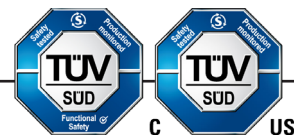


Operating Instructions: Solenoid Controlled Key Switch



Description	SS1-B	SS1-FB
The (SS unit is used where the key(s) need(s) to remain trapped until an electrical signal has been received. The standard sequence is: Solenoid de-energised - Key trapped, Solenoid energised - Key free (Other sequences available upon request) SS1-B / SS1-F • Direct drive operation - positively opens contacts • Suitable for machines with a rundown cycle • Special switch ratings, solenoid voltage and/or contact arrangements available on request • Solenoid monitoring contacts as standard • IP66 Option Available (SS1-FS) • Weatherproof option available: SS1-WP • Complete solenoid monitoring contacts as standard • Stainless Steel dustcover • Solenoids available in 24v, 110v and 230v • Front and back of board versions available • 4NO, 2NO/2NC, 6NO or 3NO/3NC contacts available (Key trapped in lock operating switch)		
	SS1-WP 	

Important:

This product is designed for use according to the installation and operating instructions enclosed. It must be installed by competent and qualified personnel who have read and understood the whole of this document prior to commencing installation. Any modification to or deviation from these instructions invalidates all warranties. Fortress Interlocks Ltd accepts no liability whatsoever for any situation arising from misuse or mis-application of this product. This product is not to be used as a Mains Isolator or Emergency Stop. The unit is a component to be added to a permanent electrical installation meeting the requirements of the applicable IEC/EN standards. **The voltages used on the SS terminals must all be of the same type. i.e. ALL Hazardous Live or ALL Machine Extra Low Voltage.**

IF YOU HAVE ANY QUESTIONS OR QUERIES OF ANY NATURE PLEASE CONTACT THE SUPPLIER WHO WILL BE PLEASED TO ADVISE AND ASSIST.

It is the user's responsibility to implement proper management controls and risk assessment for master and spare keys, without which they can be used to defeat trapped key interlock systems; ISO/TS 19837 can offer further guidance.

Technical Specifications	SS Unit
Housing Materials	Zinc plated mild steel Polycarbonate moulded enclosure (SS-F)
Lock Mechanism	Die-cast zinc body with stainless steel
Minimum Operating Current	5mA at 20v
Solenoid Power Rating	12W (current at Nominal 24V DC = 500mA)
Ingression Protection	IP66 (SS-F)

Safety Data		
Standards	EN60947-3:2009 ISO EN14119:2013 EN13849-1:2008 EN13849-2:2012 EN62061:2005	
Certifications	CE marked for all applicable directives	
Category	Cat. 4, PLe (EN/ISO 13849-1) and SIL3 (EN/IEC 62061)	
Functional safety data	B10d	5,000,000
	DC	High 99% (with correct monitoring)

Operating Instructions: Solenoid Controlled Key Switch

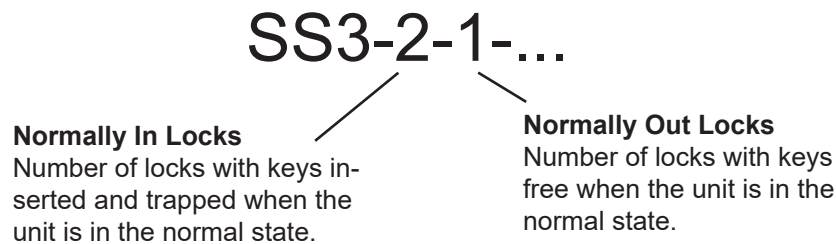
mGard Terminology

mGard part numbers describe their units in the reference state we call the “Normal State”, which means the following will be true:

- Switches will be in their described state, i.e. “Normally Closed” or “Normally Open”
- Any keys used as personnel keys will be inserted in a lock.

