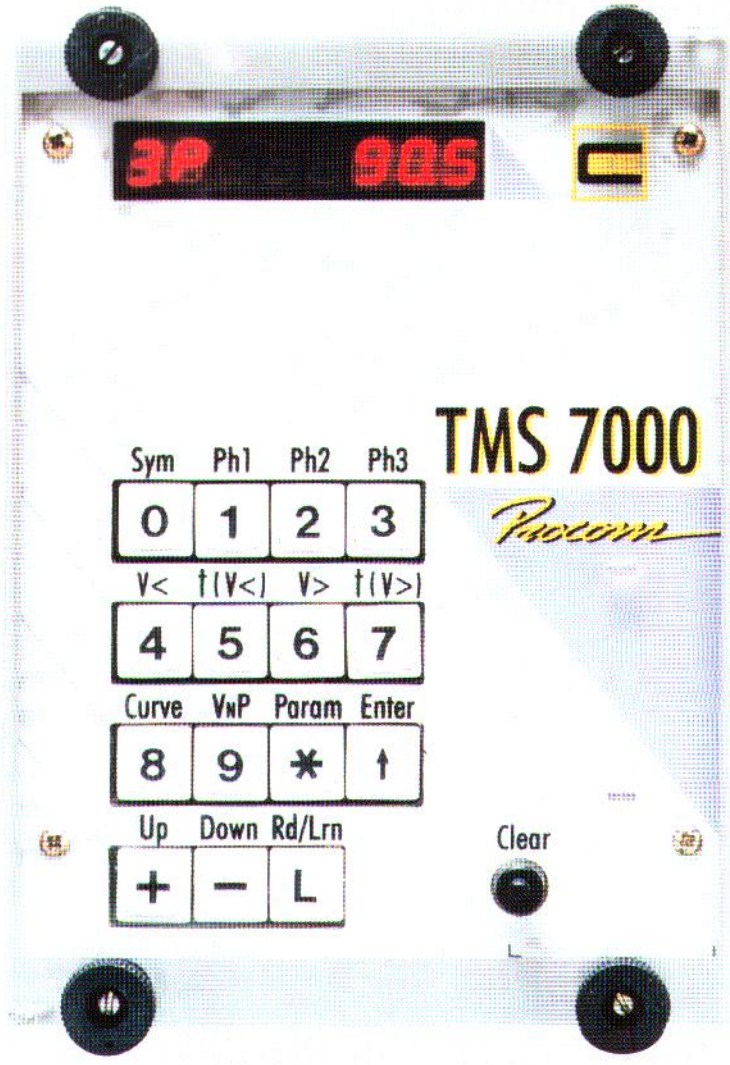
TMS 7000

Procom



MULTICURVE DIGITAL UNDER AND OVER VOLTAGE PROTECTION

The ultimate in power network supervision

Multicurve digital under and over voltage protection

PROCOM

The optimum performance of electrical power systems depends particularly upon the reliability and the availability of the protection, measuring and automation devices and the ability shown by these devices to communicate the information in their possession.
PROCOM, **C.E.E.**'s new modular system, satisfies these criteria by providing the possibility of using either separately or in an integrated system all of the intelligent functions of an electrical cubicle: Protection, Measurement, Automation, Communication.
C.E.E's exceptional experience in the field of power system protection using static relays (more than 450,000 units in operation throughout the world) enabled our engineers to define, develop and manufacture **PROCOM** to the standards of quality and concepts of technical innovation which have been the foundation of **C.E.E**'s reputation over the past 30 years.

Principles and applications

TMS 7000 series relays are designed to monitor the voltage of three phase electrical networks either balanced or unbalanced. Of a modular design, it fits perfectly into the **PROCOM** architecture or can be used separately in any traditional relay scheme.

Using microprocessor technology the TMS 7000 samples the applied signals and uses (F.F.T.) Fast Fourier Transform to provide the value of the fundamental voltage as well as its symmetrical components.

The TMS 7000 is remarkable firstly because of its wide range of operating frequency (15 Hz - 70 Hz) making it particularly suitable to supervise the voltage of networks whose frequency can vary widely (residual voltage during automatic transfer, overspeed of hydro generator), and secondly due to its insensitivity to 3rd harmonic voltages which al lows it to use low earth fault settings (generator protection).

