



Safehouse

The power to protect

Guide to
Switches

Introduction

In the South African electrical industry, it is often said that “a switch is a switch is a switch!” Nothing could be further from the truth; switches and sockets are not only functional devices, they are also elements of interior design.

They must have the technical requirements essential for modern household and office appliances and equipment, but should not detract from the aesthetic of their environment.

The following guide is applicable to alternating current (ac), whilst any direct current (dc) applications require confirmation with the relevant supplier regarding applicable ratings.

What does a switch do?

- Make and break current
- Indicate whether power supply is ON or OFF
- Provide aesthetic appeal.





What does a switch consist of and how does it work?

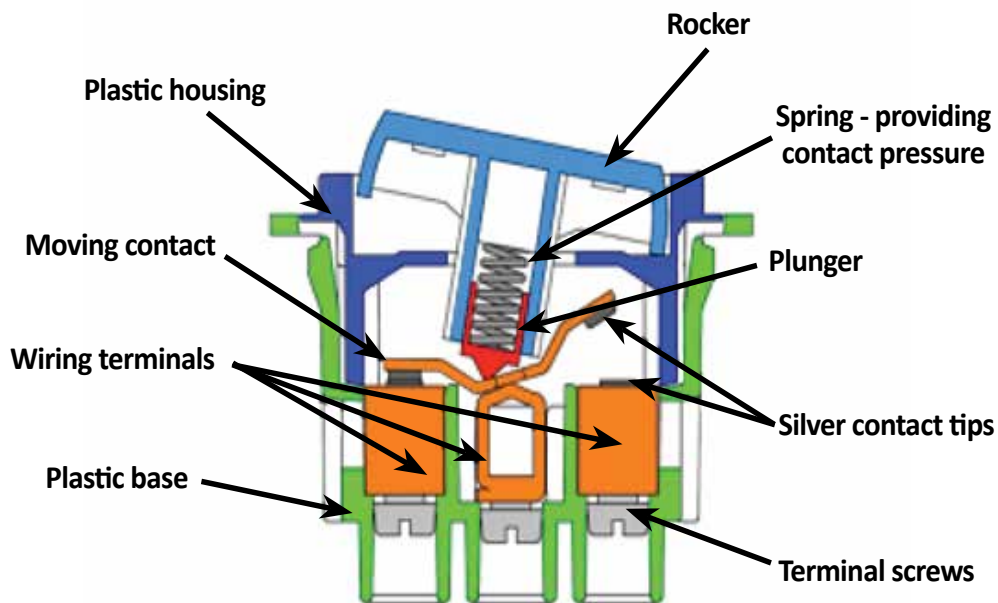
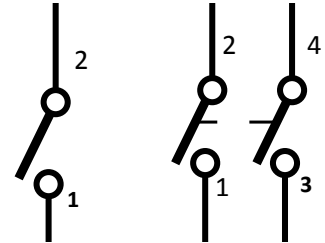
This is the IEC symbol for a switch: Single pole, single throw and double pole, single throw.

These are typically used in lighting circuits in electrical installations. There are other configurations such as change-over (two way) and intermediate switching.

Contacts of the right material are essential for effective functionality and safety.

Where current is being connected and disconnected, it is essential that small silver or silver inlaid copper contact tips are part of the contact construction.

These are usually alloyed with small amounts of Nickel or Tin-oxide to ensure they do not weld together at the point of current inrush when switched on. High inrush currents are present where fluorescent lights are installed. The more light fittings, the higher the inrush.



Basic construction of a switch.

Contact 'snap-over' is a fundamental design characteristic, which prevents the user from 'teasing' the contacts by changing the switch-on speed and thereby allowing the moving contact to hover around the fixed contact – this causes arcing and eventual fritting away of the conductive parts, producing a risk of overheating and fire.



Switching surges (inrush currents)

Depending on the nature of the load, which may include fluorescent lights with transformer-type ballasts or a small electric motor, an inrush current will flow into that circuit at the point where the switch is switched on.

