

	Standard	Technology
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Title: **SPECIFICATION FOR LOW
VOLTAGE AUXILIARY
ELECTRICAL COMPONENTS
STANDARD**

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DISCLOSURE**

Compiled by



**Tshego Cornelius
Protection Engineer**

Date: 01/11/2013

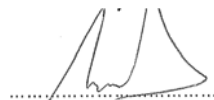
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Date: 01/11/2013

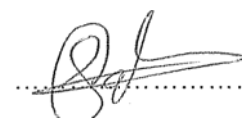
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1. Introduction

This standard document describes the generic requirements for low voltage auxiliary electrical components within Eskom.

2. Supporting clauses

2.1. Scope

This document describes the functional requirements and specifications for LV auxiliary electrical components such as MCBs, auxiliary relays, control switches, diodes, fuses, etc., within the Eskom environment.

2.1.1. Purpose

The purpose of this document is to define a standard for the low voltage auxiliary electrical components used within Eskom.

2.1.2. Applicability

This document shall apply throughout Eskom Transmission and Distribution secondary plant equipment.

2.2. Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1. Normative

International document(s):

ISO 9001 Quality Management Systems.

IEC 60898-1, Electrical accessories – Circuit breakers for overcurrent protection for household and similar installations Part 1: Circuit-breakers for a.c. operation.

IEC 60898-2, Electrical accessories – Circuit breakers for overcurrent protection for household and similar installations Part 1: Circuit-breakers for a.c. and d.c. operation.

South African National document(s):

SANS 60947-5-1, Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices.

SANS 60947-2, Low-voltage switchgear and controlgear – Part 2: Circuit-breakers.

SANS 60269-2, Low-voltage fuses Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to J.

SANS 60269-1, Low-voltage fuses Part 1: General requirements.

SANS 10142-1, The wiring of premises Part 1: Low-voltage installations.

Eskom National document(s):

32-9: Definition of Eskom documents.

32-644: Eskom documentation management standard.

474-65: Operating Manual of the Steering Committee of Wires Technologies (SCOT)

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Eskom Divisional documents(s):

240-64685228, Generic Specification for Protective IEDs
 240-70413291, Specification for electrical terminal blocks.
 240-70975231, Specification for Current and Voltage Transformer Test Blocks.
 DSP 34-392, Specification for digital transducer based measurement for electrical quantities
 DSP 32-310, Specification for analogue transducer based measurement for electrical quantities
 TSP 41-395, Goods Information – Digital transducer based measurements systems for electrical quantities
 240-64100247, Specification for PTM&C equipment

2.2.2. Informative

Not Applicable.

2.3. Definitions

2.3.1. General

Definition	Description
Intelligent electronic device	A device that has versatile electrical protective functions, advanced local control intelligence, monitoring abilities and the capability of communication directly to the SCADA system. ["from "Practical electrical network automation and communication" by Cobus Strauss"]
Transducer	A device for converting an a.c or d.c.. measurand to a direct current, a direct voltage or a digital signal for measurement purposes
Low Voltage	The supply system voltage less than 1000 V AC.
Protection Scheme	All switches, IEDs, controls, indications, wiring, terminals and module housings that provide the required protection and control functionality for the specific application. A protection scheme is usually centralised into one panel, but may be distributed amongst many panels or cubicles

2.3.2. Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4. Abbreviations

Abbreviation	Description
A	Ampere(s)
a.c or AC	Alternating Current
CT	Current Transformer
d.c or DC	Direct Current
Hz	Hertz

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Abbreviation	Description
IED	Intelligent Electronic Device
LED	Light Emitting Diode
LV	Low Voltage
MCB	Miniature Circuit Breaker
ms	milliseconds
TNS	Test Normal Switch
VT	Voltage Transformer

2.5. Roles and responsibilities

- Power Delivery Engineering is responsible for ensuring that the requirements stipulated in this standard are adhered to.
- Quality Assurance is responsible for ensuring that all low voltage auxiliary electrical components used in Eskom are according to this standard.
- Eskom Grids/Operational units are responsible for ensuring that correct components are used before commissioning the secondary plant equipment

2.6. Process for monitoring

QA is responsible for monitoring that the standard is adhered to at all times and making use of a check list to assess all the components stipulated in this document.