THE TMS ALLOWS :

- The detection of **voltage drops (27)(V<,V<<)** single, two or three phase dangerous the operation of electrical equipment, in particular that of asynchronous motors as the torque is greatly affected that of synchronous motors as the possibility of a loss of synchronism is predicted by an inverse time voltage characteristic.
This detection is achieved by an element with 1 threshold whose operating characteristic can be selected as definite time, inverse or very inverse and 1 definite time low set threshold.
- The detection of **over voltages (59) (V>,V>>)** single, two or three phase result in the accelerated ageing or breakdowns of insulation of electrical equipment, more particularly in rotating machines.
This detection is achieved by an element with 1 threshold whose operating characteristic can be selected as definite time, inverse or very inverse and 1 definite time high set threshold.
- The detection of **insulation faults (59N) (Vo>,Vo>>)** in electrical networks by monitoring the zero sequence voltage, and the emission of an alarm to alert the operator, when continued operation with a permanent fault is allowed.
- The detection of supply unbalances (47) (Vi>,Vi>>) (incorrect phase sequence, single phasing...) by monitoring of the negative phase sequence voltage, and the emission of an alarm to alert the operator of a permanent voltage unbalance.
- The detection **positive sequence voltage drops (27P) (Vd<)** as an overall three phase voltage supervision or rotating machine torque, in the case of temporary or permanent operation with an unbalanced supply (single phase reclose).
- Provision of **sub station control schemes** by initiating load shedding or bus transfer, by monitoring the decay of the residual magnetic field at the terminals of motors before reclose, or inhibiting the closure of an element if the voltage of the unit to be supplied is not within defined limits.

THE TMS 7000 COMPRISES :

- The **TMS 7003**, used when only the phase to phase voltages are available and are used as the measurement quantities in the relay (e.g. 2 vts connected in V).
The monitoring of the zero sequence voltage needs a dedicated winding, connected in open delta. This relay suits systems where the vt neutral is not distributed.
- The **TMS 7004**, used when the phase voltages are available (neutral point distributed). The measurement quantity used in the relay can be selected by the user as either the phase or the phase to phase voltages. In the same manner, the monitoring method for the zero sequence voltage is user selectable, either by internal summation or by using a dedicated winding connected in open delta.

Main Advantages

The **TMS 7000** relays provide three main sets of advantages as follows:

— Reliability and availability

The design and construction of this equipment meet the same standards of reliability and safety used by **C.E.E.** for the manufacture of conventional static protection devices:
- Compliance with I.E.C.255 recommendations and standards,
- Mechanical, fool-proof fouling pins on cases and bases,
- Debugging and individual testing of certain critical components,
- Component selection based upon not only thermal withstand but also over voltages considerations, etc...
- Withstand to severe environmental conditions: heat/humidity - 56 days, 40°C, 93% relative humidity.

In addition to these basic construction details, the **TMS 7000** devices incorporate an automatic self-supervision system which, together with the plug-in case facility, optimises their availability.

The automatic self-supervision system intervenes at three different levels:
- Detection of loss of auxiliary supply,
- Detection of a microprocessor failure using a "watchdog",
- Detection of a breakdown in a microprocessor peripheral (such as RAM, EEPROM, etc.) by executing microdiagnostic programs.

The user is notified that the automatic self-supervision system has operated by the closure of a clean contact brought out to terminals and/or, if the case arises, by the interruption of the digital communication channel.

— Power and flexibility of the communications

The **TMS 7000** series communicates with the external world in three major ways:

- **Local communication**

Dialogue between the user and the equipment is ensured by means of a keyboard on the device itself, which may be used to set up and read back all of the quantities, recorded, calculated or measured by the **TMS 7000**.
An easy to read LED display unit enables the user to have direct readout of the electrical quantities in true primary values.
The phase or the symmetrical component (positive, negative, zero) having caused the alarm or trip condition is indicated on the flashing display.

- **Communication by digital channels**

The TMS 7000 contains RS-232-C/DB9 and current loop (0-20mA) digital serial communication channels selected by a switch by the user.

The RS-232-C/DB25 on the face plate enables the relay to be directly connected (copper wire or fibre optic) to a PC*. The (0-20mA) current loop plugs enable the relays to be connected into a network controlled by a PC or other equipment.*. All data available locally, measurements, alarms or settings, may be transmitted to a remote location. When an event occurs such the relay tripping or when requested via the communications or when the dedicated key is pressed, the RMS values of the phase and earth fault voltages, calculated during the approximate period 3.5 seconds prior to the event and 1 second after it, are made available to the centralised system.

(*) ☛ Consult us.

