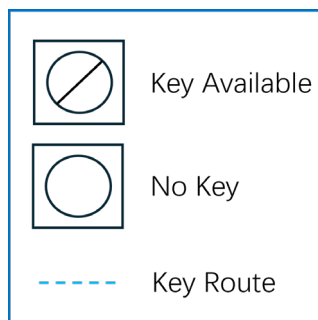


## Description

### Interlock Procedure for Disconnect Switch Opening and Grounding for Maintenance

#### Disconnect Switch + Grounding Switch

1. Open the disconnect switch, lock it in the open position, and retrieve free key NA;
2. Insert the mentioned key NA into the grounding switch lock, turn to unlock the grounding switch to make grounding switch on; key NA remains secured in the lock in the process of following maintenance work
3. Close the grounding switch to begin maintenance;
4. After the maintenance work is completed, restore normal status by reversing the sequence of steps.

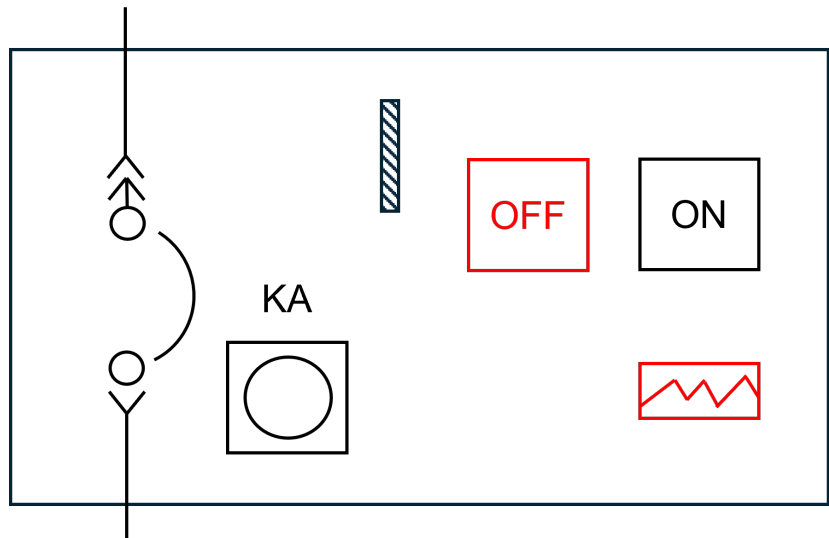
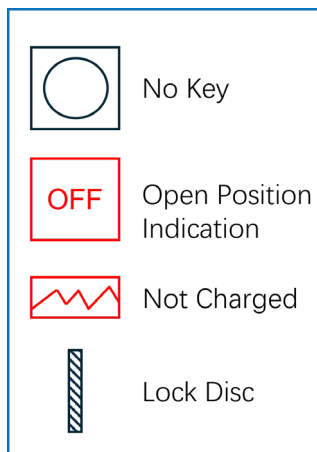


## Description

### Circuit Breaker Closing Lock

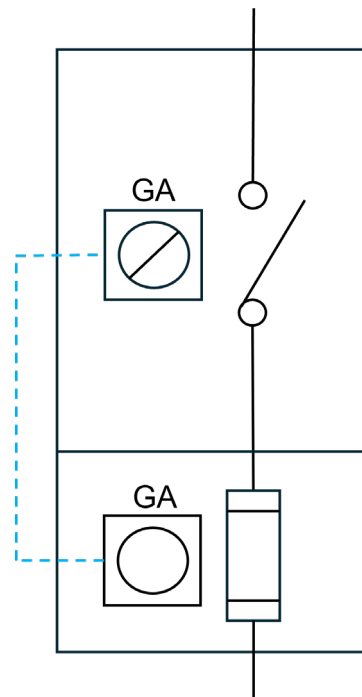
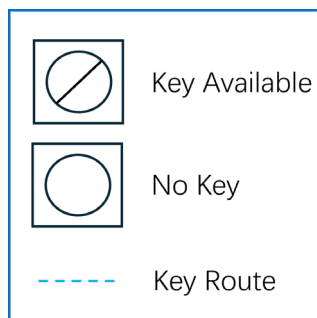
#### Air Circuit Breaker

1. Charge the closing spring for the circuit breaker until the red indicator turns green.
2. Insert key KA into the lock, rotate to unlock, and complete closing preparation; the “READY” indicator will illuminate indicating that the braker is ready to close.
3. Press the closing button to close the circuit breaker.
4. Press the opening button to open the circuit breaker. After opening, key KA is freed to be removed, but the latch must be pulled first before key is removed.



**Fuse Maintenance Interlock for Switchgear****Switch + Cabinet Door**

1. Open the switch, lock the switch lock to secure it in the open position, and obtain key GA.
2. Insert key GA into the fuse compartment door lock, turn the key to open the door; the key remains secured in the lock.
3. Begin the maintenance work.
4. After the maintenance work is completed, restore normal operation by reversing the sequence of steps.

