



Trapped Key Interlocks for HV Substations Switchgear



Applications Guide

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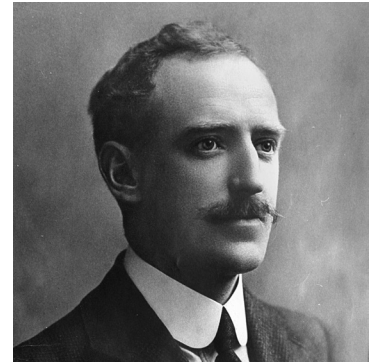
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Worldwide**

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Why Choose Castell?



Founder:
James Harry Castell
1880 - 1953

Castell's Expertise in the Switchgear Industry

The original Castell interlock concept dates from 1922 and was developed for the electrical switchgear industry. For over 90 years Castell delivers solutions across the electrical network from power stations to transmission and distribution equipment and from sub stations to incomer rooms.

The ability to work across HV, MV and LV means that a Castell system can be used as a single solution to provide personnel safety and ensure equipment is used in the correct mode.

Working closely with key switchgear manufacturers has enabled Castell to produce interlocks designed specifically for use on the leading manufacturers own breakers, isolators, switch disconnectors and earth switch mechanisms.

That makes Castell trapped key interlocks be the perfect choice for protecting personnel in the switchgear environment.

Castell Offers:

- Expertise in providing the best possible trapped key solution whatever the industry
- 90 years of experience protecting people and assets in industry
- High quality innovative products
- ISO 9001: 2008 accreditation
- Global team dedicated to providing technical support and assistance in selecting the correct solution
- The widest range of rugged and reliable trapped key interlock products globally
- The ability to produce customised solutions to meet the demands of your specific application
- Safety solutions that last for decades

Interlocking Switchgear

Interlocking switchgear ensures that personnel can safely operate equipment to the correct procedures. Using a well-designed interlocking scheme will ensure that personnel cannot access potentially dangerous areas without the switchgear system being put in a safe state. A good interlocking scheme will also ensure that the system operates correctly and there is no chance of, for example, switching two incoming feeds on to a common bus bar. This ensures that the equipment is not damaged and the risk of fire and arc flash are greatly reduced.

Interlocking in switchgear provides safety for personnel and equipment during following procedures:

- Switching of high, medium and low voltage
- Switching incomers and feeders
- Switching earthing systems
- Maintaining substation equipment

The schemes in this applications guide are for reference only and the overall system should be designed and reviewed by a competent electrical engineer.

Common HV Substation Applications are:



- AIS Substation Interlocking
- GIS Substation Interlocking
- Wind Farm Substation Interlocking

How to design an interlock system?

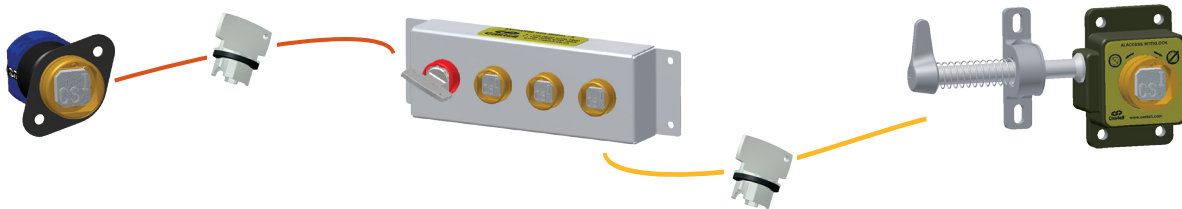
Through development and experience Castell has a number of methods to isolate switchgear. This can be done mechanically, through control circuitry or through power circuitry. In complex operations a number of isolations may need to occur to ensure the plant is safe to work on. The isolation key(s) are then used to either gain direct access, are transferred to a time delay unit or for multiple entry points access through an exchange box.

The three points of trapped key interlocking

1 Isolation

2 Key Exchange

3 Access Control



Access and Personal Protection

Access to the hazardous area needs to be assessed as either part body (arm only), or full body access. Once this is determined an access lock(s) can be selected.