- **Communication by "all or nothing" channels**

The **TMS 7000** relays are fitted with electromagnetic output units to provide self-supervision, alarm, close or load shedding signals:
- self-supervision : by clean contact of the "watchdog" device (unit W).
- alarm : via the instantaneous operation of C indicating the passage of a setpoint.
- trip or load shed: two high closing current capacity relays "A"and "B" for controlling power equipment, contactors or circuit breakers.

The configuration of each of these relays A, B or C is completely under the control of the user.

— Adaptability and autonomy

As they are mounted in modular, plug-in, metallic type R cases, devices in the **TMS 7000** series may be used either:
- as independent modules.
- as modules integrated into a rack incorporating conventional static relays from the 7000 series.
- as modules integrated into a rack as an element of the **PROCOM** system.

The flexible presentation means that the **TMS 7000** devices may be easily adapted to the user's actual technical and economic requirements and can, for example, be inserted into existing schemes and installations.

The **TMS 7000**'s autonomous and flexible nature is further reinforced by the fact that it can, without the use of special devices, be connected to a source of ac or dc auxiliary supply having a very wide operating range (38 to 250V, or 20 to 66V).

General characteristics

① Input and output quantities

Voltage

• voltage rated:	
TMS7003: Un (phase to phase voltage)	100 -110-120V
TMS7004: Vn (phase voltage)	100/$\sqrt{3}$ -110/$\sqrt{3}$ -120/$\sqrt{3}$ - 400/$\sqrt{3}$ V
• residual voltage (3Von)	100 - 110 -100$\sqrt{3}$ -110$\sqrt{3}$ V
• operating range	0.04 to 2.4 Un or Vn
• continuous withstand	1.9 Un or Vn
• short time thermal withstand (10 seconds)	2 Un or Vn

Frequency

• rated frequency	Fn = 50Hz or 60Hz
Auxiliary supply	20-66 Vdc or Vac - 50/60Hz
	38-250 Vdc or Vac - 50/60 Hz
Burden	< 10W -dc
	< 13VA -ac

Output contacts

• A relay and B relay	1NO and 1 changeover
	or 1NC and 1 changeover
• C relay	1 changeover
• W relay ("watchdog relay")	1NC
• maximum voltage (C)	250V
(A, B and W)	600V
• maximum continuous current (C)	2.5A
(A, B and W)	5A
• making capacity 0.2s (C)	5A
(A, B and W)	10A
• breaking capacity	
• dc (L/R = 40ms) (C) :	25W (0.5A/48Vdc-0.25A/110Vdc)
(A, B and W) :	50W (1A/48Vdc - 0.5A/110Vdc)
• ac (cosφ = 0.4) (C) :	625VA; I < 1.5A
(A, B and W) :	1 250VA; I < 3A
• "watchdog" operation	normally picked up drops off for abnormal conditions
Display and indications	8 digits/LED display, showing setting, configuration and fault details.

② Nominal ranges of influencing factors

Temperature	-10°C +55°C
Frequency	15Hz - 70Hz

③ Measurements

Characteristic quantity

	phase to phase voltage: TMS 7003
	phase voltage or phase to phase voltage: TMS 7004

Operating value

• independent time:	100% of setting
• dependent time (maximum function >):	110% of setting
• dependent time (minimum function <):	90% of setting

General characteristics (cont'd)

Voltage settings	Un or Vn
• phase setting minimun: V<<	0.15 to 1.2
V<	0.2 to 1.2
• phase setting maximun: V>	0.7 to 1.5
V>>	0.7 to 1.5
• positive phase sequence setting minimun: Vd<	0.2 to 1.2
• negative phase sequence: alarm setting Vi>	0.03 to 0.3
alarm setting maximun Vi>>	0.03 to 0.3
• zero phase sequence: alarm setting V0>	0.03 to 0.15 * (3Von)
alarm setting maximun V0>>	0.03 to 0.5 * (3Von)
• setting step:	0.01 Un, Vn or 3 Von
Time delay settings	
• independent time:	0.1 to 99s
setting step	0.01 s
• dependent time: function minimun V<	0.1 to 3s (time at V/V< = 0.2)
function maximun V>	0.1 to 3s (time at V/V> = 2)
setting step	0.05 s
Drop-off:	Un or Vn
• setting maximum and minimum V and Vd:	2%
• setting maximum and minimum Vi and V0:	1%
Accuracy class under reference conditions for the influencing factors	
• operating levels:	1% Un or Vn*
• time delays:	5% of setting or ± 30 ms
	7.5% of setting or ± 30 ms for extremely inverse time
* on the measured quantities	
Operating logic	
• minimun functions (V<,V<<)	"AND" or "OR" on the 3 phases (selectable)
• maximun functions (V>,V>>)	"OR" on the 3 phases
Voltage display	
• display:	All measurements and settings
• default display:	Average value of the phase to phase voltages
• rated phase to phase voltage adjustable:	100V to 240kV
• display resolution	1V from 100V to 1kV
	10V from 1kV to 10kV
	100V from 10kV to 240kV
• setting resolution	10V