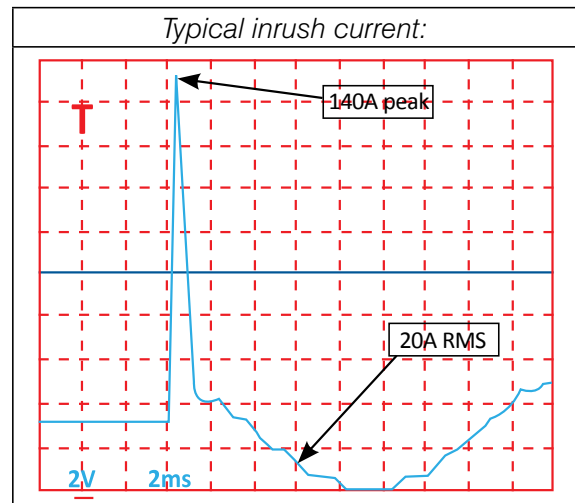
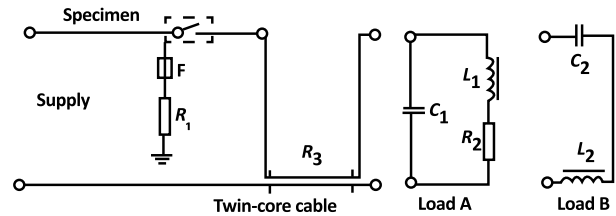
This inrush is generally of a short duration but there could be currents of a few hundred amperes. For this reason certain tests are included in the switch standard (SANS 60669-1) to determine that the switch can withstand such currents. If it cannot, in general, a switch would fail by developing an open circuit i.e. the contacts burning off, or the contacts could remain closed, known as 'contact welding'.

SANS 60669-1 Clause 19.2 - Test circuit

The switch standard provides a test to determine the suitability of the switch to handle inrush current, normally present in fluorescent lighting loads

NB: Switches suitable for fluorescent loads are marked with the letters 'AX' behind the current rating, i.e. 10AX or 20AX. Where the rating is marked only 10A or 20A, this switch is not suitable for fluorescent loads and should therefore not be installed in such circuits..

The test circuit consists of the following:



Switch functions and combinations

Illumination: Find it in the dark

Two-way switching: For corridors and multiple entries and exits

Dimmer: Alter light levels

Sensor: Detect presence and daylight

Timer: Select time-of-day switching

Automation: Programmable switching of loads



What are the applicable standards?

The principal purpose of standards and compulsory specifications is to protect the user against unsafe products.

In the early 1990s, the SABS adopted many IEC standards to replace those developed in South Africa. Switches, which were covered under SANS 152, were then required to meet SANS (IEC) 60669-1. The applicable standards are tabulated below:

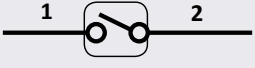
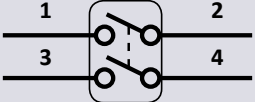
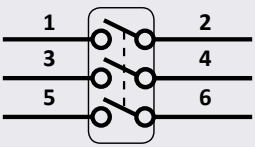
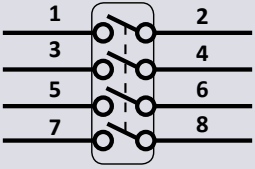
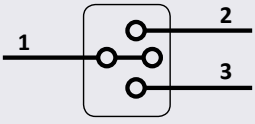
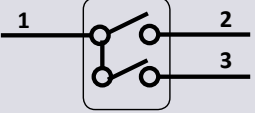
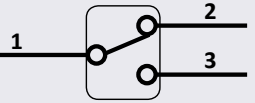
The wording below referring to 'household' installations is quoted from the regulations. These standards are equally applicable to commercial and industrial installations containing this equipment.

SANS 60669-1 Which also refers to several parts listed below	Switches for household and similar fixed-electrical installations. Part 1: General requirements.	Specifies the general tests for all types of fixed installation switches. (See switch configurations below).
SANS 60669-2-1	Switches for household and similar fixed-electrical installations. Part 2-1: Particular requirements – Electronic switches.	Includes: Touch switches, light dimmers, speed controllers (such as those for fans) with or without electronic switching devices, switches incorporating light sensors (daylight switches) and switches incorporating heat sensors (under-floor heating control units).
SANS 60669-2-2	Switches for household and similar fixed-electrical installations. Part 2-2: Particular requirements – Electromagnetic remote-control switches.	Remotely activated switches making use of a relay or a stepping relay, which can be operated remotely by the application of an electrical signal.
SANS 60669-2-3	Switches for household and similar fixed-electrical installations. Part 2-3: Particular requirements – Time-delay switches.	Time delay ON or time delay OFF, adjustable and operated by any means. Generally, these devices are not in use in SA but are quite common in Europe for stairways and corridors. When switched on, they remain on for a limited period of time only.
SANS 60669-2-5	Switches for household and similar fixed-electrical installations. Part 2-5: Particular requirements – Switches and related accessories for use in home and building electronic systems (HBES).	Switches for home and building automation. Programmable switches and associated accessories such as electronic relays and switching modules.
VC8003 Which refers to the standards listed above and additional administrative requirements	The SA compulsory specification for switches for fixed installations. This includes administrative requirements.	Legislation issued under Government Gazette No. 38441 of 6 February 2015, making the compliance with SANS 60669 series of standards a mandatory requirement for the selling, distribution and installation of these products.
SANS 10142-1	Wiring of premises. Refer to the Safehouse Guide to Electrical Installations.	Table 4.1 of this standard specifies VC8003 as the mandatory safety specification for manually operated switches.



