

TEST REPORT FILE

EN 60947-5-1:2017+AC:2020

Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices

Report reference No.....: TLJS23082550066

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Date of issue.....: September 04, 2023



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Reviewing location.....: Floor 2nd, Building D-1, No. 128, Shenfu Road, Minhang District, Shanghai, China.

Applicant.....: Nanjing ODES Intelligent Control System Co., Ltd.

Address.....: No.34 Zifeng Road, Pukou District, Nanjing, Jiangsu Province, P.R.China

Manufacturer.....: Nanjing ODES Intelligent Control System Co., Ltd.

Address.....: No.34 Zifeng Road, Pukou District, Nanjing, Jiangsu Province, P.R.China

Standard.....: EN 60947-5-1:2017+AC:2020

Review Report Form No.....: 60947

TRF originator.....: GTS

Master TRF.....: Reference No.EN 60947-5-1

Review procedure: GTS

Type of Review object.....: Voltage Switching Relay

Trademark.....: 

Model/type reference.....: GRUS-11G,GRUS-11G-*,
GRUS-11GS,GRUS-11GS-*,*=1~9

Main Model.....: GRUS-11G,GRUS-11GS

Rating.....: Rated Voltage Un: 220VDC/125VDC/110VDC
Rated Power: ≤5W;
Permanent Current : 10A

Possible review case verdicts:

- review case does not apply to the test object..... : N(.A.)
- review object does meet the requirement..... : P(ass)
- review object does not meet the requirement..... : F(ail)

General remarks:

"(see remark #)" refers to a remark appended to the report.

"(see appended table)" refers to a table appended to the report.

Throughout this report a comma is used as the decimal separator.

The review results presented in this report relate only to the object reviewed.

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Testing:

Date of receipt of review item:

August 25, 2023

Date(s) of performance of review:

August 25, 2023 to September 04, 2023

General product information:

Voltage Switching Relay

Summary of reviewing:

This review report includes:

Annex I: 2 page(s) of photo documentation.

Copy of marking plate

Voltage Switching Relay,

Model

GRUS-11G,GRUS-11G-*,
GRUS-11GS,GRUS-11GS-*,*=1~9

Nanjing ODES Intelligent Control System Co.,
Ltd.



EN 60947-5-1			
Clause	Requirement + Test	Result - Remark	Verdict
5.2	MARKING		P
5.2.1	Data shall be preferably marked on the equipment:		P
	a - manufacturer's name or trademark	Nanjing ODES Intelligent Control System Co., Ltd.	P
	b - type designation or serial number	GRUS-11G,GRUS-11GS	P
	Data shall be included on the nameplate, or on the equipment, or in the manufacturer's published literature:		P
	c - number of this standard	IEC/EN 60947-5-1	P
	d - rated operational voltages	220VDC/125VDC/110VDC	P
	e - utilization category and rated operational currents, at the rated operational voltages of the control circuit device	10A	P
	f - rated insulation voltage:	380VAC	P
	g - rated impulse withstand voltage	2000VAC/1minute	P
	h - switching overvoltages, if applicable		P
	i - IP code, in case of enclosed control circuit device	IP40	P
	j - pollution degree	3	P
	k - type and maximum ratings of short-circuit protective device		N
	l - conditional short-circuit current if less than 1000 A	30A	P
	m - suitability for isolation, where applicable, with the symbol 07-13-06 of IEC 60617-7		N
	n - indication of contact elements of same polarity		N
5.2.2	Terminal identification and marking	(see 7.1.7.4 of IEC 60947-1)	P
	Clearly and permanently identified according IEC 60445 and Annex L, unless superseded by relevant standard.		P
	Neutral terminal identified by letter :		N
	Protective earth terminal identified by letter		P
5.2.3	Functional markings		P
	Actuators may be identified by symbols in the form of engravings, but if a stop button carries any symbol engraved or marked this symbol shall be a circle or oval		P
	Letters or words may used where space is available		P
5.2.4	Emergency stop		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Control Push Button Switches intended to be used as "stop" control for emergency use shall be coloured red and in case of a push-button, be of mushroom shape		N
5.2.5	Operating diagram		P
	As rotary Push Button Switches may have multiplicity of contacts elements and a multiplicity of actuator positions, it necessary that the manufacturer indicates the relationship between the actuator positions and the associated contact elements position		P
5.2.5.1	The position indication shall be clear, and the associated text or symbols shall be indelible and easily legible		P
5.2.5.2	Terminal markings for operating diagrams		P
	Terminal markings shall be clearly identifiable with respect to the operating diagram		P
5.2.6	Time delay markings		P
	The manufacturer shall indicate, for each time-delay contact element, the characteristic of the delay, according to 2.4.1.1 or 2.4.1.2		P
5.3	Instructions for installation, operation and maintenance		P
	The manufacture shall specify, in his documents or catalogues:		P
	- the conditions for installation, operation and maintenance, if any, of the equipment during operation and after a fault		P
	- the specify the measures to be taken with regard to EMC, if any,		P
	- equipment only suitable in environment A shall provided with the following notice		P
	- if necessary, the instructions for transport, installation and operation of the equipment shall indicate the measures that are particular importance for the proper and correct installation, commissioning and operation of the equipment.		P
6	1.1 Normal service, mounting and transport conditions		P
6.1.1	Ambient temperature		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Ambient air temperature does not exceed +40 °C and its average over 24 hours does not exceed +35°C and the lower limit is –5°C		P
6.1.2	Altitude of side of installation does not exceed 2000m	Less than 2000m	P
6.1.3.1	Relative humidity does not exceed 50 % at max temp +40 °C, higher rel. hum may at lower temperatures e.g. 90% at +20 °C		P
6.1.3.2	Pollution degree		P
	Unless otherwise stated, equipment for: - industrial use shall have a degree 3, depending upon micro-environment - household and similar shall have degree 2		P
6.1.4	Shock and vibration		P
	Under consideration		P
6.2	Conditions during transport and storage		P
	Under consideration		P
6.3	Mounting		P
	According manufacturer's instruction		P
6.3.1	Mounting of single hole mounted devices		P
	Dimensions according Table 2		P
6.3.1.1	Location of key recess(if any)		P
	Dimensions according Table 3		N
6.3.1.2	Range of panel thickness		P
	The device shall be capable of being mounted on any thickness between 1 and 6 mm		P
6.3.1.3	Grouping of devices		P
	The distances a between the mounting centres in the same row and b between the centre lines of the rows shall be not less than those given in table 3. Distances a and b may be interchanged		P
7.1	CONSTRUCTION		P
7.1.1	Materials		P
7.1.2	Current-carrying parts and their connection		P
	No contact pressure through insulating materials		P
7.1.3	Clearances		P
	Clause 7.1.3 of IEC 60947 applies		P
	Rated impulse withstand voltage	(see test sequence I)	P
	Case B (mm)		P
	Case A (mm)		P
	Creepage distances		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Pollution degree		P
	Comparative tracking index (V)		P
	Material group		P
	Rated insulation voltage U_i (V)		P
	Minimum creepage distances (mm)		P
	Measured creepage distances (mm)		P
	In case U_{imp} is not indicated, clearances and creepage distances in according with Annex D		P
7.1.4	Actuator		P
7.1.4.1	Insulation		P
7.1.4.2	Direction		P
7.1.4.3	Actuating force (or moment) :		P
7.1.4.4	Limitation of rotation (of rotary Push Button Switch)		N
7.1.4.5	Emergency stop		N
7.1.5	Indication of the contact position		P
7.1.5.1	Indication means		P
7.1.5.2	Indication by the actuator		P
7.1.6	Conditions for control Push Button Switches suitable for isolation		P
7.1.7	Class II control circuit devices		N
	Not provided with means for protective earthing and insulated by encapsulation,	See annex F	N
7.1.8	Requirements for control devices with integrally connected cables	See annex G	N
7.1.11	Degree of protection of enclosed equipment		P
	Degree of protection		P
	Test for first characteristic		N
	Test for first numeral		N
	Test for second characteristic		N
	Test for second numeral		N
7.2	Performance requirements		P
	Subclauses 7.2.1.1 and 7.2.2 of IEC 60947-1 apply with the following additions:		P
7.2.1.2	Limits of operation of contactor relays		P
	The limits of operation for contactor relays shall be in accordance with IEC 60947-4-1	See clause 8.3.3.2	P
7.2.3	Dielectric properties		P
	Subclause 7.2.3 of IEC 60947-1 applies with the following addition	See clause 8.3.3.4	P
	For class II control circuit devices insulated by encapsulation	See Annex F	N

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Clause	Requirement + Test	Result - Remark	Verdict
7.2.4	Ability to make and break under normal and abnormal load conditions		P
7.2.4.1	Making and breaking capacities		P
	Making and breaking capacities under normal conditions as state in table 4	See clause 8.3.3.5.2	P
	Making and breaking capacities under abnormal conditions as state in table 5	See clause 8.3.3.5.3	P
7.2.4.2	Vacant		P
7.2.4.3	Durability		P
	Sub-clause 7.2.4.3 of IEC 60947-1 applies with the following additions:		P
	Mechanical durability	See Annex C	P
	Electrical durability	See Annex C	P
7.2.5	Conditional short-circuit current		P
	The switching element shall withstand the stresses resulting from short-circuit current under the conditions specified in 8.3.4		P
7.2.6	switching overvoltage		P
	Subclause 7.2.6 of IEC 60947-1 applies		P
7.2.7	Additional requirements for control Push Button Switches suitable for isolation		P
	Control Push Button Switches suitable for isolation shall be tested according to 8.3.3.4 of IEC 60947-1 with a value of test voltage as specified in Table 14 or IEC 60947-1 corresponding to the rated impuls withstand voltage Uimp declared by the manufacturer.		P
	Other additional requirements applicable to such control Push Button Switches are under consideration		P
7.3	Electromagnetic compatibility (EMC)		P
	Subclause 7.3 of IEC 60947-1 applies unless otherwise specified in this standard		P
8.3.1.a	TEST SEQUENCE I (sample No. 1)		P
Test No. 1	- operating limits of contactor relays (8.3.3.2), if applicable		N
Test No. 2	- temperature rise (Clause 8.3.3.3.)		P
Test No. 3	- dielectric properties (Clause 8.3.3.4)		P
Test No. 4	- mechanical properties of terminals (8.2.4 of IEC 60947-1)		P
8.3.3.2	2 Operating limits of contactor relays		N
9.3.3.2.1	Power-operated equipment:		N

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Clause	Requirement + Test	Result - Remark	Verdict
8.2.1.2.1	Electromagnetic contactors and starters		N
	rated control supply voltage U_s (V)	220VDC/125VDC/110VDC	P
	frequency (Hz)		P
	declared ambient temperature(>40 °C) for 100% U_s		P
	limits of close satisfactorily at any value between 85% and 110% of rated control supply voltage U_s		P
	limits of drop out and open fully are: 75% to 20% for a.c. and 75% to 10% for d.c.		P
	ambient temperature(-5 °C) for 100% U_s		P
	limits of close satisfactorily at any value between 85% and 110% of rated control supply voltage U_s		P
	Limits of drop out and open fully are: 75% to 20% for a.c. and 75% to 10% for d.c.		P
8.2.1.2.2	Contactors and starters with electronically controlled electromagnet		N
	Rated control supply voltage U_s (V)	220VDC/125VDC/110VDC	P
	Frequency (Hz)		P
	Declared ambient temperature(>40 °C) for 100% U_s		N
	Limits of close satisfactorily at any value between 85% and 110% of rated control supply voltage U_s		N
	Limits of drop out and open fully are: 75% to 20% for a.c. and 75% to 10% for d.c.		N
	Ambient temperature(-5 °C) for 100% U_s		N
	Limits of close satisfactorily at any value between 85% and 110% of rated control supply voltage U_s		N
	Limits of drop out and open fully are: 75% to 20% for a.c. and 75% to 10% for d.c.		N
8.2.1.2.3	Electro-pneumatic contactors and starters		N
	Rated air supply pressure(Bar)		N
	Declared ambient temperature(>40 °C) for 100% of the rated air supply pressure(Bar)		N
	Limits of close satisfactorily at any value between 85% and 110% of rated air supply pressure(Bar) :		N
	Limits of drop out and open fully are: 75% to 10% of rated air supply pressure(Bar)		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Ambient temperature(-5 °C) for 100% of the rated air supply pressure(Bar)		N
	Limits of close satisfactorily at any value between 85% and 110% of rated air supply pressure(Bar) :		N
	Limits of drop out and open fully are: 75% to 10% for the rated air supply pressure(Bar)		N
8.3.3.3	Temperature rise		P
	ambient temperature 10-40 C		P
	test enclosure W x H x D (mm x mm x mm)		P
	material of enclosure		P
	NO-contacts, test conditions:		P
	- rated operational current I _e (A)		P
	- cable cross-section (mm ²)		P
	- temperature rise of NO terminals (K)		P
	NC-contacts, test conditions:		P
	- rated operational current I _e (A)		P
	- cable cross-section (mm ²)		P
	- temperature rise of NC terminals (K)		P
	Coils and electromagnets, test conditions:		P
	- rated control supply voltage U _s (V)		P
	- Class of insulating material		P
	- temperature rise of coil and electromagnets (K) :		P
8.3.3.4	Test of dielectric properties, impulse withstand voltage (U _{imp} indicated):		P
	- verification by measurement of clearances instead of testing		P
	- rated impulse withstand voltage (V)		P
	- test U _{imp} auxiliary circuits (kV)		P
	Test of dielectric properties, dielectric withstand voltage (U _{imp} not indicated):		P
	- rated insulation voltage (V)		P
	- control and auxiliary circuits, test voltage (V) for 5 sec		P
8.2.4	Mechanical properties of terminals		P
8.2.4.2	Mechanical strength of terminals		P
	maximum cross-sectional area of conductor (mm ²)		P
	diameter of thread (mm)		P
	torque (Nm)		P
	5 times on 2 separate clamping units		P
8.2.4.3	Testing for damage to and accidental loosening of conductor (flexion test)		P
	conductor of the smallest cross-sectional area (mm ²)		P