2.7. Related/supporting documents

This document cancels and replaces some parts of DSP 34 -2093 "Generic Specification for Protective IEDs and Tripping Relays". The rest of the DSP 34-2093 document is replaced by 240-64685228 – Generic Specification for Protective IEDs.

The following are the documents being referred to and which the most recent edition should always be used.

- 240-64685228 - Generic Specification for Protective IEDs
- 240-70413291 - Specification for electrical terminal blocks.
- 240-70975231 - Specification for Current and Voltage Transformer Test Blocks.
- DSP 34-392 - Specification for digital transducer based measurement for electrical quantities
- DSP 32-310 - Specification for analogue transducer based measurement for electrical quantities
- TSP 41-395 - Goods Information : Digital transducer based measurements systems for electrical quantities
- 240-64100247, Specification for PTM&C equipment

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3. Scheme Components Specification

3.1. General Requirements

All scheme components shall be suitable for application in the environmental conditions listed below, without performance being out of limits or life being shortened beyond the specification:

- a) Ambient temperature range: -25 °C to +55 °C in control room,
- b) Ambient temperature range: -25 °C to +70 °C installed within enclosure in substation yard and
- c) Relative humidity: up to 98%.

Components shall endure and respond without mal-operation for shock, vibration, bump and seismic tests of IEC 60255-21.

Unless specified to the contrary, scheme components shall be suitable for application in a substation control room or yard environment, within substations of voltage levels up to and including 765 kV.

All circuits intended to be electrically isolated from external circuits shall be designed to withstand the following voltage levels:

- a) All circuits requiring isolation (including contacts of switches, relays or contactors) shall have an insulation resistance across the isolating barrier of not less than 20 MΩ when measured at 500 V d.c..
- b) a circuit intended for connection to 100 V a.c. or d.c. and above, a station battery and a current or voltage transformer shall withstand 2 kV 50 Hz r.m.s. between itself and all other points for 1 min.

Equipment shall be designed such that a minimum of routine maintenance is required in terms of both total accumulated time and frequency.

No components shall require periodic adjustments and/or calibration, apart from those adjustments required to change the settings.

Eskom's prior approval shall be obtained regarding the use of equipment requiring special tools.

Components shall be chosen and used in such a manner that the risk of fire being caused as a result of component failure or a possible short-circuit, is negligible. If there is such a risk, the supplier shall state this fact in his tender.

As far as possible, components which could be a hazard to personnel, either in use or under failure or disposal conditions shall not be used. Where such use appears unavoidable then full details shall be given in the tender.

All components shall be subject to Eskom approval. Eskom reserves the right to subsequently revoke approval of components deemed, via operating experience, to be of poor quality.

3.2. Scheme Components

3.2.1. Auxiliary and Tripping relays

Unsealed relays or groups of relays shall be provided with protective covers to prevent dust ingress; unless otherwise necessary for screening purposes, the covers shall be transparent.

The relay design and material selection shall be such that the contacts do not inadvertently change state when a reasonable gripping force is applied to the cover for removal of the relay from its base. This shall apply specifically to relays for application with their operating coils permanently energised.

Unless otherwise approved, all relay coils shall be suppressed so as to minimize the production of switching transients which would be detrimental to the operation of electronic circuits. Care shall be taken that the ratings of components used for this purpose are adequate for the most arduous operational conditions. Due regard shall be given to the effect of suppression on the timing characteristics of the relay.

Flip-flop relays shall use mechanical latching. An electrical seal-in is not acceptable.

Unless otherwise approved, hermetically sealed and reed relays or relays with mercury-wetted contacts shall not be used.

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Relay contact ratings shall be rated as follows :

- a) Make and carry for 200 ms:30 A @ 250 V d.c.
- b) Carry for 1s:10 A
- c) Carry continuously:5 A
- d) Break (inductive L/R = 40 ms):30 W @ 250 V d.c.

The break current rating may be reduced if a current operated seal-in (compatible with the proposed design) is provided

Tripping relays shall comply with the type test requirements as shown in **Annexure B** of this document.

3.2.2. Selector Switches

Selector switches shall be rated for both switching and isolating duty (i.e. shall be switch-disconnectors) and shall be specified in accordance with SANS 60947-5-1.

The switch control knob design shall be such that it cannot be removed without the aid of a tool and that it shall be positively fixed to the drive spindle in such a manner that it cannot slip. This latter requirement also applies to coupling devices associated with control knobs and shafts.