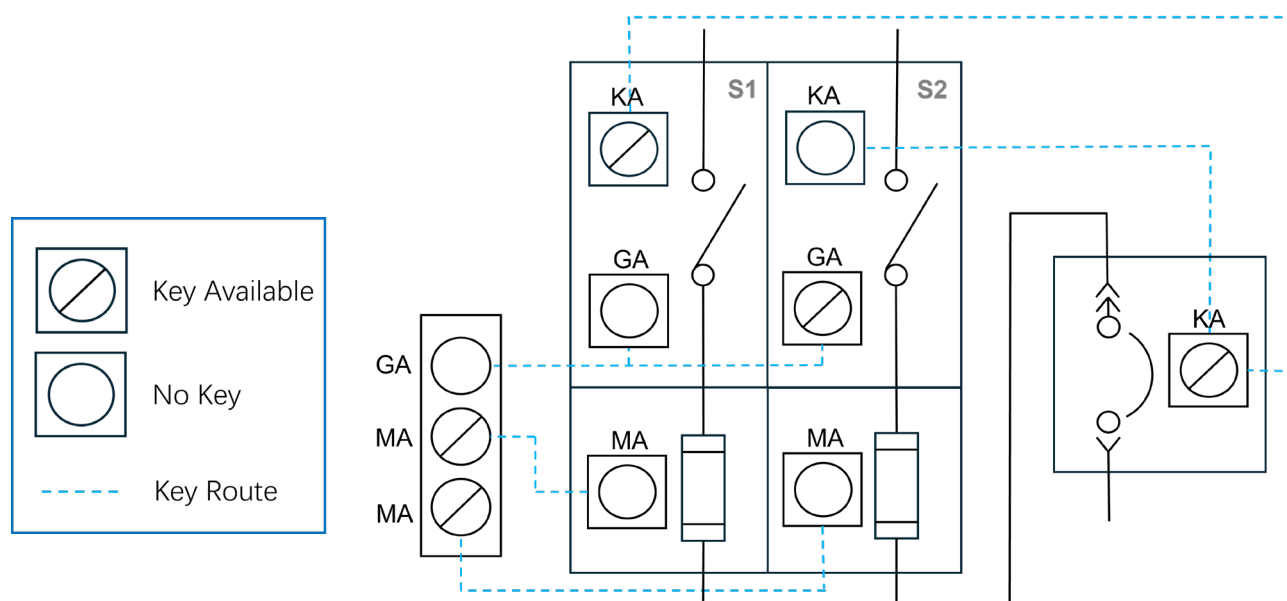


## Description

### Interlock for Fuse Maintenance in Medium/Low Voltage Switchgear with Dual Incoming Lines Air Circuit Breaker + Dual Load Switches + Dual Fuse Cabinet Doors

1. Open the low-voltage circuit breaker by unlocking the breaker lock and retrieve free key KA.
2. Insert mentioned key KA into the interlock of switch S2 to unlock it; the key remains secured in the lock.
3. Open switch S2 for line 2, lock the switch lock to secure it in the open position, and free key GA.
4. Insert the mentioned key into the exchange box at position GA, then release the rest two keys MA which previously secured in exchange box; key GA remains secured in the exchange box.
5. Use keys MA to open both fuse cabinet doors simultaneously; during maintenance work, keys MA remain secured in the locks, to prevent any mis operation.
6. After the maintenance work is completed, ensure both cabinet doors are fully closed. \*Restore normal status by reversing steps of operation.

\*During reverse operation steps, either S1 or S2 may be closed by using key GA to unlock its open-position lock.



## Transfer Switch



- Key driven electrical switch
- Designed for machine control circuits
- Intended for short term, off load isolation usage
- To be mounted into an existing panel or for surface mounting
- Available with 20 A as standard
- Environmentally resistant construction.
- Metal surfaces: nickel-plated or passivated.
- Salt spray resistance: ≥720 hours.

### Application

TS transfer switch is used as part of an integrated safety system for machine guarding and typically works in combination with an access interlock. When the key on the TS is turned and removed, the switch opens the machine's safety circuit to bring the equipment to a safe state; the released key is then taken to the access interlock to permit controlled entry. The machine cannot be restarted until the guard door is closed, the bolt is securely trapped in the access interlock, and the key is removed and returned to the TS Transfer Switch.

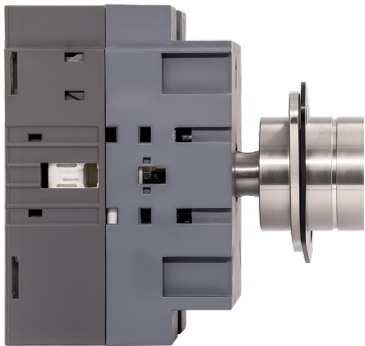
### Order Information

|             |     |    |   |    |   |
|-------------|-----|----|---|----|---|
| Part Number | 1   | 2  | 3 | 4  | 5 |
| RLGTS1206   | RLG | TS | 1 | 20 | 6 |

|   |                    |                         |
|---|--------------------|-------------------------|
| 1 | RELGUARD INTERLOCK | RLG                     |
| 2 | COMPONENT TYPE     | TS: TRASFER SWITCH LOCK |
| 3 | FORM               | 1/2                     |
| 4 | TRASFER SWITCH     | 20 : 20A                |
| 5 | NUMBER OF CONTACT  | 6                       |

Isolation

Disconnect Switch



- Key driven disconnect switch for the isolation of currents/ motors
- Complete with 3 main poles
- Suitable for use in standard or harsh, corrosive environments
- Panel or surface mounting
- 100 A standard version
- Environmentally resistant construction.
- Metal surfaces: nickel-plated or passivated.
- Salt spray resistance: ≥720 hours.

Application

The DS disconnect switch is designed to operate as part of an integrated safety system, controlling access to hazardous areas. Typical machinery using the DS range are motor-driven, high-risk applications where complete isolation of the power supply is required before access is granted. Removing the key from the DS changes the machine’s electrical supply to a safe state; the key can then be used at the access interlock to gain entry to the hazardous area. The machine cannot be restarted until the access door is closed and locked, and the key is returned to and reinserted into the DS.

Order Information

|             |     |    |   |     |
|-------------|-----|----|---|-----|
| Part Number | 1   | 2  | 3 | 4   |
| RLGDS1100   | RLG | DS | 1 | 100 |

|   |                    |                            |
|---|--------------------|----------------------------|
| 1 | RELGUARD INTERLOCK | RLG                        |
| 2 | COMPONENT TYPE     | DS: DISCONNECT SWITCH LOCK |
| 3 | FORM               | 1/2                        |
| 4 | DISCONNECT SWITCH  | 100:100A                   |

## Key Exchange

### Exchange Box



- Enables sequential key release triggered by inserting an initial key
- Suited for installations with multiple access points
- Offered in various configurations and lock quantities
- Surface mounting
- A maximum of 5 selector knob positions is available
- Supplied in an enclosure suitable for surface mounting
- Environmentally resistant construction.
- Metal surfaces: nickel-plated or passivated.
- Salt spray resistance:  $\geq 720$  hours.