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Clause	Requirement + Test	Result - Remark	Verdict
	number of conductor of the smallest cross section		P
	diameter of bushing hole (mm)		P
	height between the equipment and the platen (mm)		P
	mass at the conductor(s) (kg)		P
	135 continuous revolutions: the conductor shall neither slip out of the terminal nor break near the clamping unit		P
8.2.4.4	Pull-out test		P
	force (N)		P
	1 min, the conductor shall neither slip out of the terminal nor break near the clamping unit		P
	Flexion test		P
	conductor of the largest cross-sectional area (mm ²)		P
	number of conductor of the largest cross-section :		P
	diameter of bushing hole (mm)		P
	height between the equipment and the platen (mm)		P
	mass at the conductor(s) (kg)		P
	135 continuous revolutions: the conductor shall neither slip out of the terminal nor break near the clamping unit		P
	Pull-out test		P
	force (N)		P
	1 min, the conductor shall neither slip out of the terminal nor break near the clamping unit		P
	Flexion test		P
	conductor of the largest and smallest cross-sectional area (mm ²)		P
	number of conductor of the smallest cross sectional, number of conductor of the largest cross sectional		P
	diameter of bushing hole (mm)		P
	height between the equipment and the platen (mm)		P
	mass at the conductor(s) (kg)		P
	135 continuous revolutions: the conductor shall neither slip out of the terminal nor break near the clamping unit		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Pull-out test		P
	force (N)		P
	1 min, the conductor shall neither slip out of the terminal nor break near the clamping unit		P
8.3.1.a	TEST SEQUENCE II (sample No. 2)		P
Test No. 1	- Making and breaking capacities of switching elements under normal conditions (8.3.3.5.2)		P
Test No. 2	- Dielectric verification (8.3.3.5.5.b)		P
8.3.3.5	TEST SEQUENCE II		P
8.3.3.5.2	Making and breaking capacities of switching elements under normal conditions		P
	contact element (figure / form)		P
	contact polarity		P
	utilization category		P
	rated operational voltage U_e (V)		P
	rated operational current I_e (A) or power (kW)		P
3 Test No.1	- test voltage $U/U_e = 1,1$ (V)		P
	- power factor/time constant		P
	- make operations: test current I/I_e (A)		P
	- break operations: test current I/I_e (A)		P
	- a.c. test: Inductor shunted by a resistor taking 3% of the total power consumed - d.c. test: test current increase from zero to steady-state value within limits of figure 9		P
	- on-time (ms)		P
	- operating cycles per minute		P
	- number of operating cycles		P
	- test voltage $U/U_e = 1,0$ (V)		P
	- power factor/time constant		P
	- make operations: test current I/I_e (A)		P
	- break operations: test current I/I_e (A)		P
4 Test No. 2	- on-time (ms)		P
	- operating cycles per minute		P
	- number of operating cycles		P
Test No. 3	- on-time (ms)		P
	- operating cycles per minute		P
	- number of operating cycles		P
Test No. 4	- on-time (ms)		P
	- operating cycles per minute		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- number of operating cycles		P
	Behaviour and condition during and after the test:		P
	- no electrical or mechanical failures		P
	- no contact welding or prolonged arcing		P
	- no blowing of the fusible element in the earth circuit		P
	Dielectric verification:		P
	dielectric test voltage (V) 2 xUe with a min.of 1000V:		P
8.3.1.a	TEST SEQUENCE III (sample No. 3)		P
Test No. 1	- Making and breaking capacities of switching elements under abnormal conditions (8.3.3.5.3)		P
Test No. 2	- Dielectric verification (8.3.3.5.5.b)		P
8.3.3.5	TEST SEQUENCE III		P
8.3.3.5.3	Making and breaking capacities of switching elements under abnormal conditions:		P
	contact element (figure / form)		P
	contact polarity		P
	utilization category		P
	rated operational voltage Ue (V)		P
	rated operational current Ie (A) or power (kW)		P
	Conditions, make/break operations:		P
	- test voltage U/Ue = 1,1 (V)		P
	- power factor/time constant		P
	- make operations: test current I/Ie (A)		P
	- break operations: test current I/Ie (A)		P
	- a.c. test: Inductor shunted by a resistor taking 3% of the total power consumed - d.c. test: test current increase from zero to steady-state value within limits of figure 9		P
	- on-time (ms)		P
	- operating cycles per minute		P
	- number of operating cycles		P
	Behaviour and condition during and after the test:		P
	- no electrical or mechanical failures		P
	- no contact welding or prolonged arcing		P
	- no blowing of the fusible element in the earth circuit		P
	Dielectric verification:		P
	dielectric test voltage (V) 2 xUe with min.of 1000V:		P

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Clause	Requirement + Test	Result - Remark	Verdict
8.3.1.	TEST SEQUENCE IV (sample No. 4)		P
Test No. 1	- Performance under conditional short-circuit current (8.3.4)		P
Test No. 2	- Dielectric verification (8.3.3.5.5.b)		P
	TEST SEQUENCE IV		P
8.3.4	Performance under conditional short-circuit current		P
	contact element (figure / form)		P
	contact polarity		P
	type of SCPD		P
	ratings of SCPD		P
	prospective current (min- 1 kA)		P
	test voltage (V) $U/U_e = 1,1$ (V)		P
	r.m.s. test current obtained (kA)		P
	power factor (max. 0,7)		P
	first CO operation by closing the separate making Push Button Switch: test (I_p / I^2dt (A / A ² s)		P
	time interval between test (min. 3 min)		P
	second CO operation by closing the separate making Push Button Switch: test (I_p / I^2dt (A / A ² s)		P
	time interval between test (min. 3 min)		P
	third making operation to closed switching elements: test I^2dta (A ² s)		P
	Behaviour of the equipment during the test:		P
	switching elements open by the normal actuating system		P
	Dielectric verification:		P
	dielectric test voltage (V) $2 \times U_e$ with min.of 1000V:		P
8.3.1.	TEST SEQUENCE V (sample No. 5)		P
Test No. 1	- Degree of protection of enclosed control circuit-devices (Annex C of IEC 60947-1)		P
Test No. 2	- Verification of actuation force or moment (8.2.5)		P
8.3.4	TEST SEQUENCE V		P
	Degree of protection of enclosed control circuit-devices		P
	The enclosed control circuit devices shall comply with the requirements of Annex C of IEC60947-1		P
5	Verification of actuation force or moment		P
8.2.5	When required in 7.1.4.3, the minimum actuating force or moment shall be tested during sequence V of 8.3.1. The performance shall be as stated in 7.1.4.3		P

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Clause	Requirement + Test	Result - Remark	Verdict
7.1.4.3	Actuating force (or moment)		P
	The force (or moment) required to operate the the actuator shall be compatible with the intended application, taking into account the size of the actuator, the type of enclosure or panel, the environment of the installation and the use for which it is intended		P
	The minimum starting force (or moment) shall be sufficiently large to prevent inadvertent operation; e.g. push-buttons and rotary Push Button Switches to be used with enclosures complying with degrees of protection IPX5 or IPX6 shall not become actuated when hit by the jet of water applied during the test of the enclosed equipment.		P
8.3.1.	TEST SEQUENCE VI (sample No. 6)		P
Test No. 1	- Measurement of clearances and creepage distances, if applicable (7.1.3)		P
Test No. 2	- Verification of limitation of rotation of a rotary Push Button Switch (8.2.6)		P
8.3.4	TEST SEQUENCE VI		P
	Measurement of clearances and creepage distances, if applicable (7.1.3)		P
	Clearances and creepage distances according Annex D	See clause 7.1.3	P
	Verification of limitation of rotation of a rotary Push Button Switch (8.2.6)		P
8.2.6	When this test is required in 7.1.4.4, it shall be tested during sequence VI of 8.3.1 The test sample shall be mounted according to the manufacturers instructions		P
7.1.4.4	Limitation of rotation (of a rotary Push Button Switch)		P
	When actuators with limited or unidirectional movement are used, they shall be fitted with robust means of limitation, capable of withstanding five times the actual maximum actuating moment		P
8.2.6	The operating moment shall be measured five times and the maximum value recorded.		P
	The maximum moment value, multiplied by five, shall be applied to the actuator by forcing it against the means of limitation. The moment shall be applied for 10 s.		P
	Means of limitation has not moved, become loose or prevented the actuator's normal operation		P

Annex C of IEC 60947-1		
Annex C	Degree of protection of enclosed control circuit-devices	N
C.1	Scope	N
	This annex applies to degrees of protection of enclosed Push Button Switchgear and control gear at rated voltages not exceeding 1000 V a.c. or 1500 V d.c. hereafter referred as "equipment"	N
C.2	Object	N
	Clause 2 of IEC 60529 applies with additional requirements of this annex	N
C.3	Definitions	N
	Clause 3 of IEC 60529 applies except that "Enclosure" is replaced by the following:	N
	"A part providing a specified degree of protection of equipment against certain external influences and a specified degree of protection against approach to or contact with live parts and moving parts"	N
C.4	Designation	N
	Clause 4 of IEC 60529 applies except for letters H, M and S	N
C.5	Degrees of protection against access to hazardous parts and against ingress of solid foreign objects indicated by the first characteristic numeral	N
	Clause 5 of IEC 60529 applies	N
C.6	Degrees of protection against ingress of water indicated by the second characteristic numeral	N
	Clause 6 of IEC 60529 applies	N
C.7	Degrees of protection against access to hazardous parts indicated by the additional letter	N
	Clause 7 of IEC 60529 applies	N
C.8	Supplementary letters	N
	Clause 8 of IEC 60529 applies	N
C.9	Examples of designations with IP Code	P
	Clause 9 of IEC 60529 applies	N
C.10	Marking	N
	Clause 10 of IEC 60529 applies with the following addition:	N

	If the IP Code is designated for one mounting position only, it shall be indicated by the symbol 0623 of ISO 7000 placed next to the IP Code specifying this position of the equipment, e.g. vertical		N
C.11	General requirements for the tests		N
C.11.1	Clause 11.1 of IEC 60529 applies		N
C.11.2	Clause 11.2 of IEC 60529 applies with the following additions:		N
	All tests are made in the unenergized state		N
	Certain devices(e.g. exposed faces of push-buttons) can be verified by inspection		N
	The temperature of the test sample shall not deviate from the actual temperature by more than 5 K		N
	Where equipment is mounted in an empty enclosure which already has an IP code the following requirements apply:		P
	a) For IP1X to IP4X and additional letters A to D This shall be verified by inspection and compliance with the enclosure manufacturer's instructions		P
	b) For IP6X dust test This shall be verified by inspection and compliance with the enclosure manufacturer's instructions		N
	c) For IP5X dust test and IP1X to IP8X water tests Testing of the enclosed equipment is only required where the ingress of dust or water may impair the operation of the equipment		N
C.11.3	Subclause 11.3 of IEC 60529 applies with the following addition:		N
	Drain and ventilating holes are treated as normal openings		N
C.11.4	Clause 11.4 of IEC 60529 applies		N
C.11.5	Where an empty enclosure is used as a component of an enclosed equipment, Clause 11.5 of IEC 60529 applies		N
C.12	Degrees of protection against access to hazardous parts indicated by the first characteristic numeral		N
	Clause 12 of IEC 60529 applies except for 12.3.2		N
C.13	Degrees of protection against ingress of solid foreign objects indicated by the first characteristic numeral		N
	Clause 13 of IEC 60529 applies except for		N
C.13.4	Dust test for first characteristic numerals 5 and 6		N
	Enclosed equipment having a degree of protection IP5X shall be tested according to category 2 of 13.4 of IEC 60529		N