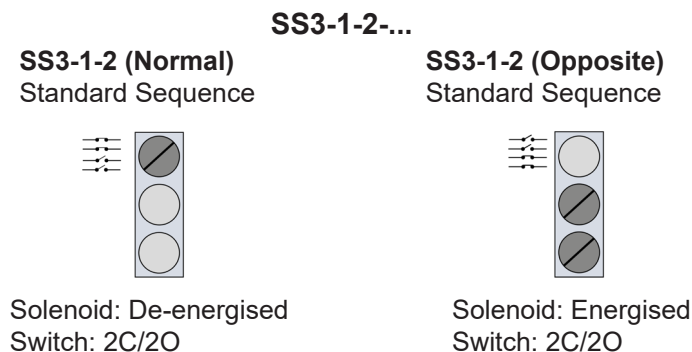
Locks are split into two groups, which are described in the part number as shown below:

- Normally In Locks (NIL) have keys inserted in the Normal State
- Normally Out Locks (NOL) do not have keys inserted in the Normal State



The other reference point used to describe our units is the “Opposite State”, which means all the locks, switches and actuators will be in the opposite state to the Normal State. The schematics below represent the two reference states using the symbols defined in the Trapped Key Interlocking standard ISO TS19837 (2018).

For a typical machine guarding system, the system will be described with all units in their Normal State (i.e. machine running). For more complicated systems like switch gear interlocking, the system might be described with some units in their Normal State, and others in their Opposite State. Similarly, the process to convert a system in its normal state to the system in its opposite state will result in steps where parts of the system are in Normal State, parts are in Opposite State.



When defining the state of an SS, the product is always described in the orientation shown in the diagram above where the cap is at the top of the unit.

For the SS standard sequence (V):

- The Normally In locks will always be closest to the solenoid of the unit unless there are no NIL.
- The top key from the NIL group must be freed (rotated 120°) first, followed by the next locks in order of proximity to the top lock, nearest first. Keys must be inserted into the NOL group in order of furthest from the solenoid first, second furthest second etc. When returning keys within the NIL group, the bottom most NIL must be inserted first, operating locks in order, and finishing with the top-most lock. Keys must be removed from the top NOL first, followed in order as closest to the top lock working downwards.
- When removing a key, all locks in the other group must have keys inserted before the key is releasable
- The rear mounted switch is operated by the lock closest to the solenoid.
- Additional switches can be added and operated by other locks within this system if required. Contact our team to discuss your solution.
- The solenoid directly acts upon the cam operated by the top-most lock.
- For products with only one lock, when the solenoid is energised, the top key is freed. When the solenoid is de-energised, and when the top key is inserted and rotated it will be trapped.

Alternative sequences are available and will be indicated in the part number.

Operating Instructions: Solenoid Controlled Key Switch

Standard Functionality

When all wiring is complete, conduct a Protective Earth Test to BS 60204, clause 20 to all accessible metal parts.
Test the unit for correct operation:

Key Trapped State (With all Gate Keys Inserted)

When the solenoid is not energised, all the keys are trapped. The solenoid operated safety circuits are closed.

Key Unlocked State

When voltage is applied to the solenoid, the solenoid safety circuits are positively opened.

Key Free State

When the control lock is operated (the key in the top-most lock is rotated), the contacts on the rotary switch change state. This allows the removal of any other keys within this product in order of the locality to the control lock (nearest first).

Electrical Connection

Check that the unit to be installed is of the same electrical type and voltage rating as the machine control circuits. Note that all units are designed to operate at +/-10% of the nominal supply voltage. The use of an incorrect voltage can seriously damage the unit.

The electrical system must incorporate fuse protection for all circuits, using a Quick-Acting (F) fuse (maximum rating 3A, 250V to IEC 127). Make the electrical connections:

Reference Figure 2

Terminals A-B and E-F are N/C contacts opened mechanically by the solenoid operating. These are normally used as the solenoid operated safety circuits.