### Application

The E key exchange box is designed to release secondary keys upon the insertion of one or more primary keys. This type of product is typically used where there are multiple points of entry. The unit generally serves as the link between isolation locks and access devices. It is supplied in a surface-mountable enclosure and is available in various configurations and lock counts.

### Order Information

Part Number

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

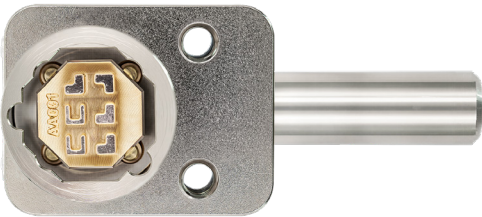
RLGE4VAB

|     |   |   |   |   |   |
|-----|---|---|---|---|---|
| RLG | E | 4 | V | F | G |
|-----|---|---|---|---|---|

|   |                      |                              |
|---|----------------------|------------------------------|
| 1 | RELGUARD INTERLOCK   | RLG                          |
| 2 | COMPONENT TYPE       | E: KEY EXCHANGE BOX          |
| 3 | QUANTITY OF LOCK     | 3: 1/2<br>4: 1/3<br>5: 1/4   |
| 4 | MOUNTING             | H: HORIZONTAL<br>V: VERTICAL |
| 5 | FREE KEY LOCATION    | F                            |
| 6 | TRAPPED KEY LOCATION | G                            |

Access Control

Bolt Lock



- Key-operated mechanical bolt interlock
- Designed for controlling electrical switchgear
- Features a bolt available in various lengths
- Comes with a diameter bolt available in various lengths
- Environmentally resistant construction.
- Metal surfaces: nickel-plated or passivated.
- Salt spray resistance: ≥720 hours.

Application

The bolt lock is used as part of an integrated safety system. Under normal conditions, mechanical interlocking is achieved using two bolt locks in combination with a single key. The two bolt locks are interlinked: when the key is trapped in either lock, the other side cannot be operated. Only after the required condition is met and the key is released can it be transferred to the other lock to perform the next step. This arrangement is suitable for sequential safety procedures such as power-off → grounding → door opening.

Order Information

|             |     |   |   |   |
|-------------|-----|---|---|---|
| Part Number | 1   | 2 | 3 | 4 |
| RLGBG2      | RLG | B | D | 2 |

|   |                          |                               |
|---|--------------------------|-------------------------------|
| 1 | RELGUARD INTERLOCK       | RLG                           |
| 2 | COMPONENT TYPE           | B: BOLT LOCK                  |
| 3 | EXTENDED BLOT LENGTH(MM) | B: 25.4<br>D: 38.1<br>E: 44.4 |
| 4 | FORM                     | 1/2/3/4                       |

Door Lock



- Two-part panel door interlock
- Consists of a lock body plus a catch mounted for rear entry
- Commonly used to interlock electrical control cubicles and distribution panels
- Also suitable for light access doors or hatches
- Catch available in two variants to suit well-aligned or misaligned doors
- Environmentally resistant construction.
- Metal surfaces: nickel-plated or passivated.
- Salt spray resistance: ≥720 hours.

Application

The Door Locks used as part of an integrated safety system. When power is applied, access doors to the hazardous area are locked closed. Removing the isolation key from the TS or DS isolates the electrical supply to the panel; this key is then used to unlock the door interlock on the panel door. Power cannot be restored until the door is closed, the catch is trapped, and the key has been returned to the TS or DS.

Order Information

Part Number

1

2

3

4

**RLGDG2**

RLG

D

G

2

|   |                    |                                   |
|---|--------------------|-----------------------------------|
| 1 | RELGUARD INTERLOCK | RLG                               |
| 2 | COMPONENT TYPE     | D: DOOR LOCK                      |
| 3 | CATCH TYPE         | D: SOLID CATCH<br>G: SPRING CATCH |
| 4 | FORM               | 1/2/3/4                           |

Keys & Accessories

Key



- Nickel-plated brass
- Each key is a password, encoded by specific digital patterns and accurately manufactured with CNC technology.
- 36720 code options available
- Environmentally resistant construction.
- Metal surfaces: nickel-plated or passivated.
- Salt spray resistance: ≥720 hours.

Order Information

Part Number 

|   |   |   |
|---|---|---|
| 1 | 2 | 3 |
|---|---|---|

RLGKYW 

|     |    |   |
|-----|----|---|
| RLG | KY | W |
|-----|----|---|

|   |                    |                                                         |
|---|--------------------|---------------------------------------------------------|
| 1 | RELGUARD INTERLOCK | RLG                                                     |
| 2 | COMPONENT TYPE     | KY: KEY                                                 |
| 3 | KEY TYPE           | R: Disconnect switch KEY<br>W: WIDE KEY<br>S: Short KEY |

Keys & Accessories

Protective Cap



- Protective cap
- Helps prevent dust from entering the lock components
- Can be fitted with a padlock to prevent lock operation during maintenance
- Environmentally resistant construction.
- Metal surfaces: nickel-plated or passivated.
- Salt spray resistance: ≥720 hours.