	Enclosed equipment having a degree of protection IP6X shall be tested according to category 1 of 13.4 of IEC 60529		N
C.13.5.2	Acceptance conditions for first characteristic numeral 5		N
	The following text to be added:		N
	Where dust deposits could raise as to the correct functioning and safety of the equipment, a preconditioning and a dielectric test shall be conducted as follows:		N
	The preconditioning, after dust test, shall be verified by test Ca: damp heat, steady state, according to IEC 60068-2-3, under the following conditions.		N
	The equipment shall be prepared so that the dust deposits are subjected to the test by leaving open the lid and/or removing parts, where possible without the aid of tool		N
	Before being placed in the chamber the equipment shall be stored at room temperature at least 4 h before the test		N
	The test duration shall be 24 consecutive hours		N
	After this period the equipment is to be removed from the chamber within 15 min and submitted to a power-frequency dielectric test for 1 min, the value being 2 U _{max} with a minimum of 1000 V		N
C.14	Tests for protection against ingress of water indicated by the second characteristic numeral		N
C.14.1	Clause 14.1 of IEC 60529 applies		N
C.14.2	Clause 14.2 of IEC 60529 applies		N
C.14.3	Clause 14.3 of IEC 60529 applies with following addition:		N
	The equipments then submitted to a power-frequency dielectric test for 1 min, the value being 2 U _{max} with a minimum of 1000 V		N
C.15	Tests for protection against access to hazardous parts indicated by additional letter		N
	Clause 15.1 of IEC 60529 applies		N
C.16	Summary of responsibilities of relevant technical committees		N
			N

	Annex C	
Annex C	Special tests ----- Durability tests	P
C.1.1	Durability declaration	P
	The special durability tests described in this annex are conducted at the discretion of the manufacturer	P
	Declared number of operating cycles by the manufacturer:	P

	- mechanical		P
	- electrical		P
C.1.2	Test procedures		P
	As stated in 8.3.2.1 and at a rate equal or higher than that declared by the manufacturer		P
	The moving parts of the device shall reach their maximum operating positions in both directions, as recommended by the manufacturer		P
C.1.2.2	Single 8 test		P
	Eight control circuit devices shall be tested to the declared number of operating cycles		P
	If the number of failed devices does not exceed two, the test is considered passed		P
C.1.2.3	Double 3 test		P
	Three control circuit devices shall be tested to the declared number of operating cycles		P
	The test is considered passed if there is no failure, and failed if there is more than one failure.		P
	Should there be only one failure, then three additional control devices are tested to the declared number of operating cycles and providing there is no additional failure, the test is considered passed.		P
C.1.3	Failure criteria		P
	During the tests described in C.2.2 and C.3.2, there shall be no electrical and/or mechanical failures		P
	Following the tests, the switching element shall pass the dielectric test of 8.3.3.4 with a rated test voltage equal to 2 U _e with a minimum of 1000 V		P
C.2	Mechanical durability		P
C.2.1	General		P
	The mechanical durability of a control circuit device is defined as the number of no-load operating cycles which will be attained or exceeding by 90 % of all devices tested without repair or replacement of any part.		P
C.2.2	Test procedures		P
	Test are carried out according to C.1.2.		P
	During the test, periodically the contacts shall be checked at any voltage and current, selected by the manufacturer, and there shall be no failure		P
C.3	Electrical durability		P
C.3.1	General		P

	Electrical durability of a control device is defined as the number of on-load operating cycles which will be attained or exceeded by 90% of all devices tested, without repair or replacement of any part		P
C.3.2	Test procedures		P
	Electrical durability tests are carried out by operating the device under the conditions defined in table C.1, in accordance with C.3.2.1 for a.c. or with c.3.2.2. for d.c		P
	Each mechanical operation cycle shall include an interruption of the test current		P
	The ON- duration of the current shall not more 50% and not-less than 10% of an operating cycle.		P
	If the test circuit shown in figure C.1 is used, the ON-duration of current at 10 times I_e shall not cause overheating		P
	Alternatively these test may be performed on the actual load for which the control Push Button Switch is intended		P
C.3.2.1	AC test		P
	Used circuit:		P
	The circuit to be used as shown in fig C.1:		P
	- Making circuit consisting air-cored inductor, in series with resistor, power factor of 0,7		P
	- Breaking circuit consisting air-cored inductor, in series with resistor, parallel damping resistor in which flows 3 % of breaking current, power factor of 0,4	6	P
	If the contact element has a bounce time less than 3 ms, the test may be made with the simplified circuit shown in Figure C.2		P
C.3.2.2	D.C Tests		-
	Used inductor		P
	The circuit to be used as shown in fig C.1:		P
	- circuit consisting air-cored inductor, in series with resistor, parallel damping resistor across the complete circuit in which flows 1 % of test current power factor of T 0,95 or		P
	-circuit consisting iron-cored inductor, in series with resistor, power factor of T0,95 T 0,95 = 6 x P for P < 50 W T 0,95 = 300 ms for P = 50 W		P
	Annex D		

Annex D	Clearance and creepage distances of control circuit devices		P
D3	General		P
D3.1		See clause 7.1.3	P
	Annex E		N
Annex E	Items subject to agree between manufacturer and user		N
	Annex J of IEC 60947-1 applies, as far as covered by clauses and of this standard, with the following additions		N
5.2.5	Relationship between the positions of the actuator of rotary Push Button Switches and the associated contact element positions in the operating diagram (indication by the manufacturer)		N
5.2.6	Characteristics of the delay of time contact elements with adjustable delay of contactors relays (indication by manufacturer)		N
6.1.1 (Annex K)	Choice of connecting conductors for position Push Button Switches with direct opening action		N
8.3.1	Test sequences made on one sample only (at manufacturer's request)		N
8.3.4.3	Conditional short-circuit current test:		N
	- adjustment of the test current if the prospective current is different from 1000 A (to be specified by the manufacturer)		N
	- power factor of the test circuit less than 0,5 (with manufacturer's consent		N
	Annex F		N
Annex F	Class II control circuit devices insulated by encapsulation Requirements and tests		N
F.1	General		N
	This annex specifies constructional requirements and tests for class II control circuit devices or parts of devices in which insulation of class II according to IEC 61140 is archived by encapsulation		N
	All non-encapsulated parts shall have clearances and creepage distances double to those specified in 7.1.3		N
F.5	Marking		N
	Control devices according to this annex shall be marked with the following symbol		N
F.7	Instructional and functional requirements		N

F.7.1	Choice of compound	N
	The compound shall be chosen so that the encapsulated control devices comply with the tests defined in F.8.	N
F.7.2	Adhesion of the compound	N
	The adhesion of the compound shall be sufficient to prevent the ingress of moisture between the compound and all encapsulated parts and to prevent movement of the encapsulated portion of cable if any.	N
	Compliance shall be verified by tests of F.8.2.5 and F.8.1.2.2.	N
F.7.3	Dielectric properties	N
	Sub-clause 7.2.3 applies with the following changes:	N
	For the verification of the impulse withstand voltage, the test voltage U_{imp} shall be the next higher category of the maximum rated operational voltage in the first column of Table H.1 of IEC 60947-1 for stated overvoltage category.	N
	For verification of the power frequency withstand voltage, the test voltage shall be the sum of the voltage stated in Table 12A of IEC 60947-1 plus 1000 V.	N
F.8	Tests	N
F.8.1	Kind of tests	N
F.8.1.1	General	N
	Subclause 8.1.1 of IEC 60947-1 applies	N
F.8.1.2	Type test	N
	The following sequence of 6 tests shall be applied to each of 3 samples in the specified order	N
F.8.1.2.1	Dielectric tests in new conditions	N
	Subclause 8.3.3.4 of IEC 60947-1 applies with the exception that the values of voltages shall be applied between the stripped joined ends of the cable or the shorted terminals and any point of the surface (or metallic foil on the surface) of the encapsulated device (see fig F.1)	N
	No breakdown of the insulation shall occur	N
F.1.2.2	Cable tests (if applicable)	N
	Control circuit devices provided with integrally connected cables shall comply with the requirements of Annex G	N

F.8.1.2.3	Rapid change of temperature test		N
	Test Na shall be performed in accordance with IEC 60068-2-14 with the following values:		N
	T_a and T_b are the minimum and the maximum temperatures stated in f.2.3		N
	Transition time t_2		N
	Number of cycles		N
	Exposure time t_1		N
	After the test no visible damage shall be observed		N
F.8.1.2.4	Impact test		N
	The test is performed as follow:	See Figure F.2	N
	Three impacts of 0,5 Joule shall applied near the centre of the largest surface or the longest axis (for cylindrical shape) of the encapsulated device		N
	The impacts are provided by dropping a steel ball of 0,25 kg from a height of 0,20 m		N
	The support is consired sufficiently rigid if its displacement under the impact energy is lower than 0,1 mm		N
	After the test no visible damage shall be observed		N
F.8.1.2.5	Damp heat, cyclic		N
	Test Db shall be performed in accordance with IEC 60068-2-30 with the following values:		N
	6.1.1.1.1 Upper temperature		N
	Number of cycles		N
	Variant		N
	After the test no visible damage shall be observed		N
F.8.1.2.6	Dielectric test after stresses		N
	Test of dielectric properties, dielectric withstand voltage (U_{imp} not indicated):		N
	- rated insulation voltage (V)		N
	- test voltage (V) for 5 sec :		N
	Leakage current measurements at 1,1 U_i		N
	Annex G		N
Annex G	Additional requirements for control circuit devices with integrally connected cables		N
G.1	General		N

	This annex gives additional requirements applying to control circuit devices with integrally connected cables for electrical connection to other equipment and / or to the power source.		N
	The cable integrally connected to such control devices is not considered replaceable by the user.		N
	This annex states the constructional and performance requirements for the cable, the cable anchorage and the cable entrance seal		N
G.7	Constructional and performance requirements		N
G.7.1	Constructional requirements		N
G.7.1.1	Cable material		N
	The control device shall provided with flexible cable of appropriate voltage, current and temperature rating and environmental condition		N
G.7.1.2	Cable anchorage		N
	The cable anchorage shall be such that a force being applied to the cable is not transmitted to electrical connections integral to the device		N
	Movement of the cable intro or out of the control circuit device shall not cause damage to the connection or internal parts of the device		N
G.7.1.3	Cable entrance sealing means		N
	A sealing means shall provided at the cable entrance to the control circuit device suitable for the degree of protection or internal parts of the device		N
G.7.2	Performance requirements		N
	The cable and the cable entrance sealing means shall be capable of withstanding the tests given in G.8		N
G.8	Tests		N
	The purpose of these tests is to ensure integrity of the cable anchorage during handling and installation. Once installed, the control circuit device and cable should be fixed relative to each other		N
G.8.1	Type test		N
	The following sequence of four test shall be performed on a representative sample in the specified order		N
G.8.1.1	Pull test		N
	The cable shall be subjected to a steady pull along the axis of the cable entry, applied to the insulating jacket of the cable for a duration of 1 min		N
	The pull force for a cable diameter greater than or equal to 8 mm		N

	The pull force for cable diameters of less than 8 mm shall be of a value of 20 times the external cable diameter		N
G.8.1.2	Torque test		N
	The cable shall be subjected to a torque of 0,1 Nm or limited to the value giving an angle of torque of 360°		N
	The torque shall be applied clockwise and then counter-clockwise for 1 min, to the cable at a distance of 100 mm from the control circuit device entrance		N
G.8.1.3	Push test		N
	The push force shall be applied along the axis of the cable as close as possible to the cable entrance		N
	The force is increased to 20 N. The force shall be applied for 1 min for each time and with 1 min pause between applications		N
	After the tests, no visible damage of the cable entrance sealing means and no displacement of the cable shall be observed		N
G.8.1.4	Bend test		N
	The cable shall beloaded and bent in the following manner:		N
	a) suspend a 3 kg mass by attaching it to the cable, 1 m from the cable entrance and with the axis of the cable entrance vertical		N
	b) tilt the control circuit device 90° to cause a 90° bend in the cable, maintaining that position for 1 min		N
	c) tilt the contral device 90° in the opposite direction relative to vertical so as to cause an opposite 90° bend in the cable, maintaining the posisiton for a duration of 1 min.		N
G.8.2	Results to be obtained		N
	There shall be no damage to the cable, cable sealing means, cable entrance or the electrical connecting means of the control circuit device.		N
	This will be verified by visual examination and verification of compliance with the stated IP designation	See 7.1. 11	P
	Annex H		N
Annex H	Additional requirements for semiconductor switching elements for control circuit devices		N
H.3	Classification		N
H.3.1	Semiconductor switching elements		N
	1) Utilization categories (see 4.4. and H.4.2)		N

