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Electrical Switchboards**

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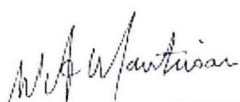
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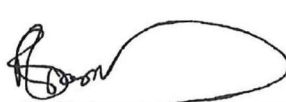
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## Content

	Page
1 Introduction.....	5
2 Scope.....	5
3 Purpose.....	5
4 Applicability .....	5
5 Effective date.....	5
6 Normative/Informative References.....	5
6.1 Normative.....	5
6.2 Informative.....	6
7 Definitions.....	6
8 Abbreviations.....	7
9 Roles and Responsibilities.....	7
10 Process for Monitoring.....	8
11 Related/Supporting Documents .....	8
12 Requirements.....	8
12.1 General Requirements and Considerations .....	8
12.2 Service Conditions.....	9
12.2.1 Ambient Conditions (Before Operation).....	9
12.2.2 Ambient Conditions (For Operation).....	9
12.3 Qualification and Testing .....	9
12.3.1 Safety Related Relays .....	9
12.3.2 Non-Safety related Relays .....	10
12.3.3 Qualification and Test Report.....	10
12.3.4 Seismic Qualification Testing (for Safety Related relays only).....	10
13 Relay Identification .....	11
13.1 Number and Location of Protection Relays Installed.....	12
13.1.1 Unit 1 .....	12
13.1.2 Unit 2 .....	13
13.1.3 Unit 9 and Diesel switchboards .....	14
13.2 TMA: Definite Time Overcurrent Relays.....	15
13.3 TMV: Definite Time Voltage Measurement.....	15
13.4 TCV: Three-Phase Filter .....	16

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13.5 TMWR3: Active or Reactive Power Directional Relay .....	16
13.6 MESURISOL U: Insulation controller for HV networks .....	16
13.7 TMFB2 (100V): Two-Step Frequency Measurement Relay .....	16
14 Terminal Inputs and Schematic Philosophy .....	17
15 Equipment Classification .....	17
16 Test Plan and Specifications.....	17
17 Test Report.....	17
18 Documentation .....	18
19 Acceptance.....	18
20 Revisions.....	18
21 Development Team .....	18
22 Attachments .....	19
22.1 TMA 111.....	20
22.2 TMA 210.....	23
22.3 TMA 211 (3 to 5A) .....	26
22.4 TMA 211 (8 to 63 A & 0,13 to 1,3 s).....	29
22.5 TMA 222-2 high step: 8 to 63 A & 0,13 to 1,3 s; low step: 3 to 5 A & 6 to 60 s.....	32
22.6 TMA 222-2 high step: 8 to 63 A & 0,02 to 0,13 s; low step: 3 to 5 A & 6 to 60 s.....	35
22.7 TMA 222-2 high step: 2 to 16 A & 0,06 to 0,6 s; low step: 1 to 8A & 6 to 60 s.....	38
22.8 TMA 222-2 high step: 1 to 8 A & 0,13 to 1,3 s; low step: 0,25 to 2 A & 6 to 60 s.....	41
22.9 TMV 110m (30 to 58,5V).....	44
22.10 TMV 110m (60 to 117V).....	46
22.11 TMV 111m (40 to 78V).....	48
22.12 TMV 310 (80 to 156V).....	52
22.13 TMV 311 (80 to 156V).....	55
22.14 TCV 110/125V .....	59
22.15 TCV 48V .....	62
22.16 TMWR3 (Power Direction Relay) .....	65
22.17 MESURISOL U .....	68
22.18 TMFB2.....	71

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## **1 Introduction**

This technical procurement specification shall be used to procure the protection relays used in the 6.6 kV electrical switchboards at the Koeberg Operating Unit (KOU). The function of each protection relay shall be described in this document. These relays are network relays inside the Medium Voltage (MV) switchboards for the protection of over current, overload, insulation, power direction, over and under voltage.

## **2 Scope**

This document describes and identifies the technical requirements for the 6.6 kV protection relays that are used in the 6.6 kV switchboards. These relays are analogue network relays inside the MV switchboards for various applications at Koeberg Nuclear Power Station.

## **3 Purpose**

This procurement specification describes the minimum design, manufacturing, testing and qualification requirements of the protection relays used in the 6.6 kV electrical switchboards at the KOU.

## **4 Applicability**

This document shall apply to Koeberg Nuclear Power Station.

## **5 Effective date**

This document is effective from the authorisation date.

## **6 Normative/Informative References**

### **6.1 Normative**

- [1] Maintenance manual 303;
- [2] Maintenance Manual 308;
- [3] KBA0022D01011-1, 6.6 kV Protections Safeguards and Non-Safeguards Selectivity;
- [4] IEC 60255-27: 2005; Measuring relays and protection equipment Part 27: Product safety requirements;
- [5] IEEE C37.98-2013; IEEE Standard for Seismic Qualification Testing of Protective Relays and Auxiliaries for Nuclear Facilities
- [6] IEEE Std C37.105™-2010; IEEE Standard for Qualifying Class 1E Protective Relays and Auxiliaries for Nuclear Power Generating Stations
- [7] IEEE Std 323™-2003(R2008), IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations;
- [8] IEEE Std 344™-2004(R2010), IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations;

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[9] ASME NQA-1, Subpart 2.2 Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Nuclear Power Plants;

[10] SAR, Safety Analysis Review of Koeberg Power Station.

[11] DSG-318-033 The specification for seismic qualification of electrical and mechanical equipment

## **6.2 Informative**

[12] ISO 9001 Quality Management Systems

## **7 Definitions**

Instantaneous Protection Element	An element with no intentional time delay active above a pre-determined pick-up current setting.
Inverse Definite Minimum Time (IDMT) protection element	A protection element the minimum operating time of which is adjustable and is inversely proportional to the fault current.
Unbalance Protection	An element providing protection against overvoltage on insulation failure of cable or coil elements, causing an unbalance current to flow in the neutral connection between conductors.
Class 1E:	The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment. (IEEE Std 323-2003). Safety related is synonymous with Class 1E.
Controlled disclosure	Controlled disclosure to external parties (either enforced or by law, or discretionary)
Design basis event	Postulated events used in the design to establish the acceptable performance requirements for the structures, systems, and components
Qualified life	Period for which equipment has been demonstrated, through testing, analysis and/or experience, to be capable of functioning within acceptance criteria during specific operating conditions while retaining the ability to perform its safety functions in accident condition or earthquake.
Quality Control Plan	Manufacturing Inspection and Test Plan, Contract Quality Plan, Product and Process Quality Plan. This is a document that sets out the specific quality practices, resources, and sequence of activities relevant to a particular product, project, or contract.
Mild Environment	An environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences.

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## **8 Abbreviations**

<b>Abbreviation</b>	<b>Explanation</b>
ASL	Approved Supplier Listing
ASME	American Society of Mechanical Engineers
COC	Certificate of Conformance
DBE	Design Basis Event
IEC	International Electrotechnical Commission
IEEE	The Institute of Electrical and Electronic Engineers
KOU	Koeberg Operating Unit
MESURISOL U	Insulation Controller for HV Networks
OBEMV	Operating Basis earthquake Medium Voltage
QCP	Quality Control Plan
QADP	Quality Assurance Data Package
RCC-E	Design and Construction Rules for Electrical Equipment for nuclear islands
SAR	Safety Analysis Review
TMA	Definite Time Over Current
TMV	Definite Time Voltage Measurement
TCV	Three-Phase Filter for Positive Sequence and Negative Sequence Symmetrical Component
TMFB2	Frequency relay
TMWR3	Active or Reactive Power directional relay
r.m.s.	root mean square
SSE	Safe Shutdown Earthquake

## **9 Roles and Responsibilities**

The manufacturer/supplier of the 6.6 kV electrical switchboards protection relays shall use this document as the reference for the minimum manufacturing, testing and qualification requirements.

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## **10 Process for Monitoring**

A. Suppliers shall be assessed / audited by the Procurement Quality Engineering (PQE) Group, against this specification, and appropriately scored to determine the suppliers' technical profile ranking on the ASL. Such audits shall be conducted whenever Supplier performance dictates and /or at a frequency that does not exceed once every six (6) years.

B. The PQE group shall conduct internal reviews/assessments when appropriate to determine supplier adherence to this specification.

## **11 Related/Supporting Documents**

- 11.1 Document CRN 3183, Reference: D742 - TMA110, 210 and 310;
- 11.2 Document CRN 3184, Reference D657 - MWR3 & TMWR3;
- 11.3 Document CRN 3185, Reference D791 - TMV111, 211 and 311;
- 11.4 Document CRN 3186, Reference D754 - TMV111, 211 and 311;
- 11.5 Document CRN 3187, Reference D734 - Mesurisol U;
- 11.6 Document CRN 3188, Reference D831 - TMA122.2, 222.2 and 322.2;
- 11.7 Document CRN 3189, Reference D744 - TMA121&2.2, 221&2.2 and 321&2.2;
- 11.8 Document CRN 3190, Reference D832 - TMV111, 211 and 311;
- 11.9 Document CRN 3191, Reference D756 - TMV110, 210 and 310m;
- 11.10 Document CRN 3192, Reference D775 - BCV and TCV filter;
- 11.11 Document CRN 3193, Reference D800 - positive and negative TCV filter;
- 11.12 Document CRN 3194, Reference D869 - TMFB 1;
- 11.13 Document CRN 3195, Reference D694 - TMV110m;
- 11.14 Document CRN 3196, Reference D733 - TMFB1 and TMFB2;
- 11.15 Document CRN 41826, Reference D789 - TMA111, 211 and 311.

## **12 Requirements**

### **12.1 General Requirements and Considerations**

Should a conflict arise between the requirements set out in this specification and any other standard or specification, this specification shall take precedence.

The acceptance of any alternative requirements other than those contained in this specification shall be at the sole discretion of Eskom.

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The schematic diagrams with technical parameters are attached to this document. It is important that the new relays are manufactured to the same form, fit, and function as the original relays. The characteristics, inputs and pin configurations of the new proposed relay shall stay the same as the original (inputs, voltage, amperage, and time) as indicated in attachments A1 to A18.

## **12.2 Service Conditions**

### **12.2.1 Ambient Conditions (Before Operation)**

During Transportation, Storage, and Installation:

Air temperature	: - 25°C to 40°C
Atmospheric pressure	: 86 to 106 kPa
Relative humidity	: ≤ 80%
Ionising radiation	: Background

### **12.2.2 Ambient Conditions (For Operation)**

During Operation:

Air temperature	: 15°C to 40°C
Absolute pressure	: 86 to 106 kPa
Relative humidity	: ≤ 80%
Integrated radiation dose	: Background

## **12.3 Qualification and Testing**

Depending on the function fulfilled, the relay is:

- Safety related, 1E or K3, or
- non-Safety related (NSF)

### **12.3.1 Safety Related Relays**

The relay is included in the category of equipment classified in the IEEE 323-2003 for 1E, or RCC-E for K3.

The protection relay is classified as Class 1E and shall be qualified by testing in accordance with IEEE 323-2003 for use in a mild environment or K3 qualification in accordance with RCC-E. A thermal ageing simulation procedure shall be developed and presented to Eskom for approval as part of the Qualification Program Plan prior to commencement of the qualification of the protection relay.

The operational ambient and postulated design basis event conditions used during qualification shall be equivalent or more severe than those specified in this specification. Qualification shall demonstrate the ability of the protection relay to function before, during, and after a design basis event.

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The protection relay shall have a minimum qualified life of 40 years.

### **12.3.2 Non-Safety related Relays**

For non-safety related relays, any recognised industrial standards shall be considered for qualification. Seismic qualification is not required for non-safety related relays.

### **12.3.3 Qualification and Test Report**

A qualification report containing all the data, test results, and evidence used to demonstrate the qualification of the protection relay shall comply with clause 7.1 of IEEE 323-2003. The qualification report shall be presented to Eskom as part of the quality assurance data package (QADP).

### **12.3.4 Seismic Qualification Testing (for Safety Related relays only)**

The documentation for seismic qualification of the protection relays and auxiliaries shall consist of a qualification specification and a qualification report. The documentation shall demonstrate that the protection relays and auxiliaries are qualified and shall perform their safety function when subjected to the earthquake motions. A vibration test for the relays used at the KOU must be in accordance with the data in the attached in appendix A1 to A18 [Withstand vibrations of 10 to 2000 Hz, Transition frequency 57 to 62 Hz, Amplitude 0,3 mm, Acceleration 2 g].

IEEE Std 344-2013 is accepted for the seismic qualification of new or replacement protection relays in operating NPPs, subject to the following provision:

- Rigorous seismic qualification by analysis, testing, or combined analysis and testing, as described in Clauses 7, 8, and 9 of IEEE Std 344-2013, are acceptable methods for the seismic qualification of the protection relays. The seismic qualification program shall be presented to the KOU for approval.

A seismic test is the preferred test method to confirm that a protection relay is not sensitive to high-frequency ground motion.

Alternative seismic qualification methods and standards shall be considered at the sole discretion of the KOU.

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### 13 Relay Identification

Each relay is fitted with a clear Perspex cover that clips onto the front face of the relay. At the bottom of the cover there is a circular opening for throughway of the seal bolt and a moulded bracket with a whole through which the seal is fitted.



**Figure 1: Clear Perspex cover**

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### 13.1 Number and Location of Protection Relays Installed

#### 13.1.1 Unit 1

Attach	Relay Type	Medium Voltage Electrical Switchboard							Total
		Description	1LGA	1LGB	1LGC	1LGD	1LHA	1LHB	
A1	TMA 111	Installed	9	3	7	10	17	15	61
		Spare	2	1	0	1	1	3	8
A3	TMA 211 (3 to 5A)	Installed	1	2	6	5	0	0	14
		Spare	2	1	0	1	0	0	4
A4	TMA 211 (8-63A & 0.13-1.3s)	Installed	1	2	3	1	3	3	13
		Spare	0	0	0	0	0	0	0
A5	TMA 222-2 (8-63A & 0.13-1.3s) (3-5A & 6-60s)	Installed	0	0	0	0	16	14	30
		Spare	0	0	0	0	1	2	3
A6	TMA 222-2 (8-63A & 0.02-0.13s) (3-5A & 6-60s)	Installed	7	0	0	4	0	0	11
		Spare	0	0	0	0	0	0	0
A7	TMA 222-2 (2-16A & 0.06-0.6s) (1-8A & 6-60s)	Installed	0	1	0	0	0	0	1
		Spare	0	2	0	0	0	0	2
A9	TMV 110m (30 to 58,5V)	Installed	3	3	3	3	0	0	12
		Spare	0	0	0	0	0	0	0
A10	TMV 110m (60 to 117V)	Installed	2	2	2	2	2	2	12
		Spare	0	0	0	0	0	0	0
A14	TCV 110/125V	Installed	2	2	2	2	2	2	12
		Spare	0	0	0	0	0	0	0

Note: 1LGB011JA has a unique TMA222-2 (2 to 16A & 1 to 8A).

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### 13.1.2 Unit 2

Attach	Relay Type	Medium Voltage Electrical Switchboard							
		Description	2LGA	2LGB	2LGC	2LGD	2LHA	2LHB	Total
A1	TMA 111	Installed	9	3	7	10	17	15	61
		Spare	2	1	0	1	1	3	8
A3	TMA 211 (3 to 5A)	Installed	1	2	6	5	0	0	14
		Spare	2	1	0	1	0	0	4
A4	TMA 211 (8-63A & 0.13-1.3s)	Installed	1	2	3	1	3	3	13
		Spare	0	0	0	0	0	0	0
A5	TMA 222-2 (8-63A & 0.13-1.3s) (3-5A & 6-60s)	Installed	0	0	0	0	16	14	30
		Spare	0	0	0	0	1	3	4
A6	TMA 222-2 (8-63A & 0.02-0.13s) (3-5A & 6-60s)	Installed	7	0	0	4	0	0	11
		Spare	0	0	0	0	0	0	0
A7	TMA 222-2 (2-16A & 0.06-0.6s) (1-8A & 6-60s)	Installed	0	1	0	0	0	0	1
		Spare	0	2	0	0	0	0	2
A9	TMV 110m (30 to 58,5V)	Installed	3	3	3	3	0	0	12
		Spare	0	0	0	0	0	0	0
A10	TMV 110m (60 to 117V)	Installed	2	2	2	2	2	2	12
		Spare	0	0	0	0	0	0	0
A14	TCV 110/125V	Installed	2	2	2	2	2	2	12
		Spare	0	0	0	0	0	0	0

Note: 2LGB011JA has a unique TMA222-2 (2 to 16A & 1 to 8A).

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### 13.1.3 Unit 9 and Diesel switchboards

Attach	Relay Type	Medium Voltage Electrical Switchboard						Total
		Description	LGE	LGF	LGI	LHC	LHP/Q/S	
A1	TMA 111	Installed	9	8	11	2	0	30
		Spare	2	0	0	1	0	3
A2	TMA 210	Installed	0	0	1	0	0	1
		Spare	0	0	0	0	0	0
A3	TMA 211 (3 to 5A)	Installed	6	5	0	0	0	11
		Spare	2	0	0	0	0	2
A4	TMA 211 (8-63A & 0.13-1.3s)	Installed	3	4	3	1	0	11
		Spare	0	0	0	0	0	0
A5	TMA 222-2 (8-63A & 0.13-1.3s) (3-5A & 6-60s)	Installed	0	0	9	1	0	10
		Spare	0	0	0	1	0	1
A6	TMA 222-2 (8-63A & 0.02-0.13s) (3-5A & 6-60s)	Installed	2	2	0	0	0	4
		Spare	0	0	0	0	0	0
A8	TMA 222-2 (1 to 8A & 0.25 to 2A)	Installed	0	0	2	0	0	2
		Spare	0	0	0	0	0	0
A9	TMV 110m (30 to 58,5V)	Installed	3	3	3	0	0	9
		Spare	0	0	0	0	0	0
A10	TMV 110m (60 to 117V)	Installed	0	0	0	2	0	2
		Spare	0	0	0	0	0	0
A11	TMV 111m (40 to 78V)	Installed	0	0	0	0	10	10
		Spare	0	0	0	0	0	0
A12	TMV 310 (80 to 156V)	Installed	0	0	0	0	5	5
		Spare	0	0	0	0	0	0
A13	TMV 311 (80 to 156V)	Installed	0	0	0	0	5	5
		Spare	0	0	0	0	0	0
A14	TCV 110/125V	Installed	0	0	0	2	0	2
		Spare	0	0	0	0	0	0
A15	TCV 48V	Installed	0	0	0	0	10	10
		Spare	0	0	0	0	0	0
A16	TMWR3	Installed	0	0	0	0	5	5
		Spare	0	0	0	0	0	0
A17	MESURISOL U	Installed	0	0	0	0	5	5
		Spare	0	0	0	0	0	0
A18	TMFB2 (100V)	Installed	0	0	0	0	5	5
		Spare	0	0	0	0	0	0

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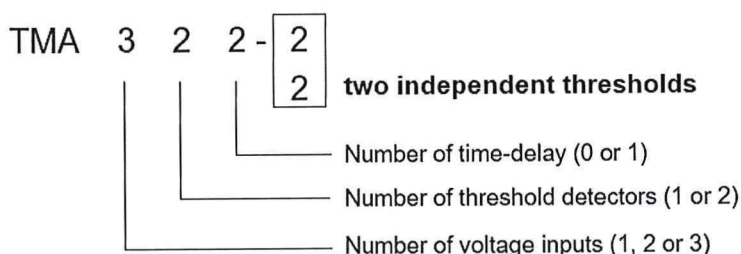
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### 13.2 TMA: Definite Time Overcurrent Relays

**Definite Time Overcurrent Relays** (TMAs) are used in a network protection scheme as overcurrent relays, adapted to protect the network against overcurrent's, short circuit currents, phase-to-phase fault currents and phase-to-ground fault currents. For generators and motors the relays are combined with positive and negative filter protection relays (TCV). They are listed as follows:

- A1: TMA 111
- A2: TMA 210
- A3: TMA 211 (3 to 5 A and 6 to 60 s)
- A4: TMA 211 (8 to 63A and 0.13 to 1.3 s)
- A5: TMA 222-2 high step: 8 to 63A, time (0,13 to 1,3 s); low step: 3 to 5 A, time (6 to 60 s)
- A6: TMA 222-2 high step: 8 to 63 A, time (0,02 to 0,13 s); low step: 3 to 5 A, time (6 to 60 s)
- A7: TMA 222-2 high step: 2 to 16 A, time (0,06 to 0,6 s); low step: 1 to 8 A, time (6 to 60 s)
- A8: TMA 222-2 high step: 1 to 8 A, time (0,13 to 1,3 s); low step: 0,25 to 2 A, time (6 to 60 s)



### 13.3 TMV: Definite Time Voltage Measurement

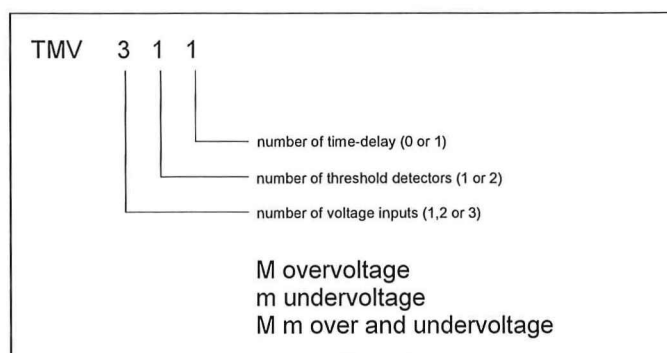
**Definite Time Voltage Measuring Relay** (TMV) are used as network protection or rotating machines protection to measure over and under voltage in medium and high voltage circuits, these relays are combined with positive and negative sequence filters (TCV). The relays are listed as follows:

- A9: TMV 110m (30 to 58,5V)
- A10: TMV 110m (60 to 117V)
- A11: TMV 111m (40 to 78V) Single phase under voltage independent time and setting time-lag relay
- A12: TMV 310 (80 to 156V)
- A13: TMV 311 (80 to 156V)

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### 13.4 TCV: Three-Phase Filter

The three-phase positive and negative sequence symmetrical component TCV filter delivers an image voltage of the network positive and negative components according to the way it is connected. The filter relay is combined with the TMV relay to detect a phase interruption (blown fuse), Phase inversion and voltage unbalance. They are listed as follows:

- A14: TCV 110/125V Positive sequence - trip filter
- A15: TCV 48V

VT1 - VT2 - VT3: Voltage transformes  
PA : Preamplifier  
A : Amplifier  
P : Output voltage ajustment potentiometer

### 13.5 TMWR3: Active or Reactive Power Directional Relay

The active or reactive power directional TMWR3 (A16) relay operates at maximum or minimum power and detects power feedback to the network. These relays measure the active current components ( $I \cos \varphi$ ) or reactive current components ( $I \sin \varphi$ ).