Terminals C-D are the solenoid power supply. The D.C. supply can be connected either way around.

The earth wire used to bond the unit to Earth potential must be multi-stranded Yellow and Green PVC sheathed and approved to BS 6231 with conductor cross-sectional area of 2.5mm². The Earth lead must be fitted such that it will be the last to be broken if the wiring loom is pulled from the product.

Figure 1: Wiring Diagram (switch contacts shown with key trapped in switch operated lock)

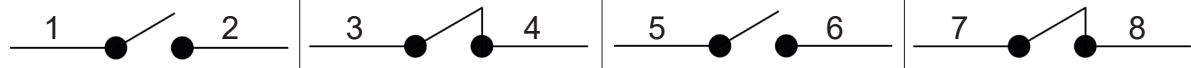
20A, 32A, 63A

0NO / 4NC



20A

2NO / 2NC



32A, 63A

2NO / 2NC

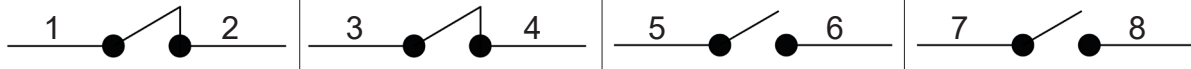
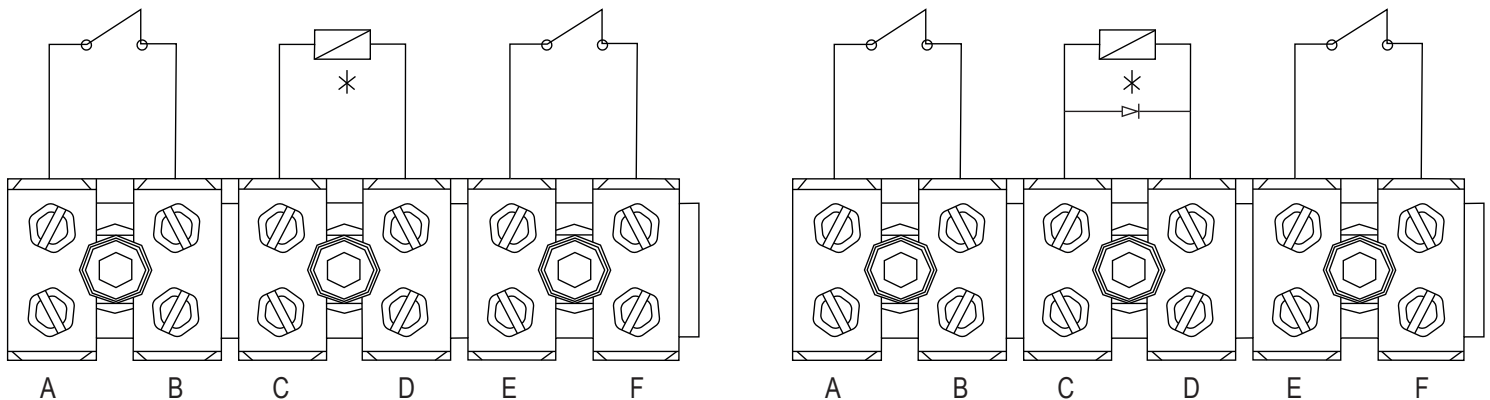


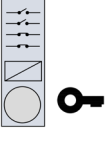
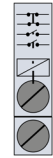
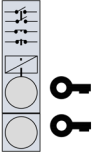
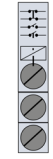
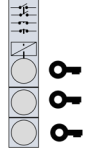
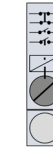
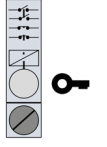
Figure 2: Wiring Details - Solenoid and Monitoring Switches (switch contacts shown with the key trapped and locked)