	2) Electrical ratings based on utilization categories (see annex A)		N
			N
H.5	Product information		N
	The following information shall be given by the manufacturer:		N
	Clause 5.1 applies with the following additions:		N
	Basic rated values and utilization		N
	a) Voltage drop (H.7.1.1)		N
	b) Minimum operational current		N
	c) Off-state current		N
	d) Making and breaking capacities		N
	e) Conditional short-circuit current		N
	f) Electromagnetic compability, EMC		N
H.8	Tests		N
H.8.1	Type test		N
	Subclause 8.1.2 applies with the following additions:		N
H.8.2	Voltage drop (U_d)		N
	The voltage drop is measured across the active output of the switching element in the ON state and carrying the current range of I_m and I_e at an ambient temperature of $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and at rated frequency.		N
	The measurement is performed with the circuit in figure H.2, with the Push Button Switch S closed. The loads shall be resistive and R_2 is adjusted to obtain the test current with the supply voltage		N
	Voltage drop at I_m		N
	Voltage drop at I_e		N
	The measured voltage drop exceed not the specified value in H.7.1.1		N
H.8.3	Minimum operational current (I_m)		N
	The test is performed with the switching element connected to a test circuit shown in fig H.2. With supply voltage (U_e), the Push Button Switch open and the switching element in ON-state conduction, the resistive load R_1 is adjusted to obtain the current I_m		N
	The measured value shall be according to H.7.1.2		N
H.8.4	OFF-state current (I_r)		N

	With the circuit in Figure H.2, and the S Push Button Switch closed, the load R_2 is adjusted to obtain the rated operational current (I_e) when the highest supply voltage (U_e) is connected to the circuit. The switching element is then turned off and the OFF-state current is measured.		N
	The measured value shall be according to H.7.1.3		N
H.8.5	Making and breaking capacities		N
	Subclause 8.3.3.5 applies		N
8.3.3.5.2	Making and breaking capacities of switching elements under normal conditions		N
	contact element (figure / form)		N
	contact polarity		N
	utilization category		N
	rated operational voltage U_e (V)		N
	rated operational current I_e (A) or power (kW)		N
	- test voltage $U/U_e = 1,1$ (V)		N
	- power factor/time constant		N
	- make operations: test current I/I_e (A)		N
	- break operations: test current I/I_e (A)		N
	- a.c. test: Inductor shunted by a resistor taking 3% of the total power consumed - d.c. test: test current increase from zero to steady-state value within limits of figure 9		N
	- on-time (ms)		N
	- operating cycles per minute		N
	- number of operating cycles		N
	- test voltage $U/U_e = 1,0$ (V)		N
	- power factor/time constant		N
	- make operations: test current I/I_e (A)		N
	- break operations: test current I/I_e (A)		N
7 Test No. 2	- on-time (ms)		N
	- operating cycles per minute		N
	- number of operating cycles		N
Test No. 3	- on-time (ms)		N

	- operating cycles per minute		N
	- number of operating cycles		N
Test No. 4	- on-time (ms)		N
	- operating cycles per minute		N
	- number of operating cycles		N
	Behaviour and condition during and after the test:		N
	- no electrical or mechanical failures		N
	- no contact welding or prolonged arcing		N
	- no blowing of the fusible element in the earth circuit		N
	Dielectric verification:		N
	dielectric test voltage (V) 2 xUe with a min.of 1000V :		N
8.3.3.5.3	Making and breaking capacities of switching elements under abnormal conditions:		N
	contact element (figure / form)		N
	contact polarity		N
	utilization category		N
	rated operational voltage Ue (V)		N
	rated operational current Ie (A) or power (kW)		N
	Conditions, make/break operations:		N
	- test voltage U/Ue = 1,1 (V)		N
	- power factor/time constant		N
	- make operations: test current I/Ie (A)		N
	- break operations: test current I/Ie (A)		N
	- a.c. test: Inductor shunted by a resistor taking 3% of the total power consumed - d.c. test: test current increase from zero to steady-state value within limits of figure 9		N
	- on-time (ms)		N
	- operating cycles per minute		N
	- number of operating cycles		N
	Behaviour and condition during and after the test:		N
	- no electrical or mechanical failures		N
	- no contact welding or prolonged arcing		N

	- no blowing of the fusible element in the earth circuit		N
	Dielectric verification:		N
	dielectric test voltage (V) 2 xUe with min.of 1000V:		N
H.8.6	Performance under short-circuit conditions		7.1 N
8.3.4	Performance under conditional short-circuit current		N
	contact element (figure / form)		N
	contact polarity		N
	Maximum cable length		N
	type of SCPD :	Fuse gL/gG	N
	ratings of SCPD :		N
	prospective current (min- 1 kA) :		N
	test voltage (V) 1,1 x Ue :		N
	r.m.s. test current obtained (kA) :		N
	power factor (0,5- 0,7) / T _{0,95}		N
	first CO operation by closing the separate making Push Button Switch: test (I _p / I ² dt (A / A ² s) :		N
	time interval between test (min. 3 min) :		N
	second CO operation by closing the separate making Push Button Switch: test (I _p / I ² dt (A / A ² s) :		N
	time interval between test (min. 3 min) :		N
	third CO operation by closing the separate making Push Button Switch: test (I _p / I ² dt (A / A ² s) :		N
8.3.4.4	Condition of the switching element after the test		N
	switching elements open by the normal actuating system		N
	Dielectric verification:		N
	dielectric test voltage (V) 2 xUe with min.of 1000V:		N
H.8.7	Verification of electromagnetic compability		N
H.8.7.1	General		N
	Emission and immunity tests are type tests and shall be carried out under the following common conditions		N
	The switching element is mounted in free air connected to a load corresponding to the rated operational current (I _e) and is supplied with its rated operational voltage (U _e), or the maximum voltage of its voltage range		N
	The connecting leads shall be 2 m length		N

	The tests shall be performed: a) with the switching element in the ON-state b) with the switching element in the OFF-state		N
H.8.7.2	Immunity		N
H.8.7.2.1	General		N
	Performance criteria are based on the acceptance criteria in table 24 of IEC 60947-1		N
H.8.7.2.2	Electrostatic discharges		N
	The test shall be performed according to IEC 61000-4-2 and Table H.1		N
H.8.7.2.3	Radiated radio-frequency electromagnetic fields		N
	The test shall be performed according to IEC 61000-4-3 and Table H.1		N
H.8.7.2.4	Electrical fast transients/bursts		N
	The test shall be performed according to IEC 61000-4-4 and Table H.1, with the connecting leads of the device placed in the capacitive clamp		N
H.8.7.2.5	Surges		N
	The test shall be performed according to IEC 61000-4-5 and Table H.1, with the following additional requirements in order to simplify the test procedure without impairing the validity of the verification of the EMC requirements:		N
	- the switching element is powered during the test - the tes impulse shall be applied: - a) between terminals intended to be connected to the power supply - b) between each output terminal and each terminal intended to be connected to the power supply		N
	Three positive and three negative impulses shall be applied between each two points at intervals of not less than 5 s		N
H.8.7.2.6	Conducted disturbances induced by radio-frequency fields		N
	The test shall be performed according to IEC 61000-4-6 and Table H.1.		N
H.8.7.2.7	Power-frequency magnetic fields		N

	The test shall be performed according to IEC 61000-4-8 and Table H.1. Applicable only to equipment containing devices susceptible to power-frequency magnetic fields		N
H.8.7.2.8	Voltage dips and interruptions		N
	The test shall be performed according to IEC 61000-4-11 and Table H.1. Applicable only to a.c. switching elements		N
H.8.7.3	Emission		N
	The test shall be performed under worst case conditions according to CISPR 11 Group 1, Class A, and 7.3.3.2 of IEC 60947-1		N
	These limits are given for switching elements exclusively intended for use in industrial environment A. When they can be used in domestic environment B, the following notice shall be included in the instructions for use		N
	Annex J		N
Annex J	Special requirements for RELAYs and indicating towers		N
J.3	Classification		N
	RELAYs may be classified by:.....		N
	rated electrical power		N
	colour		N
	Fixing hole diameter		N
	Means of connection		N
	Nature of current and frequency		N
	Type of lamp socket		N
J.4	Characteristics		N
J.4.1	Rated operational voltage of an RELAY		N
J.4.2	Rated thermal power of an RELAY		N
J.4.3	Rated values of the lamp		N
J.5	Product information		N
	a - manufacturer's name or trademark		N
	b - type designation or serial number		N

	c – the following markings shall appear on the RELAY		N
	1 rated voltage of RELAY		N
	2 rated voltage of the lamp		N
	3 rated power of the lamp or its type designation, or rated current for a LED		N
J.6	Normal service, mounting and transport conditions		N
	There are no supplementary requirements		N
J.7	Constructional and performance requirements		N
	Clause 7 applies with the following additions		N
J.7.1.12	RELAYs with build-in transformers		N
	The transformer shall have separate windings		N
	It is assumed that this condition is fulfilled if the RELAY passes the test described in 8.3.3.4.1		N
J.7.1.13	Colour of the lens		N
	It is recommended that the colour of the lens be chosen among those mentioned in IEC 60073 and also in Publication No. 2 of the International Commission of Illumination (CIE)		N
	The colour shall be remain essentially unchanged in spirit of the adverse environment, including the effect of ultra-violet light		N
	Colours used for identification shall bright and easily distinguishable		N
J.7.2.1.6	Limits of operation		N
	The limit value of the supply voltage at the terminals of the RELAY shall be 1,1, times the rated operational voltage		N
	This requirement is verified only for RELAYs with built-in transformer according the test described in J.8.3.3.3		N
J.7.2.5.1	Short-circuit withstandability of build-in transformer		N
	The transformer shall be able to withstand the short-circuit of its secondary winding.		N
	It is assumed that this condition is fulfilled if the RELAY passes the test described in 8.3.3.3.		N
J.8	Tests		N
J.8.3	Tests for RELAYs and indicator towers		N
	The tests are type tests. No additional test (routine test or special test) is described in this annex		N
	Each of the tests in J 8.3.3.3, -3.4, -4, and j.8.4 shall be made on new apparatus		N
J.8.3.3.3	Temperature-rise test		N

	a) If the RELAY has the same rated thermal power (see J.4.2) regardless of mounting conditions , a single test is made in an insulated enclosure.		N
	b) If the rated thermal power (see J.4.2) is dependent on themounting conditions, two tests are made: - on a steel plate, and - in an insulated enclosure		N
	c) Mounting on a steel plate Five RELAYs fitted with green lenses are fixed in accordance with the following diagram on a steel plate 2 mm thick, painted black		N
	The plate is located vertically on a table and the RELAYs are supplied at their rated voltage		N
	The duration of the test shall besuch that a steady-state temperature is reached		N
	d) Mounting in a insulating enclosure The test deccribed in item c) is carried out again. With the lights into an enclosure of insulating material, such as bakelite-coated paper 2 mm thick		N
	The plate is located vertically on a table and the RELAYs are supplied at their rated voltage		N
	The duration of the test shall besuch that a steady-state temperature is reached		N
	Results obtained on the follow points:		N
	- on the body of the RELAY		N
	- on the terminals		N
	- on the accessible part of the lens		N
	f) For indicating towers, an arrangement of 5 units shall be mounting in vertical position. The shall be loaded maximum power of the lanp at the nominal voltage		N
	The duration of the test shall besuch that a steady-state temperature is reached		N
	- on the accessible part of the centre lens of the tower		N
	None of the corresponding temperature rises exceed the limits of 7.2.2 of IEC60947-1		N
J.8.3.3.4	Dielectric tests		N
	Clause 8.3.3.4 applies		N
J.8.3.3.4.3	RELAYs with build-in transformers		N
	Two additional dielectric tests shall be made, the duration of each being 1 min		N
	- between the primary and secondary windings of the transformer with the test voltage value specified in 8.3.3.4		N

	- between the secondary windings of the transformer and the frame of the RELAY with a test voltage of 1000 V		N
J.8.3.4	Short-circuit test (on built-in transformer, if any)		N
	The test are made under the following conditions:		N
	- primary voltage: $1,1 \times U_e$		N
	- ambient air temperature: $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$		N
	- duration: 1 h		N
	The transformer shall be short-circuit by a conductor of negligible impedance		N
	After the test and after cooling to ambient, temperature, the transformer withstand the dielectric test defined in J.8.3.3.4.3		N
J.8.3.3.4.3	RELAYS with build-in transformers		N
	Two additional dielectric tests shall be made, the duration of each being 1 min		N
	- between the primary and secondary windings of the transformer with the test voltage value specified in 8.3.3.4		N
	- between the secondary windings of the transformer and the frame of the RELAY with a test voltage of 1000 V		N
J.8.4	Shock and vibration		N
J.8.4.1	Direct mounting		N
J.8.4.1.1	General		N
	8 An indicating tower with five signaling units shall be mounted as stated by the manufacturer without extension poles and the upper three units powered at the rated voltage		N
	The test shall be performed as follows		N
J.8.4.1.2	Shock		N
	In accordance with IEC 60068-2-27 with the following conditions		N
	Six shocks applied in each direction along three perpendicular axes (a total of 36 shocks:		N
J.8.4.1.3	Vibration		N
	In accordance with IEC 60068-2-6 with the following conditions, along three mutually perpendicular axes:		N
J.8.4.2	Indirect support mounting		N
	If the product literature includes other allowable mounting conditions (e.g. pole mounting), the manufacturer shall state the severity level for shock and vibration tests at which the requirements of J.8.4.3 are met		N
J.8.4.3	Results to be obtained		N