### 13.6 MESURISOL U: Insulation controller for HV networks

The main function of the Mesurisol (A17) protection relay is the measurement of the insulation resistance by injecting direct current, into the network and comparing the differences in resistance to the earth resistance reading.

### 13.7 TMFB2 (100V): Two-Step Frequency Measurement Relay

The two-step frequency measurement TMFB2 (A18) relay.

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## 14 Terminal Inputs and Schematic Philosophy

All the protection relays inputs, functions and technical requirements can be found in the appendices A1 to A18.

## 15 Equipment Classification

The following is the classification in accordance with the OEM and the KOU classification system:

	<u>Safety related</u>	<u>non-Safety related</u>
Safety class:	1E	NSF
Seismic class:	1A	NC
Quality level:	Q3	Q3
Nuclear Safety Level of Organisation (Manufacturer/Supplier):	L2	L3

## 16 Test Plan and Specifications

The following information shall be provided in the Test Plan and Specifications. The seismic qualification information is for the Safety Related relays only:

- Physical description of relays and auxiliaries.
- Operational settings (or ranges) for adjustable relays as applicable.
- Relays and auxiliaries mounting details, including all interface connections.
- RRS for the horizontal axis and the vertical axis, with applicable damping values and indication of artificially broadened areas. When an RRS is not furnished, see DSG-318-033.

## 17 Test Report

The following information shall be provided in the Test Report. The seismic qualification information is for the Safety Related relays only:

- Identification of the relays and auxiliaries being qualified including applicable safety functions.
- Test performance specification and acceptance criteria during and after seismic testing.
- Equipment mounting details, including all interface connections.
- RRS levels.
- Test method and procedures including monitoring for operability, relay electrical inputs, and settings.
- Test data (including proof of performance, TRS plots, time histories, PSD or Fourier analysis, coherence checks as necessary, number of OBEs and SSEs applied, duration, etc.), type of multi-frequency testing employed, and the acceleration time history of the input motion shall be provided in addition to the TRS. As a minimum, a time history of the SSE table motion shall be provided for one test in each of the three directions of excitation.
- Test facility information including location, test equipment, and calibration.
- Test results and conclusions, including functional test data and statement of any anomalies and limitations.

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- i) Documentation including references to all drawings, bills of material, instruction manuals,
- j) applicable QA procedures, etc., as necessary to perform an adequate review.
- k) An approval signature and date.

## 18 Documentation

The supplier shall provide Eskom with a Qualification Program Plan and Quality Control Plan (QCP) for approval prior to commencing with the qualification and manufacture of the cable

A comprehensive quality assurance data package (QADP) shall be submitted to Eskom on delivery of the cable and shall consist of the following as a minimum:

- Qualification report (Class 1E)/(K3), when required;
- Qualification program plan;
- Quality control plan;
- Type test reports;
- Routine test reports;
- Protection relays technical datasheet;
- Storage and handling/installation instructions;
- Certificate of conformance (COC).

## 19 Acceptance

This document has been seen and accepted by:

Name	Designation or Business area
T Mthandi	Manager-Specifications Engineering Group

## 20 Revisions

Date	Rev.	Compiler	Remarks
May 2020	0	WA Martinson	Replacement of obsolete relay.
September 2023	1	WA Martinson	Full revision

## 21 Development Team

The following people were involved in the development of this document:

Name	Designation or Business area
WA Martinson	Technologist
MB Fahrenfort	Snr Tech
B Erasmus	Electrical System Engineer

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## **22 Attachments**

- A1 TMA 111
- A2 TMA 210
- A3 TMA 211 (3 to 5 A and 6 to 60 s)
- A4 TMA 211 (8 to 63 A and 0.13 to 1.3 s)
- A5 TMA 222-2 high step: 8 to 63A, time (0,13 to 1,3 s); low step: 3 to 5 A, time (6 to 60 s)
- A6 TMA 222-2 high step: 8 to 63 A, time (0,02 to 0,13 s); low step: 3 to 5 A, time (6 to 60 s)
- A7 TMA 222-2 high step: 2 to 16 A, time (0,06 to 0,6 s); low step: 1 to 8 A, time (6 to 60 s)
- A8 TMA 222-2 high step: 1 to 8 A, time (0,13 to 1,3 s); low step: 0,25 to 2 A, time (6 to 60 s)
- A9 TMV 110m (30 to 58,5V)
- A10 TMV 110m (60 to 117V)
- A11 TMV 111m (40 to 78V) Single phase under voltage independent time and setting time-lag relay
- A12 TMV 310 (80 to 156V)
- A13 TMV 311 (80 to 156V)
- A14 TCV 110/125V Positive sequence - trip filter
- A15 TCV 48V
- A16 TMWR3
- A17 MESURISOL U
- A18 TMFB2

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A1

## 22.1 TMA 111

One step single phase overcurrent independent time and setting time lag relay. The TMA 111 measures the maximum phase current and compares the value with the set threshold values on the relay. The output of the relay is time delayed in accordance with the setting on the front panel.

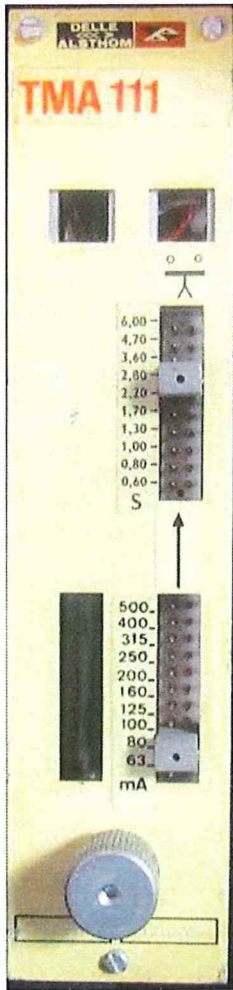
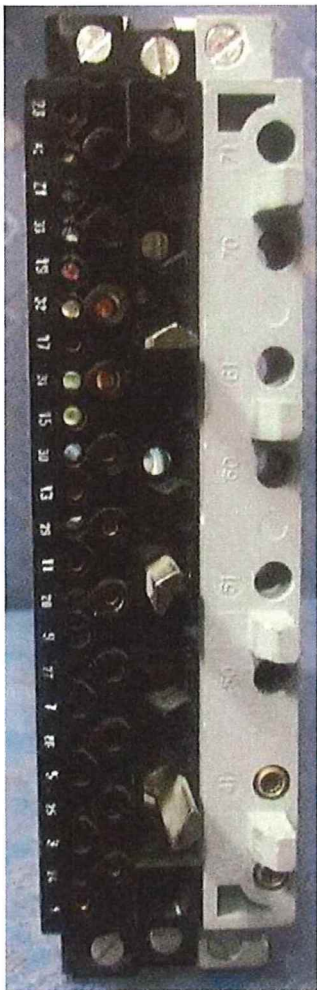
Input signal	Analogue
Current input range	63 to 500 mA
Accuracy on the steps	$\pm 5 \%$
Resetting ratio	95 % the operating step
Withstand overcurrent	0,5 A permanently
Input circuit consumption	$\leq 100$ mVA
Frequency	$30 \text{ Hz} \leq F \leq 70 \text{ Hz}$
Lamps	1 electromagnetic with memory
Time – lag output	2 reversers
Instantaneous output	2 reversers
Breaking capacity under 220-50 Hz $\cos \phi = 0,6$	5 A
Breaking capacity under 135 V dc time constant = 30 ms	0,25 A
Endurance	$10^5$ operations
Response time	$\leq 30$ ms
Accuracy on time - lag	$\pm 5 \%$ for $t > 0,3\text{s}$ $\pm 15$ ms for $t \leq 0,3$ s
Auxiliary supply voltage $U_{na}$	125 V dc
Auxiliary supply voltage range	0,9 to 1,2 $U_{na}$
Auxiliary supply voltage consumption	4 W
Dielectric withstand	2000 V <sub>rms</sub> – 50 Hz during 1 min
Operating temperature range	-5° C to 40° C
Overall design	TROPIC 1 PITCH sub-rack 42 mm
Withstand to vibrations	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; 2 g acceleration
Time lag range	0,6 to 6 seconds

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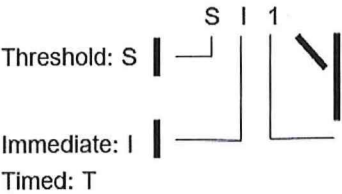
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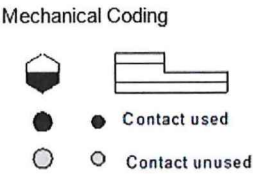
A1



Time lag range: 0,6 to 6 seconds  
Fixed Time lag Settings: 0.6; 0.8; 1; 1.3; 1.7; 2.2; 2.8; 3.6; 4.7; 6.  
Current input range: 63 to 500 mA  
Fixed Current input range Settings: 63; 80; 100; 125; 160; 200; 250; 315; 400; 500.



NO: Contact normally Open  
NC: Contact normally Close  
COM connected: Common Point  
Relay output number



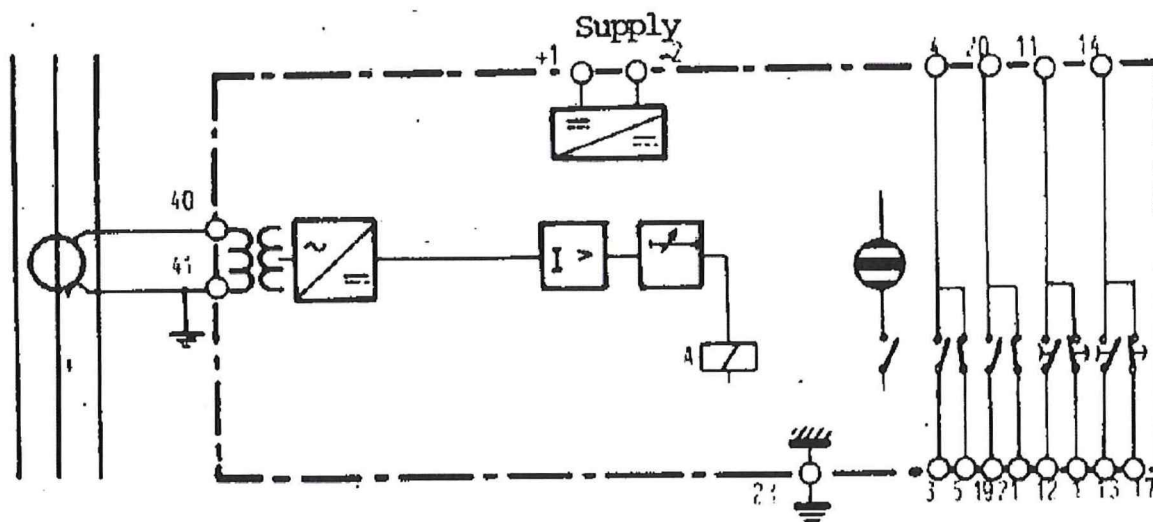
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A1

SIMPLIFIED PRINCIPAL DIAGRAM NOT ENERGIZED



TMA 111

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A2

## 22.2 TMA 210

The TMA210 phase to phase over current relay, measure the input value of the current to the inputs 1 (40 to 41) and 2 (50 to 51) of the relay, and compares the values with the threshold value setting of the relay. If the over current persists longer than the time settings, the relay switch will operate, and the indication LED will activate on the front of the relay.

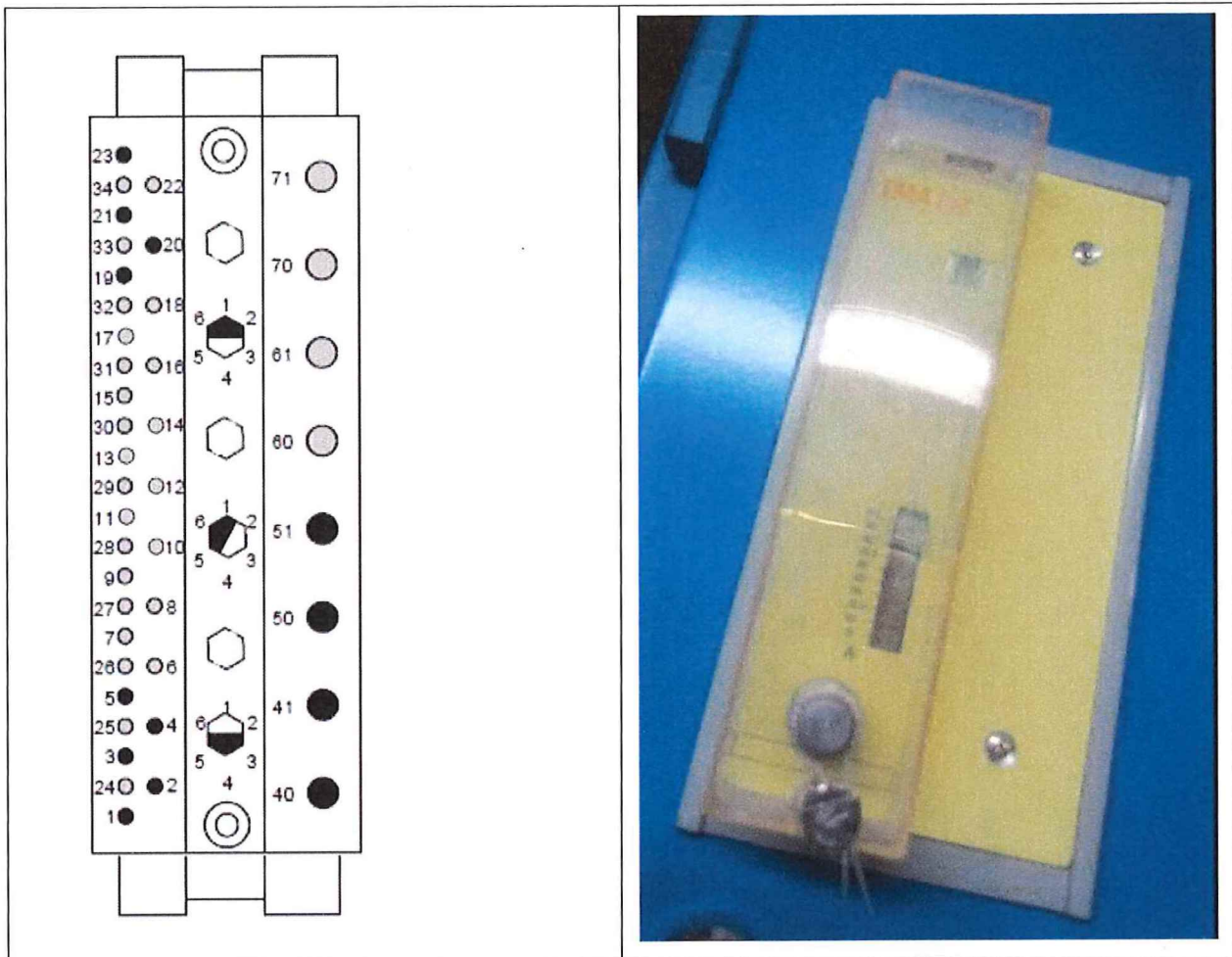
Input signal	Analogue
Current input range	8-63A
Accuracy on the steps	± 5 %
Resetting ratio	95 % the operating step
Withstand overcurrent	63A permanently
Input circuit consumption	≤ 100 mVA
Frequency	30 Hz ≤ F ≤ 70 Hz
Lamps	without
Time – lag output	without
Instantaneous output	2 reversers
Breaking capacity under 220-50 Hz Cos φ = 0,6	5 A
Breaking capacity under 135 V dc time constant 30 ms	0,25 A
Response time	≤ 30 ms
Accuracy on time - lag	± 20 %
Auxiliary supply voltage U <sub>na</sub>	125 V dc
Auxiliary supply voltage range	0,9 to 1,2 U <sub>na</sub>
Auxiliary supply consumption	4 W
Dielectric withstand	2000 V <sub>rms</sub> 50 Hz during 1 min
Operating temperature range	-5° C to 40° C
Overall design	TROPIC 2 PITCH sub-rack 84 mm
Withstand to vibrations	10 to 2000 Hz
Transition frequency 57 to 62	Amplitude 0,3 mm; 2 g acceleration
Time lag range	Instantaneous

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A2



Current Input Range: 8 to 63 A

Fixed Current Input Selections: 8; 10; 12.5; 16; 20; 25; 31.5; 40; 50; 63

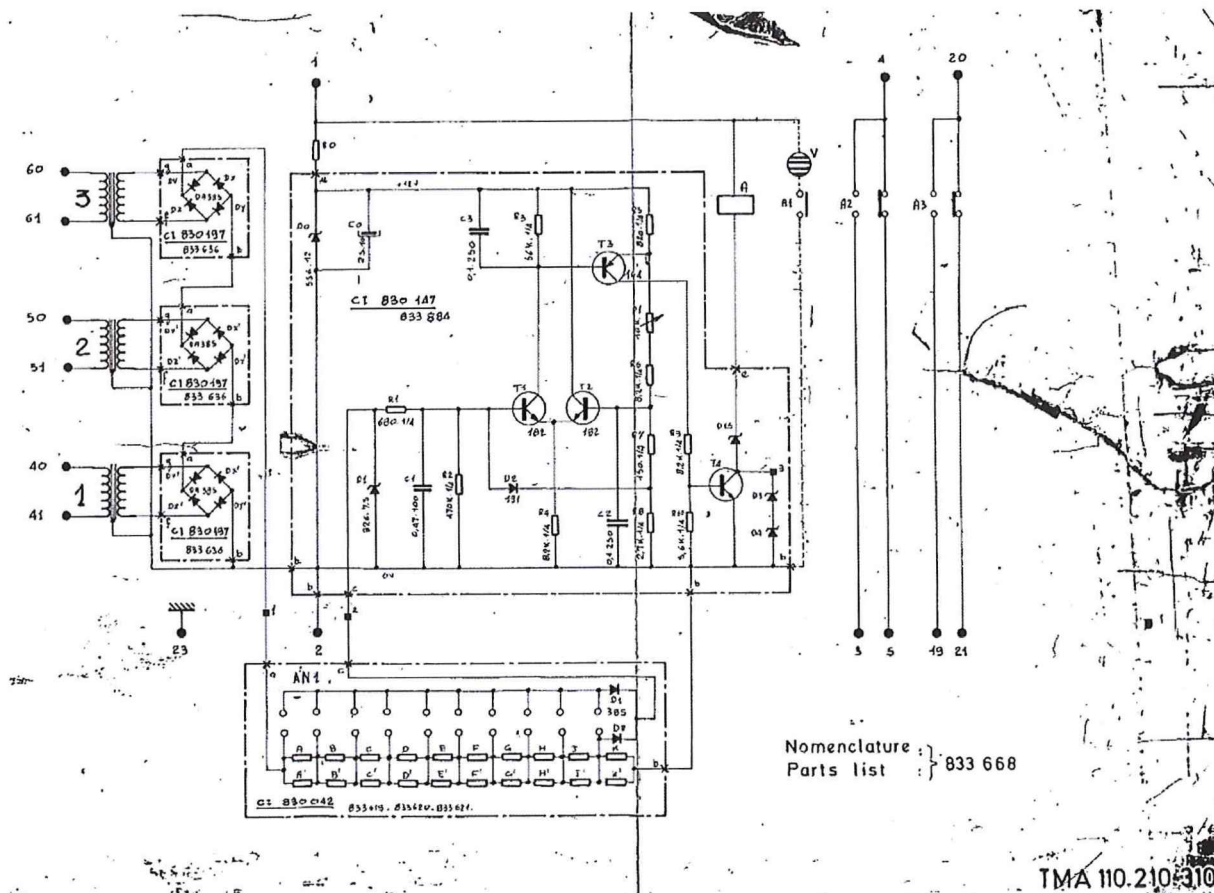
Time Lag Settings: Instantaneous

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A3

### 22.3 TMA 211 (3 to 5A)

The TMA211 phase to phase over current relay, measure the input value of the current to the input of the relay and compare the values with the threshold value setting of the relay. If the over current persists longer than the time settings, the relay switch will operate, and the indication LED will activate on the front of the relay. The relay has instantaneous and timed outputs. The time delay is adjustable on the front panel. An overcurrent fault causes the instantaneous outputs to switch, and the LED is activated. If this fault persists for a longer time than the non-operating time, the timed outputs switch immediately. This relay is installed on 6.6 kV contactors.