Control knobs shall be keyed so as to allow only one orientation when fitting to the shaft. If, for ease of handling, a relatively large knob is fixed to a relatively small rotary component, care shall be taken to ensure that the end stops on the control are not damaged by normal rotation of the control knob. The end stops shall be designed so that they are not damaged by any torque which may be applied to the knob.

Selector switch, such as TNS, is used as local control switch to physically interrupt the applicable circuit as opposed to a software feature. The actuating principle and/or relative position of the control are as per following table, which is in accordance with IEC 60447. The configuration of switches is specified in **Annexure C** of this document.

Table 1 : Local Control Actuating Principles/relative positions - switch

Actuating Direction	Turn Anti-Clockwise	Turn Clockwise
Action	Trip Off / Test / Isolate Open Circuit Put out of Service	Close On Close Circuit Put into Service

3.2.3. Diodes

Diodes used in tripping circuits/applications shall have a peak repetitive inverse voltage withstand capability of at least 1.2 kV. Their current rating shall be 16A.

3.2.4. Indication Lamps

Indication lamps shall be in accordance with SANS 60947-5-1 (IEC 60073). Indication lamp colours shall be as follows:

- a) Red: Trip conditions, Eg (PNH, Circuit Breaker Closed Indication)
- b) Amber: Alarm/Warning conditions, Eg (CBNH)
- c) White : General conditions, Eg (Earth applied, Automatic Voltage Control on Manual)
- d) Green : Safe conditions (Circuit Breaker Open Indication)

Where provided external to an IED, indications shall be provided using cluster-type LEDs, of rating less than 5 Watts, and designed life of 100'000 hours (10 years).

Filament lamps shall not be used.

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3.2.5. Low Voltage fuses

Low voltage fuses (provided externally to IEDs) shall be used by exception.

Where used, low voltage fuses shall be to Fuse System G (Fuses with fuse-links with offset blade contacts) as per SANS 60269-2, fuse size E1 or E2 (corresponding to the British Standard sizes SS and NS respectively). DIN-rail mounted fuse holder terminal blocks carrying fuse-links to Fuse System F (Fuses with fuse-links having cylindrical contact caps) are also permitted. In the latter case, 8 x 32mm fuse-links are preferred (maximum rating 16A).

The utilisation category of fuse-links shall be as per SANS 60269-1.

3.2.6. Miniature circuit-breakers (MCBs)

MCBs shall comply with the requirements of IEC 60898 (Part 1 for A.C. MCBs and Part 2 for D.C. MCBs) with the following characteristics:

- a) Number of poles:
 - AC MCBs for phase-to-neutral connection shall be two-pole with one protected pole and one switched neutral.
 - AC MCBs for phase-to-phase connection shall be two-pole with two protected poles.
 - Three phase AC supplies shall use three-pole MCBs with three protected poles.
 - DC MCBs shall be two-pole with two protected poles.
- b) Protection against external influences:
 - MCBs shall be of the enclosed type.
- c) Method of mounting:
 - DIN rail.
- d) Value of rated operational voltage:
 - AC MCBs: 250 V single phase or 440 V three phase.
 - DC MCBs: 250 V phase-to-phase.
- e) Value of rated current: (as per individual product specification)
- f) Value of rated frequency:
 - 50 Hz
- g) Range of instantaneous tripping current:
 - Type-C, Source devices e.g. AC/DC, VTJB distribution boards
 - Type-B, Load devices, e.g. protection schemes and mechanism boxes
 - Alternate type shall be subject to Eskom approval, e.g. for high inrush current drawn by the device
- h) Value of rated short-circuit capacity: (as per individual product specification)
- i) Rated time constant (D.C. MCBs):
 - 4 ms

MCBs shall be designed for installation under environmental conditions of pollution degree 3 or higher as per SANS 60947-2. All MCBs shall be wired with the source supply at the top, and the load supply at the bottom (SANS 10142-1).

Where D.C. MCBs are polarity sensitive, polarity markings shall be provided on the front of the MCB (as per IEC 60898-2). Additionally, the manufacturer shall provide a diagram indicating the correct wiring polarity with the source supply at the top.