Switch configurations (Patterns according to the standard)

SANS 60669-1 lists several switch 'patterns', each of which is tested to a defined protocol depending on the contact configurations. Here are the standard patterns, together with a brief description of their applications:

Pattern No.	No. of poles	Diagram	Description
1	1		Single-pole switch: Most commonly used for wall switches for lights, which disconnect only the live conductor.
2	2		Two-pole switch: Used where the disconnection of both Live and Neutral conductors is required for full isolation of the load circuit.
3	3		Three-pole switch: Used for three-phase circuits, disconnecting only the three live conductors.
03	4		Three-pole plus switched neutral switch: Used for three-phase, four-wire circuits, where all the live and neutral conductors are disconnected.
4	1		Two-way switch with OFF position: Used to control two stage circuits (high/low) with an off position.
5	1		Two-circuit switch with a common incoming line: Used mainly for multiple light circuits, disconnecting only the live conductor.
6	1		Two-way switch: Used where the light circuit can be switched on and off in two separate locations, disconnecting the live conductor only.

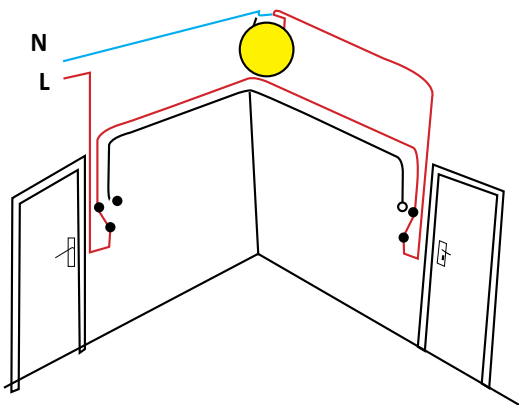


Pattern No.	No. of poles	Diagram	Description
6/2	2		Two-way, double pole switch: Used as above but where the live and neutral conductors are disconnected.
7	1		Intermediate switch: Used for multiple control of a light circuit, where several points are used to switch the light circuit on and off.

The choice of switch configurations and patterns is determined by the required functions, which is best left to qualified persons.

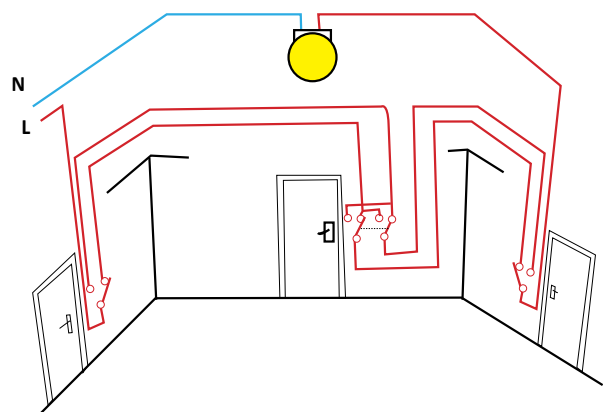
Two common examples of the use of **different pattern type switches** are as follows:

Typical two-way switching arrangement:



Two entries: Where the single light circuit is to be switched at each entry, two-way switches (pattern No. 6) are fitted at each entry and wired according to the diagram. In this case, irrespective of whether the light is on or off, it can be switched at either entry / exit.

Typical intermediate switching arrangement:



Multiple entries: Where the single light circuit is to be switched at each entry, intermediate switches (pattern No. 7) are fitted at each entry between the first and last two-way switch (pattern No. 6) and wired according to the diagram. In this case, irrespective of whether the light is on or off, it can be switched at any of the entry/exit points.

EMC and EMI compliance

Electronic switches, including various products for home automation, require compliance with the Electromagnetic Compatibility (EMC) and Electromagnetic Interference (EMI) characteristics that are part of the standards. Broadly, these important aspects cover the following:

EMC: The switch's emission of high frequency wavelengths is limited to certain prescribed levels – to prevent it from interfering with various other signal transmissions.

EMI: The switch is not acted upon by spurious signals imposed on it from outside sources.

The custodian of these requirements is the Independent Communications Authority of South Africa (ICASA) in terms of the Electronics Communications Act No. 36 of 2005.

Non-compliance with EMC requirements can affect the functioning of sensitive devices such as pacemakers and security alarm systems.

There does not appear to be systematic monitoring of compliance with the regulations in this regard, and users are advised to check the applicable performance of products, particularly in sensitive environments.