Input signal	Analogue
Current input range	3 to 5 A
Accuracy on the steps	+/- 5 %
Resetting ratio	95 % the operating step
Withstand overcurrent	5 A permanently
Input circuit consumption	≤ 100 mVA
Frequency	30 Hz ≤ F ≤ 70 Hz
Lamps	1 electromagnetic with memory
Time – lag output	2 reversers
Instantaneous output	2 reversers
Breaking capacity under 220-50 Hz Cos φ = 0,6	5 A
Breaking capacity under 135 V dc time constant 30 ms	0,25 A
Endurance	10 <sup>5</sup> operations
Response time	≤ 30 ms
Accuracy on time - lag	± 20 %
Auxiliary supply voltage U <sub>na</sub>	125 V dc
Auxiliary supply voltage range	0,9 to 1,2 U <sub>na</sub>
Auxiliary supply consumption	4 W
Dielectric withstand	2000 V <sub>rms</sub> – 50 Hz during 1 min
Operating temperature range	-5° C to 40° C
Overall design	TROPIC 1 PITCH sub-rack 42 mm
Withstand to vibrations	10 to 2000 Hz
Transition frequency 57 to 62	Amplitude 0,3 mm; 2 g acceleration
Time lag range	6 to 60 s

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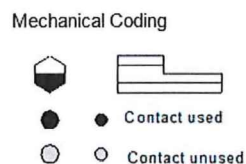
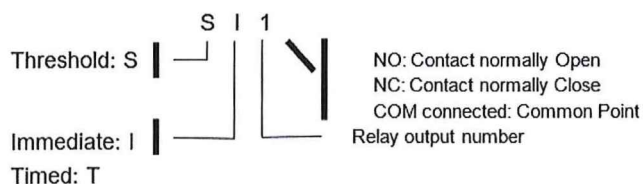
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Current Input Range: 3 to 5 A

Fixed Current Input Selections: 3; 3.2; 3.4; 3.6; 3.8; 4; 4.25; 4.5; 4.75; 5.

Time Lag Settings: 6 to 60 seconds

Fixed Time Lag Selections: 6; 8; 10; 13; 17; 22; 28; 36; 47; 60.



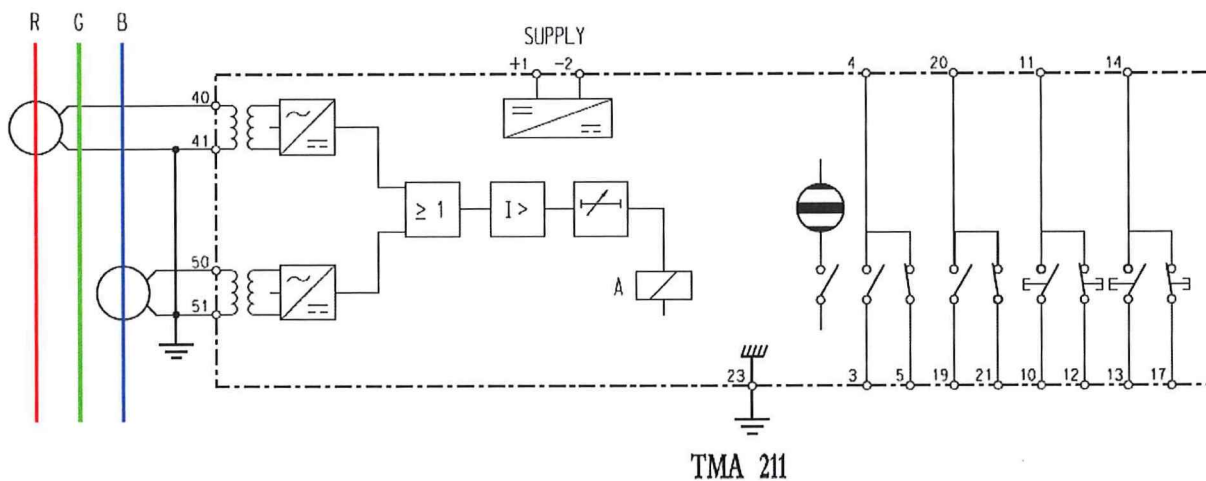
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A3

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A4

## **22.4 TMA 211 (8 to 63 A & 0,13 to 1,3 s)**

The one step two phase overcurrent independent time lag relay TMA211 phase to phase overcurrent relay, measures the input value of the current to the input of the relay and compares the value with the threshold value setting of the relay. If the overcurrent persists longer than the time settings, the relay switch will operate, and the indication LED will activate on the front of the relay. The relay has instantaneous and timed outputs. The time delay is adjustable on the front panel. An overcurrent fault causes the instantaneous outputs to switch, and the LED is lit. If this fault persists for a longer time than the non-operating time, the timed outputs switch immediately.

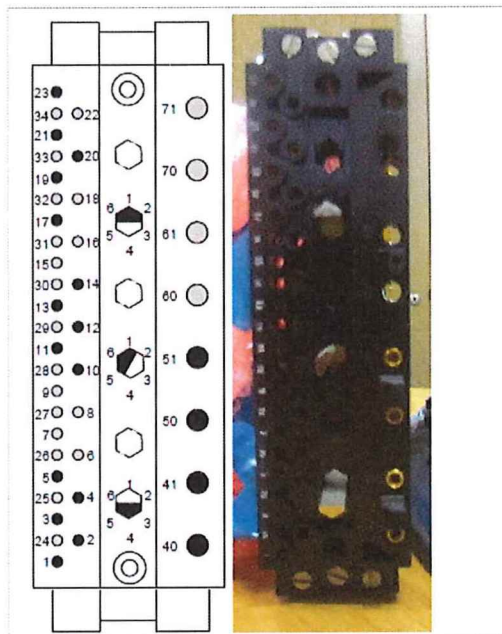
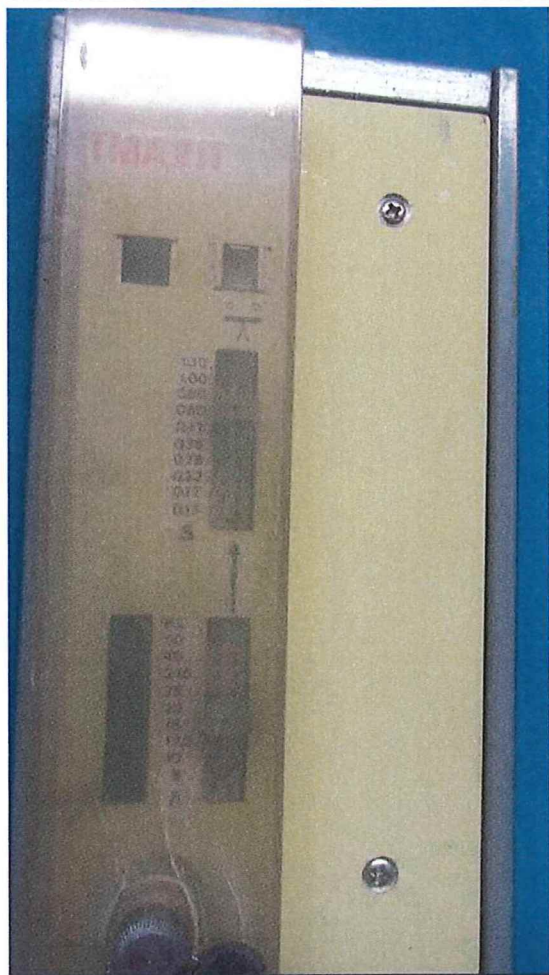
Input signal	Analogue
Current input range	8 to 63 A
Accuracy on steps	± 5 %
Resetting ratio	95 % the operating step
Withstand overcurrent	63A permanently
Input circuit consumption	≤ 100mVA
Frequency	30 Hz ≤ F ≤ 70 Hz
Lamps	1 electromagnetic with memory
Time-lag Output	2 reversers
Instantaneous Output	2 reversers
Breaking capacity under 220-50 Hz Cos φ = 0,6	5 A
Breaking capacity under 135 V dc L/R 30 ms	0,25 A
Endurance	10 <sup>5</sup> operations
Response Time	≤ 30 ms
Accuracy on Time-lag	± 5 % for t > 0,3 s-15ms for t<0,3 s
Auxiliary supply voltage U <sub>na</sub>	125 V dc
Auxiliary supply voltage range	0,9 to 1,2 U <sub>na</sub>
Auxiliary supply consumption	4 W
Dielectric withstand	2000 V rms- 50 Hz during 1 min
Operating temperature range	-5 °C to 40 °C
Overall design	TROPIC 1 PITCH sub-rack 42mm
Withstand to vibration	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g
Time lag range	0,13 to 1,3 s

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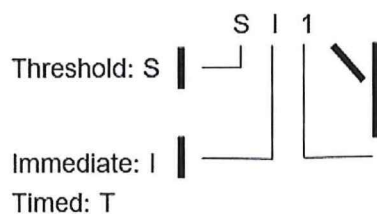


Current Input Range: 8 to 63 A

Fixed Current Input Selections: 8; 10; 12.5; 16; 20; 25; 31.5; 40; 50; 63.

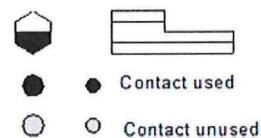
Time Lag Range: 0.13 to 1.3 seconds

Fixed Time Lag Selections: 0.13; 0.17; 0.22; 0.28; 0.36; 0.47; 0.6; 0.8; 1.3.



NO: Contact normally Open  
NC: Contact normally Close  
COM connected: Common Point  
Relay output number

Mechanical Coding

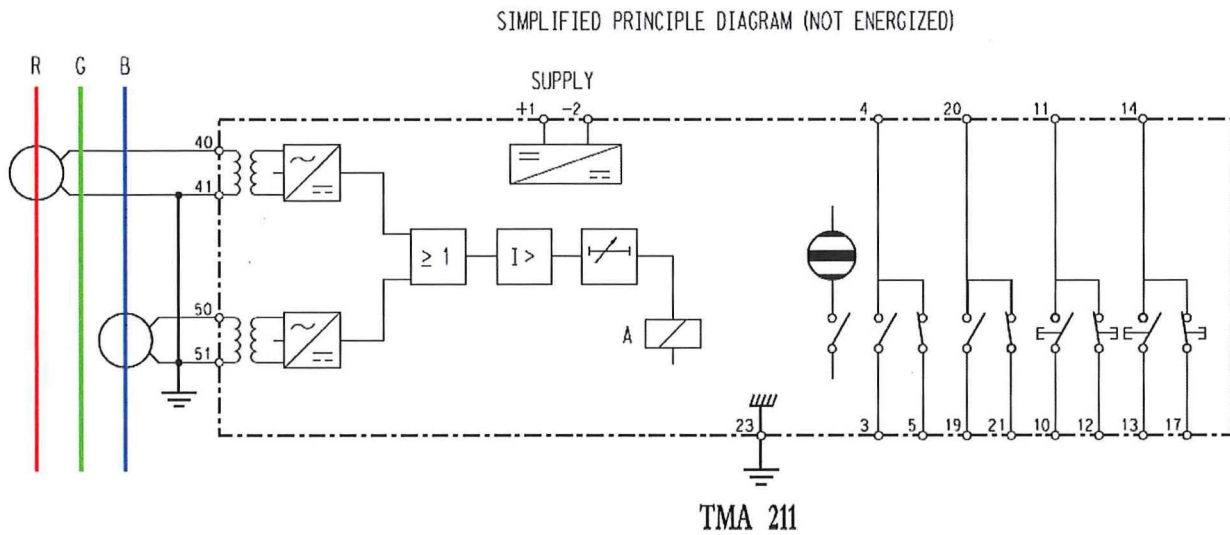


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A5

## 22.5 TMA 222-2 high step: 8 to 63 A & 0,13 to 1,3 s; low step: 3 to 5 A & 6 to 60 s

The TMA222-2 phase to phase over current relay, measures the input value of the current to the input of the relay and compares the values with threshold value setting of the relay. If the over current persists longer than the time settings, the relay switch will operate, and the indication LED will be lit on the front of the relay. The relay has instantaneous and timed outputs. The time delay is adjustable on the front panel. An overcurrent fault causes the instantaneous outputs to switch, and the LED is lit. If this fault persists for a longer time than the non-operating time, the timed outputs switch immediately

Each threshold high and low is independent and has instantaneous and timed outputs. The time delay is adjustable on the front panel for each threshold.

For each threshold, an overcurrent fault on the high threshold or overcurrent on low threshold causes an instantaneous changeover to the output switch and the indication LED is lit. If this fault persists for a longer time than the non-operating time, the timed outputs are activated.

This version of the TMA222-2 phase to phase over current relay deviates on the high step time lag that is high step: 0,13 to 1,3 s. This relay is installed on 6.6 kV contactors.

Input signal		Analogue
Current input range	High step	8 to 63 A
	Low step	3 to 5 A
Accuracy on the steps		± 5 %
Resetting ratio		95 % the operating step
Withstand overcurrent		5 A permanently
Input circuit consumption		≤ 100 mVA
Frequency		30 Hz ≤ F ≤ 70 Hz
Lamps	High step	1 electromagnetic with memory
	Low step	1 electromagnetic with memory
Time – lag output	High step	1 reverser – 1 make contact
	Low step	1 reverser – 1 make contact
Instantaneous output	High step	without
	Low step	without
Breaking capacity under 220-50 Hz Cos φ = 0,6		5 A
Breaking capacity under 135 V dc time constant 30 ms		0,25 A
Endurance		10 <sup>5</sup> operations
Response time		≤ 30 ms

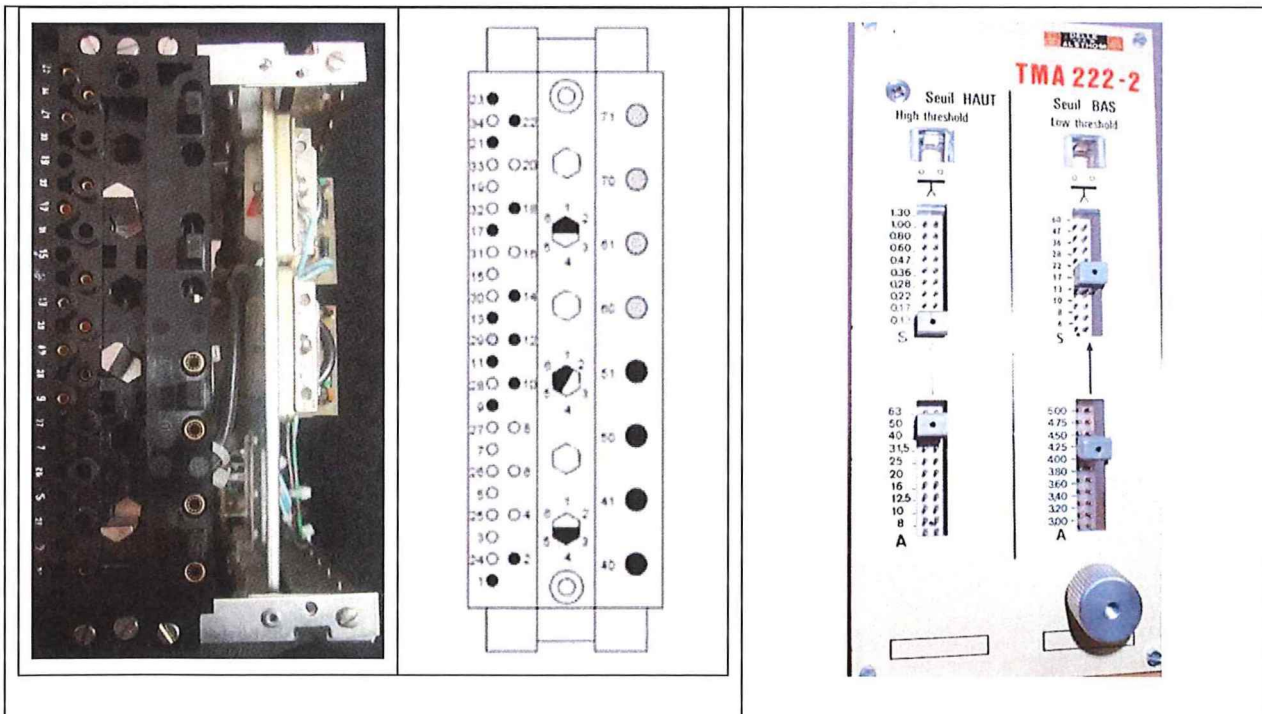
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A5

Time lag	High step	0,13 to 1,3 s
	Low step	6 to 60 s
Accuracy on time - lag	High step	-5% for $t > 0,3s$ & $\pm 15$ ms for $t \leq 0,3$ s
	Low step	$\pm 20$ %
Auxiliary supply voltage $U_{na}$		125 V dc
Auxiliary supply voltage range		0,9 to 1,2 $U_{na}$
Auxiliary supply voltage consumption		4 W
Dielectric withstand		2000 V <sub>rms</sub> – 50 Hz during 1 min
Operating temperature range		-5° C to 40° C
Overall design		TROPIC 2 PITCH sub-rack 84 mm
Withstand to vibrations		10 to 2000 Hz
Transition frequency 57 to 62 Hz		Amplitude 0,3 mm; 2 g acceleration