MCB may be required to have auxiliary contact status. Contacts shall be rated as per above “**Section 3.2.1**”

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3.2.7. Push buttons

Push buttons shall comply with the requirements of SANS 60497-5-1. Where used, clip-on auxiliary contacts shall be secured such as not to be dislodged when a reasonable pushing force is applied to the push button. This requirement is especially important for trip push buttons. The auxiliary contact rating shall be as per above **"Section 3.2.1"**

Push buttons shall be coloured black unless specified otherwise. Emergency trip push buttons shall be coloured red. The emergency trip push buttons shall be fitted with a transparent, hinged cover. The push button shall not be latched.

In cases where a pair of push buttons is used for local control of a function, the actuating principle and/or relative position of the controls shall be as per following table 2, which is in accordance with IEC 60447.

Table 2 : Local Control Actuating Principles/relative positions - Push Buttons

Vertical Push Button Pair	Bottom Button	Top Button
Horizontal Push Button Pair	Left Button	Right Button
Action	Trip Off / Test / Isolate Open Circuit Put out of Service	Close On Close Circuit Put into Service

In a case of push buttons with integrated lamps, the lamp colour shall be in accordance with **"Section 3.2.4"** of this document.

3.2.8. Terminals

Terminal blocks shall be specified as per 240-64685228 document.

3.2.9. Test blocks

The test blocks shall be of the PK2 4-way design as per 240-70975231document, unless otherwise specified by Eskom for any special application.

3.2.10. Test points

Test points shall accept a 4mm "banana" test plug. The test point shall encapsulate the full 25mm shaft of the test plug such that no live part is exposed. Test points shall be continuously rated for 1000 Va.c. or as specified, for one minute.

3.2.11. Transducers

Where required, digital transducers shall be categorized and defined in accordance with the DSP 34-392 and TSP 41-395 standards. Analogue transducers shall be specified in the DSP 32-310 document.

3.2.12. Mechanical Counters

Counters shall feature a mechanical display of at-least 4 digits and shall be mechanically or electrically operated. The counter shall increment by one count per operation. Electrical counters shall operate from 80% of rated voltage.

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4. Application Requirements

4.1. Component mounting

Components shall be located, secured and disposed with respect to each other and the structural members so that they, together with all connecting wires, can be inspected, removed and replaced without damage to, or undue disturbance of, other parts of the equipment or wiring.

No component shall be mounted hanging on the roof of the enclosure.

5. Earthing

All auxiliary components shall be earthed according to Eskom's standard document 240-64100247.

5.1. Labels

All labelling shall be in accordance with 240-62629353.

Terminal block and terminal strip labels shall be as per 240-70413291.

MCB identification labels shall indicate the MCB rating.

5.2. Component data sheets

Data sheets shall be provided for all components used, this data should be in a searchable, indexed *.pdf format.

Eskom shall have the right to freely copy and distribute the documentation by any means, whether it is by hard copy or an electronic medium.

6. Authorisation

This document has been seen and accepted by:

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7. Revisions

This is a new document.

Date	Rev.	Compiler	Remarks
March 2014	1	T Cornelius	N/A

8. Development team

This document was developed by Tshego Cornelius with assistance from PTM&C Protection Technology & Support Team.

9. Acknowledgements

Acknowledgement to everyone who has given input to this document.

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Annex A – Impact Assessment

Impact assessment form to be completed for all documents.

A1 Guidelines

- o All comments must be completed.
- o Motivate why items are N/A (not applicable)
- o Indicate actions to be taken, persons or organisations responsible for actions and deadline for action.
- o Change control committees to discuss the impact assessment, and if necessary give feedback to the compiler of any omissions or errors.

A2 Critical points

A2.1 Importance of this document. E.g. is implementation required due to safety deficiencies, statutory requirements, technology changes, document revisions, improved service quality, improved service performance, optimised costs.

Comment: This document is required to cater for technology changes and to go out on a new enquiry.

A2.2 If the document to be released impacts on statutory or legal compliance - this need to be very clearly stated and so highlighted.

Comment: N/A, Protection philosophies do comply with legal requirements (grid code)

A2.3 Impact on stock holding and depletion of existing stock prior to switch over.

Comment: None immediately

A2.4 When will new stock be available?

Comment: Order spare on contract enquiry which is 8years later

A2.5 Has the interchangeability of the product or item been verified - i.e. when it fails is a straight swap possible with a competitor's product?

Comment: No, the designs are such that the components in a scheme are supplier dependant

A2.6 Identify and provide details of other critical (items required for the successful implementation of this document) points to be considered in the implementation of this document.