A bridge rectifier is connected to the solenoid on AC Units



Operating Instructions: Solenoid Controlled Key Switch

Figure 3: Common configurations

Article	Key Position First Lock	Key Position Second Lock	Key Position Third Lock	Standard Sequence	Switch operated by	Normal State	Opposite State
SS1-1-0-...	Trapped	-	-	V	Top NIL		
SS2-2-0-...	Trapped	Trapped	-	V	Top NIL		
SS3-3-0-...	Trapped	Trapped	Trapped	V	Top NIL		
SS2-1-1-...	Trapped	Free	-	V	Top NIL		

Two-Position Rotary Switches

Fortress devices use Kraus & Naimer switches. These switches can be configured to have either late or early changing contacts as shown in Figure 4: Switch states. To confirm correct function during installation, partially turn a key connected to the switch, confirming that the state changes at the appropriate time. This is especially recommended if there has been any disassembly or reassembly of the switch during installation.

Operating Instructions: Solenoid Controlled Key Switch

Figure 4: Switch states

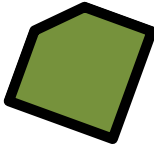
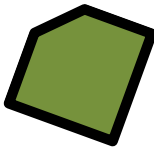
Switch Type	Switch Operated Lock State	Test Contacts via continuity**	Spindle Position (Facing lock at front of product)	Switch Angle (°)	Switch Contacts Closed (X)			
(2NO/2NC 20A) Contacts swapped state	Key Free	1 – 2 Closed 3 – 4 Open 5 – 6 Closed 7 – 8 Open			1	3	5	7
					2	4	6	8
				0	X		X	
Transition State (all contacts opened)	Key Rotated	All Contacts Opened		15				
2 Normally Open Contacts, 2 Normally Closed Contacts	Key Trapped	1 – 2 Open 3 – 4 Closed 5 – 6 Open 7 – 8 Closed		30		X		X
				30-90		X		X
				90		X		X
(4NC) Contacts swapped state	Key Free	1 – 2 Open 3 – 4 Open 5 – 6 Open 7 – 8 Open		270	T1	T2	T3	N
Transition State (all contacts opened)	Key Rotated	All Contacts Opened		270-335				
				335-345				X
4 Normally Closed Contacts	Key Trapped	1 – 2 Closed 3 – 4 Closed 5 – 6 Closed 7 – 8 Closed		0	X	X	X	X

Figure 4a: Standard 2NO/2NC Switch Contact

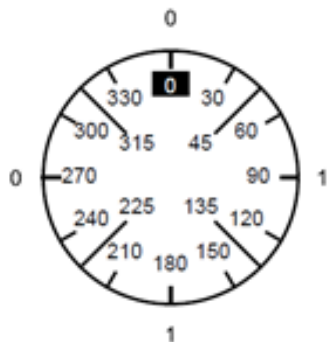
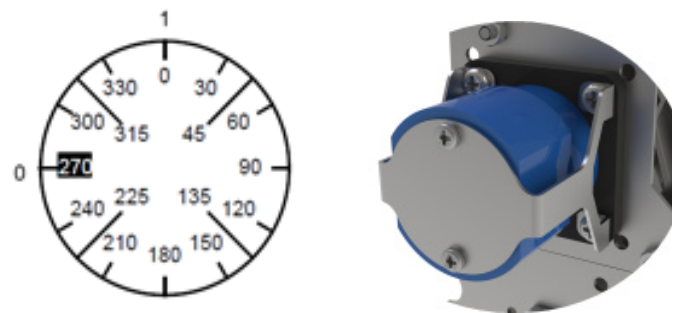
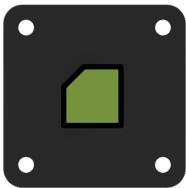


Figure 4b: Standard 4NC/0NO Switch Contact



Operating Instructions: Solenoid Controlled Key Switch

** If your switch contacts do not operate as expected at the listed angles, it could be that your switch is 180° out of phase. This can be tested by rotating the spindle at the back by 180° with a gripping tool (such as pliers) and reinserting back into the product assembly. Re-test the contacts at the back of the switch to confirm contacts operate as expected



Neutral connections on a switch (such as those on the 4NC switch reference 'N') are closed before the main poles (this is shown in Figure 4). These are referred to as 'early make' and typically use on undervoltage/PFR coil circuits to ensure they are energised prior to the circuits making.