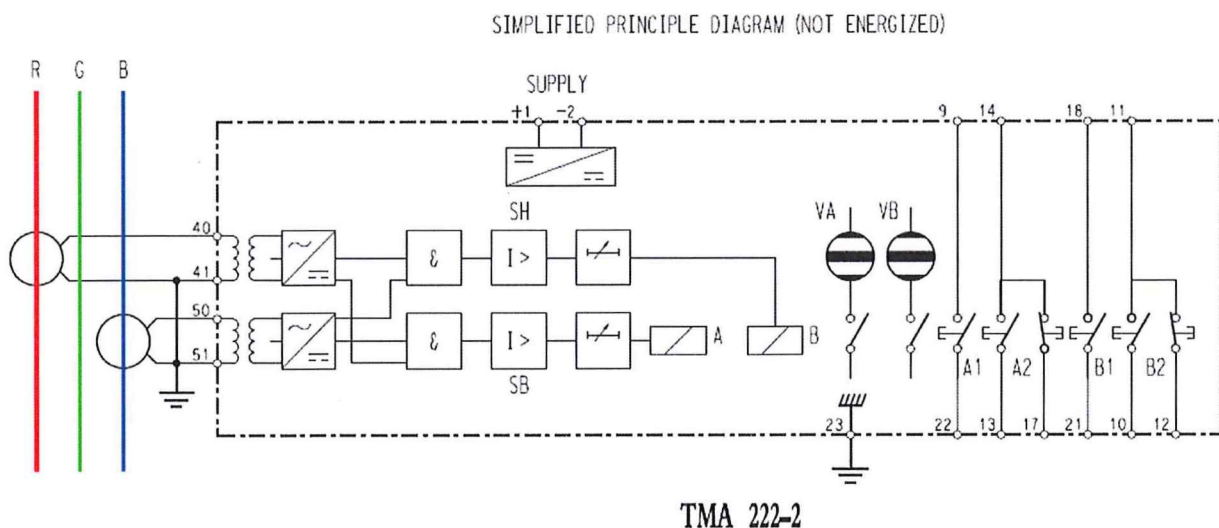
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A5

<p>Threshold: S I 1</p> <p>Immediate: I</p> <p>Timed: T</p> <p>NO: Contact normally Open NC: Contact normally Close COM connected: Common Point Relay output number</p> <p>Mechanical Coding</p> <p>● Contact used ○ Contact unused</p>	<p><b>High Step</b></p> <p>Current Range 8 to 63 A</p> <p>Current Fixed Selections: 8; 10; 12.5; 16; 20; 25; 31.5; 40; 50; 63.</p> <p>Time Settings: 0,13 to 1,3 s</p> <p>Time Fixed Selections: 0.13; 0.17; 0.22; 0.28; 0.36; 0.47; 0.6; 0.8; 1; 1.3.</p> <p><b>Low Step</b></p> <p>Current Range 3 to 5 A</p> <p>Current Fixed Selections: 3; 3.2; 3.4; 3.6; 3.8; 4; 4.25; 4.5; 4.75; 5.</p> <p>Time Settings: 6 to 60 s</p> <p>Time Fixed Selections: 6; 8; 10; 13; 17; 22; 28; 36; 47; 60.</p>
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A6

## 22.6 TMA 222-2 high step: 8 to 63 A & 0,02 to 0,13 s; low step: 3 to 5 A & 6 to 60 s

The TMA222-2 phase to phase over current relay, measures the input value of the current to the input of the relay and compares the values with threshold value setting of the relay. If the over current persists longer than the time settings, the relay switch will operate, and the indication LED will be lit on the front of the relay. The relay has instantaneous and timed outputs. The time delay is adjustable on the front panel. An overcurrent fault causes the instantaneous outputs to switch, and the LED is lit. If this fault persists for a longer time than the non-operating time, the timed outputs switch immediately

Each threshold high and low is independent and has instantaneous and timed outputs. The time delay is adjustable on the front panel for each threshold.

For each threshold, an overcurrent fault on the high threshold or overcurrent on low threshold causes an instantaneous changeover to the output switch and the indication LED is lit. If this fault persists for a longer time than the non-operating time, the timed outputs are activated.

This version of the TMA222-2 phase to phase over current relay deviates on the high step time lag that is high step: 0,02 to 0,13 s. This relay is installed on 6.6 kV circuit breakers.

Input signal		Analogue
Current input range	High step	8 to 63 A
	Low step	3 to 5 A
Accuracy on the steps		± 5 %
Resetting ratio		95 % the operating step
Withstand overcurrent		5 A permanently
Input circuit consumption		≤ 100 mVA
Frequency		30 Hz ≤ F ≤ 70 Hz
Lamps	High step	1 electromagnetic with memory
	Low step	1 electromagnetic with memory
Time – lag output	High step	1 reverser – 1 make contact
	Low step	1 reverser – 1 make contact
Instantaneous output	High step	without
	Low step	without
Breaking capacity under 220-50 Hz Cos φ = 0,6		5 A
Breaking capacity under 135 V dc time constant 30 ms		0,25 A
Endurance		10 <sup>5</sup> operations
Response time		≤ 30 ms

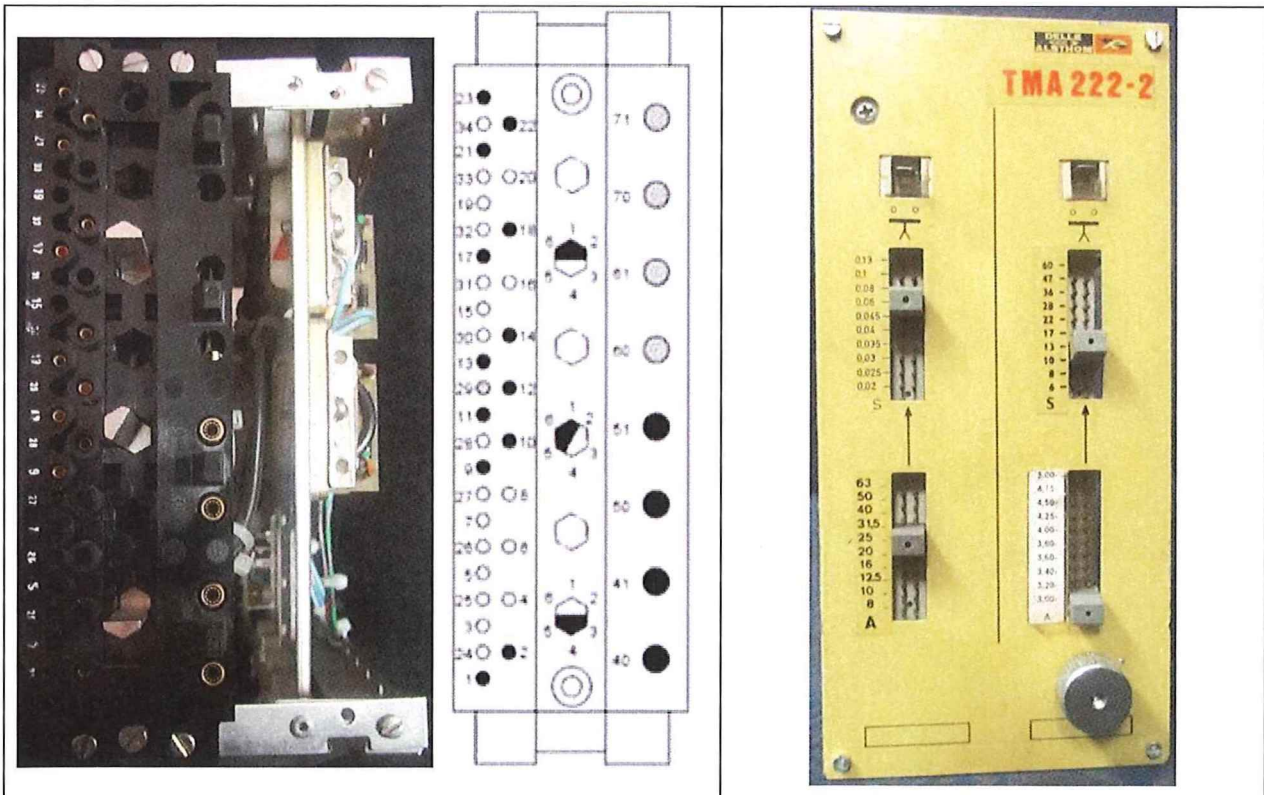
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A6

Time lag	High step	0,02 to 0,13 s
	Low step	6 to 60 s
Accuracy on time - lag	High step	-5% from $t > 0,3$ s & $\pm 15$ ms for $t \leq 0,3$ s
	Low step	$\pm 20$ %
Auxiliary supply voltage $U_{na}$		125 V dc
Auxiliary supply voltage range		0,9 to 1,2 $U_{na}$
Auxiliary supply consumption		4 W
Dielectric withstand		2000 V <sub>rms</sub> – 50 Hz during 1 min
Operating temperature range		-5° C to 40° C
Overall design		TROPIC 2 PITCH sub-rack 84 mm
Withstand to vibrations		10 to 2000 Hz
Transition frequency 57 to 62 Hz		Amplitude 0,3 mm; 2 g acceleration

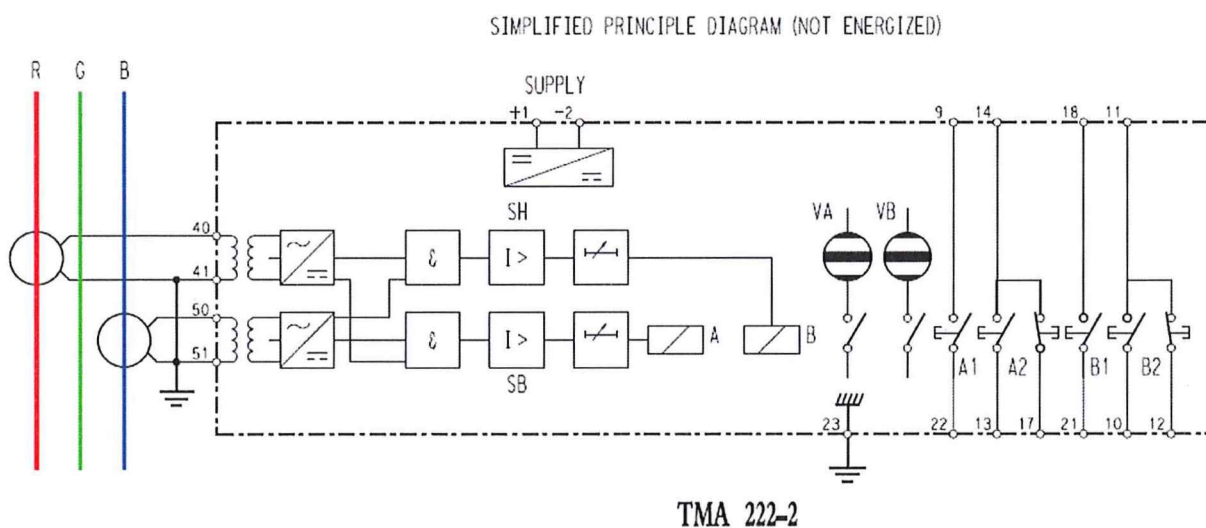
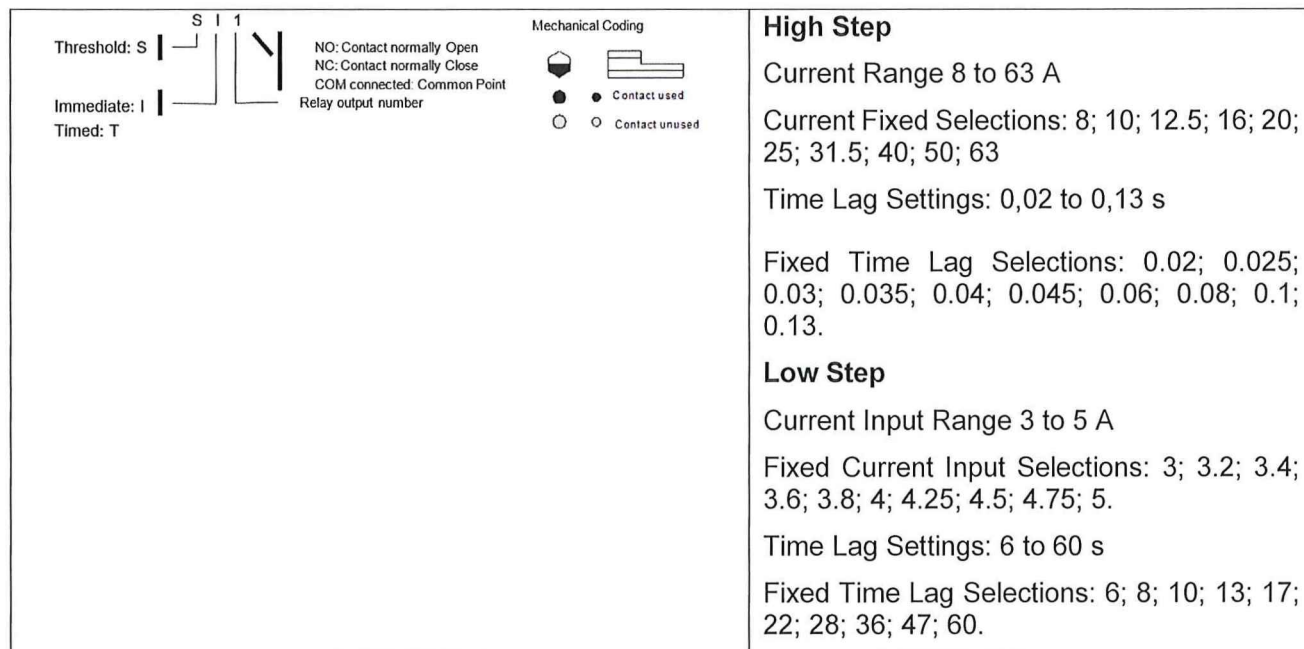


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## 22.7 TMA 222-2 high step: 2 to 16 A & 0,06 to 0,6 s; low step: 1 to 8A & 6 to 60 s

The TMA222-2 phase to phase over current relay, measures the input value of the current to the input of the relay and compares the values with threshold value setting of the relay. If the over current persists longer than the time settings, the relay switch will operate, and the indication LED will be lit on the front of the relay. The relay has instantaneous and timed outputs. The time delay is adjustable on the front panel. An overcurrent fault causes the instantaneous outputs to switch, and the LED is lit. If this fault persists for a longer time than the non-operating time, the timed outputs switch immediately

Each threshold high and low is independent and has instantaneous and timed outputs. The time delay is adjustable on the front panel for each threshold.

For each threshold, an overcurrent fault on the high threshold or overcurrent on low threshold causes an instantaneous changeover to the output switch and the indication LED is lit. If this fault persists for a longer time than the non-operating time, the timed outputs are activated.

This version of the TMA222-2 phase to phase over current relay deviates on the high step time lag that is high step: 0,06 to 0,6 s. This relay is installed on the LGB011JA circuit breaker.

Input signal		Analogue
Current input range	High step	2 to 16 A
	Low step	1 to 8 A
Accuracy on the steps		± 5 %
Resetting ratio		95 % the operating step
Withstand overcurrent		16 A permanently
Input circuit consumption		≤ 100 mVA
Frequency		30 Hz ≤ F ≤ 70 Hz
Lamps	High step	1 electromagnetic with memory
	Low step	1 electromagnetic with memory
Time – lag output	High step	1 reverser – 1 make contact
	Low step	1 reverser – 1 make contact
Instantaneous output	High step	without
	Low step	without
Breaking capacity under 220-50 Hz Cos φ = 0,6		5 A
Breaking capacity under 135 V dc time constant 30 ms		0,25 A
Endurance		10 <sup>5</sup> operations
Response time		≤ 30 ms

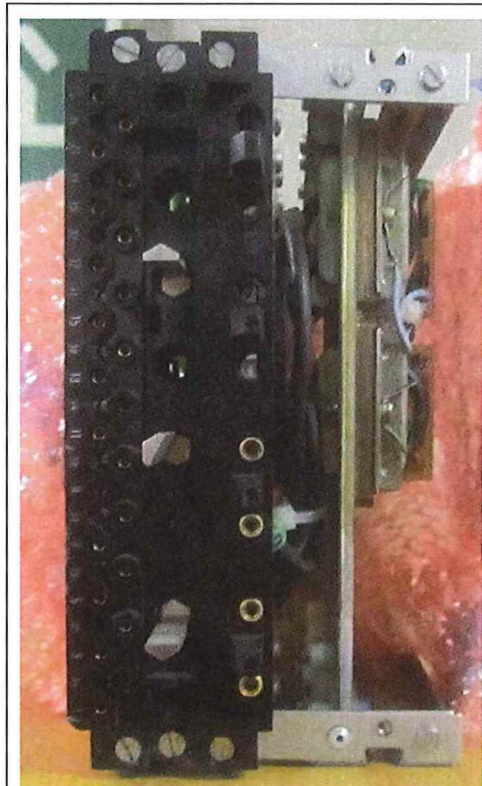
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A7

Time lag	High step	0,06 to 0.6 s
	Low step	6 to 60 s
Accuracy on time - lag	High step	-5% for $t > 0,3s$ & $\pm 15$ ms for $t \leq 0,3$ s
	Low step	$\pm 20$ %
Auxiliary supply voltage $U_{na}$		125 V dc
Auxiliary supply voltage range		0,9 to 1,2 $U_{na}$
Auxiliary supply voltage consumption		4 W
Dielectric withstand		2000 V <sub>rms</sub> – 50 Hz during 1 min
Operating temperature range		-5° C to 40° C
Overall design		TROPIC 2 PITCH sub-rack 84 mm
Withstand to vibrations		10 to 2000 Hz
Transition frequency 57 to 62 Hz		Amplitude 0,3 mm; 2 g acceleration

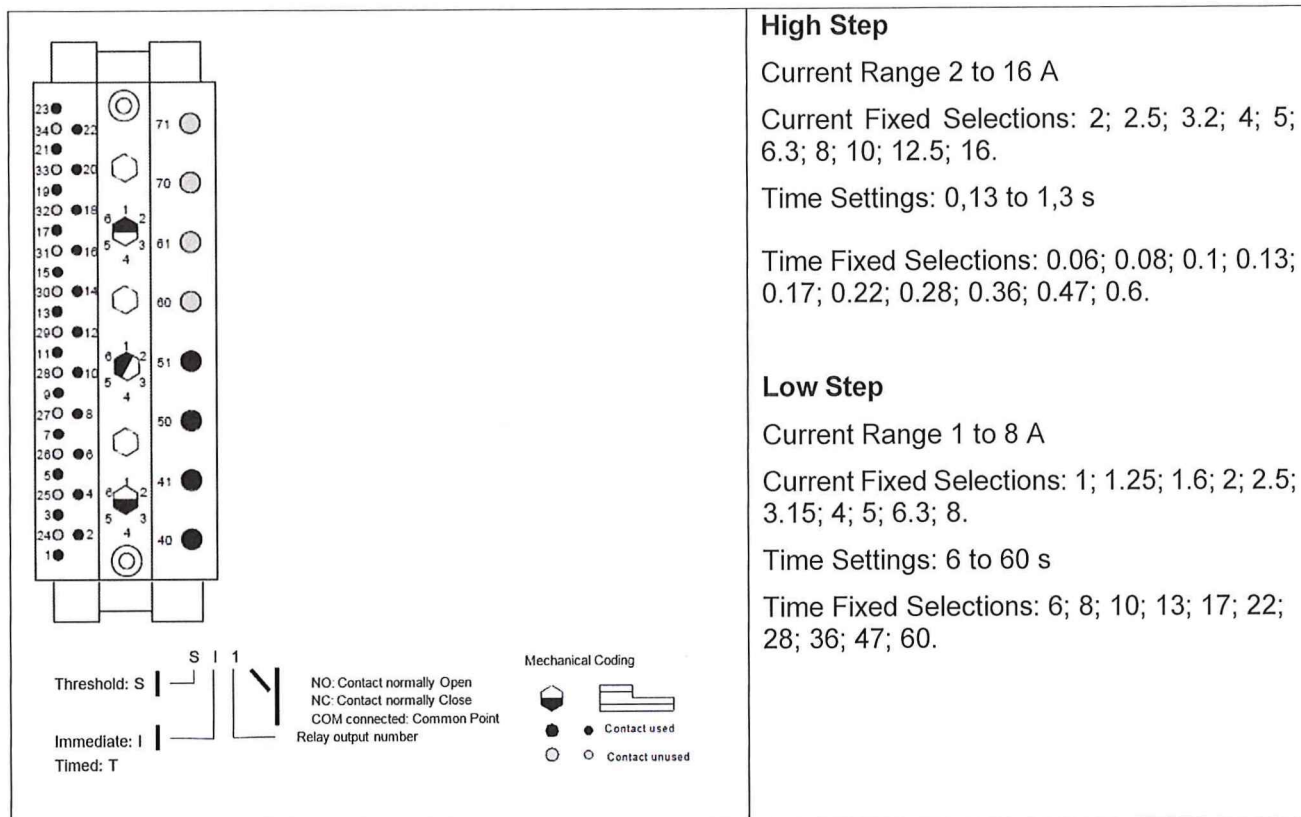


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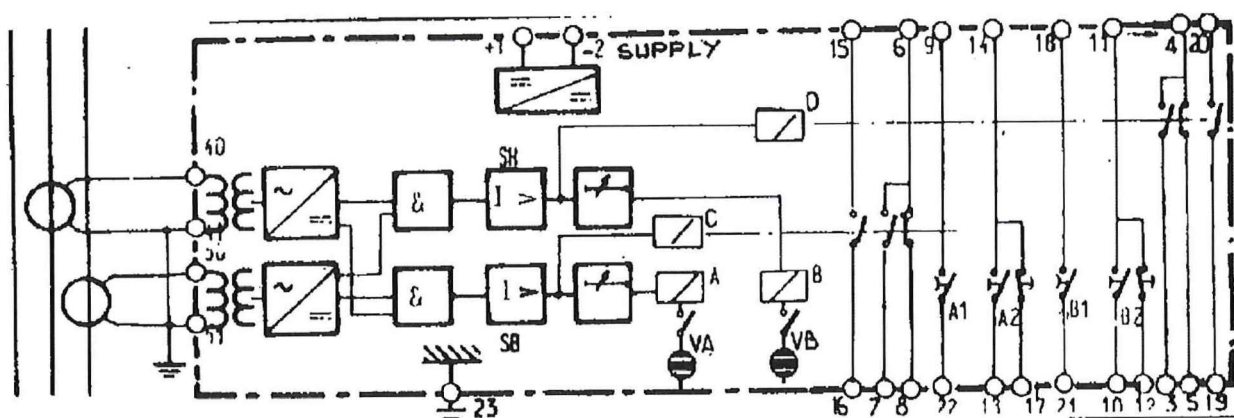
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TMA222-2 with instantaneous outputs

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A8

## 22.8 TMA 222-2 high step: 1 to 8 A & 0,13 to 1,3 s; low step: 0,25 to 2 A & 6 to 60 s

The TMA222-2 phase to phase over current relay, measures the input value of the current to the input of the relay and compares the values with threshold value setting of the relay. If the over current persists longer than the time settings, the relay switch will operate, and the indication LED will be lit on the front of the relay. The relay has instantaneous and timed outputs. The time delay is adjustable on the front panel. An overcurrent fault causes the instantaneous outputs to switch, and the LED is lit. If this fault persists for a longer time than the non-operating time, the timed outputs switch immediately

Each threshold high and low is independent and has instantaneous and timed outputs. The time delay is adjustable on the front panel for each threshold.