④ Operating curves

V<

- independent or dependent time delay: $\frac{Tx\ (V/V<)^{\alpha}}{1 - (V/V<)^{\alpha}}$ x setting t (V<)
- inverse: T= 0.033 α= 0.02
- very inverse: T= 4 α= 1

minimun time defined at: 0.2 V<

V<<, Vd<

- independent time delay

V>

- independent or dependent time delay, $\frac{T}{(V/V<)^{\alpha} - 1}$ x setting t (V>)
- extremely inverse: T=3 α= 2

minimun time defined at: 2 V>

V_0>, V_i>, V>>, V_0>>, V_i>>

- independent time delay

General characteristics (cont'd)

⑤ Digital communications

Types	2 switchable channels with dedicated sockets: - current loop/0-20mA - DB25/RS232C
Protocol	Master/Slave to JBus or other standard* (*) Consult us.
Transmission rate	1 200 - 2 400 - 4 800 bauds

⑥ Insulation to IEC 255-5

Dielectric withstand

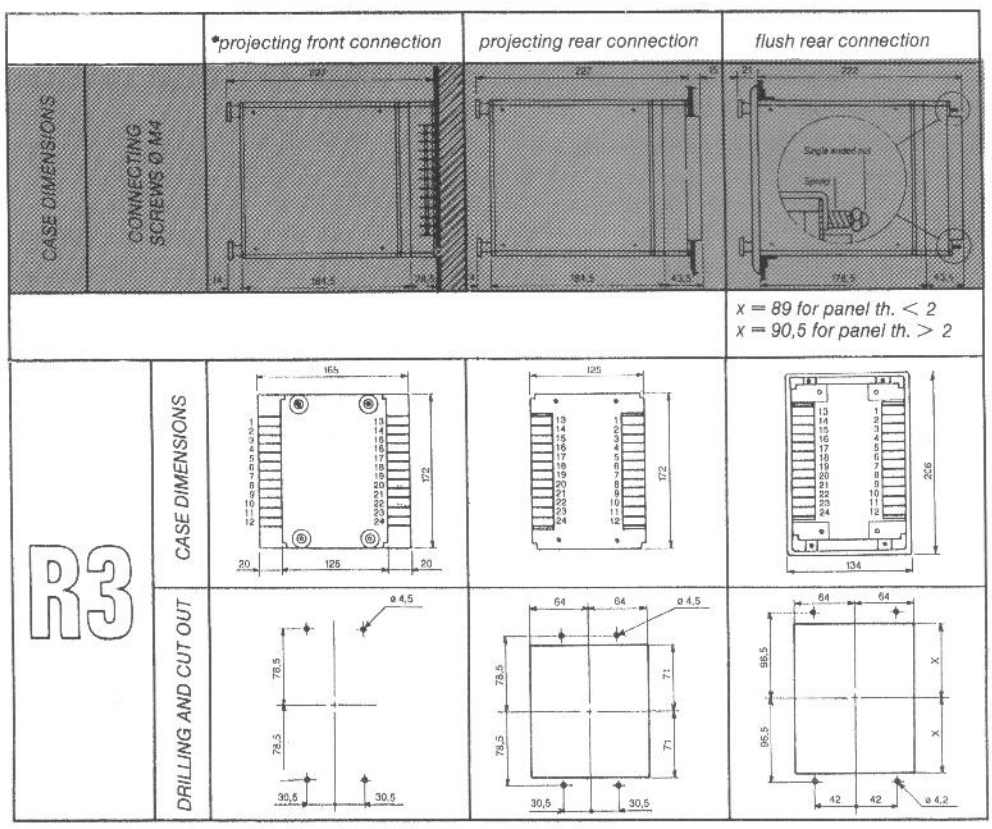
• all terminals together / frame and between galvanically isolated groups	2kV - 50/60Hz 1min (except current loops 1kV/1min)
• DB25 socket	500V - 50/60Hz 1min
• insulation resistance at 500V	> 10 000MΩ
• impulse voltage withstand (except DB25 socket)	5kV - 1.2/50µs