Part Body Access

A part body access lock has only one lock and the isolation key is used to open this. Whilst the access lock is open the key can not be removed and therefore the process can not be started. Only once the lock is closed can the isolation key be removed and the process restarted.

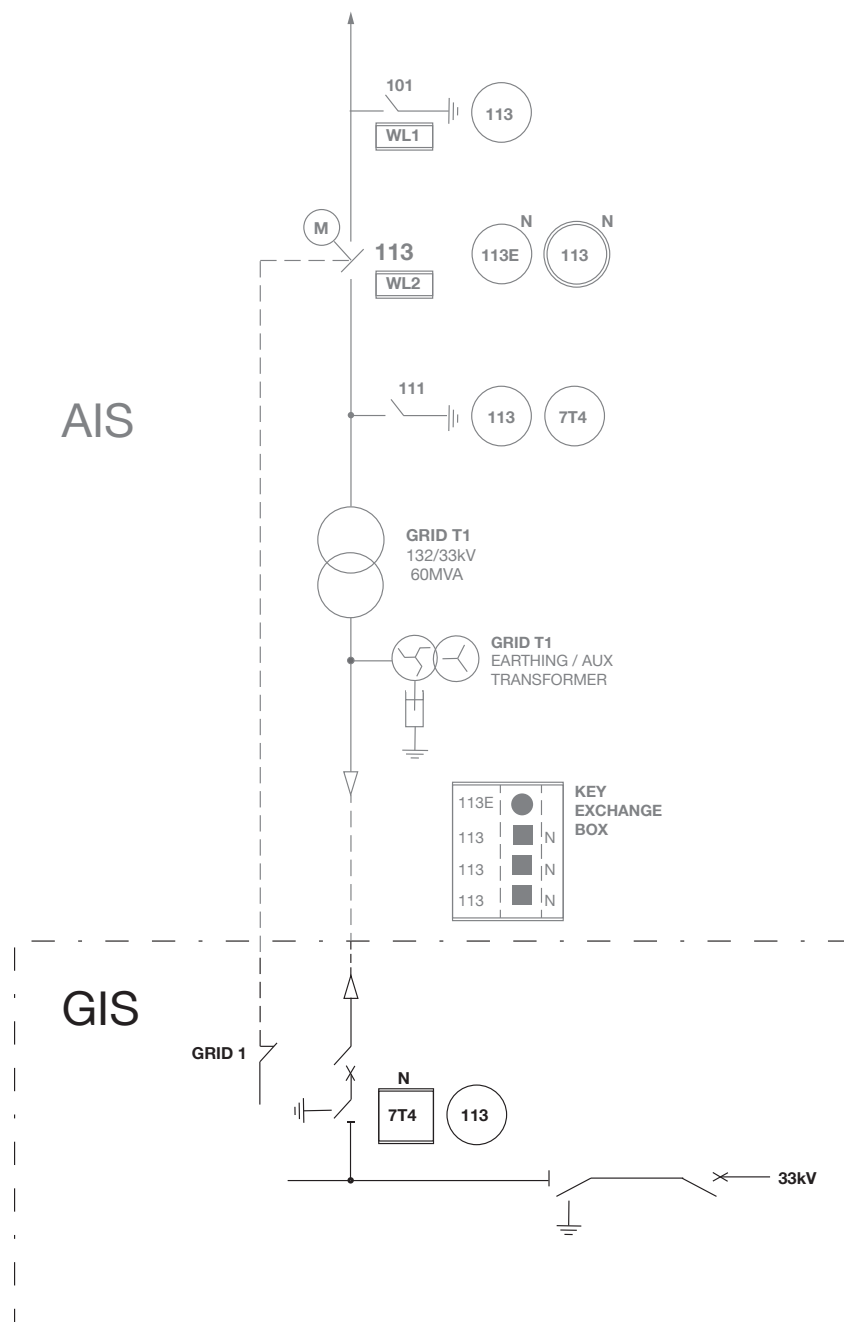
Full Body Access

Full body access locks have two locking mechanisms; the first step in the process is to insert the isolation key. This will allow the personnel key to be removed and then access can be granted by opening the bolt. The isolation key can only be removed once the personnel key has been inserted. Therefore whilst the personnel key is removed and the lock is open the process can not be started. Only once the lock is closed and the personnel key returned can the isolation key be removed and the process restarted.