Comment: None

A2.7 Provide details of any comments made by the Regions regarding the implementation of this document.

Comment: They are part of the voting process

A3 Implementation timeframe

A3.1 Time period for implementation of requirements.

Comment: The prototype development will take 2 years & the production contract will be in place for 4 + 4 years.

A3.2 Deadline for changeover to new item and personnel to be informed of DX wide change-over.

Comment: N/A

A4 Buyers Guide and Power Office

A4.1 Does the Buyers Guide or Buyers List need updating?

Comment: No

A4.2 What Buyer's Guides or items have been created?

Comment: No

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A4.3 List all assembly drawing changes that have been revised in conjunction with this document.

Comment: N/A

A4.4 If the implementation of this document requires assessment by CAP, provide details under 5
N/A

A4.5 Which Power Office packages have been created, modified or removed?

Comment: None

A5 CAP / LAP Pre-Qualification Process related impacts

A5.1 Is an ad-hoc re-evaluation of all currently accepted suppliers required as a result of implementation of this document?

Comment: No

A5.2 If NO, provide motivation for issuing this specification before Acceptance Cycle Expiry date.

Comment: Document required for new enquiry

A5.3 Are ALL suppliers (currently accepted per LAP), aware of the nature of changes contained in this document?

Comment: Yes

A5.4 Is implementation of the provisions of this document required during the current supplier qualification period?

Comment: No

A5.5 If Yes to 5.4, what date has been set for all currently accepted suppliers to comply fully?

Comment: N/A

A5.6 If Yes to 5.4, have all currently accepted suppliers been sent a prior formal notification informing them of Eskom's expectations, including the implementation date deadline?

Comment: N/A

A5.7 Can the changes made, potentially impact upon the purchase price of the material/equipment?

Comment: No

A5.8 Material group(s) affected by specification: (Refer to Pre-Qualification invitation schedule for list of material groups)

Comment: N/A

A6 Training or communication

A6.1 Is training required?

Comment: (If NO then 6.2 – 6.6 will be N/A) No

A6.2 State the level of training required to implement this document. (E.g. awareness training, practical / on job, module, etc.)

Comment: N/A

A6.3 State designations of personnel that will require training.

Comment: N/A

A6.4 Is the training material available? Identify person responsible for the development of training material.

Comment: N/A

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A6.5 If applicable, provide details of training that will take place. (E.G. sponsor, costs, trainer, schedule of training, course material availability, training in erection / use of new equipment, maintenance training, etc).

Comment: N/A

A6.6 Was Technical Training Section consulted w.r.t module development process?

Comment: N/A

A6.7 State communications channels to be used to inform target audience.

Comment: N/A

A7 Special tools, equipment, software

A7.1 What special tools, equipment, software, etc will need to be purchased by the Region to effectively implement?

Comment: None

A7.2 Are there stock numbers available for the new equipment?

Comment: Yes

A7.3 What will be the costs of these special tools, equipment, software? N/A

A8 Finances

A8.1 What total costs would the Regions be required to incur in implementing this document? Identify all cost activities associated with implementation, e.g. labour, training, tooling, stock, obsolescence

Comment: None

.....
Impact assessment completed by:

Name: Tshego Cornelius

Designation: Engineer

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Annex B – Type Tests for Tripping Relays

Type tests for tripping relays

Tripping relays (e.g. transformer Master Trip, trip repeat relays etc.) or auxiliary relays intended for critical functions (e.g. CT or VT circuit selection) shall comply with the type test requirements of Table 5.4. The contact ratings shall be as per the requirements of Section 4.1.4