⑦ High frequency disturbance withstand

(to IEC 255-22-1) except DB25/RS232C socket

Common mode	2.5kV - 1MHz - Class III
Differential mode	1kV - 1MHz - Class III

⑧ **Case**	R3
⑨ **Weight**	4kg
⑩ **Identifying drawings**	TMS 7003: 20A1 TMS 7004: 20A2



* Only without communication

Operation

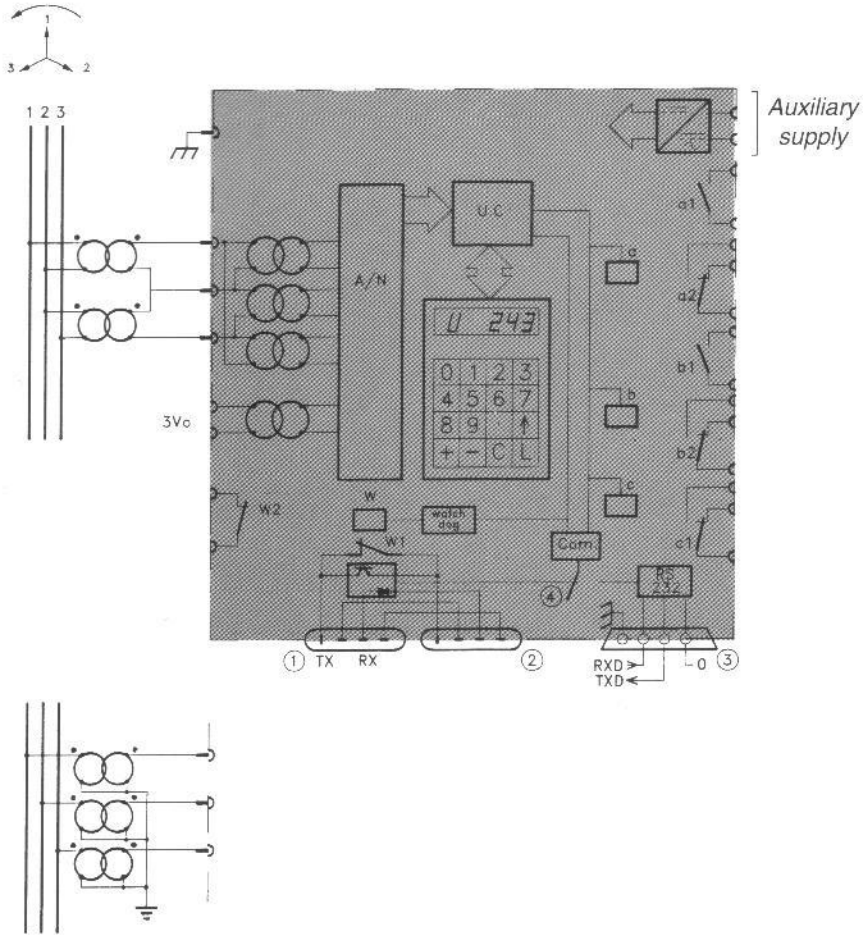


Fig. 4 - TMS 7003 - Simplified and connection diagram

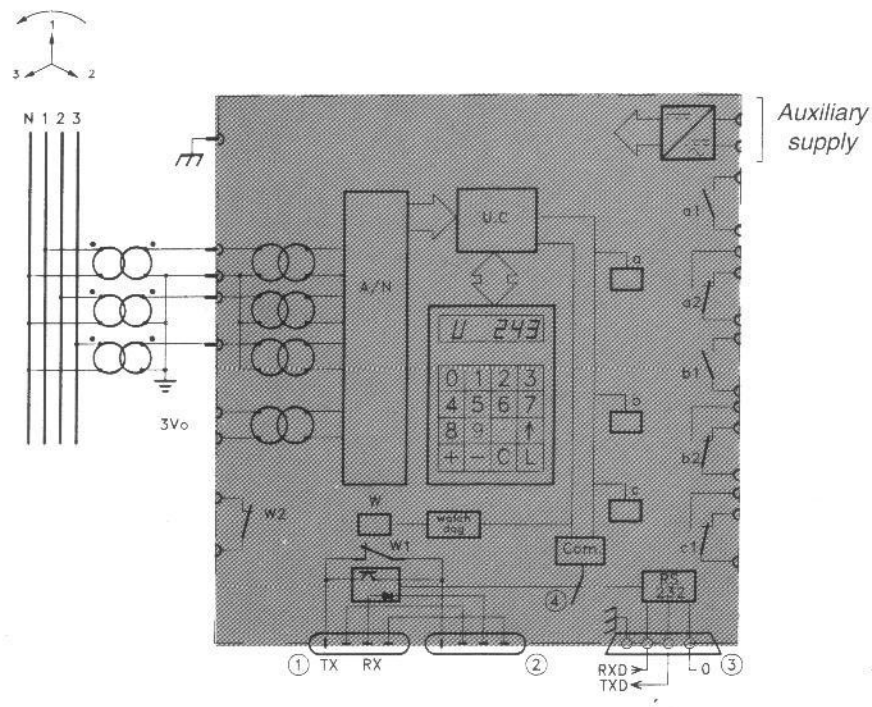
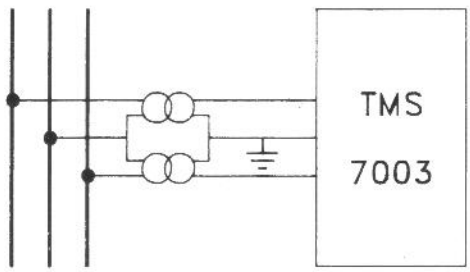
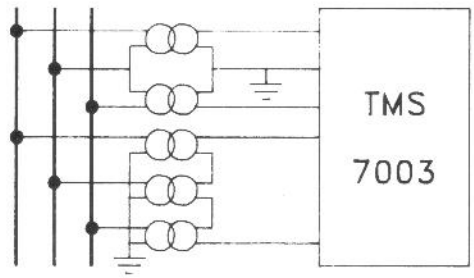


Fig. 5 - TMS 7004 - Simplified and connection diagram

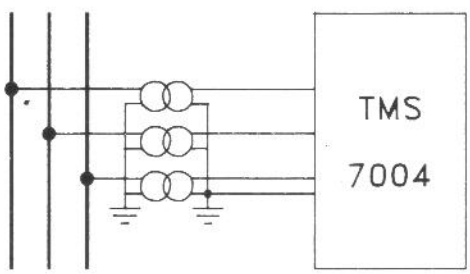
Some application diagrams



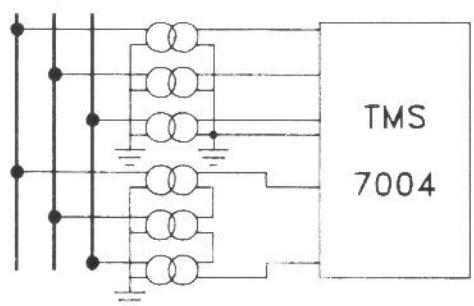