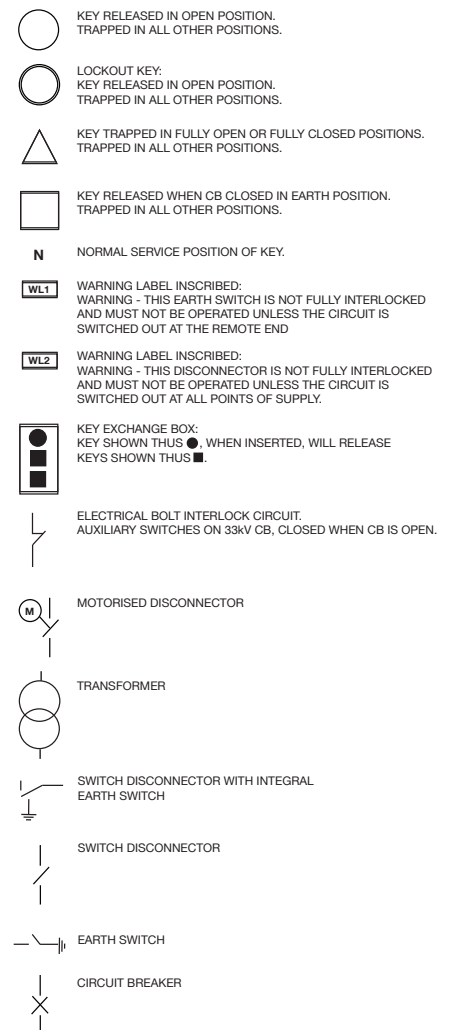
Coding a System

Please refer to our Interlock and padlock integrity policy.

Diagram of GIS Interlocking (Example)



Switchgear Interlocking Symbols



Operation

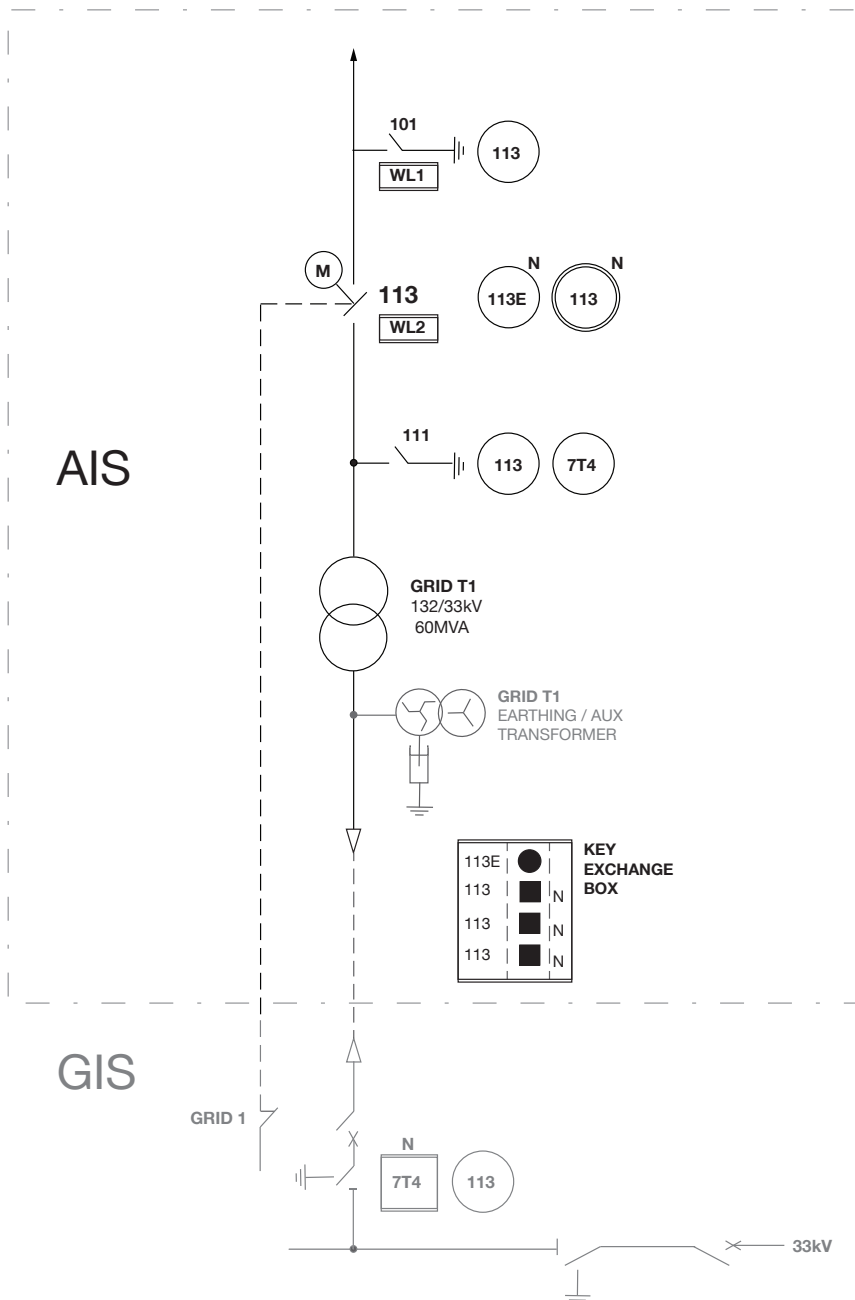
For higher voltages, gas-insulated switchgear reduces the space required around live busbars. Instead of bare conductors, bus and apparatus are built into pressurized tubular containers filled with sulfur hexafluoride (SF₆) gas. This gas has a higher insulating value than air, allowing the dimensions of the apparatus to be reduced.