Table 3 : Type testing requirements for tripping relays

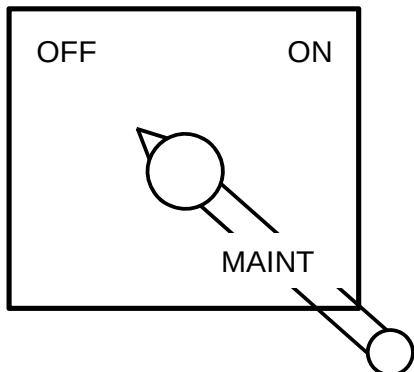
Item	Test	Standard	Test level	(Port*)/Compliance criteria	
D.C. Auxiliary power supply					
1	Operating range	-	-	V _{Nom} ± 20%	
Insulation resistance (for all circuits rated above 100V AC or D.C., plus CT and VT circuits)					
2	Dielectric withstand	IEC 60255-5	-	2kV r.m.s. 50Hz for 1 minute between all terminals to case earth. Transverse tests between contacts shall also be performed to the above specification.	
3	Insulation resistance	IEC 60255-5	-	Insulation resistance greater than 20MΩ when measured at 500Vd.c.	
4	Electrical impulse (1.2/50 μs)	IEC 60255-5	-	5kV 1.2/50μs waveform, 0.5J	
Environmental tests					
5	Cold	IEC 60068-2-1	-10°C or less	Operates within tolerance at -10°C (LCD screen operative)	
6	Dry Heat	IEC 60068-2-2	+55°C or more	Operates within tolerance at +55°C	
7	Cyclic Temperature and Humidity	IEC 60068-2-30	Tsest Db	25°C and 95% relative humidity/ 55°C and 95% relative humidity, 12 + 12 hour cycle	
8	Vibration	IEC 60255-21-1	Class 2 Response	Response: 1g, 10 - 150Hz, 1 sweep, energised. Contacts should not close for longer than 2ms.	
			Class 1 Endurance	Endurance: 1g 10 – 150Hz, 20 sweeps, un-energised. Contacts should not close for longer than 2ms.	
9	Seismic	IEC 60255-21-3	Class 1	Test method A (single axis sine sweep test) 1 – 35Hz, 1 sweep.	
Electromagnetic compatibility (immunity tests)					
Note: Refer to IEC 60255-26 for an overview of electromagnetic compatibility requirements					
10	1MHz oscillatory waves	IEC60255-22-1	Class 3	PS, IO	2.5kV CM, 1kV DM, 2s total test duration, 6 – 10 bursts at 400Hz repetition.
				COM	1kV CM, 0kV DM, 2s total test duration, 6 – 10 bursts at 400Hz repetition.
11	Fast Transient	IEC 60255-22-4	Class B (III)	PS, IO, E	2kV, 5kHz
				COM	1kV, 5kHz
12	Capacitor Discharge	See Section 5.2.2	-	IO	Digital inputs used for tripping shall not pick-up when a 60μF capacitor charged to 60% of nominal D.C. supply voltage is discharged into the input.

* EMC tests are applicable to specific "ports" of the EUT:- COM: (Rear) communication ports; E: Earth terminal; ENC: Relay enclosure; IO: Inputs/Outputs; PS: Power Supply, CM = Common Mode, DM = Differential Mode.

CONTROLLED DISCLOSURE

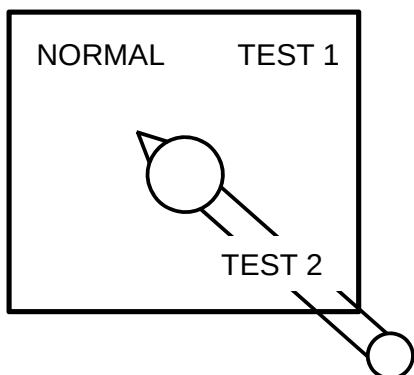
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Annex C – Configuration for switches



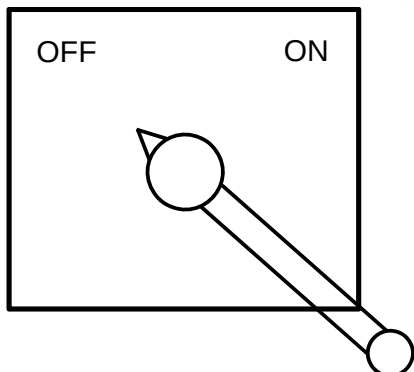
Notes:

- Rotational direction: **OFF** $\Rightarrow$ **ON** $\Rightarrow$ **MAINTENANCE**
- Rotational direction: **MAINTENANCE** $\Rightarrow$ **ON** $\Rightarrow$ **OFF**



Notes:

- Rotational direction: **NORMAL** $\Rightarrow$ **TEST 1** $\Rightarrow$ **TEST 2**
- Rotational direction: **TEST 2** $\Rightarrow$ **TEST 1** $\Rightarrow$ **NORMAL**



Notes:

- Rotational direction: **OFF** $\Rightarrow$ **ON**

Rotational direction: **ON** $\Rightarrow$ **OFF**

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