For each threshold, an overcurrent fault on the high threshold or overcurrent on low threshold causes an instantaneous changeover to the output switch and the indication LED is lit. If this fault persists for a longer time than the non-operating time, the timed outputs are activated.

This version of the TMA222-2 phase to phase over current relay is unique and only two relays are installed on plant. High step: 1 to 8 A; 0,13 to 1,3 s time lag and low step: 0,25 to 2 A; 6 to 60 s.

Input signal		Analogue
Current input range	High step	1 to 8 A
	Low step	0,25 to 2 A
Accuracy on the steps		± 5 %
Resetting ratio		95 % the operating step
Withstand overcurrent		2 A permanently
Input circuit consumption		≤ 100 mVA
Frequency		30 Hz ≤ F ≤ 70 Hz
Lamps	High step	1 electromagnetic with memory
	Low step	1 electromagnetic with memory
Time – lag output	High step	1 reverser – 1 make contact
	Low step	1 reverser – 1 make contact
Instantaneous output	High step	1 reverser – 1 make contact
	Low step	1 reverser – 1 make contact
Breaking capacity under 220-50 Hz Cos φ = 0,6		5 A
Breaking capacity under 135 V dc time constant 30 ms		0,25 A
Endurance		10 <sup>5</sup> operations
Response time		≤ 30 ms

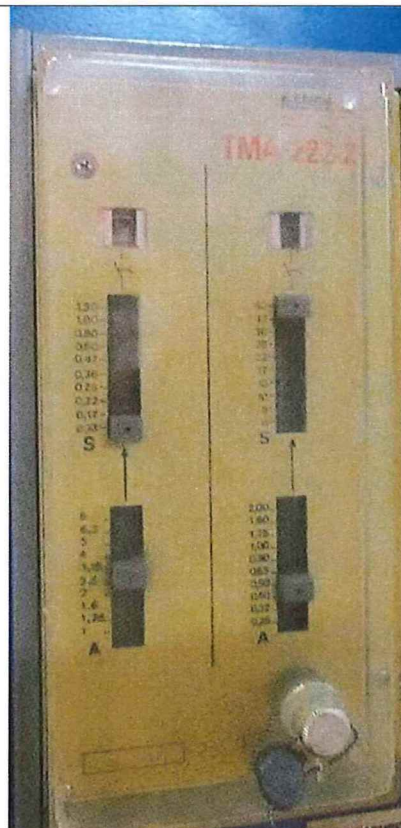
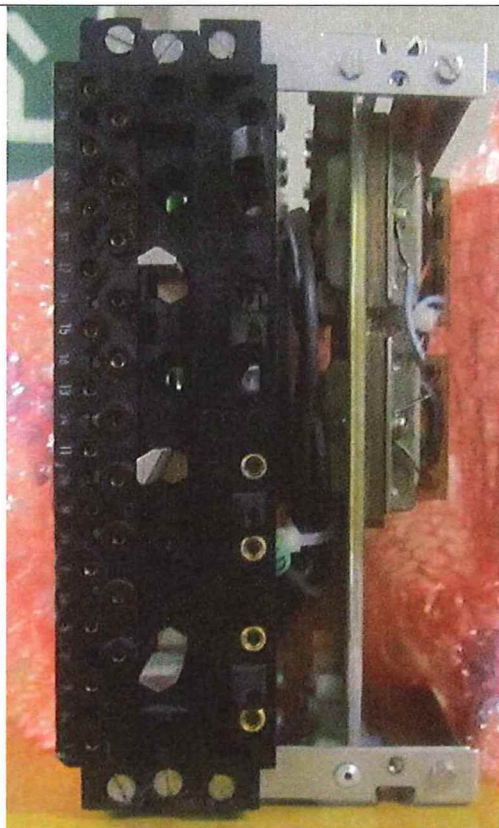
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A8

Time lag	High step	0,13 to 1,3 s
	Low step	6 to 60 s
Accuracy on time - lag	High step	$\pm 5\%$ from $t > 0,3s$ & $\pm 15$ ms for $t \leq 0,3$ s
	Low step	$\pm 20 \%$
Auxiliary supply voltage $U_{na}$		125 V dc
Auxiliary supply voltage range		0,9 to 1,2 $U_{na}$
Auxiliary supply voltage consumption		4 W
Dielectric withstand		2000 V <sub>rms</sub> – 50 Hz during 1 min
Operating temperature range		-5° C to 40° C
Overall design		TROPIC 2 PITCH sub-rack 84 mm
Transition frequency 57 to 62 Hz		Amplitude 0,3 mm; 2 g acceleration

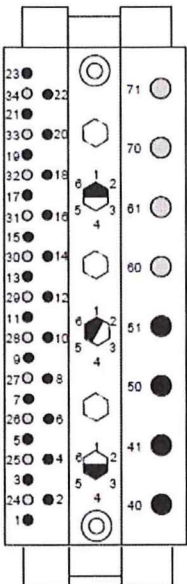


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A8



Threshold: S | 1  
Immediate: I |  
Timed: T |

NO: Contact normally Open  
NC: Contact normally Close  
COM connected: Common Point  
Relay output number

Mechanical Coding  
● Contact used  
○ Contact unused

**High Step**

Current Input Range: 1 to 8 A

Fixed Current Input Selections: 1; 1.25; 1.6; 2; 2.5; 3.15; 4; 5; 6.3; 8.

Time Lag Settings: 0.13 to 1,3 s

Fixed Time Lag Selections: 0.13; 0.17; 0.22; 0.28; 0.36; 0.47; 0.6; 0.8; 1; 1.3.

**Low Step**

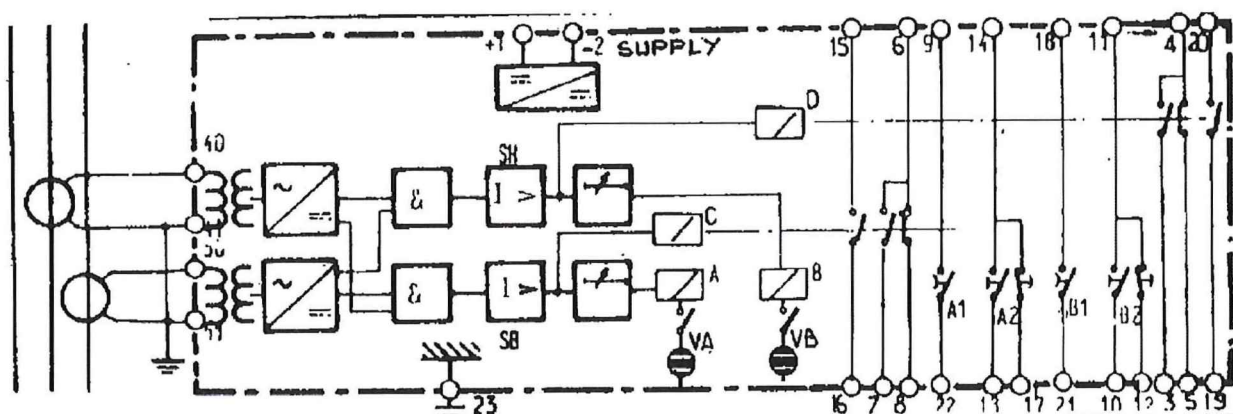
Current Input Range: 0,25 to 2 A

Fixed Current Input Selections: 0.25; 0.32; 0.4; 0.5; 0.63; 0.8; 1; 1.25; 1.6; 2.

Time Lag Settings: 6 to 60 seconds

Fixed Time Lag Selections: 6; 8; 10; 13; 17; 22; 28; 36; 47; 60.

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TMA222-2 with instantaneous outputs

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A9

## **22.9 TMV 110m (30 to 58,5V)**

The TMV 110 m is a single line under voltage relay with one voltage input.

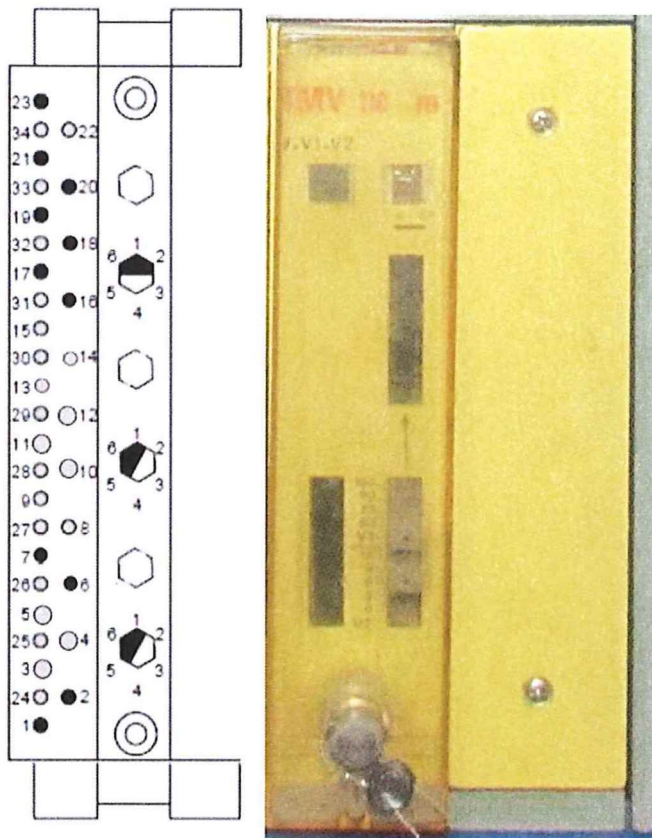
Input signal	Analogue
Voltage input range	30 to 58,5 V
Accuracy on the steps	±5%
Resetting ratio (The operating range)	95%
Withstand overvoltage	240 V
Input circuit consumption	< 500 mVA
Frequency	30 Hz ≤ F ≤ 70 Hz
Lamp/LED	1 electromagnetic with memory
Instantaneous output	2 reversers
Time-lag output	Without
Breaking capacity under 135 V dc with time constant load 30 ms	0,3 A
Breaking capacity under 220V, 50 Hz and Cos φ=0,6	5 A
Closing and permanent withstand under 135 V dc load R	3,5 A
Closing and permanent withstand under 220V, 50 Hz and Cos φ = 0,6	2,5A
Endurance	10 <sup>5</sup> operations
Response time	≤ 50 ms
DC auxiliary supply voltage U <sub>na</sub>	125 V dc
Auxiliary supply voltage range	0,8 to 1,1 U <sub>na</sub>
Auxiliary supply consumption	4 W
Dielectric withstand	2000 V rms 50 Hz during 1 min
Operating temperature range	-5 °C to 40 °C
Design spec	TROPIC 1 PITCH sub-rack 42 mm
Withstand to vibration	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g

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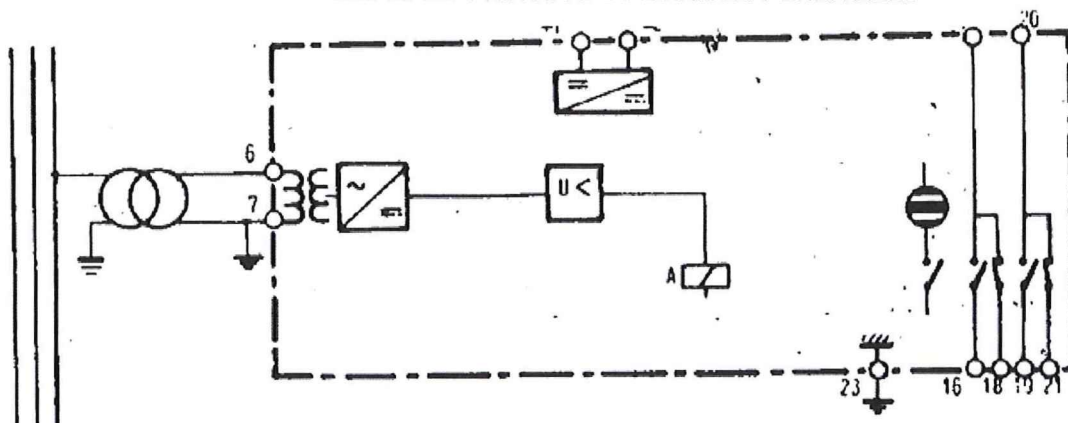
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A9



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TMV 110m

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A10

## **22.10 TMV 110m (60 to 117V)**

The TMV 110 m is a single line under voltage relay with one voltage input.

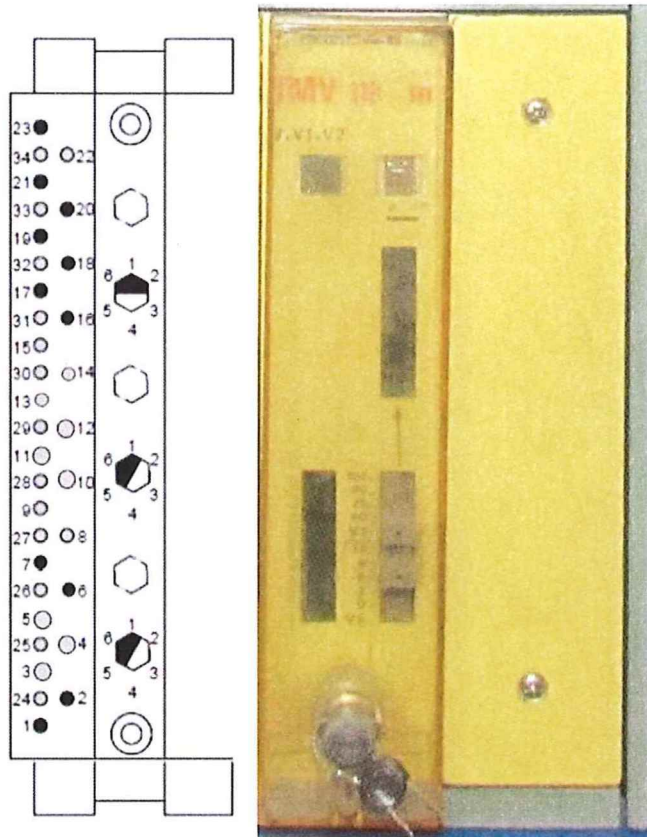
Input signal	Analogue
Voltage input range	60 to 117 V
Accuracy on the steps	±5%
Resetting ratio	95% the operating range
Withstand overvoltage	320 V
Input circuit consumption	< 500 mVA
Frequency	30 Hz ≤ F ≤ 70 Hz
Lamp/LED	1 electromagnetic with memory
Instantaneous output	2 reversers
Time-lag output	Without
Breaking capacity under 135 V dc time constant load 30 ms	0,3 A
Breaking capacity under 220V, 50 Hz and Cos φ=0,6	5 A
Closing and permanent withstand under 135 V dc load R	3,5 A
Closing and permanent withstand under 220V, 50 Hz and Cos φ = 0,6	2,5 A
Endurance	10 <sup>5</sup> operations
Response time	≤ 50 ms
DC auxiliary supply voltage U <sub>na</sub>	125 V dc
Auxiliary supply voltage range	0,8 to 1,1 U <sub>na</sub>
Auxiliary supply consumption	4 W
Dielectric withstand	2000 V rms 50 Hz during 1 min
Operating temperature range	-5 °C to 40 °C
Design spec	TROPIC 1 PITCH sub-rack 42 mm
Withstand to vibration	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g

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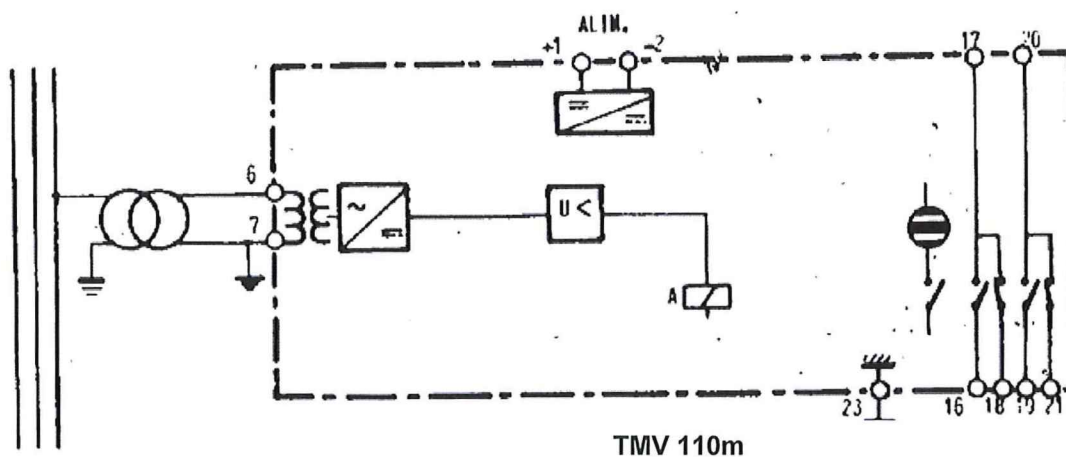
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A10



Special relay for nuclear power stations as per DMR CODE Nb 834 135.

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A11

## **22.11 TMV 111m (40 to 78V)**

The single phase under voltage independent time and setting time-lag relay.