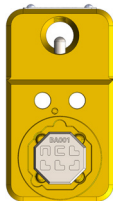
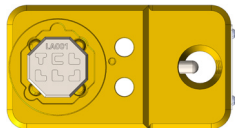
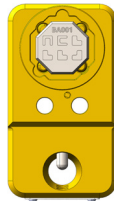
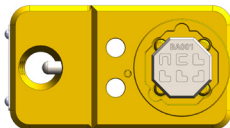
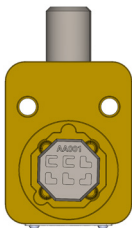
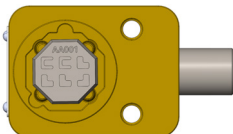
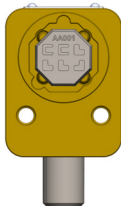
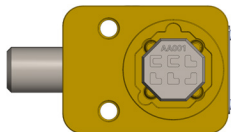
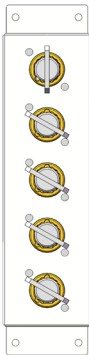
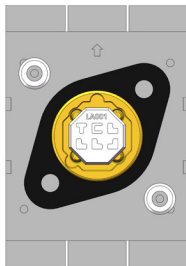
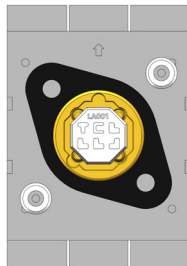
Order Information

Part Number 1 2

RLGCAP RLG CAP

|   |                    |                     |
|---|--------------------|---------------------|
| 1 | RELGUARD INTERLOCK | RLG                 |
| 2 | COMPONENT TYPE     | CAP: PROTECTIVE CAP |

Form

| COMPONENT TYPE    | INSTALLATION DIRECTION                                                                         |                                                                                                 |                                                                                                    |                                                                                               |
|-------------------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| DOOR LOCK         | FORM 1<br>    | FORM 2<br>     | FORM 3<br>       | FORM 4<br> |
| BLOT LOCK         | FORM 1<br>    | FORM 2<br>     | FORM 3<br>       | FORM 4<br> |
| EXCHANGE BOX      | VERTICAL<br> |                                                                                                 | HORIZONTAL<br> |                                                                                               |
| Disconnect Switch | FORM 1<br>  | FORM 2<br> |                                                                                                    |                                                                                               |
| Transfer Switch   | FORM 1<br>  | FORM 2<br> |                                                                                                    |                                                                                               |

## Application Example

### Presentation Requirements:

- 01 Only when the low-voltage main circuit breaker is in the open position can other operations be performed.
- 02 The load disconnect switches of the medium-voltage cabinet are interlocked (two-in-one).
- 03 The door can be opened and fuse operations can be carried out only after all the load disconnect switches are in the open position.

### Product List



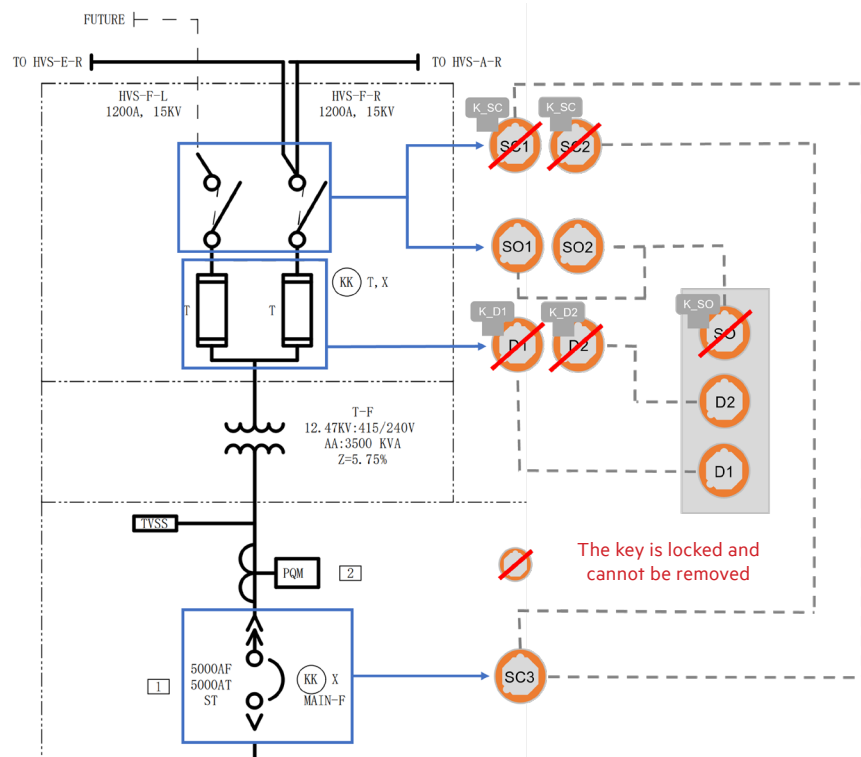
Lock x7



Key x5



Three-key key exchange box x1



## Reliability Test Summary

| Test items                                        | Test parameters                                                                                                                                                                                                                                                                                     | Test standards   |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Low air temperature                               | -40°C                                                                                                                                                                                                                                                                                               | IEC 60068-2-1    |
| High air temperature                              | 60°C                                                                                                                                                                                                                                                                                                | IEC 60068-2-2    |
| Rate of change of temperature                     | -40°C ~ 60°C, rate 1°C/min, 10hours/cycle                                                                                                                                                                                                                                                           | IEC 60068-2-14   |
| Freeze thaw                                       | -40°C ~ 60°C, 6hours/cycle                                                                                                                                                                                                                                                                          | IEC 60068-2-14   |
| Condensation                                      | 25°C ~ 60°C, 99%RH                                                                                                                                                                                                                                                                                  | IEC 60068-2-30   |
| High relative humidity                            | 25°C ~ 60°C, 99%RH                                                                                                                                                                                                                                                                                  | IEC 60068-2-30   |
| Salt spray                                        | 5% NaCl by mass, pH 6.5–7.2 at 25°C.                                                                                                                                                                                                                                                                | IEC 60068-2-11   |
| Swept-Sine Vibration                              | 10 sweep cycles per axis (a sweep cycle is defined as from Low-to-High then High-to-Low frequency). The rate of sweep within the sweep cycle will be 1 octave/min. Results shall be made available to GE Vernova                                                                                    | IEC 60068-2-6    |
| Low air pressure                                  | 70kPa, 62kPa, 84kPa, 114kPa                                                                                                                                                                                                                                                                         | IEC 60068-2-13   |
| Solar radiation                                   | 700W/m <sup>2</sup> or 1120W/m <sup>2</sup>                                                                                                                                                                                                                                                         | IEC 60068-2-5    |
| Dust and Dirt                                     | Method Lc1, Sand and dust concentration 1 g/m <sup>3</sup> , Airflow velocity 20m/s, material Sand                                                                                                                                                                                                  | IEC 60068-2-68   |
| Safety of machinery                               | B10d, 1,000,000 cycles                                                                                                                                                                                                                                                                              | ISO 13849-1:2015 |
| GEV Operational constraints, normal and abnormal. | Test the maximum torque when turning the key clockwise. Test the maximum torque when turning the key counterclockwise. Test the maximum destructive force when pulling out the key from an incorrect position.                                                                                      | GEV              |
| GEV 20,000 cycles for more realistic target.      | Bolt lock: Employ a device to simulate increased resistance on the switchgear cabinet door, and test on 4 locks, each count 5000 times. Door lock: Install the Door Lock into the Simulated Cabinet to simulate on-site opening and closing conditions, and test on 4 locks, each count 5000 times. | GEV              |
| Tolerance Analysis                                | Interlock tolerance analysis Focus on BOLT LOCK                                                                                                                                                                                                                                                     | GEV              |
| Galvanic Compatibility                            | Electrochemical Corrosion Troubleshooting                                                                                                                                                                                                                                                           | GEV              |