	After the tests, no visible damage shall be observed and the signaling shall not be impaired		N
J.8.5	Degree of protection for indicating towers		N
	If the manufacturer declares a degree of protection, the test shall be conducted according to Annex C of IEC 60947-1 with all removable parts equipped as in normal service.		N
	Annex K		-
Annex K	Special requirements for control Push Button Switches with direct opening action		-
K.1	General		-
K.1.1	Scope		-
	All control Push Button Switches with direct opening action shall also comply with the relevant requirements of the standard and, where applicable. To those given in Annexes F, G, H and/or J		-
K.3	Classification		-
	There are two types of control Push Button Switches with direct opening action:		N
K4	Characteristics		-
K.4.3.1.2	Rated insulation voltage (= 250 V)		N
K.4.3.2.1	Conventional free air thermal current (= 10 A)		N
K.4.4	Utilization categories for switching elements (AC-15 or DC-13)		N
K.5	Product information		-
	Clause 5 is applies with the following additions		-
K.5.2	Marking		-
K.5.2.7	Every contact element with direct action shall be marked on the out side by the symbol		N
K.5.2.8	Electrical separation for change-over contact element		-
	Change-over contact elements with four terminal shall be indelibly and legibly marked with the relevant form Zap or Zebu as state in Figure 4.		N
K.5.4	Additional product information		-
K.5.4.1	Actuator travel and operation force		-
	The manufacturer shall state the following		-
	a) the minimum direct opening force		N
	b) the minimum force to achieve direct opening action of all break contacts		N
	c) the maximum travel including travel beyond the minimum travel position		N
	d) for RELAYes only the maximum speed of actuation		N
	e)for RELAYes only the maximum frequency of actuation		N
	These statements shall appear in the marking or on the circuit diagram or other documents		N

K.5.4.2	Short-circuit protection	-
	Type of short-circuit protective device shall stated either as marking on the Push Button Switch or in the installation instruction	N
K.6	Normal service, mounting and transport conditions	-
	Clause 6 applies, with the following additions:	N
K.6.1.1	Ambient air temperature	-
	Subclause 6.1.1 of IEC 60947-1 applies, except for position Push Button Switches with direct opening action, for which the upper and lower limits of temperature are respectively +70 °C and +25 °C, and the average temperature, measured over a period of 24 h, does not exceed +35 °C	N
K.7	Constructional and performance requirements	-
	Clause 7 applies with following additions:	-
K.7.1.4.3.1	Robustness of the actuating system	-
	The actuating system shall pass the test described in K.8.3.7	N
K.7.1.4.3.2	Directness of the opening action	-
	The control Push Button Switch with direct opening action shall pass the tests K.8.3.4, K.8.3.5 and K.83.7 without any deformation that would reduce the impulse voltage withstand across the contact gap.	N
K7.1.4.5	Automatic opening of called operated control Push Button Switches	-
	In case of failure of the cable or its anchorage automatic return to open position	N
K.7.1.4.6	Conditions for direct opening action	-
	Parts of travel that separates the contacts, shall have no resilient member (springs) between the moving contacts and the point of the actuator to which the actuating force is applied	N
K.7.1.4.6.1	Contact elements types	-
	Control Push Button Switches with direct opening action may provided with snap-on or dependent action contact elements	N
	Break-contact shall be electrically separated from each other and from the operating make-contact element	N
	If C or Za change-over contact elements, only 1 contact element shall be used, and in case of Zebu change-over, both may be used	N
K.7.1.5.3	Actuator travel indication	-
	In order to facilitate the setting-up of the Push Button Switch actuator in relation to the external operating means, the Push Button Switch may include means for	-

	indicating the minimum travel		
K8	Tests		-
	In addition to clause 8, and Annex, the following applies		-
K.8.3.1	Test sequences		-
	Clause 8.3.1 applies with the following additions:		-
	TEST SEQUENCE VII (Sample 7)		-
	Mechanical operation of position Push Button Switches with direct opening action		-
	Test no.1 - Mechanical operation of position Push Button Switches at limits of temperature. See K.8.3.5		-
	Test no.2 – Verification of direct opening action See K.8.3.6		-
	TEST SEQUENCE VIII (Sample 8)		-
	Verification of robustness of the actuating system See K.8.3.7		-
K.8.3.4	Performance under conditional short circuit current		-
	Subclause 8.3.4 applies with the following additions:		-
K8.3.4.2.1	Verification of the conditional short-circuit current samples 4, 9 10		-
	The test shall be made as state in 8.3.4.2, except that the current is made by a positive opening contact and not by the additional switching device and the test is made on each of the tree devices by making the current three times by the same contact element in a single phase circuit		N
	For type 2 control Push Button Switches, the contact element shall be chosen at random		N
K.8.3.5	Mechanical operation of position Push Button Switches at limits of temperature.		-
	The position Push Button Switch shall be conditioned at 70°C for 8 hours..... :		N
	After 8 hours the contact shall be loaded with the maximum rated operational current for 10 min. :		N
	The contact then be operated 10 times by the application of the force stated by the manufacturer..... :		N
	The test shall be repeated, the Push Button Switch shall be conditioned at - 25 °C for 8 hours..... :		N
K8.3.6	Verification of direct opening action		-
	Impulse voltage test over the open position of the contacts at 2500 V or for position Push Button Switches for isolation in accordance with table 14 of IEC 60947-1 or as declared U_{imp} by the manufacturer..... :		N
K.8.3.7	Verification of robustness of the actuating system		-
	Closed break contact(s) shall be loaded with a force F1 of		N

	10 N.....:		
	Stated openings force shall be applied to the actuator through the direct opening travel.....:		N
	After the test the actuating system and / or contacts shall remain functional.....:		N

Object/part No.	Manufacturer/Trademark	Type/model	Technical data	Standard	Mark(s) of conformity
Relay	TE Connectivity(China)Co., Ltd. tyco	RT series	DC12V/8A DC24V/8A DC48V/8A DC110V/8A	ELV 2000/53/EC RoHS (2011/65/EU) REACH(EC) No.1907/2006	RoHS ELV REACH
Relay	Xiamen Hongfa Electroacoustic Co.,Ltd HF	HF115F series	DC12V/8A DC24V/8A DC48V/8A DC110V/8A	NO.E134517 NO.CQC08002028130 NO.116934	ROHS UL CQC VDE
Relay	Omron Electronic Components Trading (Shanghai) Limited OMRON ELECTRONIC COMPONENTS (HONG KONG) LIMITED OMRON	G2R(L) series	DC12V/8A DC24V/8A DC48V/8A DC110V/8A	NO.E41643 NO.LR31928 NO.40015012 NO.R50030327	UL CSA VDE TUV
Relay	TE Connectivity(China)Co., Ltd. tyco	RP series	DC60V/8A	ELV 2000/53/EC RoHS (2011/65/EU) REACH(EC) No.1907/2006	RoHS ELV REACH

Table 2 – Mounting hole diameter and dimensions of the key recess (if any)

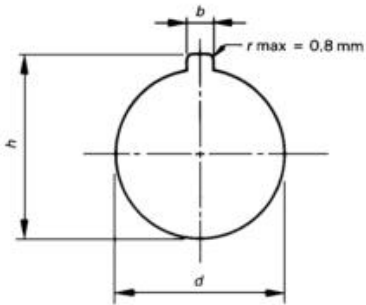
	Size	Mounting hole diameter, d mm	Key recess (if any)	
			Height, h mm	Width, b mm
	D30	$30,5^{+0,5}_0$	$33,0^{+0,5}_0$	$4,8^{+0,2}_0$
	D22	$22,3^{+0,4}_0$	$24,1^{+0,4}_0$	$3,2^{+0,2}_0$
	D16	$16,2^{+0,2}_0$	$17,9^{+0,2}_0$	$1,7^{+0,2}_0$
	D12	$12,1^{+0,2}_0$	$13,8^{+0,2}_0$	$1,7^{+0,2}_0$

Table 3 – Preferred minimum distances between centres of mounting holes

Size	a mm	b mm
D30	50	65
D22	30	50
D16	25	25
D12	20	20

Table 4 – Verification of making and breaking capacities of switching elements under normal conditions corresponding to the utilization categories

Utilization category	Make ^a			Break ^a			Minimum on-time	Sequence, number and rate of operations			
	I/I_e	U/U_e		I/I_e	U/U_e						
AC			$\cos \phi$			$\cos \phi$	Cycles (at 50 Hz or 60 Hz)	Order No. ^{d, e}			
								1	2	3	4
AC-12	1	1	0,9	1	1	0,9	2	50	10	990	5 000
AC-13	2	1	0,65	1	1	0,65	2 ^b				
AC-14	6	1	0,3	1	1	0,3	2 ^b				
AC-15	10	1	0,3	1	1	0,3	2 ^b				
DC			$T_{0,95}$ ms			$T_{0,95}$ ms	Time ms				
DC-12	1	1	1	1	1	1	25	50	10	990	5 000
DC-13	1	1	$6 \times P^c$	1	1	$6 \times P^c$	$T_{0,95}$				
DC-14	10	1	15	1	1	15	25 ^b				
I_e Rated operational current						I Current to be made or broken					
U_e Rated operational voltage						U Voltage before make					
$P = U_e \times I_e$ Steady-state power consumption, in W						$T_{0,95}$ Time to reach 95 % of the steady-state current					
NOTE For the objective of the test see 8.3.3.5.3.											
^a For tolerances on test quantities, see 8.3.2.2. ^b Both on-time values (for I_{make} and for I_{break}) shall be at least equal to 2 cycles (or 25 ms for DC-14). ^c The value " $6 \times P$ " results from an empirical relationship which is found to represent most d.c. magnetic loads to an upper limit of $P = 50$ W, i.e. $6 \times P = 300$ ms. Loads having power consumption greater than 50 W are assumed to consist of smaller loads in parallel. Therefore, 300 ms is to be an upper value, irrespective of the power. For semiconductor switching devices the maximum time constant shall be 60 ms, i.e. $T_{0,95} = 180$ ms ($3 \times$ time constant). ^d For all utilization categories the test sequence shall be in the order given. ^e The rate for the test shall be: For Order No.1: 6 operating cycles per minute, which shall be made with the test voltage raised to $U_e \times 1,1$, the test current I_e having been first set with the voltage at U_e . For Order No.2: as rapidly as possible whilst ensuring complete closing and opening of contacts. For Order No.3: 60 operating cycles per minute. For Order No.4: 6 operating cycles per minute.											

Table 5 – Verification of making and breaking capacities of switching elements under abnormal conditions corresponding to the utilization categories

Utilization category	Make ^a			Break ^a			Minimum on-time	Making and breaking operation	
	I/I_e	U/U_e		I/I_e	U/U_e			Number	Rate per minute
AC			$\cos \varphi$			$\cos \varphi$	Cycles (at 50 Hz or 60 Hz)		
AC-12	–	–	–	–	–	–	–	–	–
AC-13 ^b	10	1,1	0,65	1,1	1,1	0,65	2 ^c	10	6
AC-14	6	1,1	0,7	6	1,1	0,7	2	10	6
AC-15	10	1,1	0,3	10	1,1	0,3	2	10	6
DC			$T_{0,95}$ ms			$T_{0,95}$ ms	Time ms		
DC-12	–	–	–	–	–	–	–	–	–
DC-13 ^d	–	–	–	–	–	–	–	–	–
DC-14	10	1,1	15	10	1,1	15	25 ^c	10	6
I_e Rated operational current U_e Rated operational voltage $P = U_e \times I_e$ Steady-state power consumption, in W									
I Current to be made or broken U Voltage before make $T_{0,95}$ Time to reach 95 % of the steady-state current									
NOTE The abnormal condition is to simulate a blocked open electromagnet. See 8.3.3.5.4.									
^a For tolerances on test quantities, see 8.3.2.2. ^b For semiconductor switching devices an overload protective device specified by the manufacturer should be used to verify the abnormal conditions. ^c Both on-time values (for I_{make} and for I_{break}) shall be at least equal to 2 cycles (or 25 ms for DC-14). ^d The test for DC-13 under abnormal conditions is covered by the test under normal conditions.									

Table 6 – Test conditions for glow-wire test

Part under test	Test condition
Part with a mass lower than 2 g (see 3.14 of IEC 60695-2-11:2014)	Test is not required ^a
Part which is a small part according to 3.15 of IEC 60695-2-11:2014	Test is not required ^a
Part which retains current-carrying parts in position	Glow-wire test at a temperature of 750 °C
All other parts	Glow-wire test at a temperature of 650 °C ^b
^a Alternative tests do not have to be conducted. ^b Glow wire temperature can be reduced to 550 °C if it can be demonstrated that the residual risk of fire is acceptable.	