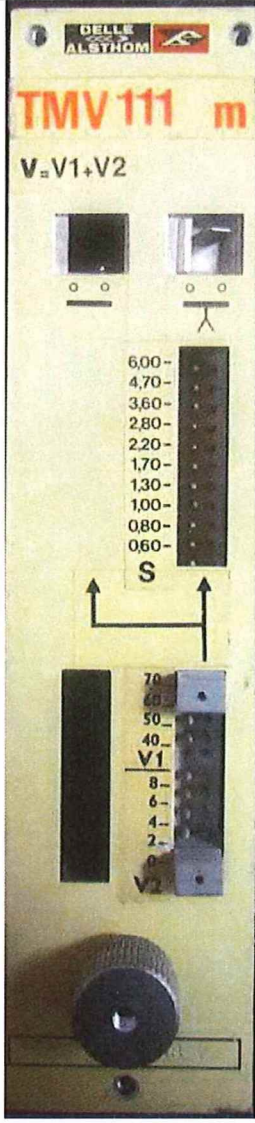
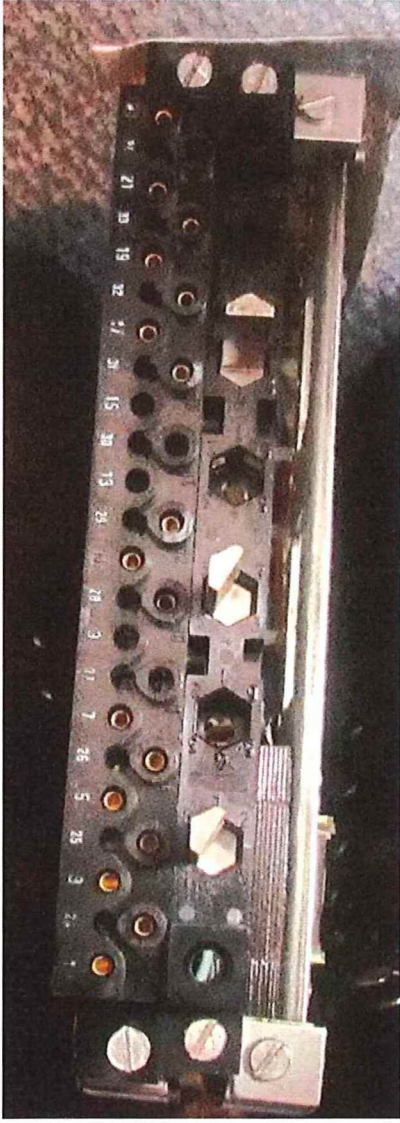
Input signal	Analogue
Voltage input range	40 to 78 V
Accuracy on the steps	± 5 %
Resetting ratio	95 % the operating steps
Withstand voltage	320 V
Input circuit consumption	< 500 mVA
Frequency	30 Hz ≤ F ≤ 70 Hz
Lamp	without
Instantaneous output	2 reversers
Time-lag output	2 reversers
Breaking capacity under 135 V dc with time constant 30 ms	0,3 A
Breaking capacity under 220V, 50 Hz and Cos φ=0,6	5 A
Closing and permanent withstand under 135 V dc load R	3,5 A
Closing and permanent withstand under 220V, 50 Hz and Cos φ = 0,6	2,5 A
Endurance	10 <sup>5</sup> operations
Response time	≤ 50 ms
Time – lag	0,6 to 6 s
Accuracy on time - lag	± 6 %
De auxiliary supply voltage U <sub>na</sub>	48 V
Auxiliary supply voltage range	0,8 to 1,1 U <sub>na</sub>
Auxiliary supply consumption	1,5 W
Dielectric withstand	2000 V rms 50 Hz during 1 min
Operating temperature range	-5 °C to 40 °C
Design spec	TROPIC 1 PITCH sub-rack 42 mm
Withstand to vibration	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g

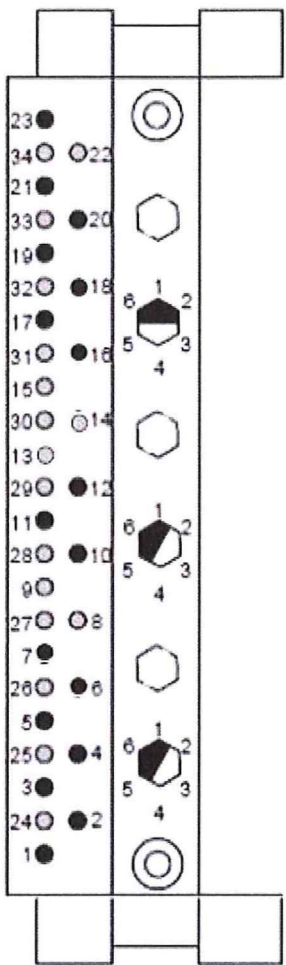
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A11





23 ●  
34 ○  
21 ●  
33 ●  
19 ●  
32 ○  
17 ●  
31 ○  
15 ●  
30 ○  
13 ○  
29 ●  
11 ●  
28 ○  
9 ○  
27 ○  
7 ●  
26 ○  
5 ●  
25 ○  
3 ●  
24 ○  
1 ●

22 ○  
20 ○  
18 ●  
16 ●  
14 ○  
12 ●  
10 ●  
8 ○  
6 ●  
4 ●  
2 ●

1 2 3 4 5 6

Voltage Input Range:  $V=V1+V2$

- V1: 40 to 70
- V1 Selection: 40; 50; 60; 70.
- V2: 0 to 8
- V2 Selection: 0; 2; 4; 6; 8.

Time Lag Settings: 0.6 to 6 seconds

Fixed Time Lag Selections: 0.6; 0.8; 1; 1.3; 1.7; 2.2; 2.8; 3.6; 4.7; 6.

Threshold: S | 1

Immediate: I |

Timed: T |

NO: Contact normally Open  
NC: Contact normally Close  
COM connected: Common Point  
Relay output number

Mechanical Coding

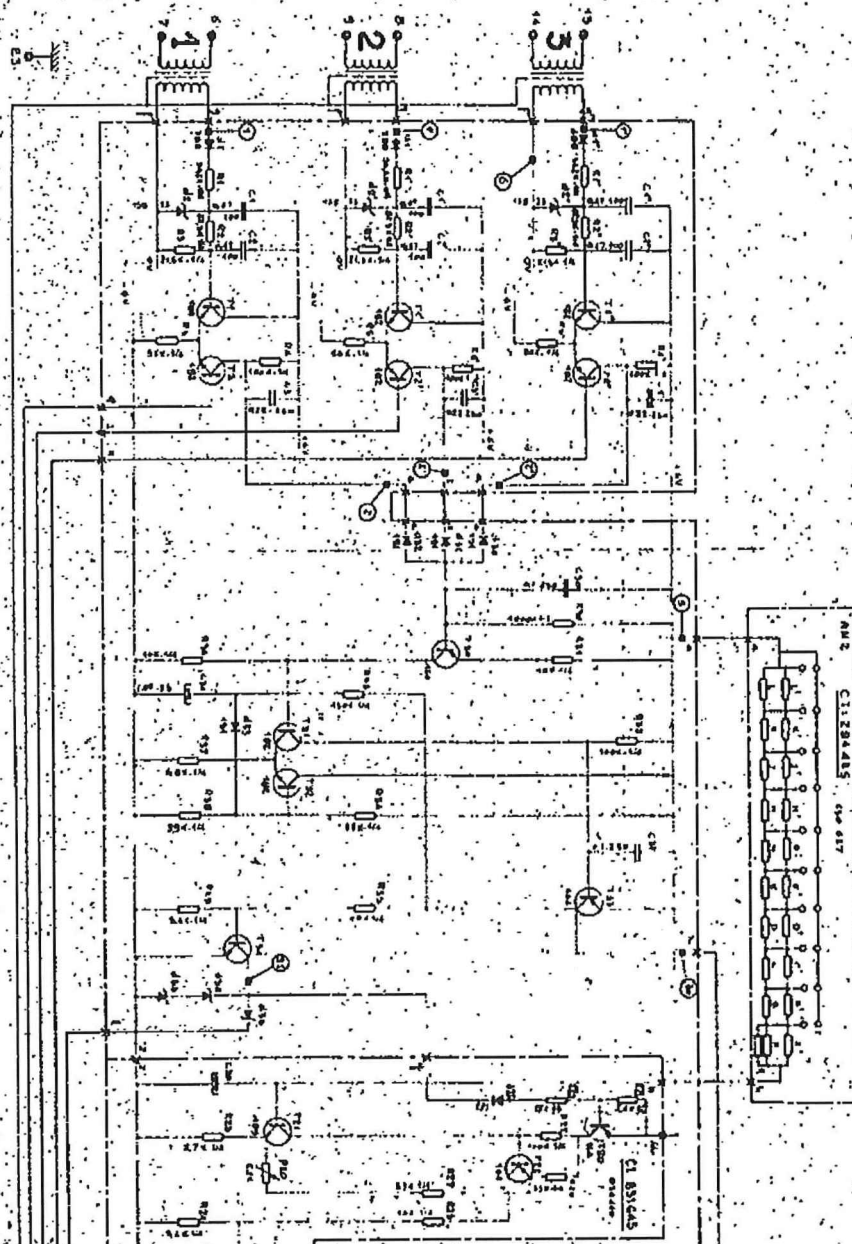
● Contact used  
○ Contact unused

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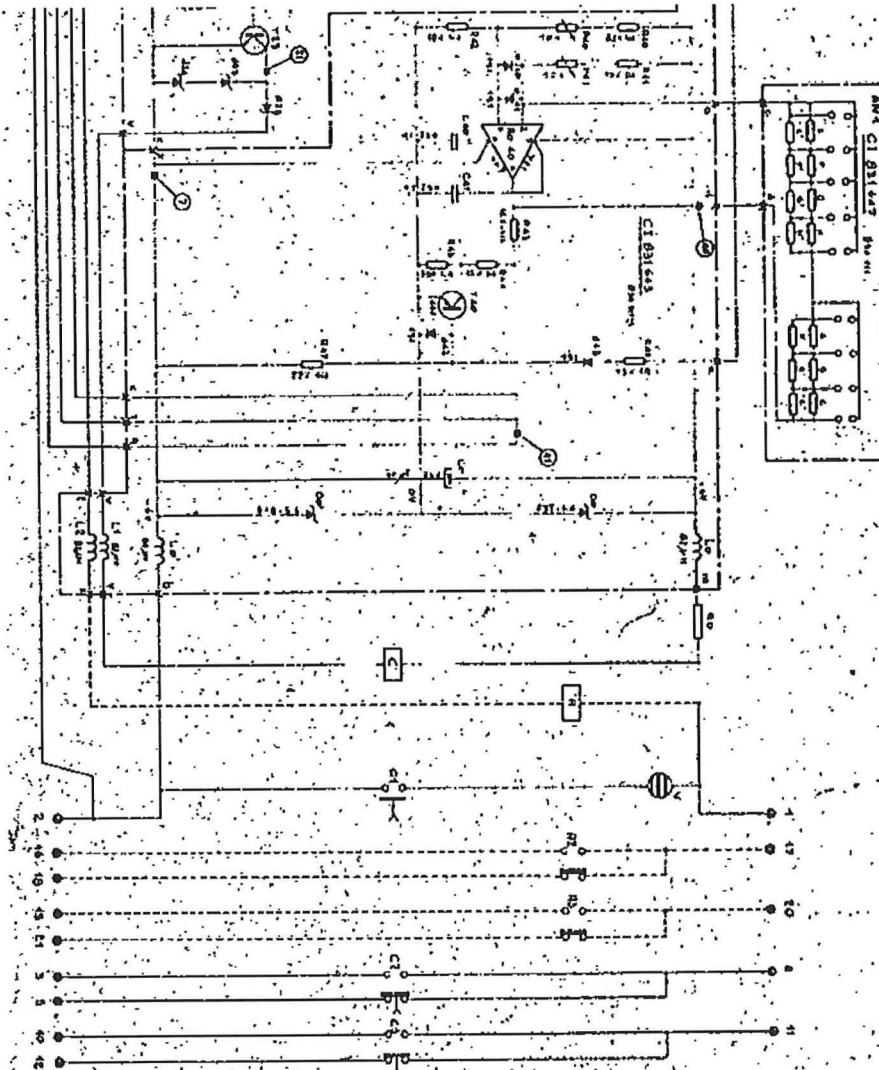


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A12

## **22.12 TMV 310 (80 to 156V)**

Input signal	Analogue
Voltage input range	80 to 156 V
Accuracy on the steps	± 5%
Resetting ratio	95 % the operating range
Withstand voltage	400 V
Input circuit consumption	< 500 mVA
Frequency	30 Hz ≤ F ≤ 70 Hz
Lamp	without
Instantaneous output	2 reversers
Time-lag output	without
Breaking capacity under 135 V dc with time constant load 30 ms	0,3 A
Breaking capacity under 220V, 50 Hz and Cos φ=0,6	5 A
Closing and permanent withstand under 135 V dc load R	3,5 A
Closing and permanent withstand under 220V, 50 Hz and Cos φ = 0,6	2,5A
Endurance	10 <sup>5</sup> operations
Response time	≤ 50 ms
Auxiliary supply voltage U <sub>na</sub>	48 V
Auxiliary supply voltage Range	0,8 to 1,1 U <sub>na</sub>
Auxiliary supply consumption	1,5 W
Dielectric withstand	2000 V <sub>rms</sub> - 50 Hz during 1 min
Operating temperature range	-5 °C to 40 °C
Overall design	TROPIC 1 PITCH sub-rack 42 mm
Withstand to vibration	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g

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A12



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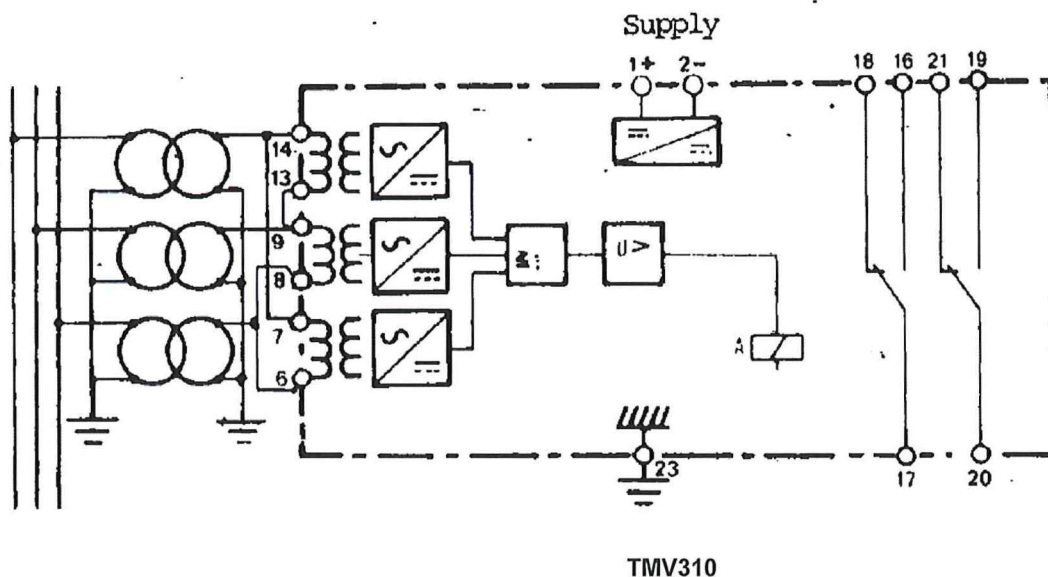
A12

Voltage Input Range:  $V=V1+V2$

- V1: 80 to 140
- V1 Selection: 80; 100; 120; 140.
- V2: 0 to 16
- V2 Selection: 0; 4; 8; 12; 16.

Time Lag Settings: Instantaneous

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A13

### **22.13 TMV 311 (80 to 156V)**

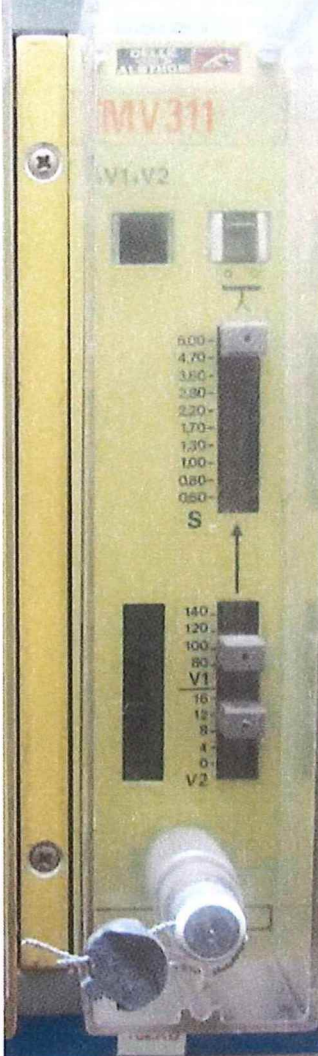
Input signal	Analogue
Voltage input range	80 to 156 V
Accuracy on the steps	± 5%
Resetting ratio	95 % the operating range
Withstand voltage	400 V
Input circuit consumption	< 500 mVA
Frequency	30 Hz ≤ F ≤ 70 Hz
Lamp	without
Instantaneous output	without
Time-lag output	2 reversers
Breaking capacity under 135 V dc with time constant load 30 ms	0,3 A
Breaking capacity under 220V, 50 Hz and Cos φ=0,6	2 A
Closing and permanent withstand under 135 V dc load R	3,5 A
Closing and permanent withstand under 220V, 50 Hz and Cos φ = 0,6	2,5A
Endurance	10 <sup>5</sup> operations
Response time	≤ 50 ms
Auxiliary supply voltage U <sub>na</sub>	48 V
Auxiliary supply voltage range	0,8 to 1,1 U <sub>na</sub>
Auxiliary supply consumption	1,5 W
Dielectric withstand	2000 V <sub>rms</sub> - 50 Hz during 1 min
Operating temperature range	-5 °C to 40 °C
Overall design	TROPIC 1 PITCH sub-rack 42 mm
Withstand to vibration	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g

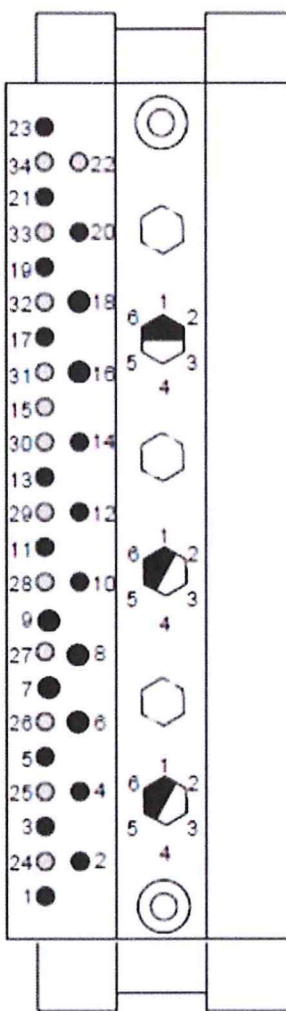
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A13





Voltage Input Range:  $V = V1 + V2$

- V1: 80 to 140
- V1 Selection: 80; 100; 120; 140.
- V2: 0 to 16
- V2 Selection: 0; 4; 8; 12; 16.