Solenoid controlled interlocks are normally used with GIS Switchgear as there are no mechanical parts to interlock, but only electrical signals, which are sent dependant upon the position of the switches.

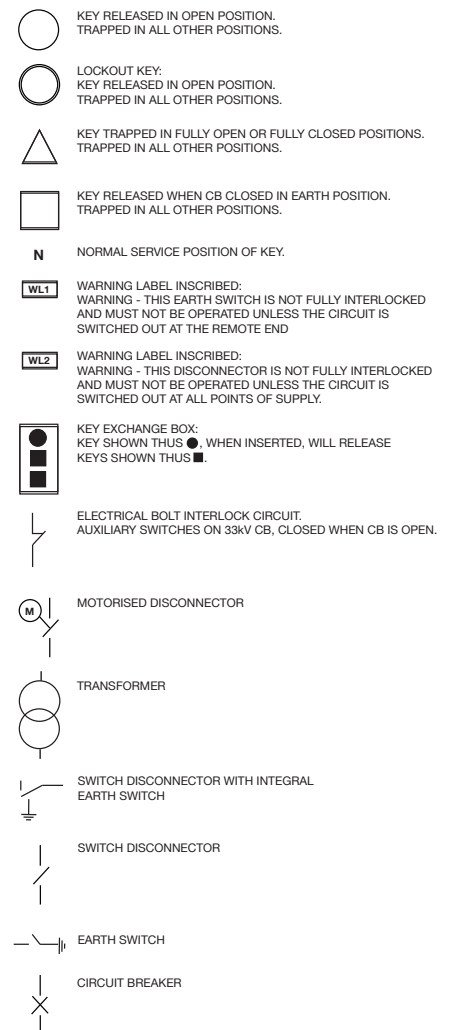
I.e. GRID 1 key 7T4 can only be released when key 113 inserted and trapped sending signal to controls allowing switch to be opened and put into earth position. Signal is then sent to 7T4 releasing the key 7T4.

Standard locks used for this application are solenoid controlled locks KSUPS or KSS (with Q-type lock portions).