Table 7 – Acceptance criteria

Item	Acceptance criteria (performance criteria during tests)		
	A	B	C
Overall performance	No noticeable changes of the operating characteristic. Operating as intended ^a	Temporary degradation or loss of performance which is self-recoverable ^b	Temporary degradation or loss of performance which requires operator intervention or system reset.
Operation of displays and signalling components	No changes to visible display information. Only slight light or sound intensity fluctuation of the optical or audible signal source, or slight movement of characters or slight change of frequency of the audible signal source.	Temporary visible changes or loss of information. Undesired optical or audible signal.	Shut down, permanent loss of display or wrong information. Unpermitted operating mode. Not self-recoverable.
Information processing and sensing functions	Undisturbed communication and data interchange to external devices remains within the specification.	Temporarily disturbed communication, which is detected and is self-recoverable.	Erroneous processing of information. Undetected loss of data and/or information. Errors in communication. Not self-recoverable.
^a The manufacturer shall state in his literature the operating frequency and bandwidth where conducted radio frequencies may cause malfunction. ^b The recovery time shall not exceed the maximum time which can be measured when the device is started by power-on at the power supply terminals (maximum recovery time, see 7.2.8).			

Table 8 – Immunity tests

Type of test	Basic standard	Test level required		Acceptance criteria
Electrostatic discharge immunity test	IEC 61000-4-2	8 kV / air discharge or 4 kV / contact discharge		B ^k
Radiated radio-frequency electromagnetic field immunity test 80 MHz to 1 GHz	IEC 61000-4-3	10 V/m		A
Radiated radio-frequency electromagnetic field immunity test 1,4 GHz to 2 GHz	IEC 61000-4-3	3 V/m		A
Radiated radio-frequency electromagnetic field immunity test 2 GHz to 2,7 GHz	IEC 61000-4-3	1 V/m		A
Electrical fast transient/burst immunity test (with capacitive coupling clamp)	IEC 61000-4-4	2 kV / 5 kHz on power ports ^a 1 kV / 5 kHz on signal ports ^b		B ^k
Surge immunity test (1,2/50 µs - 8/20 µs) ^c	IEC 61000-4-5	2 kV (line to earth) 1 kV (line to line)		B
Conducted disturbances induced by radiofrequency fields immunity test (150 kHz to 80 MHz)	IEC 61000-4-6	10 V		A
Power frequency magnetic field immunity test ^d	IEC 61000-4-8	30 A/m		A
Voltage dips immunity test ^h	IEC 61000-4-11	Class 2 ^{e, f} 0 % during 0,5 cycle	Class 3 ^{e, f} 0 % during 0,5 cycle	B ^{k, i}
		Class 2 ^{e, f} 0 % during 1 cycle	Class 3 ^{e, f} 0 % during 1 cycle	B
		Class 2 ^{e, f, g} 70 % during 25/30 cycles	Class 3 ^{e, f, g} 40 % during 10/12 cycles 70 % during 25/30 cycles 80 % during 250/300 cycles	C
Voltage interruptions immunity test ^h	IEC 61000-4-11	Class 2 ^{e, f, g} 0 % during 250/300 cycles	Class 3 ^{e, f, g} 0 % during 250/300 cycles	C
Immunity to harmonics in the supply	IEC 61000-4-13	No requirements ⁱ		

- ^a Power port: the point at which a conductor or cable carrying the primary electrical power needed for the operation of the electronic circuit or the switching element or associated equipment is connected.
- ^b Signal port: the point at which a conductor or cable carrying information for transferring data or signals is connected to the electronic circuit or the switching element.
- ^c Not applicable for extra-low voltage a.c. ports (≤ 30 V) and extra-low voltage d.c. input/output ports (≤ 60 V), when the secondary circuits (isolated from the a.c. mains) are not subject to transient overvoltages.
- ^d Applicable only to equipment containing devices susceptible to power frequency magnetic fields.
- ^e Class 2 applies to points of common coupling and in-plant points of common coupling in the industrial environment in general.
Class 3 applies to in-plant couplings in industrial environment only. This class should be considered when a major part of the load is fed through converters; welding machines are present; large motors are frequently started or loads vary rapidly.
The manufacturer shall state the applicable class.
- ^f The given percentage means percentage of the rated operational voltage, e.g. 0 % means 0 V.
- ^g The value before the solidus (/) is for 50 Hz and the value behind is for 60 Hz tests.
- ^h Applicable for a.c. equipment only.
- ⁱ Requirements are under study for the future.
- ^k For keeping the functionality at the system level (e.g. automation or process) the state of the switching element shall not change for more than 1 ms for d.c. devices or one half-cycle of supply frequency for a.c. devices.
- ^l For devices with power consumption of more than 750 mW, the recovery time of the switching element may be longer than one half-cycle but shall be less than the maximum recovery time.

**Table 9 – Test values for electrical performance
and ageing test of screwless-type clamping units**

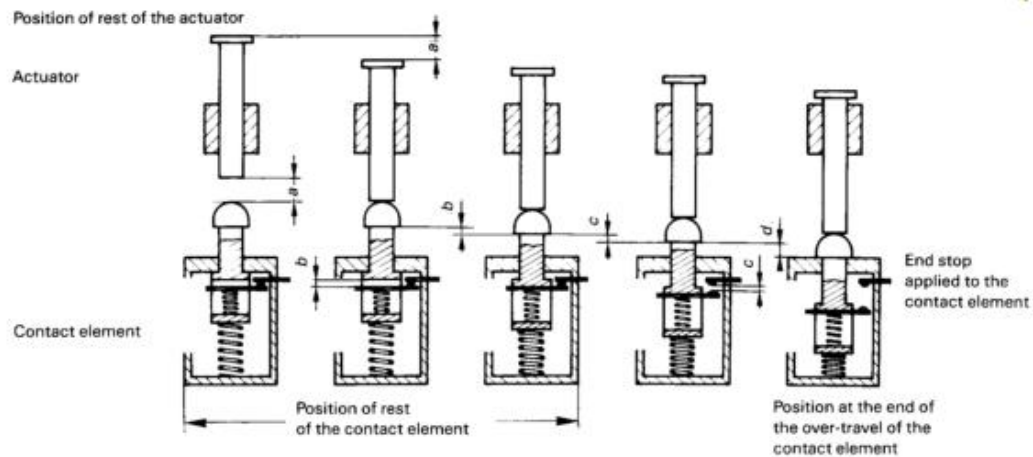
Conductor size mm ²	Test current A	
	for minimum cross-section	for maximum cross-section
0,2	1	I_{en} or I_{the} declared for the product
0,34	2	
0,5	3	
0,75	6	
1,0	8	
1,5	12	
2,5	20	
4,0	25	

Number of the example	Disposition of the contact element(s)	Actuator positions					
		1	2	3	4	5	
1		x					Contact element closed in actuator position No. 1 only.
2			x				Contact element closed in actuator positions No. 2, 4 and 5.
3			x				Two contact elements used as change-over contact elements with 3 terminals.
4				x			Contact element with pulse (flexing) contact closed between actuator positions No. 2 and 3.
5					x		Contact element with pulse (flexing) contact open between actuator positions No. 3 and 4.
6						x	Contact element with maintained contact between actuator positions No. 4 and 5.
7		x					Two contact elements with close-before-open contacts between actuator positions No. 1 and 2.
8		x	x				Two contact elements with open-before-close contacts between actuator positions No. 1 and 2 (*).
9		x		x			Operation in which contact element B is arranged to close before and open after contact element A.

(*) Open-before-close contact elements may be used to break the current in one circuit before making the current in the other circuit, provided the time interval be properly related to the circuit conditions.

IEC

Figure 1 – Examples of the recommended method for drawing an operating diagram of a rotary switch

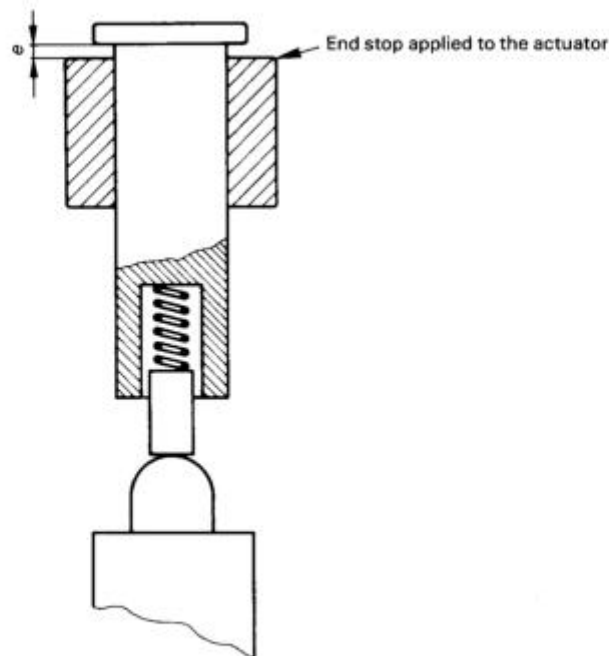


IEC

- a* Pre-travel of the actuator
- b* Pre-travel of the contact element
- c* Minimum value required to give adequate contact gap
- d* Over-travel of the contact element
- $b + c + d$ Total travel of the contact element
- $a + b + c + d + e)^*$ Total travel of the actuator

* NOTE Because of a possible resilient connection between the actuator and the contact element (for example, see Figure 3), the over-travel of the actuator can exceed the over-travel of the contact element by a length *e*.

Figure 2 – Operation of push-buttons



IEC

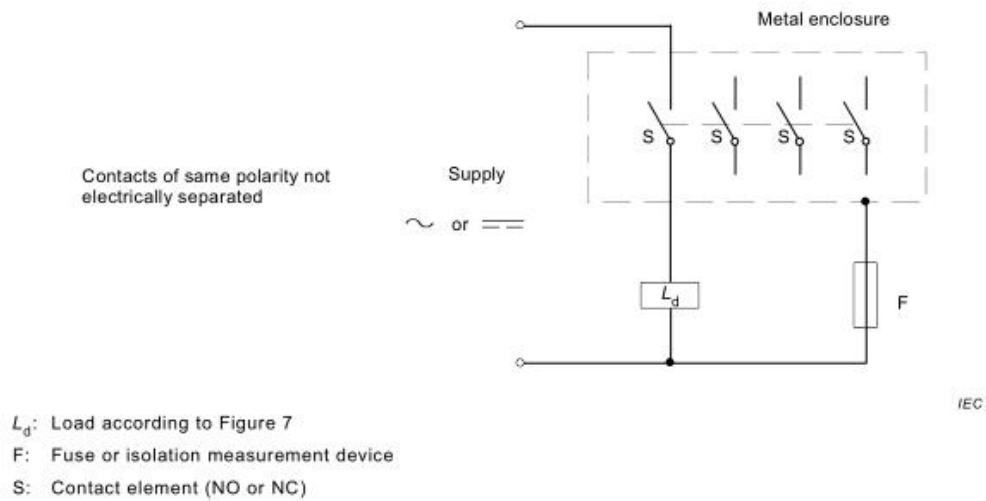
Figure 3 – Difference *e* between the over-travel of the actuator and that of the contact element

Figure No.	Figure	Symbols	Forms	Description
4a)		 Note 1	A	Single gap contact element with two terminals
		 Note 1	B	
4b)		 Note 1	X	Double gap contact element with two terminals
		 Note 1	Y	
4c)		 Note 1	C	Change-over, single gap, contact element with three terminals
4d)			Za	Change-over, double gap, contact element with four terminals Note – The contacts are of the same polarity
4e)			Zb	Change-over, double gap, contact element with four terminals (The two moving contacts are electrically separated) Note – Multiple electrically separated contact configurations are also covered by Zb

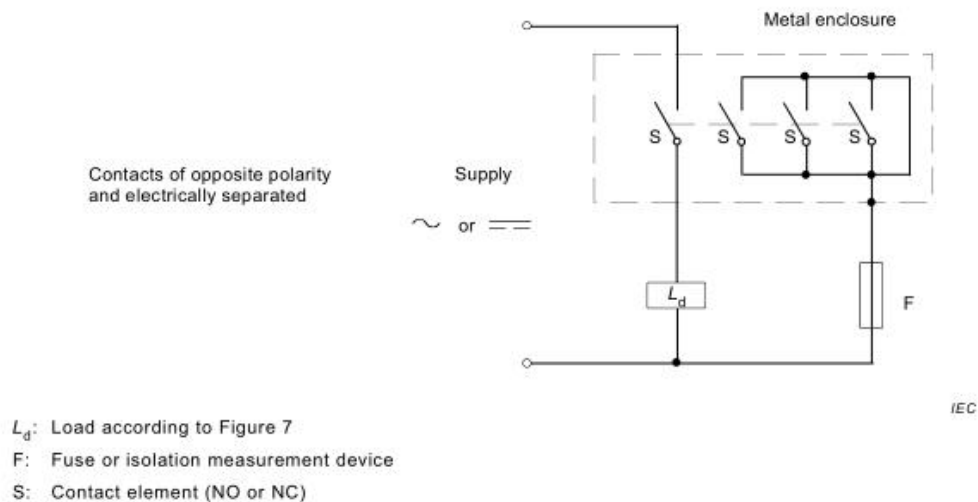
IEC

NOTE 1 Symbols according to IEC 60617.