Time Lag Settings: 0.6 to 6 seconds

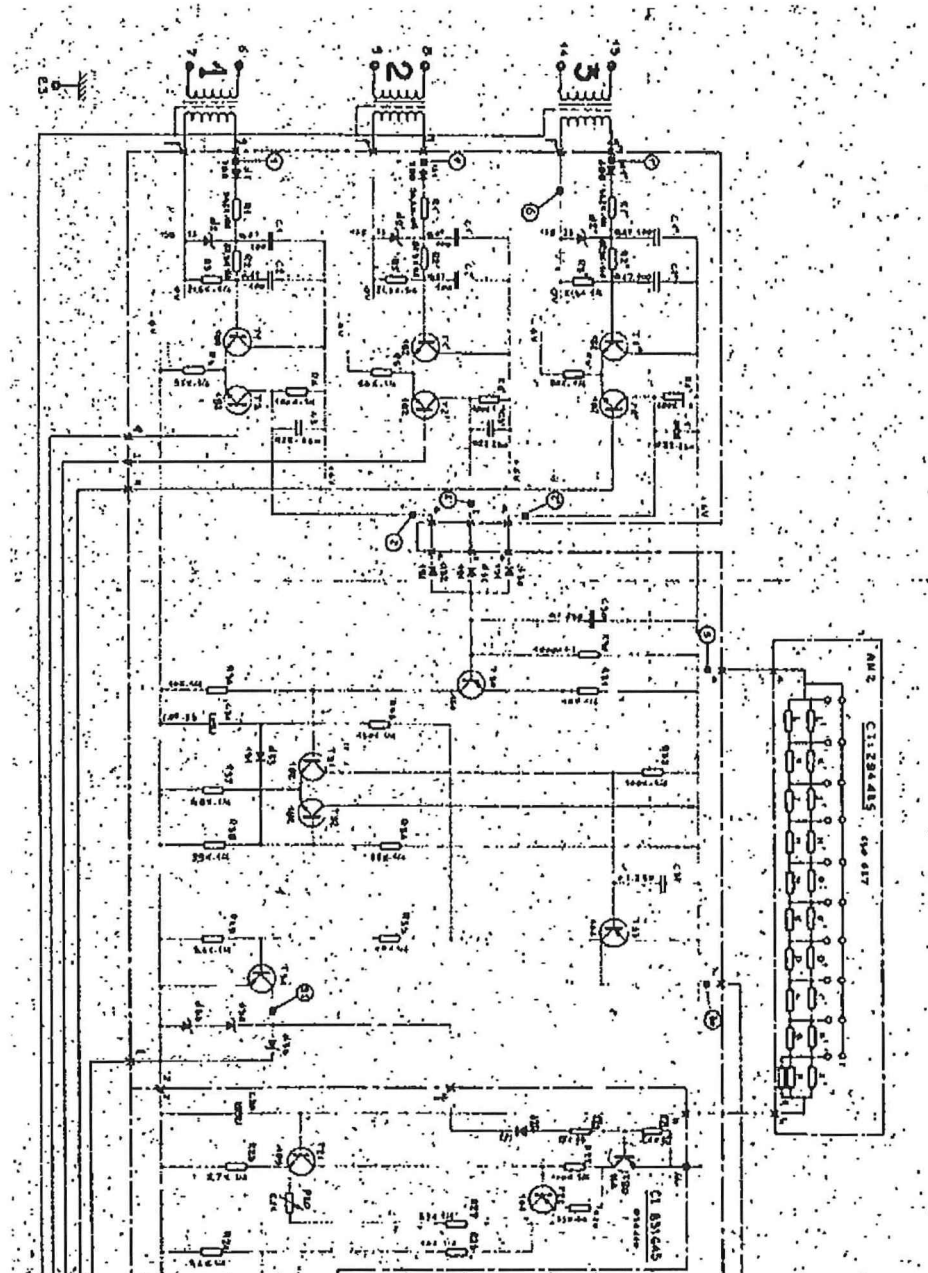
Fixed Time Lag Selections: 0.6; 0.8; 1; 1.3; 1.7; 2.2; 2.8; 3.6; 4.7; 6.

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A13

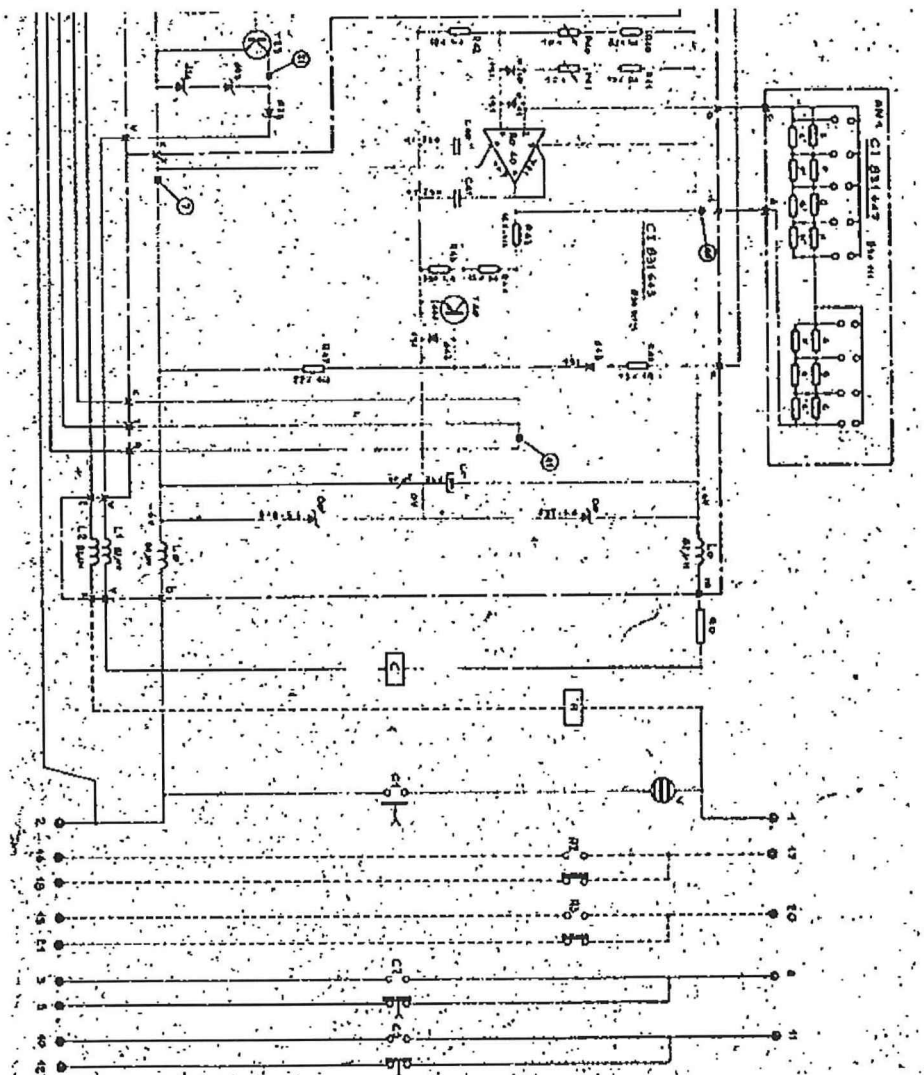


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A14

## 22.14 TCV 110/125V

The positive sequence trip filter.

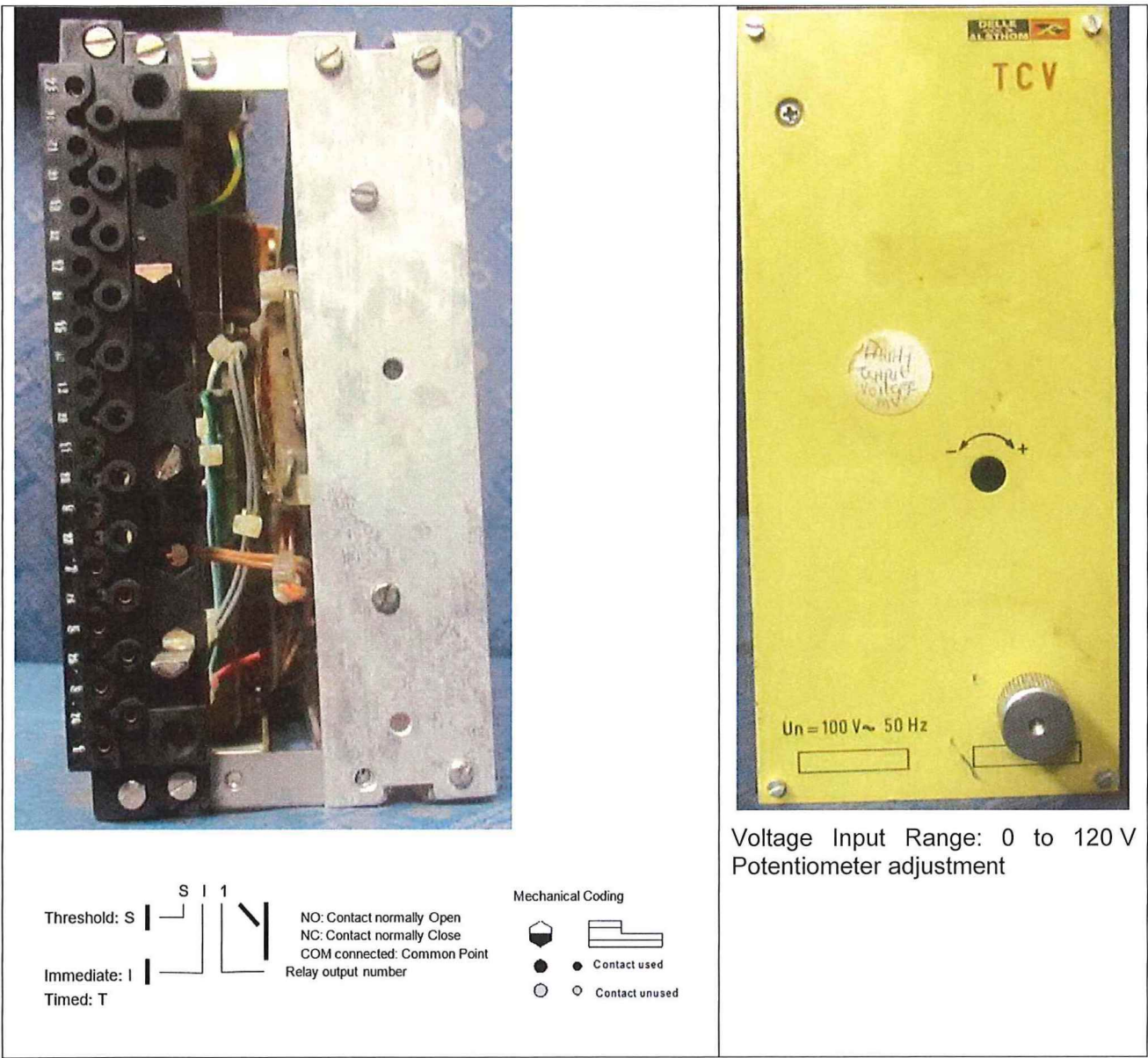
Input signal	Analogue
Voltage input range	100 V <sub>rms</sub>
Voltage range	0 to 1,2 U <sub>n</sub>
Permanent maximum input voltage	1,2 U <sub>n</sub>
Withstand overload	2 U <sub>n</sub> during 1 min
Input circuit consumption	1 VA
Setting consistency	± 1 %
Frequency	50 to 60 Hz ± 10 Hz
Maximum output voltage	1,3 U <sub>n</sub>
Maximum output current for U <sub>n</sub> = 100 V	1,5 mA
Rated output power	1 W
De auxiliary supply voltage U <sub>na</sub>	110/125 V
Auxiliary supply voltage range	0,8 to 1,1 U <sub>na</sub>
Auxiliary supply consumption	4 W
Dielectric withstand	2000 V <sub>rms</sub> - 50 Hz during 1 min
Operating temperature range	-5 °C to 40 °C
Overall design	TROPIC 2 PITCH sub-rack 84 mm
Withstand to vibrations	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g

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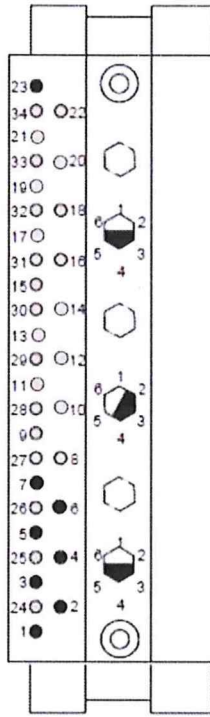


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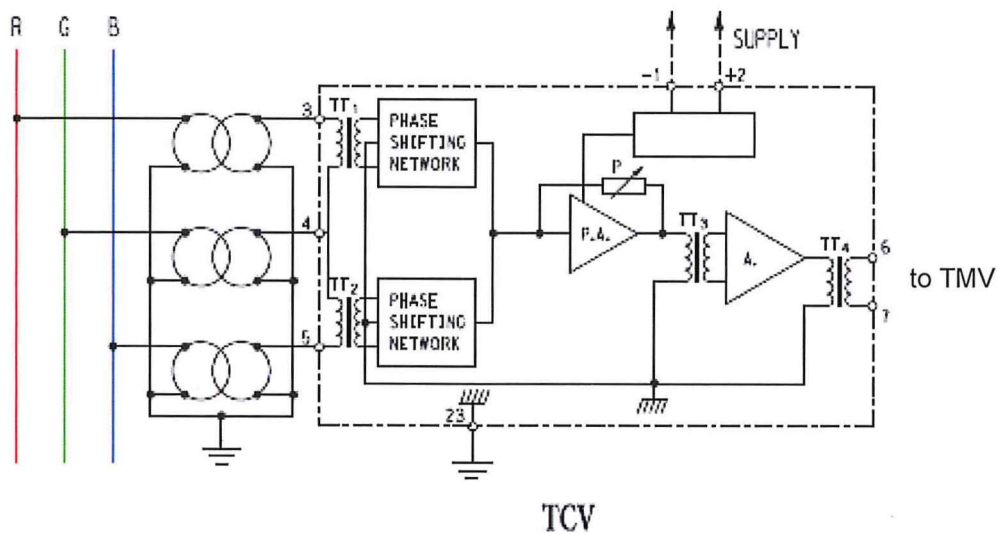
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A14



SIMPLIFIED PRINCIPLE DIAGRAM (NOT ENERGIZED)



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A15

## **22.15 TCV 48V**

The TCV is a filter that delivers an image voltage of the network positive or negative sequence.

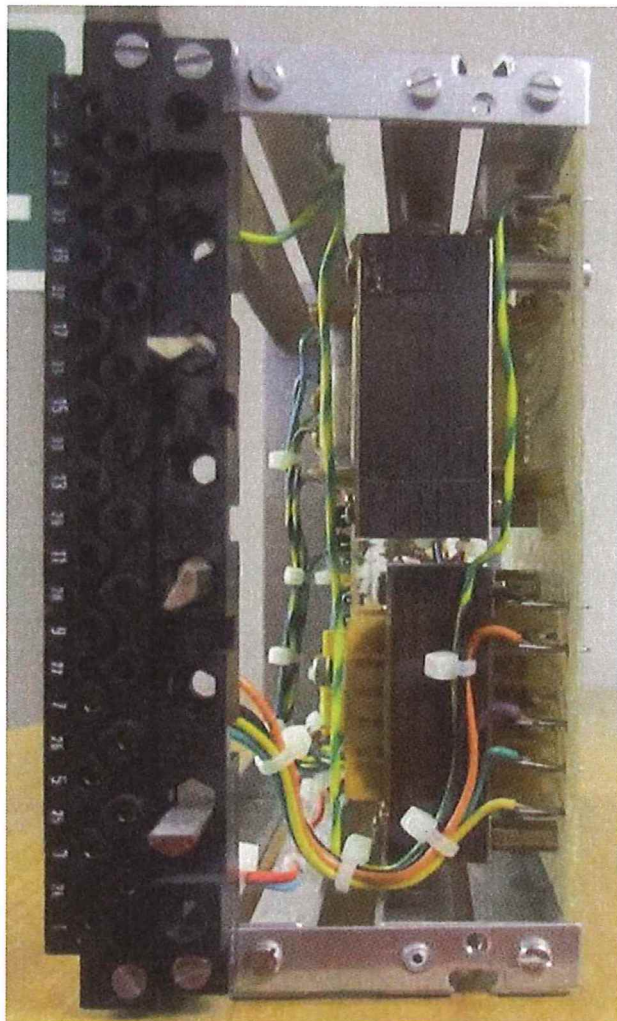
Input voltage $U_n$	100 V rms
Voltage range	0 to 1,2 $U_n$
Permanent maximum input voltage	1,25 $U_n$
Withstand overload	2 $U_n$ during 1 min
Input circuit consumption	1 VA
Setting consistency	$\pm 1 \%$
Frequency	50 or 60 Hz $\pm 10$ Hz
Maximum output voltage	1,3 $U_n$
Maximum output current for $U_n = 100$ V	15 mA
Rate output power	1 W
De auxiliary supply voltage $U_{na}$	48 V
Auxiliary supply voltage range	0,8 to 1,1 $U_{na}$
Auxiliary supply consumption	4 W
Dielectric withstand	2000 V <sub>rms</sub> - 50 Hz during 1 min
Operating temperature range	-5 °C to 40 °C
Overall design	TROPIC 2 PITCH sub-rack 84 mm
Withstand to vibration	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g

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A15



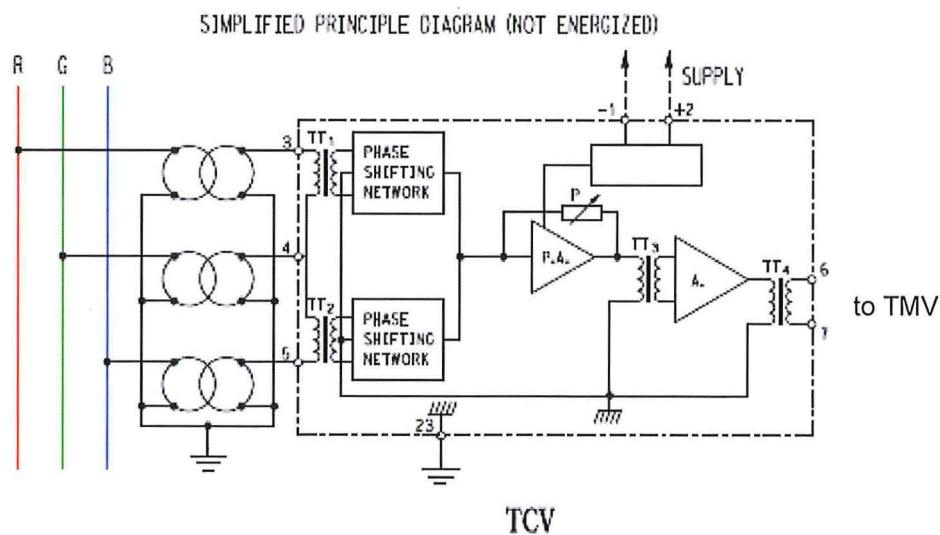
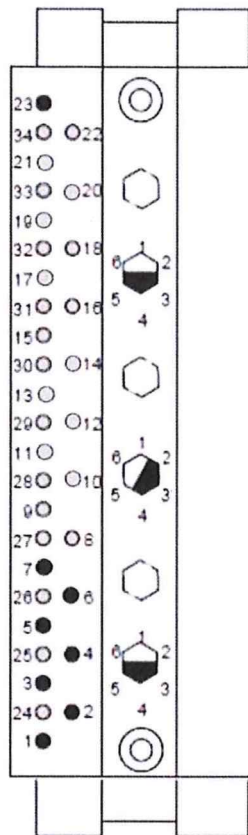
Voltage Input Range: 0 to 120 V Potentiometer adjustment.