Auxiliary contacts typically close after the main poles are switched such that open contacts will change to closed after the switch contacts, 'late make'. When changing from closed to open, auxiliary contacts will 'early break' to change state before the main contacts.

OFF	ON	
Open	Closed	Main Poles
Open	Closed	Early Make ('N' Poles)
Open	Closed	Late Make / Early Break (Aux Poles)

Figure 5

Contact pole configuration	Key Position	Wiring details from the KGRSS
	 Key free	
	 Key inserted but not trapped	
	 Key trapped	

Operating Instructions: Solenoid Controlled Key Switch

Figure 6: Front of Board - SS1-B

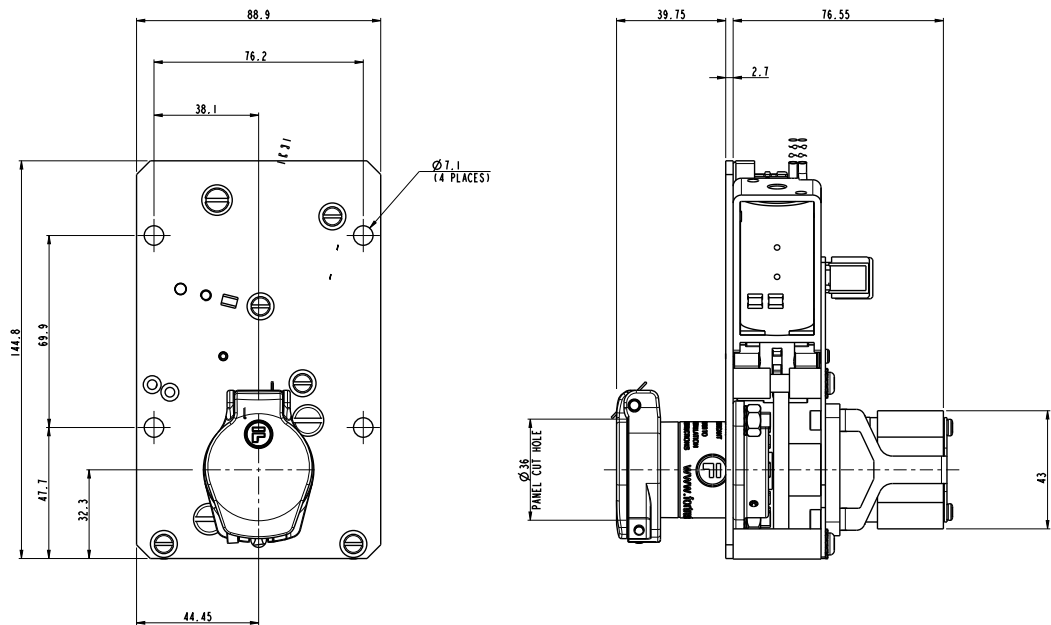
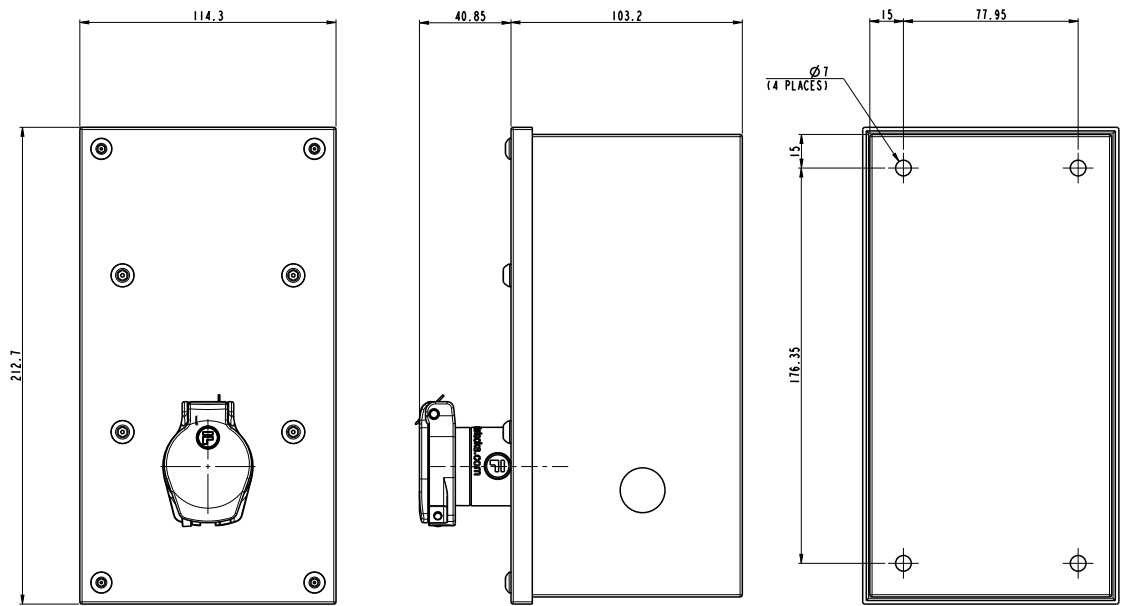
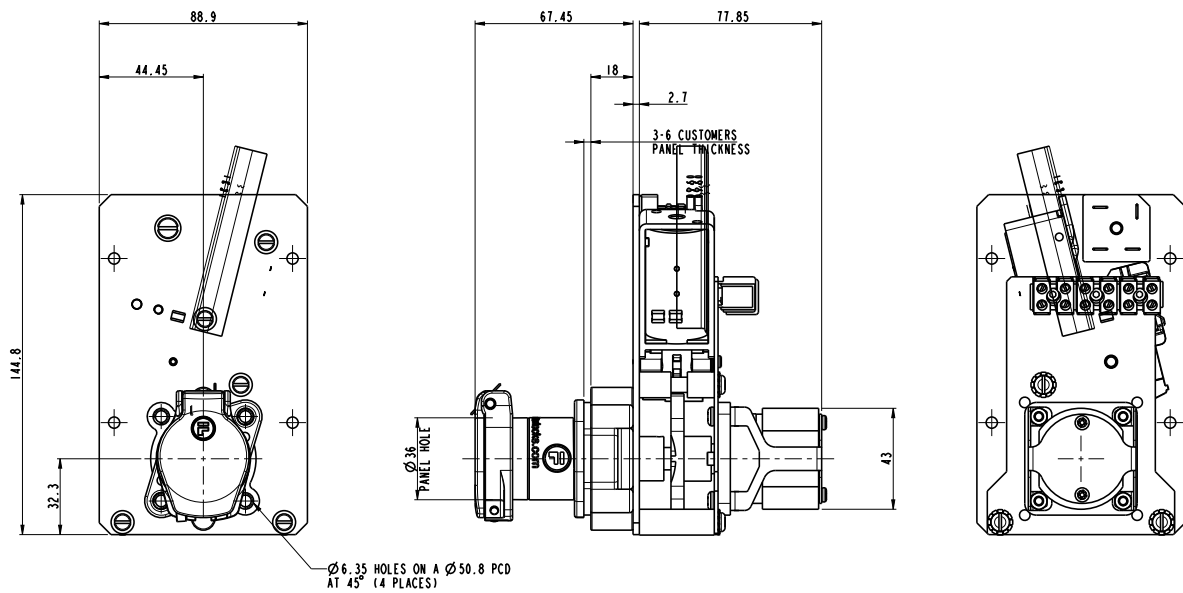