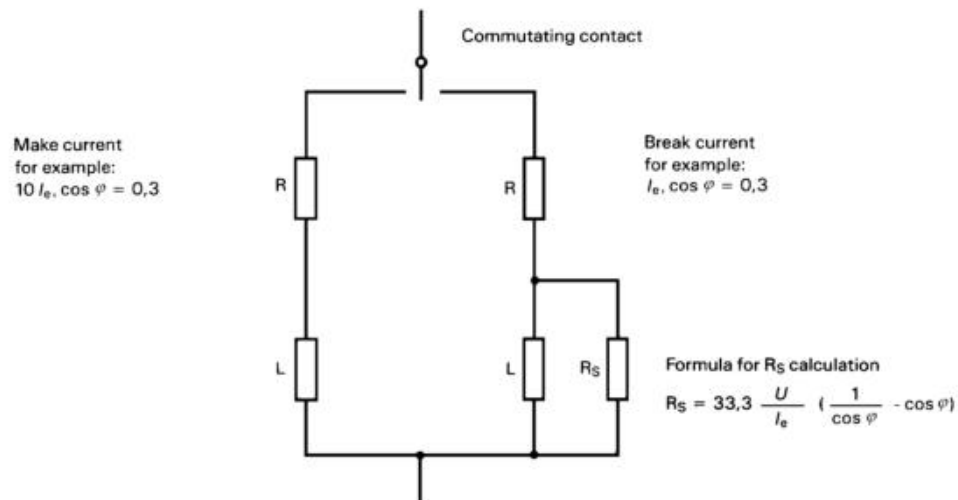
Figure 4 – Examples of contact elements (schematic sketches)



**Figure 5 – Test circuits for multi-pole control switches –
Contacts of same polarity, not electrically separated**

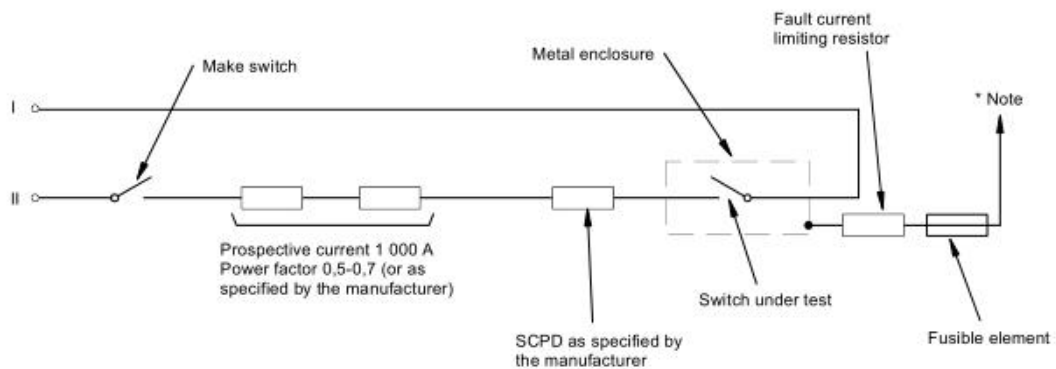


**Figure 6 – Test circuits for multi-pole control switches –
Contacts of opposite polarity, and electrically separated**



IEC

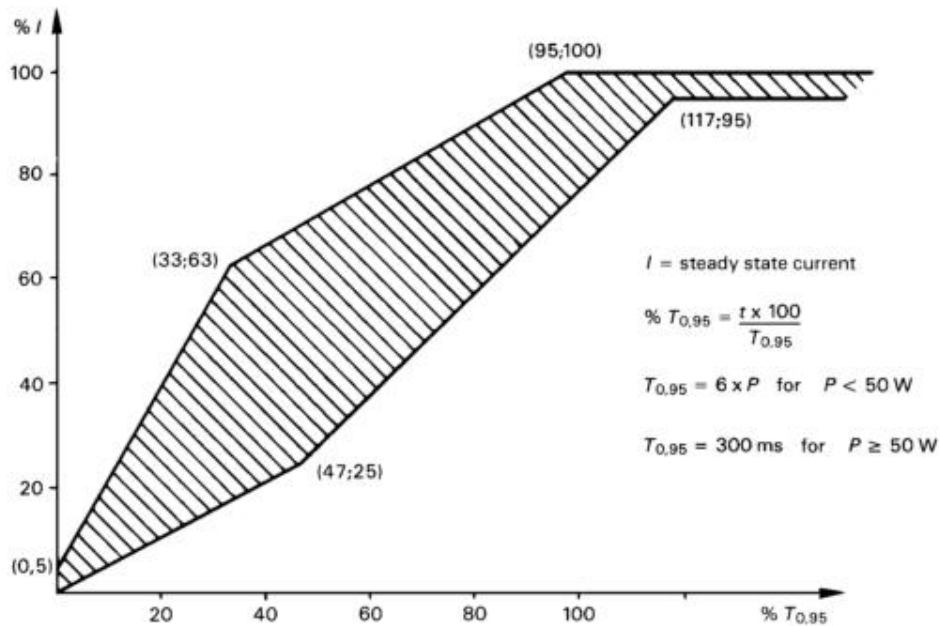
Figure 7 – Load L_d details for test conditions requiring different values of make and break current and/or power factor (time constant)



IEC

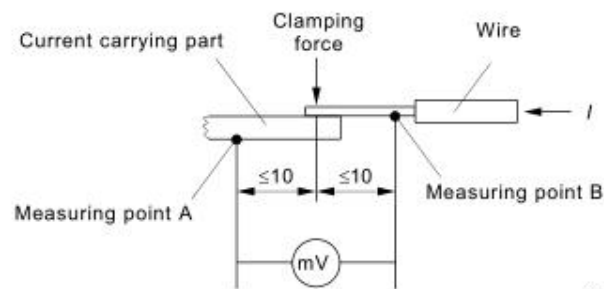
NOTE To be connected alternatively to I or II on successive tests.

Figure 8 – Test circuit, conditional short-circuit current (see 8.3.4.2)



IEC

Figure 9 – Current/time limits for d.c. test loads (see 8.3.3.5.4)



IEC

Figure 10 – Voltage drop measurement at contact point of the clamping unit or terminal

PHOTO DOCUMENTATION:

Type of equipment:	Voltage Switching Relay
Model:	GRUS-11G,GRUS-11G-*, GRUS-11GS,GRUS-11GS-*,*=1~9

Details of:	GRUS-11G
View:	
☒ general	
☐ front	
☐ rear	
☐ right	
☐ left	
☐ top	
☐ bottom	