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A16

## 22.16 TMWR3 (Power Direction Relay)

Input signal	Analogue
Input Voltage $U_n$	100-110V
Withstand voltage on $U_n$	5% to 150% $U_n$
Maximum permanent input voltage	1,5 $U_n$
Withstand voltage overload	2 $U_n$ during 1 min
Voltage circuit consumption	0,4 W to $U_n$
Step 1 Cos ( $\varphi = \alpha$ ) or 1 Sin $\varphi$ active or reactive current	0,2 to 1 A
Accuracy on the steps	6% for Cos ( $\varphi = \alpha$ ) / Cos $\varphi$ / > 0,5
Resetting ratio	85 % of the displayed step
Internal phase shift	-30°, -20°, -10°, 0°, 10°, 20°, 30°
Withstand current overload	8A permanently
Current circuit consumption	At the step < 50 mVA
Frequency	50 Hz
Lamp/LED	without
Time lag output	2 reversers
Instantaneous output	2 reversers
Breaker capacity under 220 - 50 Hz - Cos $\varphi = 0,6$	5 A
Breaker capacity under 135 V dc time constant load =30 ms	0,25 A
Closing and permanent withstand under 220 - 50 Hz - Cos $\varphi = 0,6$	10 A
Closing and permanent withstand under 135 V dc time constant load =30 ms	0,5 A
Endurance	10 <sup>5</sup> operations
Response time	$t \leq 150$ ms for ICos $\varphi$ or ICos ( $\varphi = \alpha$ )
Time lag	1,3 to 13 s
Accuracy on time lag	$\pm 3$ %
Auxiliary supply voltage $U_{na}$	48 V dc
Auxiliary supply voltage range	0,8 to 1,1 $U_{na}$
Auxiliary supply consumption	1,1 W
Dielectric withstand	2000 V <sub>rms</sub> - 50 Hz during 1 min

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**Protection Relays for 6.6 kV Electrical Switchboards**

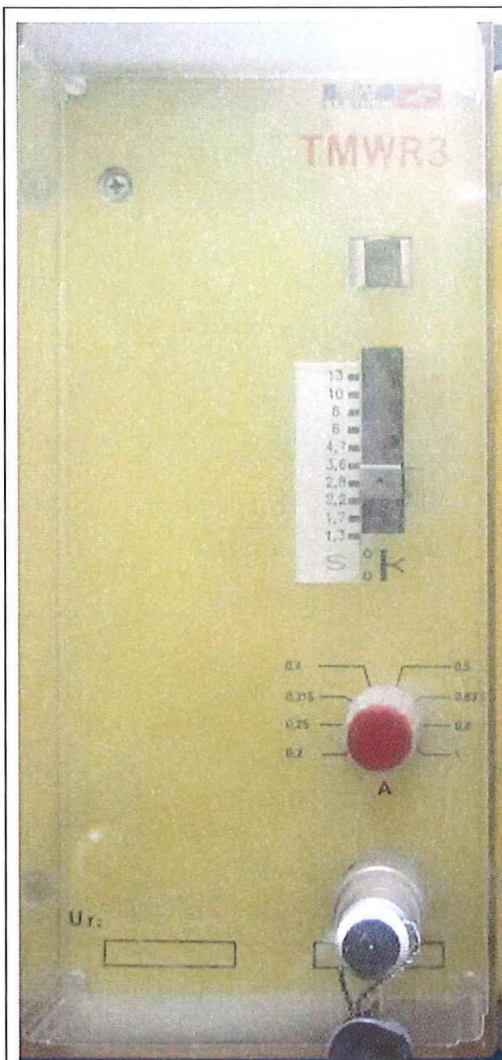
Unique Identifier: **240-151575940**

Revision: **1**

Page: **66 of 73**

A16

Operating temperature range	-5 °C to 40 °C
Overall Design	TROPIC 2 PITCH sub-rack 84 mm
Withstand to vibration	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g



Step 1 Cos ( $\phi = \alpha$ ): 0,2 to 1 A

Fixed Step 1 Cos ( $\phi = \alpha$ ): Selections: 0.2; 0.25; 0.315; 0.4; 0.5; 0.63; 0.8; 1

Time Lag Range: 0,06 to 0,6 seconds

Fixed Time Lag Selections: 1.3; 1.7; 2.2; 2.8; 3.6; 4.7; 6; 8; 10; 13.

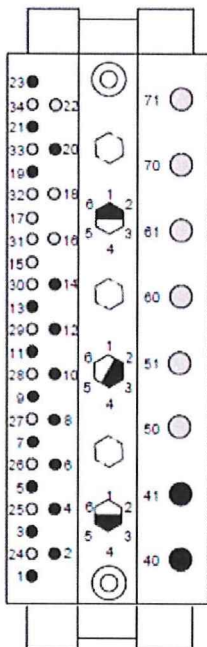
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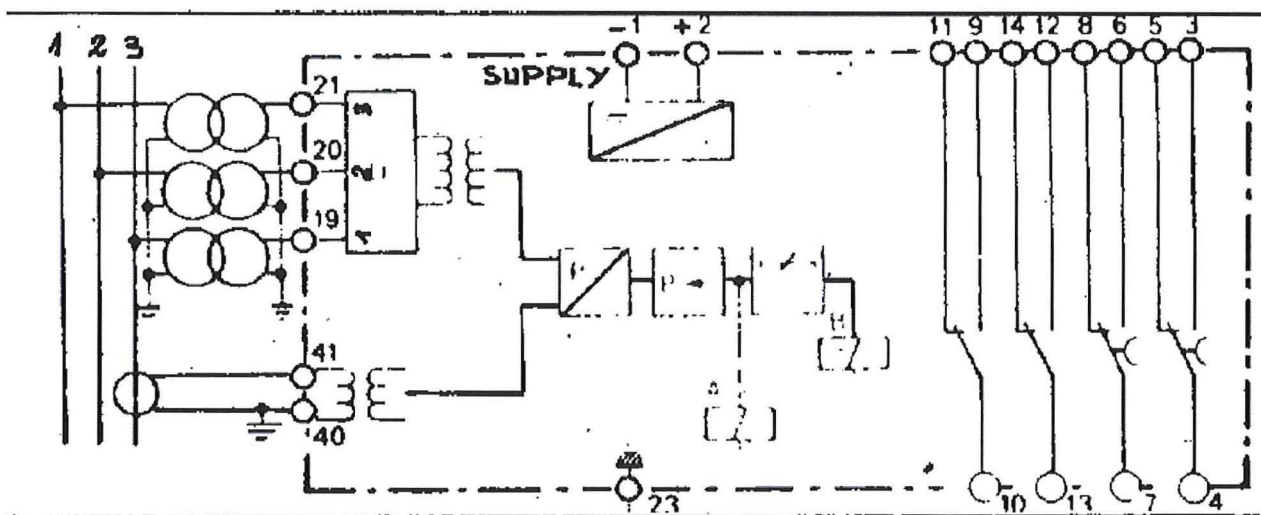
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A16

Operation in active power detection



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TMWR3

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A17

## 22.17 MESURISOL U

Insulation controller for HV networks

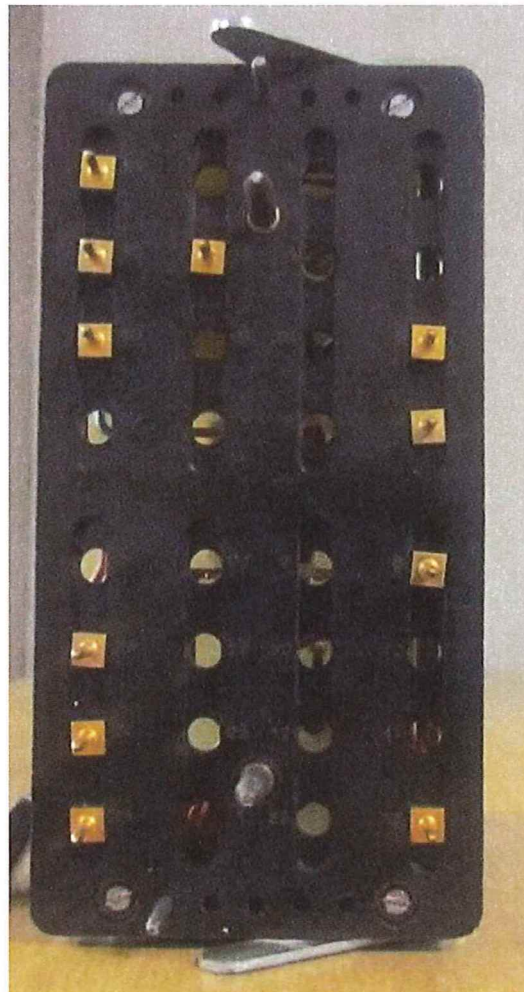
Supply and measurement boxes	Rating 1	Rating 2	Rating 3
Alarm stop	1 M	500 K	250 K
Trip – off step	100 K	50 K	25 K
Injection Current (by VT)	0,125 mA	0,25 mA	0,5 mA
Maximum voltage of the monitored network	30 kV (with plate nb 1)		
Signalling – time lag	1 to 2		
Rate frequency	50 to 400 Hz		
Output contacts	<ul style="list-style-type: none"><li>• One 'Alarm' and 'Signalling' reverser</li><li>• One 'Trip-off' and 'Signalling' reverser</li></ul>		
Breaking capacity under 135 V dc time constant load 30 ms	0,25 A		
Breaking capacity under 220 V - 50 Hz - Cos $\phi$ = 0,6	5 A		
Closing and permanent withstand under 135 V dc time constant load 30 ms	0,5 A		
Closing and permanent withstand under 220 V - 50 Hz - Cos $\phi$ = 0,6	10 A		
Endurance	10 <sup>5</sup> operations		
Auxiliary voltage source (supply box)	100 – 220 or 380 V (single phase)		
Voltage range	0,85 to 1,1 U <sub>n</sub>		
Dielectric withstand	2000 V <sub>rms</sub> - 50 Hz during 1 min		
Operating temperature range	-5 °C to 40 °C		
Housing overall design	Type European Flush-mounted		
Withstand to vibrations	10 to 2000 Hz		
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g		

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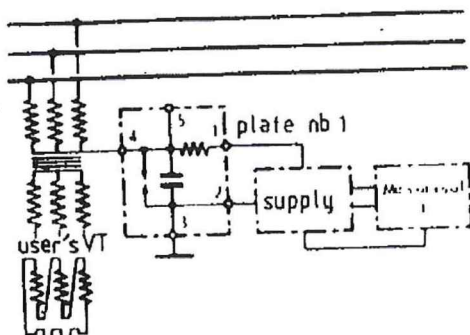
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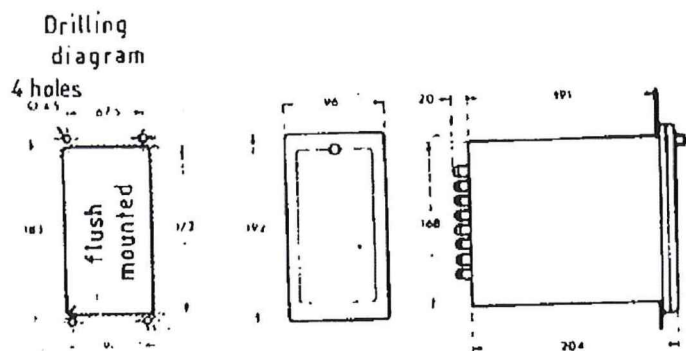
A17

CONNECTION DIAGRAM OF THE MESURISOL  
NETWORKS WITH NON ACCESSIBLE  
NEUTRAL



VT TERTIARY WINDING TO CLOSE  
IMPERATIVELY ON A RESISTANCE  
SO AS TO AVOID FERRO-RESONANCE  
phenomenon

OVERALL DIMENSIONS DIAGRAM  
FOR FLUSH-MOUNTING



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A18

## **22.18 TMFB2**

2 step frequency measurement relay.

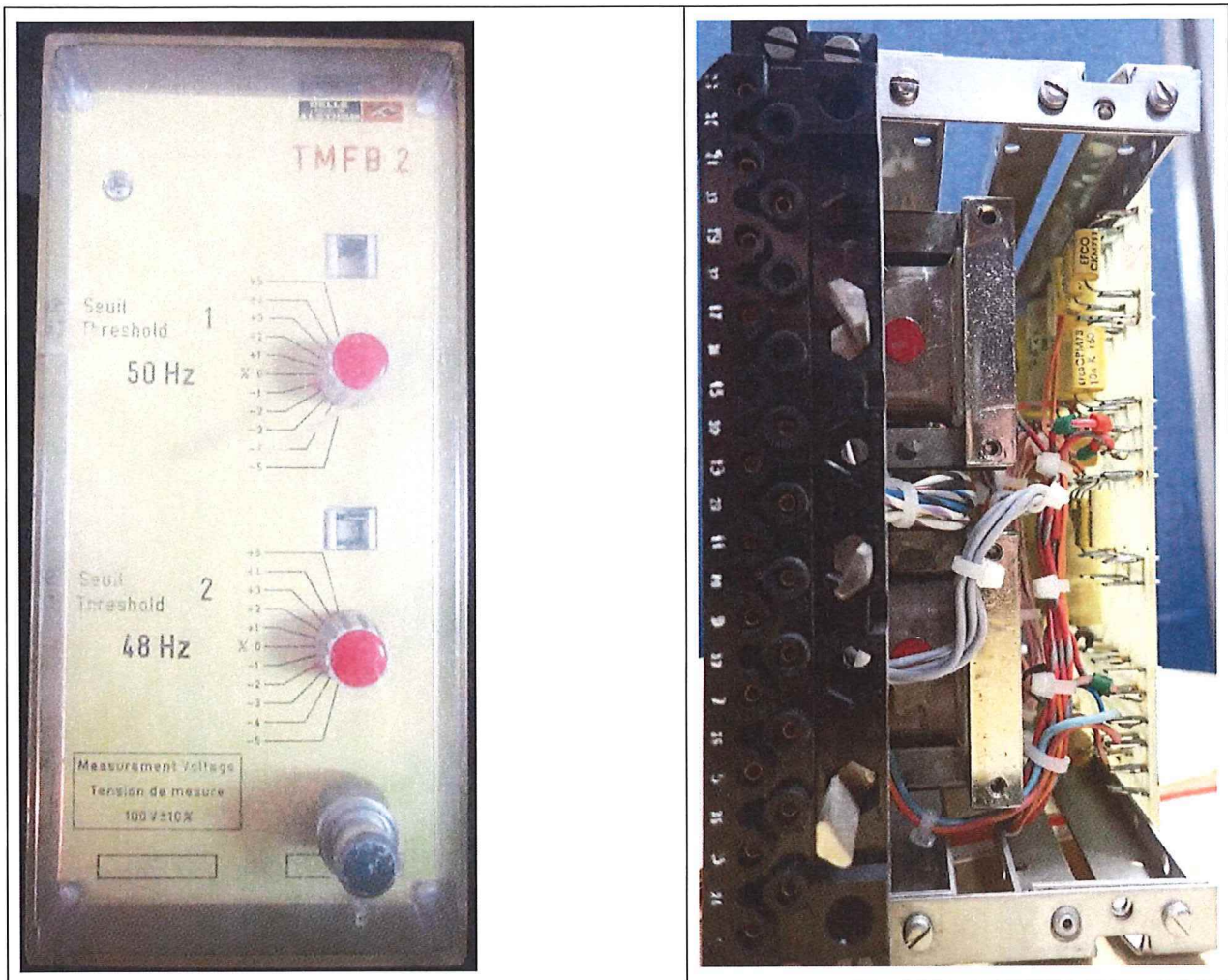
Input signal	Analogue
Input voltage $U_n$	100 V
Accuracy on voltage	$\pm 10 \%$
Withstand overload	Permanently $4 U_n$ at $F_n$
Input circuit consumption	150 mVA under $U_n$
1 <sup>st</sup> frequency step $F_n$	50 Hz $\pm 5 \%$
2 <sup>nd</sup> frequency step $F_n$	48 Hz $\pm 5 \%$
Accuracy on the steps	$\pm 0,1 \%$
Lamp	without
Instantaneous outputs	2 reversers per output
Breaking capacity under 220 - 50 Hz - $\cos \varphi = 0,6$	5 A
Breaking capacity under 135 V dc time constant = 30 ms	0,25 A
Closing and permanent withstand under 220V, 50 Hz and $\cos \varphi = 0,6$	10 A
Closing and permanent withstand under 135 V dc time constant = 30ms	0,5 A
Endurance	$10^5$ operations
Response Time	$\leq 200$ ms
Auxiliary supply voltage $U_{na}$	48 V
Auxiliary supply voltage range	0,8 to 1,1 $U_{na}$
Auxiliary supply consumption	1,6 W
Dielectric withstand	2000 V <sub>rms</sub> - 50 Hz during 1 min
Operating temperature range	-5 °C to 40 °C
Overall design	TROPIC 2 PITCH sub-rack 84 mm
Withstand to vibrations	10 to 2000 Hz
Transition frequency 57 to 62 Hz	Amplitude 0,3 mm; Acceleration 2 g

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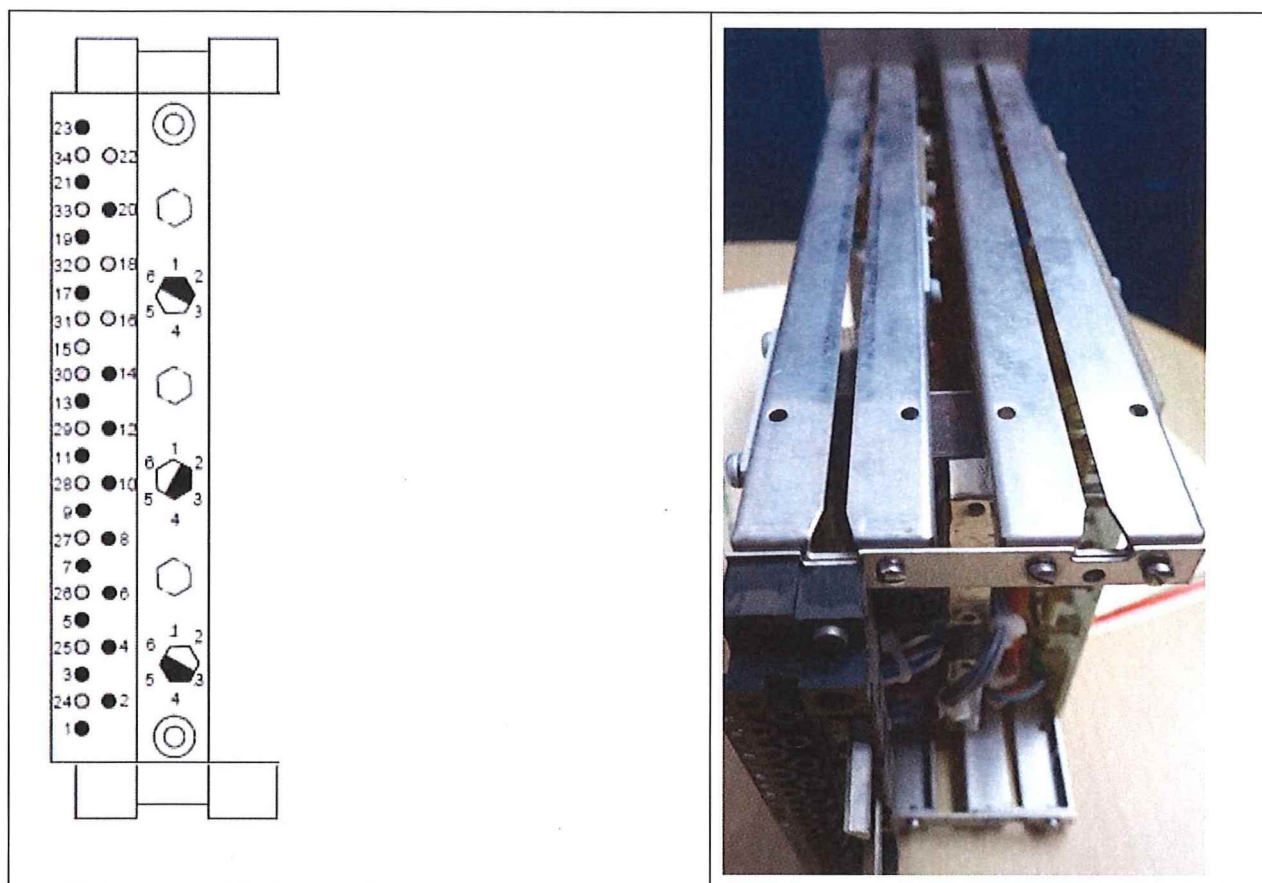


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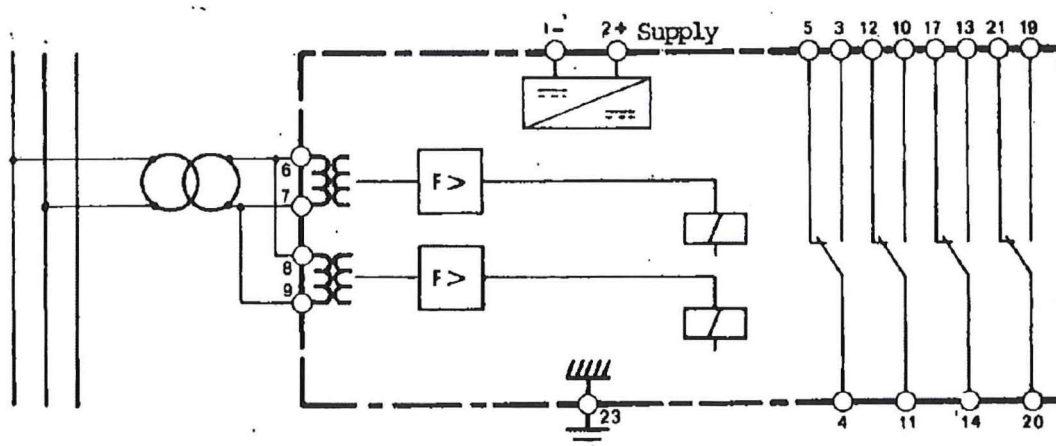
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A18



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TMFB2

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