Substandard Products: typical shortcuts taken by unscrupulous manufacturers

Safety of a switch is compromised by unscrupulous manufacturers in order to reduce costs. Some suppliers may do so out of ignorance or negligence.

Typical compromises and failings are:

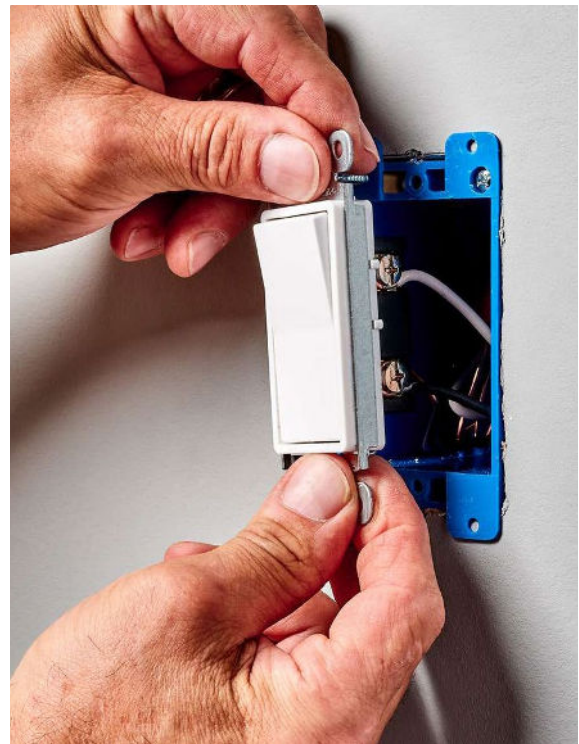
- Avoiding the product testing and regulatory requirements altogether.
- Using inferior plastics that are not heat-resistant.
- Avoiding the use of silver contacts, which would lead to abnormal heat rise.
- Providing inadequate contact pressure, leading to overheating.
- Providing inadequate thickness of copper/brass contacts, leading to overheating.
- Poor contact mechanism design, leading to contact freezing and/or an open circuit.



Some guidelines as to what users can do to **avoid using unsafe products:**

- Buy brands you know and can trust.
- Buy from reputable distributors, outlets and installers.
- Beware of copies of prominent brands.
- Be suspicious of prices substantially lower than for other, similar products or services on offer.
- Try to make contact with the seller's supplier and judge responses critically.
- Be suspicious of lack of information on, or with, the product packaging and on the product itself. Specifications require certain minimum markings. Packaging should describe the electrical capacities and the correct application of the product. Look out for contradictions between data provided e.g. different voltage ratings for the same product.
- If the purchase warrants it, ask the supplier for references to other users – and make the effort to contact them.
- When dealing with an electrical contractor, ask about its membership of the ECA (Electrical Contractors Association) and call the ECA in your region to check credentials. Be critical of a suspect installation or a Certificate of Compliance (COC) that is issued too easily.
- Ask the supplier to prove compliance with regulations: A National Regulator for Compulsory Specifications (NRCS) approval in the form of a Letter of Authority (LOA) for the products used that are subject to regulations (See the Safehouse Guide to the Regulation of Electrical Products).
- Look for the test specification marking: 'Tested to SANS 60669' or 'VC8003'.
- Look for certification marks such as SABS, VDE and UL. (Note that the SABS mark is not necessarily a substitute for the LOA.).
- Beware of fraudulent use of well-known certification emblems, such as the SABS mark.
- Be careful - A 'CE' mark is not necessarily proof of conformity or of independent testing.
- Report any electrical product failure to the dealer, manufacturer, the NRCS and, if applicable, the National Consumer Commission.

If in doubt, check with the Safehouse Association for information it may possibly have to help you.





Examples of switches to illustrate differences in aesthetics

The purchaser has a wide variety of aesthetics to choose from, including colours and finishes of wall plates to suit any interior design.





About Safehouse

Safehouse is a non-profit organisation that protects South African businesses and people from preventable harm caused by unsafe electrical products and services.

We're a voluntary group of electrical industry stalwarts, technical experts and leaders of our respective businesses and fields. We believe it's our civic and commercial duty to protect our industry and fellow South Africans from suppliers of unsafe electrical products and services.

We work to eradicate dangerous products from the market, to make electrical safety information understandable and accessible and to hold one another, and our industry, to the highest standards of excellence.

Safehouse members have signed a code of conduct that commits them to dealing only in safe electrical products and to responsible behaviour.

If you have doubts about a particular product or service, contact Safehouse for guidance.

No portion of this publication may be reproduced, copied or transmitted save with written permission of the Safehouse Association.

While every care has been taken in compiling the information contained in this guide, neither the Safehouse Association nor the publisher can accept any responsibility for any errors or omissions herein.