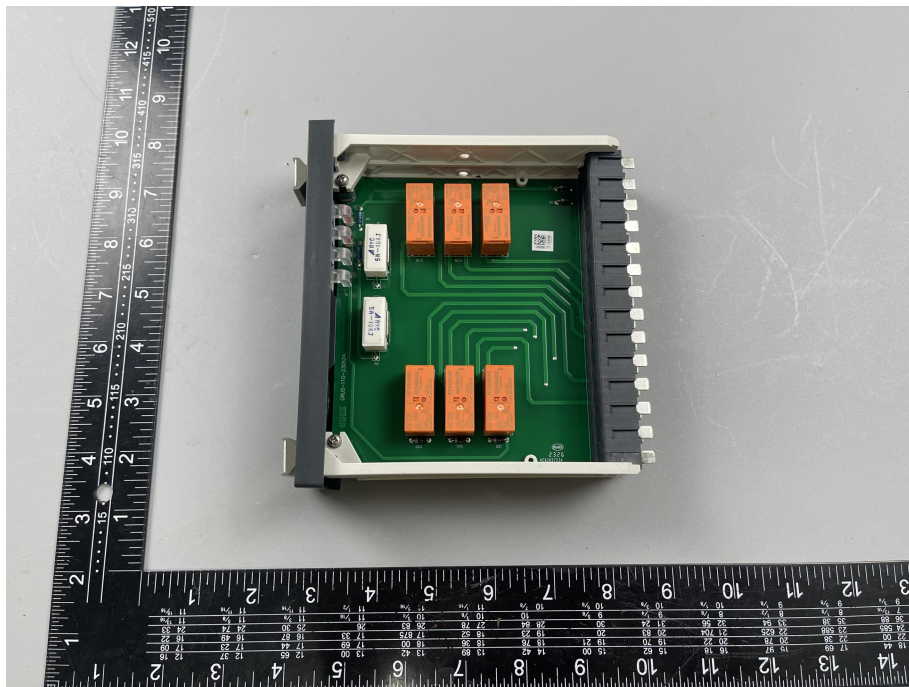
Details of:	
View:	
☒ general	
☐ front	
☐ rear	
☐ right	
☐ left	
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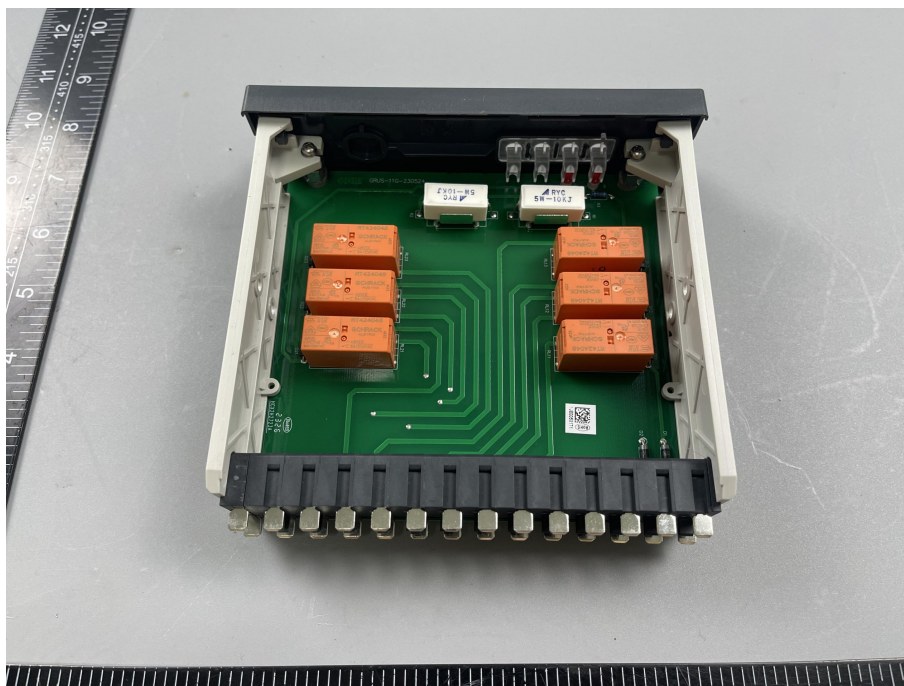
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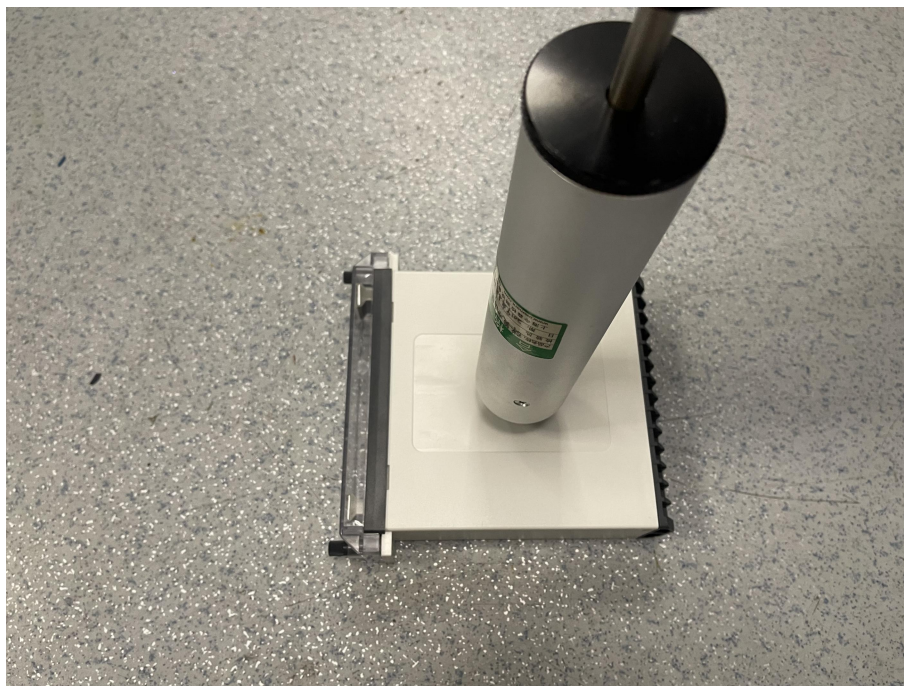
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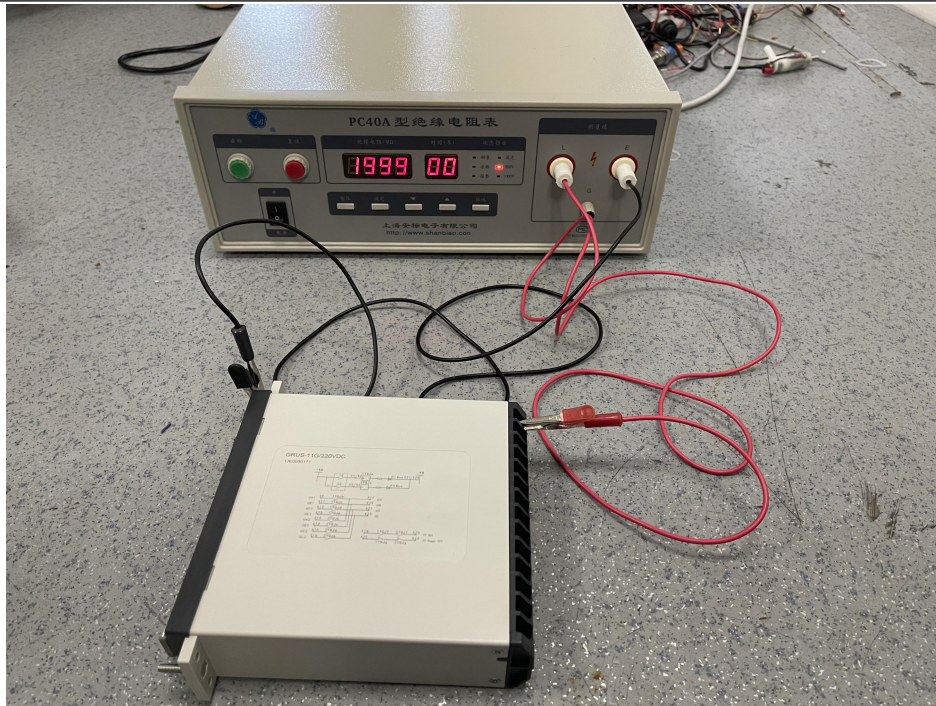
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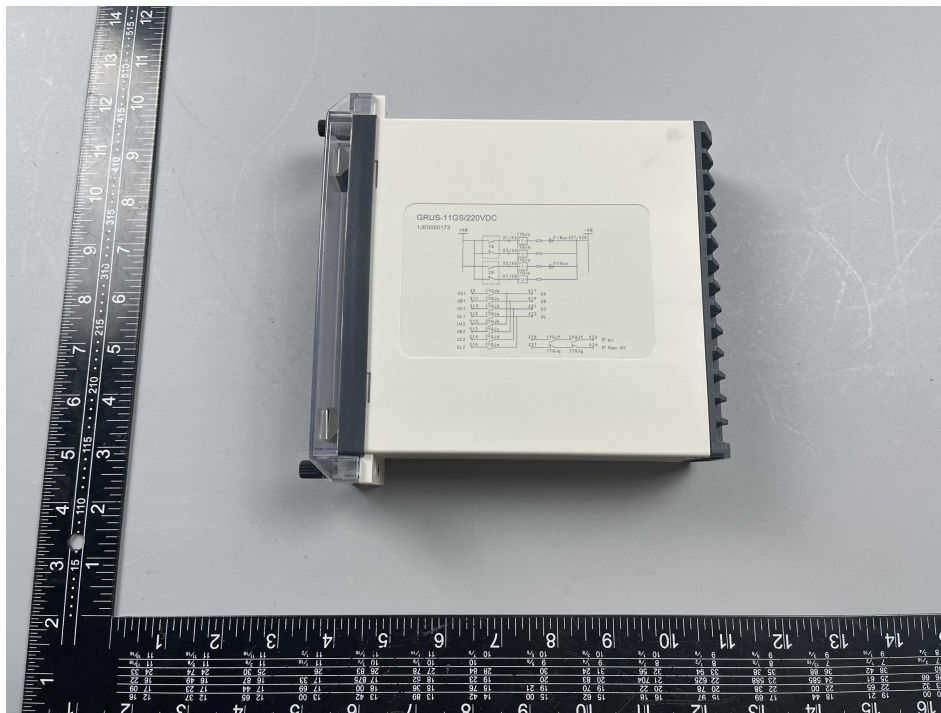
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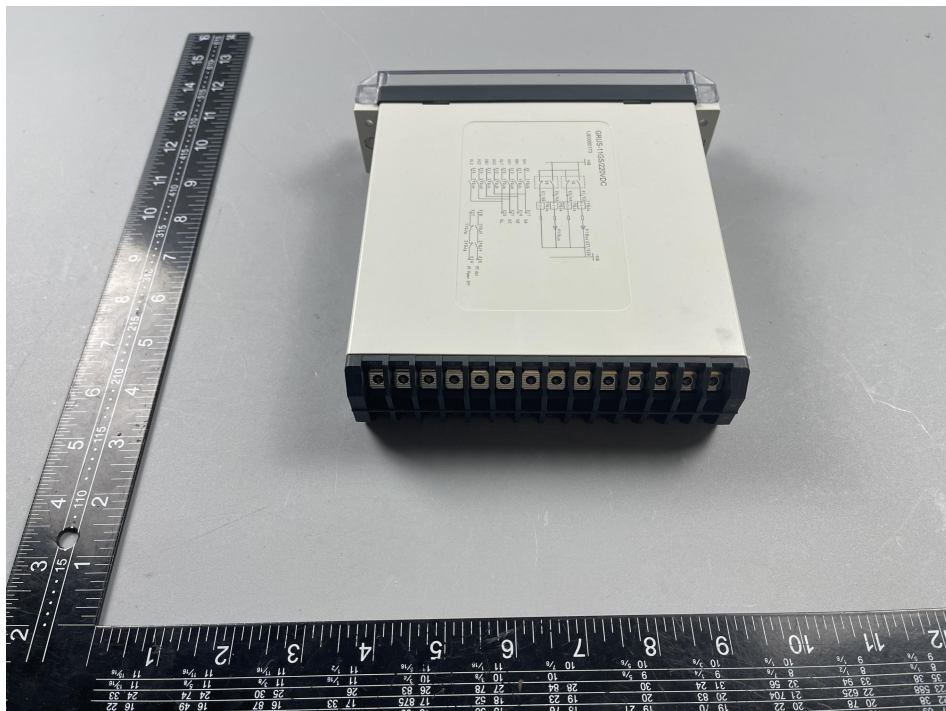
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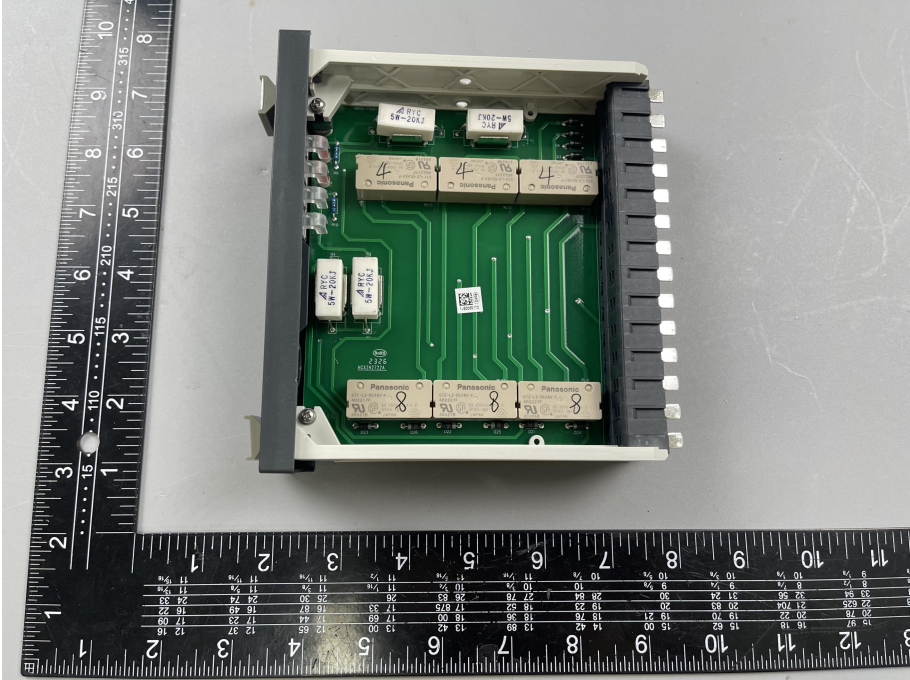
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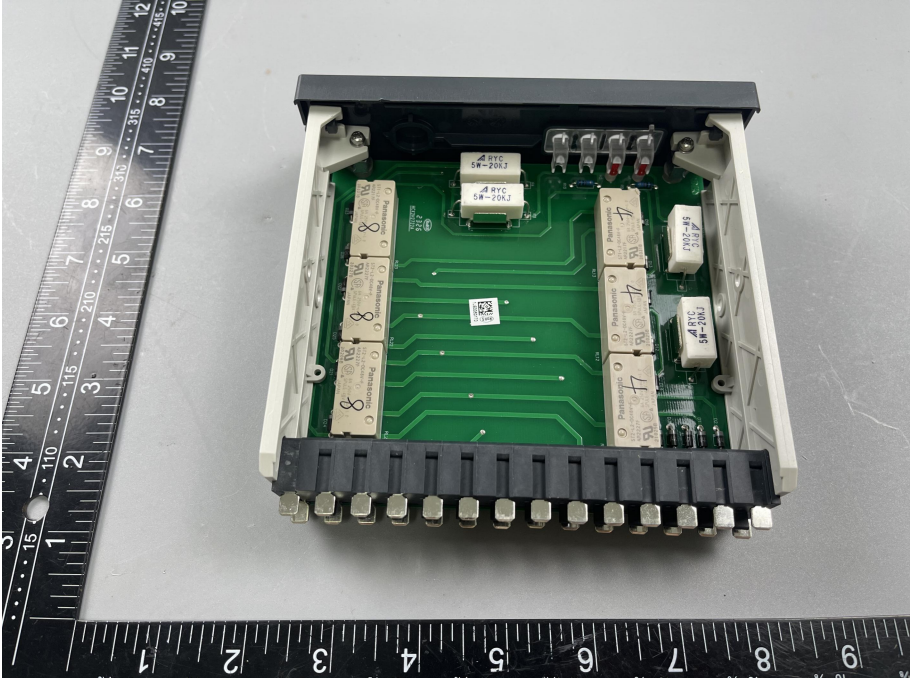
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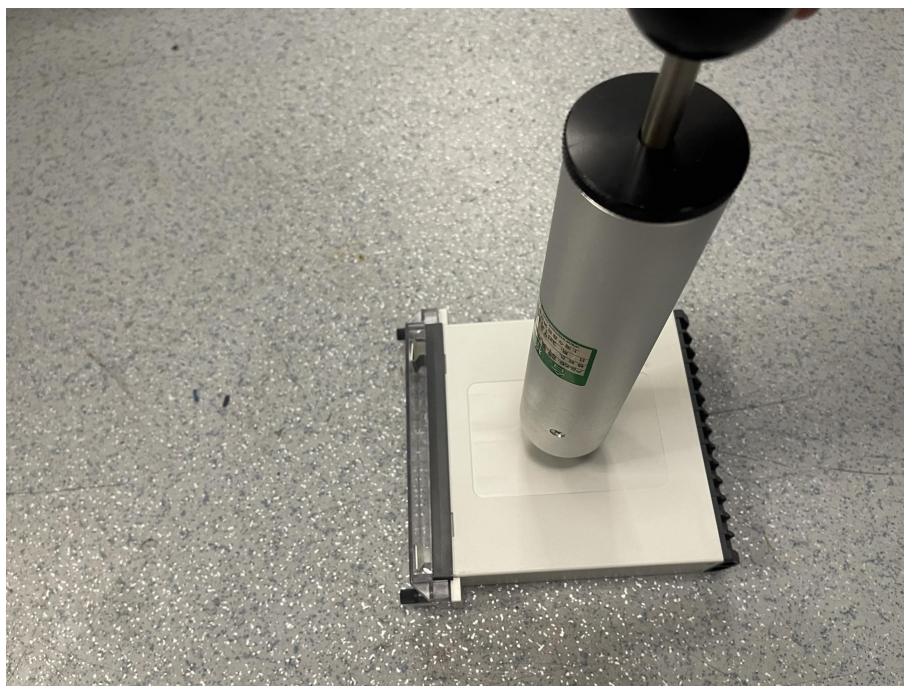
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