Diagram of AIS Interlocking (Example)



Switchgear Interlocking Symbols



Operation

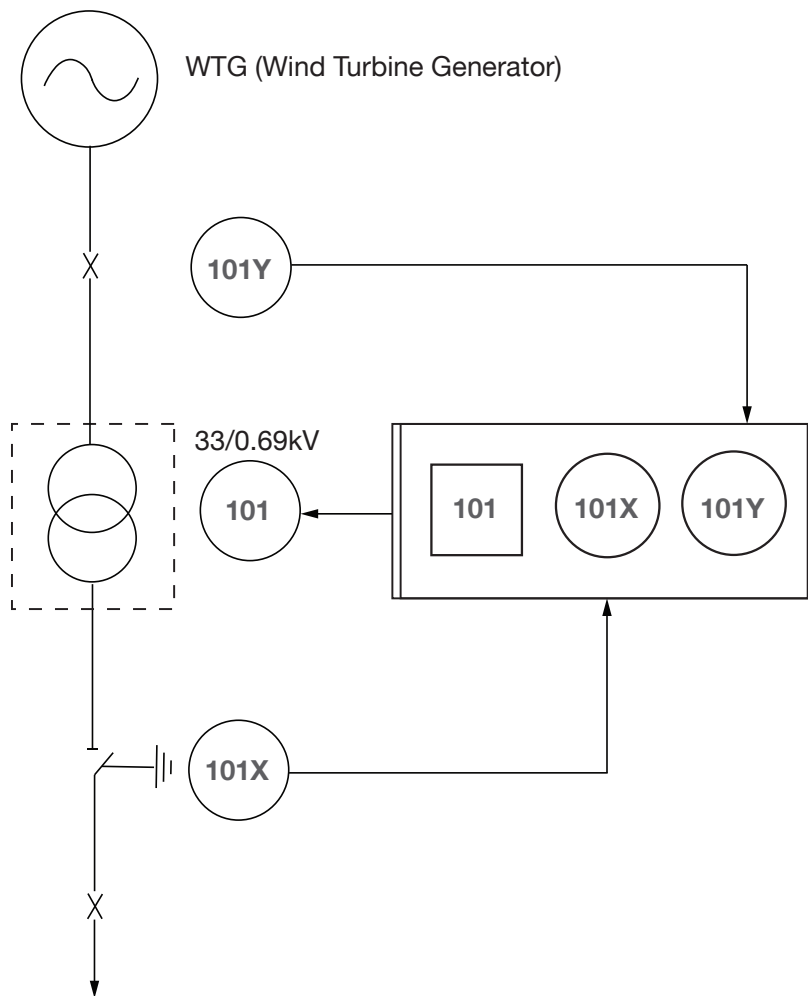
Switches, circuit breakers, transformers and other apparatus may be interconnected by air-insulated bare conductors strung on support structures. The air space required increases with system voltage. For medium-voltage distribution substations, metal-enclosed switchgear may be used and no live conductors exposed at all.

Mechanical interlocks are normally used to control the sequence of operation of the switch disconnectors and earth switches to ensure safe operation for both personnel and plant security.

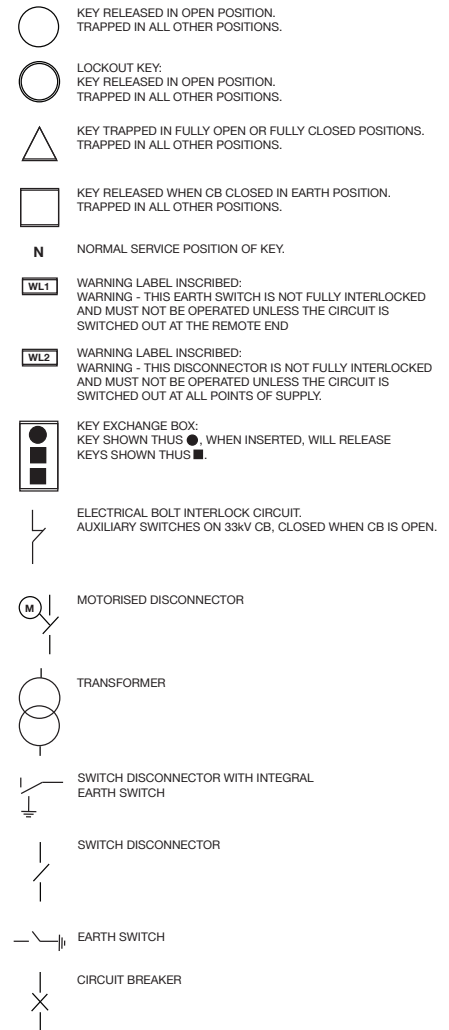
I.e. earth switch 111 shown above cannot be switched to earth until the switch disconnector 113 and the GRID1 CB are switched and locked in open position releasing key 7T4. Keys 113 and 7T4 can then be inserted into earth switch 111, which can now be closed.