## Reliability Test Summary

### Low air temperature

#### Low air temperature

##### Product list:

1. TS LOCK with switch ×1
2. DS LOCK×1
3. Door Solid LOCK×2
4. Door Spring Catch LOCK×1
5. Bolt LOCK×1
6. Exchange Box×1

Test Parameters : -40°C

Test Cycle: 8h

Test Standards: IEC 60068-2-1

#### Sample During Test



#### After Test Sample



### High air temperature

#### High air temperature

##### Product list:

1. TS LOCK with switch ×1
2. DS LOCK×1
3. Door Solid LOCK×2
4. Door Spring Catch LOCK×1
5. Bolt LOCK×1
6. Exchange Box×1

Test Parameters : 60°C

Test Cycle: 8h

Test Standards: IEC 60068-2-2

#### Sample During Test



#### After Test Sample



## Reliability Test Summary

### Rate of change temperature test

#### Rate of change temperature test

##### Product list:

1. TS LOCK with switch ×1
2. DS LOCK×1
3. Door Solid LOCK×2
4. Door Spring Catch LOCK×1
5. Bolt LOCK×1
6. Exchange Box×1

Test Parameters : -40°C~60°C

Test Cycle: rate 1°C/min, 10hours/cycle, 2cycle

Test Standards: IEC 60068-2-14

#### Sample During Test



#### After Test Sample



### Freeze thaw Test

#### Freeze thaw Test

##### Product list:

1. TS LOCK with switch ×1
2. DS LOCK×1
3. Door Solid LOCK×2
4. Door Spring Catch LOCK×1
5. Bolt LOCK×1
6. Exchange Box×1

Test Parameters : -40°C, 60°C

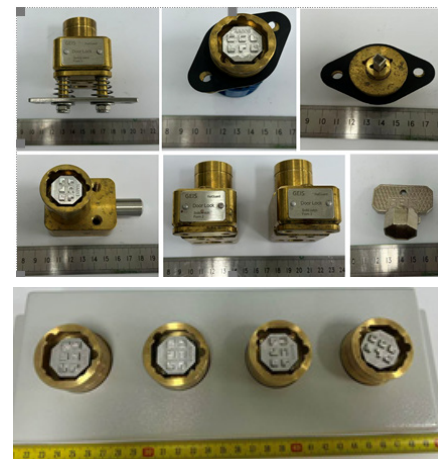
Test Cycle: 6hours/cycle, 5cycle

Test Standards: IEC 60068-2-14

#### Sample During Test



#### After Test Sample



## Reliability Test Summary

### Condensation Test

#### Condensation Test

##### Product list:

1. TS LOCK with switch ×1
2. DS LOCK×1
3. Door Solid LOCK×2
4. Door Spring Catch LOCK×1
5. Bolt LOCK×1
6. Exchange Box×1

Test Parameters : 25°C~60°C, 99%RH

Test Cycle: 6 days

Test Standards: IEC 60068-2-30

#### Sample During Test



#### After Test Sample



### High relative humidity

#### High relative humidity

##### Product list:

1. TS LOCK with switch ×1
2. DS LOCK×1
3. Door Solid LOCK×2
4. Door Spring Catch LOCK×1
5. Bolt LOCK×1
6. Exchange Box×1

Test Parameters : 25°C~60°C, 99%RH

Test Cycle: 6 days

Test Standards: IEC 60068-2-30

#### Sample During Test



#### Sample After Test



# Reliability Test Summary

## Salt spray

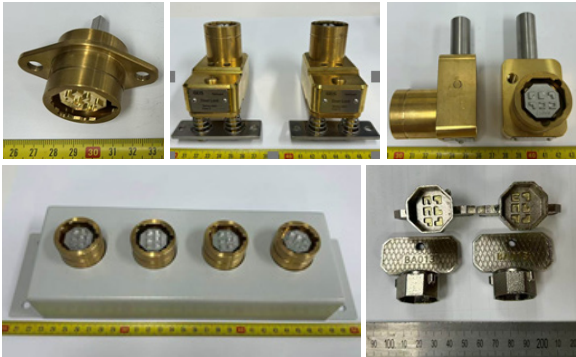
### Salt spray

Product list:

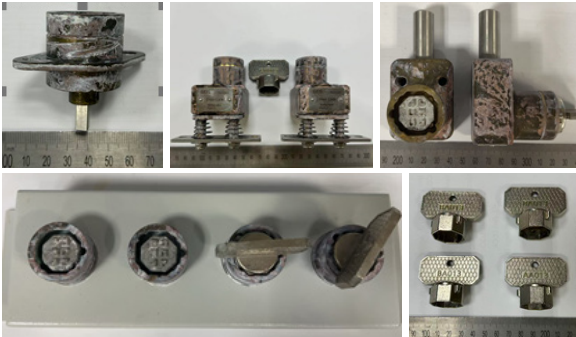
- 1. Exchange Box×1
- 2. DS LOCK×1
- 3. Door LOCK×1
- 4. Bolt LOCK×1
- 5. Key×1