Figure 7: Weatherproof Front of Board - SS1-F



Operating Instructions: Solenoid Controlled Key Switch

Figure 8: Front of Board - SS1-WP



Tools and Fixings Required

Front of Board:

- M6 Tap or Dia. 4.5 Drill
- 3.5mm Flat Blade Electrical Screwdriver
- 4 x M6 Screws
- 4 x M6 Nuts
- 4 x M6 Washers

Back of Board:

- M6 Tap or Dia. 6.5 Drill
- 3.5mm Flat Blade Electrical Screwdriver
- 4 x M6 Screws
- 4 x M6 Nuts
- 4 x M6 Washers

Mounting

Mount the unit only in its correctly assembled condition to flat metal plate of minimum thickness 3.0mm. The plate must be bonded to earth potential. A sound earth connection must be made to the front plate of the product. A shakeproof washer may be required on at least one fixing, to ensure Earth continuity.

Back of Board (BOB) Mounting

1. Locate the unit so that all the locks are within easy reach.
2. If there is a dust cover on the Solenoid switch unit, remove this before mounting by loosening the cap head fixing holding this onto the lock. Do not over-loosen, the thread of the fixing should not become freed.



3. Machine the panel to meet the requirements of the product. SS1-.. products should have minimum four fixing holes drilled to fit M6 fixing, and one hole to enable the lock barrel to protrude from the mounting surface. For SS(2-10).. an additional two fixing holes and one additional lock barrel hole will be required for each additional lock present on the product.

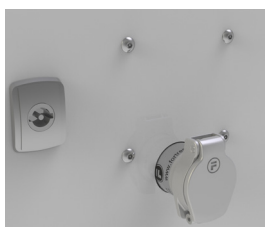


Operating Instructions: Solenoid Controlled Key Switch

4. Mount the unit to the panel using the 4 x M6 fixings, nuts and washers, as applicable. An additional 2 x M6 fixings will be required per additional lock module on the device.



5. Return the dustcover to the product by aligning over the lock barrel and re-tightening the dustcover fixing.



6. All fixing screws must be permanently prevented from removal, either by vibration or by personnel using standard tools.

Front of Board (FOB) Mounting

1. Locate the unit so that all the locks are within easy reach.
2. Mount the unit to the panel using the 4 x M6 screws, nuts and washers, as applicable. The fixing holes are accessible with the lid removed and will not be within the sealed area.
3. All fixing screws must be permanently prevented from removal, either by vibration or by personnel using standard tools.
4. For Waterproof units, cable glands must be sealed against ingress of dust and liquids.

For multiple lock FOB units, please contact Fortress for dimensional drawings

Maximum Permissible Wire Gauge

Wire Type	Units	20A	32A	63A
	mm ²	2 x 2.5	2 x 6	2 x 16
	AWG	2 x 12	2 x 8	2 x 6
	mm ²	2 x 2.5	2 x 4	2 x 10
	AWG	2 x 14	2 x 10	2 x 6

The 20A, 32A and 63A switches will accept 2 wires per terminal, one either side of the terminal screw. Only copper wires are to be used.

Wire Strip Length

The wire strip length is the length of wire left exposed at the end of a cable when the insulation is removed. The recommended lengths are shown below.

Switch	Strip Length (mm)
20A	8
32A	11
63A	15

Minimum Voltage and Current

The standard 20A switch has been tested to work down to 5mA at 20V. For lower voltage and current requirements, please contact Fortress.