Standard locks used for this application are single, double or multiple deadlocks such as K and KL (with Q-type lock portions).

Diagram of Wind Farm Interlocking (Example)



Switchgear Interlocking Symbols



Operation

A typical onshore wind turbine generator installation has a transformer fitted to step-up the output voltage from 690V to 33KV for connection onto the Grid. To maintain this transformer, which is usually housed in its own enclosure or room, it is necessary to isolate both the HV and LV connections to gain access to the transformer.

I.e. access lock 101 on transformer enclosure can only be opened when both the LV isolator and the HV circuit breaker are switched to OFF, releasing keys 101X & 101Y. These keys are then inserted into key exchange box releasing the trapped key 101, which can now be used to open the access. The process is reversed to put the transformer back into service.

Standard locks used for this application are single K deadlocks, AI or AIE access interlocks, X key exchange boxes.

Switch Disconnecter & Earth Switch Manufacturer's Interlocks Specifications

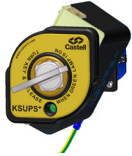
Disconnecter & Earth Switch Manufacturer	Castell Interlock	Interlock Description
Alstom GRID (UK)	K	Bolt Interlock (Single Key)
	KL	Bolt Interlock (Double or Multiple Key)
	KP	Bolt Interlock with Safety Switch (Single Key)
	KLP	Bolt Interlock with Safety Switch (Double Key)
Acrastyle (UK)	K	Bolt Interlock (Single Key)
	KL	Bolt Interlock (Double or Multiple Key)
	KP	Bolt Interlock with Safety Switch (Single Key)
	KLP	Bolt Interlock with Safety Switch (Double Key)
Hapam (Holland)	K	Bolt Interlock (Single Key)
	KL	Bolt Interlock (Double or Multiple Key)
	KP	Bolt Interlock with Safety Switch (Single Key)
	KLP	Bolt Interlock with Safety Switch (Double Key)
Gevea (Sweden)	K	Bolt Interlock (Single Key)
	KL	Bolt Interlock (Double or Multiple Key)
	KP	Bolt Interlock with Safety Switch (Single Key)
	KLP	Bolt Interlock with Safety Switch (Double Key)
Ruhrtal (Germany)	K	Bolt Interlock (Single Key)
	KL	Bolt Interlock (Double or Multiple Key)
	KP	Bolt Interlock with Safety Switch (Single Key)
	KLP	Bolt Interlock with Safety Switch (Double Key)
Lucy Switchgear (UK)	Q	Switchgear Interlock
Siemens (UK / Germany)	KSUPS	Solenoid Controlled Switch
ABB (UK / Germany)	KSUPS	Solenoid Controlled Switch
	KSS	Solenoid Controlled Switch (Single Key)
	KSSE	Solenoid Controlled Switch (Double or Multiple Key)

****All locks are available in various specifications to suit individual applications.**

Please see our full product catalogue for more information or our data sheets on www.castell.com/downloads

Solenoid Controlled Switching

KSUPS⁺



KSS



KSSE

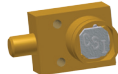


Mechanical Isolation

FS / Q



K



KL



Key Exchange Boxes

X



Y



Z

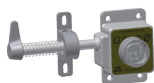


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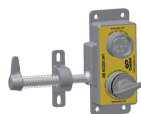
Part Body Access

AI



Full Body Access

AIE



****All locks are available in various specifications to suit individual applications.**

Please see our full product catalogue for more information or our data sheets on www.castell.com/downloads



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