Test Parameters : 5% NaCl (m/m); pH 6.5–7.2 at 35°C  
Test Cycle: 720h  
Test Standards: ISO 9227: 2022

### Sample Before Test



### Sample After Test



## Vibration Test

### Vibration Test

Product list:

- 1. Exchange Box×1
- 2. DS LOCK×1
- 3. Door LOCK×1
- 4. Bolt LOCK×1

Test Parameters :

| Frequency (Hz) | Z-axis (Top to bottom)   | X & Y-Axis (Side to side & front to back) |
|----------------|--------------------------|-------------------------------------------|
| 5-9            | 0.1181" double amplitude | 0.2362" double amplitude                  |
|                | 3mm                      | 6mm                                       |
| 9-40           | 0.5G                     | 1G                                        |
| 40-57          | 0.0059" double amplitude | 0.0118" double amplitude                  |
|                | 0.15mm                   | 0.3mm                                     |
| 57-100         | 1G                       | 2G                                        |

### Sample before Test

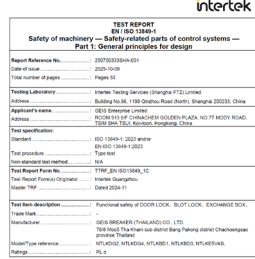


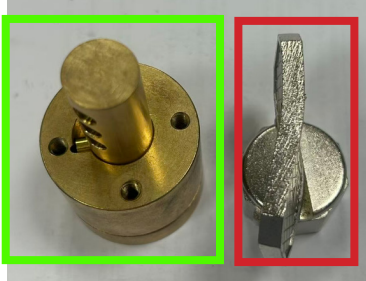
### Sample After Test



# RelGuard Trapped Key Interlocks

## Reliability Test Summary

| Test                                                                                                                                                                          |                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>Vibration Test</b><br>Test parameters: 70kPa, 62kPa, 84kPa, 114kPa<br>Test standards: IEC 60068-2-13                                                                       |   |
| <b>Solar radiation</b><br>Test parameters: 700W/m <sup>2</sup> or 1120W/m <sup>2</sup><br>Test standards: IEC 60068-2-5                                                       |                                                                                     |
| <b>Dust and Dirt</b><br>Test parameters: Method Lc1, Sand and dust concentration 1 g/m <sup>3</sup> , Airflow velocity 20m/s, material Sand<br>Test standards: IEC 60068-2-68 |                                                                                     |
| <b>Safety of machinery</b><br>Test parameters: B10d, 1,000,000 cycles<br>Test standards: ISO 13849-1:2015                                                                     |  |

| Test the maximum torque when turning the key clockwise                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Using an incorrect key</p> <p>Model: Door lock<br/>Key Code: BA014</p> <p>a. Insert the key: Apply a down force of 100 N<br/>Functions Check after test: Normal</p> <p>b. Rotate the key clockwise<br/>Functions Check after test:</p> <ul style="list-style-type: none"> <li>The incorrect key started to deform at 78N.m and cracked at 137N.m, (shown in the red box).</li> <li>After disassembly, the lock cylinder were normal and the functions were normal with correct key, (shown in the green box).</li> </ul> | <p>Apply a down force</p>  <p>Rotate the key clockwise</p>  <p>Disassembly</p>  |

## Reliability Test Summary

### Test the maximum torque when turning the key clockwise

#### Using a correct key

Model: Door lock

Key Code: BA002

a. Rotate the key clockwise

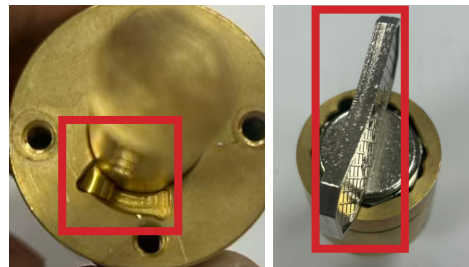
Functions Check after test:

- The key is slightly deformed at 50.9N.m (shown in the red box).
- The middle of the lock cylinder's limit pin is deformed at 50.9N.m (shown in the red box).

#### Rotate the key clockwise



#### Disassembly



### Test the maximum torque when turning the key counterclockwise

#### Using an incorrect key

Model: Door lock

Key Code: BA008

a. Insert the key: Apply a down force of 100 N

Functions Check after test: Normal

b. Rotate the key clockwise

Functions Check after test:

- The incorrect key started to deform at 50.3N.m (shown in the red box).
- After disassembly, the lock cylinder were normal and the functions were normal with correct key, (shown in the green box).

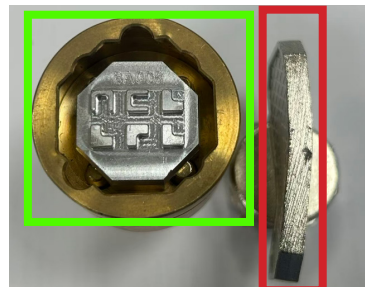
#### Apply a down force



#### Rotate the key counterclockwise



#### Disassembly



## Reliability Test Summary

### Test the maximum torque when turning the key counterclockwise

#### Using a correct key

Model: Door lock

Key Code: SA004

a. Rotate the key counterclockwise

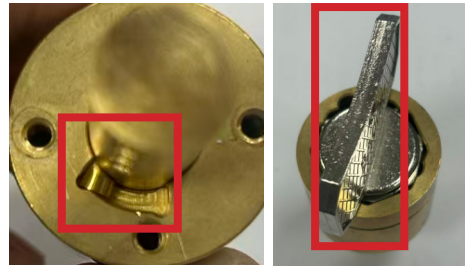
Functions Check after test:

- The key is slightly deformed at 50.7N.m (shown in the red box).
- The middle of the lock cylinder's limit pin is deformed at 50.7N.m (shown in the red box).