Operating Instructions: Solenoid Controlled Key Switch

DC Ratings

The rotary switches are all AC but have the following DC ratings:

DC Voltage	20A Switch	32A Switch	63A Switch
24V	20A	32A	63A
48V	12A	25A	50A
60V	4.5A	10A	16A
110V	1A	2A	3A
220V	0.4	0.6A	0.7A
440V	0.27A	0.3A	-

Mechanical and Electrical Life

The mechanical life of the lock and bolt mechanism is 1,000,000 operations. The life of the rotary switch is shown below:

Switch Type	Mechanical Life (N° of Operations)	AC - 21A Electrical Life (N° of Operations)
20A	1,500,000	100,000
32A	1,500,000	100,000
63A	1,500,000	100,000

Approvals

The switches are approved to the following:

20A BS, CCC, CSA, GOST, IEC, UL

32A BS, CSA, GOST, IEC, UL

63A BS, CSA, GOST, IEC, UL

150A BS, CSA, GOST, IEC, UL

Where

BS = BS EN 60947 (British and EU)

CCC = China Compulsory Certification

CSA = Canadian Standards Association

GOST = Gosudarstvennyj Standard (Russian)

IEC = IEC 60947 – International Electrical Commission (Global)

UL = Underwriters Laboratory (USA)

International Current Variations

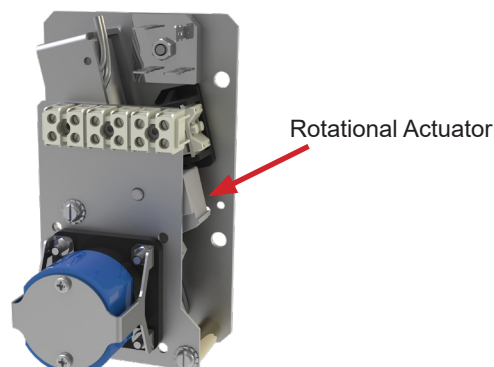
BS / IEC / VDE Current Rating	UL Current Rating	CSA Current Rating
20A	20A	16A
32A	30A	30A
63A	65A	65A

Once the maximum electrical or mechanical number of operations had been reached, the unit must be replaced.

Commissioning

Mechanical Testing

1. Isolate electrical supplies.
2. Insert all the keys (starting from the bottom lock and working downwards).
3. Check that all the keys are trapped in position.
4. Manually override the solenoid to allow the removal of the keys, starting from the top working downwards. Ensure electrical supplies remain isolated. The Solenoid can be overridden via accessing the back of the unit, and pressing in the rotational actuator pictured below. This will pivot the locking mechanism allowing the cam to freely rotate.



Operating Instructions: Solenoid Controlled Key Switch

Service and Inspection

Regular weekly inspection of the following is necessary to ensure trouble-free, lasting operation:

1. Correct switching function.
2. Secure mounting of components.
3. Debris and wear.
4. Loose cable terminals.

DO NOT USE DRY LUBRICANT.

The frequency of lubrication / cleaning will depend on the environment. There are no user serviceable parts in a SS module. If damage or wear is found, the whole module must be replaced. If switch replacement is required, the switch(s) must only be obtained from Fortress. This is because the switch arrangement has been specifically designed for these products and is non-standard. This is a critical safety issue.

Disposal

This interlock does not contain any certified hazardous materials so should be disposed of as industrial waste.

Liability coverage is voided under the following conditions:

1. If these instructions are not followed.
2. Non-compliance with safety regulations.
3. Installation and electrical connection not performed by authorised personnel.
4. Non-implementation of functional checks.

Environmental Specification

Environment Type: Indoor
Max. Altitude: 2000m
Ambient Temperature: -5°C to +40°C
Maximum Relative Humidity: 80%@≤31°C, 50%@40°C
Transient Overvoltages Installation: Uimp 2500V
Pollution Degree (IEC 664): Degree 2
Ingress Protection: BOB - IP00, FOB - IP40,
Waterproof: FOB - IP66

Fortress Interlocks Ltd reserves the right to modify the design at any time and without notice.

This guide should be retained for future reference.