#### Rotate the key counterclockwise



#### Disassembly



### Test the maximum destructive force when pulling out the key from an incorrect position

#### Destructive Force

Model: Door lock

Key Code: SA004

a. Destructive Force: 1687N (Forcibly pull out the key)

Functions Check after test:

Schematic diagram:

Keep the key in this position, then pulling upward it.

#### Pulling upward the key



#### Functions check after test



## Reliability Test Summary

### Bolt Lock: 20,000 cycles

|                  |                                                                                                                                                                       |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | Employ a device to simulate increased resistance on the switchgear cabinet door, and test on 4 locks, each count 5000 times.                                          |
| Product List     | Bolt lock number: S1, S2, S3, S4                                                                                                                                      |
| Test Condition   | a. Check every 500 cycles to ensure the lock bolt are being tested under the resistance force exceeds 20 N.m.                                                         |
| Test Result      | a. Function: Normal<br>b. Appearance: There are obvious scratches at the contact position between the lock bolt and the ball plunger, and all other items are normal. |

### Test the maximum destructive force when pulling out the key from an incorrect position

#### Torque-to-Resistance Ratio

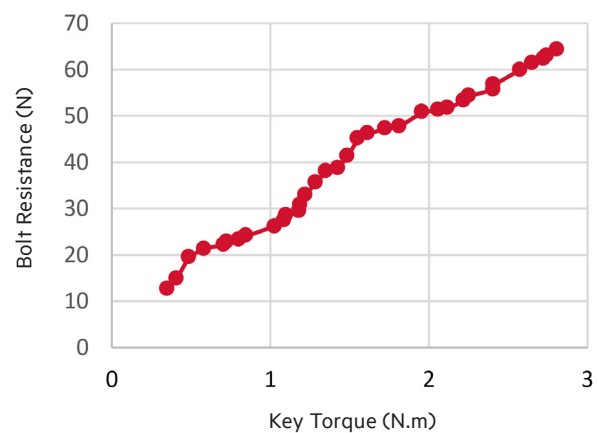
We tested and analyzed the ratio of key torque to bolt resistance, with the data and line chart as follows.

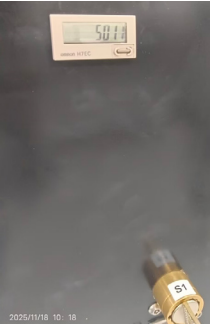
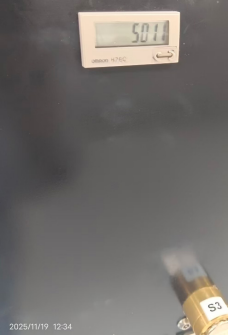
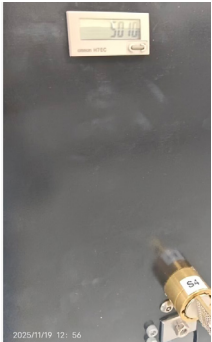
#### Torque-to-Resistance Ratio Video

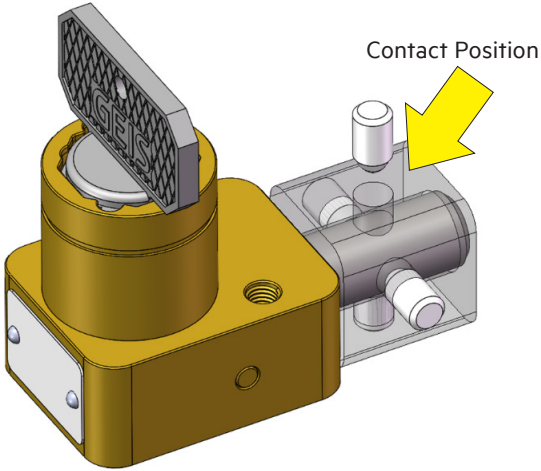
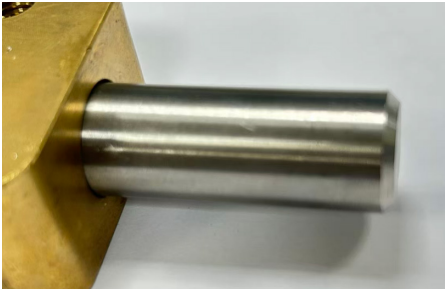
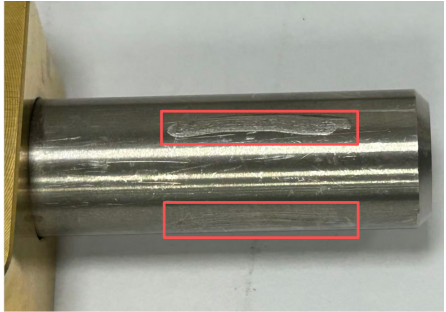
#### Torque-to-Resistance Ratio Data

| Number | Key Torque (N.m) | Bolt Resistance (N) | Number | Key Torque (N.m) | Bolt Resistance (N) |
|--------|------------------|---------------------|--------|------------------|---------------------|
| 1      | 0.353            | 12.58               | 18     | 1.488            | 41.35               |
| 2      | 0.408            | 14.76               | 19     | 1.555            | 45.16               |
| 3      | 0.487            | 19.57               | 20     | 1.619            | 46.16               |
| 4      | 0.584            | 21.37               | 21     | 1.723            | 47.22               |
| 5      | 0.709            | 22.12               | 22     | 1.818            | 47.78               |
| 6      | 0.729            | 22.77               | 23     | 1.958            | 50.76               |
| 7      | 0.807            | 23.32               | 24     | 2.058            | 51.37               |
| 8      | 0.852            | 24.08               | 25     | 2.122            | 51.62               |
| 9      | 1.029            | 26.19               | 26     | 2.223            | 53.33               |
| 10     | 1.085            | 27.49               | 27     | 2.257            | 54.35               |
| 11     | 1.102            | 28.49               | 28     | 2.412            | 55.66               |
| 12     | 1.182            | 29.39               | 29     | 2.412            | 56.72               |
| 13     | 1.192            | 30.77               | 30     | 2.577            | 59.99               |
| 14     | 1.226            | 32.94               | 31     | 2.657            | 61.48               |
| 15     | 1.285            | 35.56               | 32     | 2.725            | 62.26               |
| 16     | 1.353            | 37.96               | 33     | 2.746            | 62.98               |
| 17     | 1.43             | 38.79               | 34     | 2.812            | 64.31               |

#### Line Chart

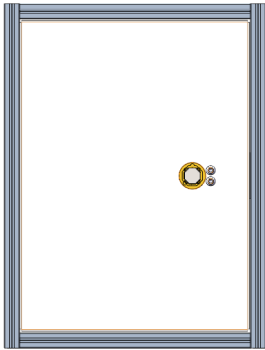
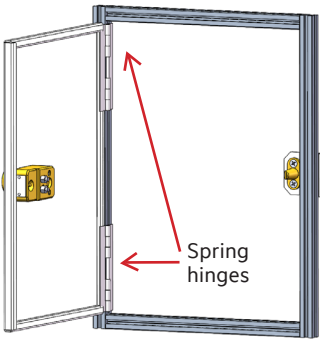


|                                                                                                                                                                                   |                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Bolt Lock: 20,000 cycles</b>                                                                                                                                                   |                                                                                                                                                                                     |
| <p>Bolt lock: S1</p> <p>Test star at 2025.11.17, 13:00;<br/>Test end at 2025.11.18, 10:18;</p>   | <p>Bolt lock: S2</p> <p>Test star at 2025.11.17, 13:00;<br/>Test end at 2025.11.18, 10:07;</p>   |
| <p>Bolt lock: S3</p> <p>Test star at 2025.11.18, 14:00;<br/>Test end at 2025.11.19, 12:34;</p>  | <p>Bolt lock: S4</p> <p>Test star at 2025.11.18, 14:00;<br/>Test end at 2025.11.19, 12:56;</p>  |

|                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Bolt Lock: 20,000 cycles</b>                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                              |
| <p><b>Destructive Force</b></p> <p>a. The functions of the Interlocks are normal after the test.<br/>b. There are obvious scratches at the contact position between the lock bolt and the ball plunger.<br/>Schematic diagram:</p>  | <p><b>Before test</b></p>  <p><b>After test</b></p>  |

## Reliability Test Summary

| Door Lock: 20,000 cycles |                                                                                                                                                                                  |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement         | Door lock: Install the Door Lock into the Simulated Cabinet to simulate on-site opening and closing conditions, and test on 4 locks, each count 5000 times.                      |
| Product List             | Door lock number: D1, D2, D3, D4                                                                                                                                                 |
| Test Condition           | a. Check the door-closing resistance every 500 cycles to ensure it exceeds 3 N.<br>b. Test every 500 cycles to ensure the gap between the catch and the door cylinder is 0.7 mm. |
| Test Result              | a. Function: Normal<br>b. Appearance: Wear is present on the catch, but it does not affect functionality; all other items are OK.                                                |

| Door Lock: 20,000 cycles                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <p><b>Door Lock Assembly Installation Simulation Test</b></p> <p>a. Cabinet door spring hinges: Apply a resistance of 3 N to prevent the door from closing.<br/>Schematic diagram:</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>Closing Door</p>  </div> <div style="text-align: center;"> <p>Opening Door</p>  <p>Spring hinges</p> <p>Laser sensor</p> </div> </div> | <p>Door-closing resistance: 3.15N</p>  |

## Reliability Test Summary

### Door Lock: 20,000 cycles

#### Torque-to-Gap Ratio

We tested and analyzed the ratio of key torque to gap, with the data as follows.

The max gap is 1.1mm, and the key torque is 5.113N.m.

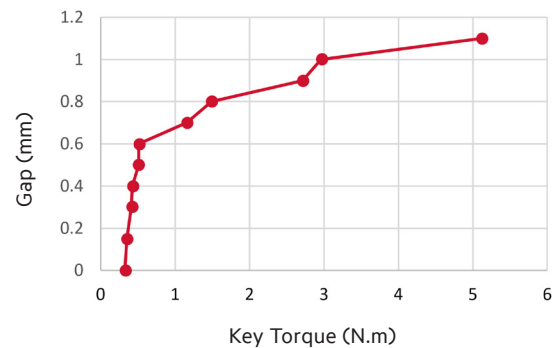
Gap: 1.1mm  
Key Torque: 5.113N.m



#### Torque-to-Gap Ratio Data

| Number | Key Torque (N.m) | Gap (mm) |
|--------|------------------|----------|
| 1      | 0.326            | 0        |
| 2      | 0.354            | 0.15     |
| 3      | 0.412            | 0.3      |
| 4      | 0.427            | 0.4      |
| 5      | 0.51             | 0.5      |
| 6      | 0.512            | 0.6      |
| 7      | 1.156            | 0.7      |
| 8      | 1.492            | 0.8      |
| 9      | 2.711            | 0.9      |
| 10     | 2.96             | 1        |
| 11     | 5.113            | 1.1      |

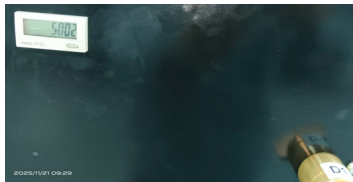
#### Line Chart



### Door Lock: 20,000 cycles

#### Door lock: D1

Test star at 2025.11.20, 13:00;  
Test end at 2025.11.21, 09:29;



#### Door lock: D2

Test star at 2025.11.20, 13:00;  
Test end at 2025.11.21, 10:53;



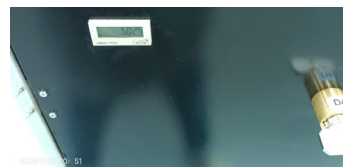
#### Door lock: D3

Test star at 2025.11.21, 11:00;  
Test end at 2025.11.21, 22:33;



#### Door lock: D4

Test star at 2025.11.21, 10:00;  
Test end at 2025.11.21, 22:51;



# GEIS

GEIS Electric

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This catalog may be subjected to revision without prior notice.

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