Measurement of 3 phase-to-phase voltages (U)



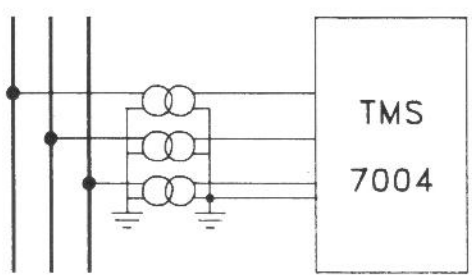
Measurement of 3 phase-to-phase voltages (U) + zero sequence voltage (Vo) supplied from 3 VTs in a delta connection



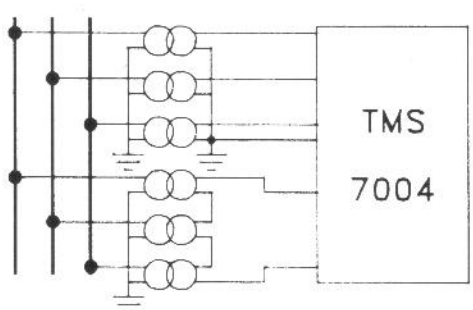
Measurement of 3 phase-to-neutral voltages (V) + zero sequence voltage (Vo) developed internally



Measurement of 3 phase-to-neutral voltages (V) + zero sequence voltage (Vo) supplied form 3 VTs in a delta connection



Measurement of 3 phase-to-phase voltages (U) + zero sequence voltage (Vo) developed internally



Measurement of 3 phase-to-phase voltages (U) + zero sequence voltage (Vo) supplied form 3 VTs in a delta connection

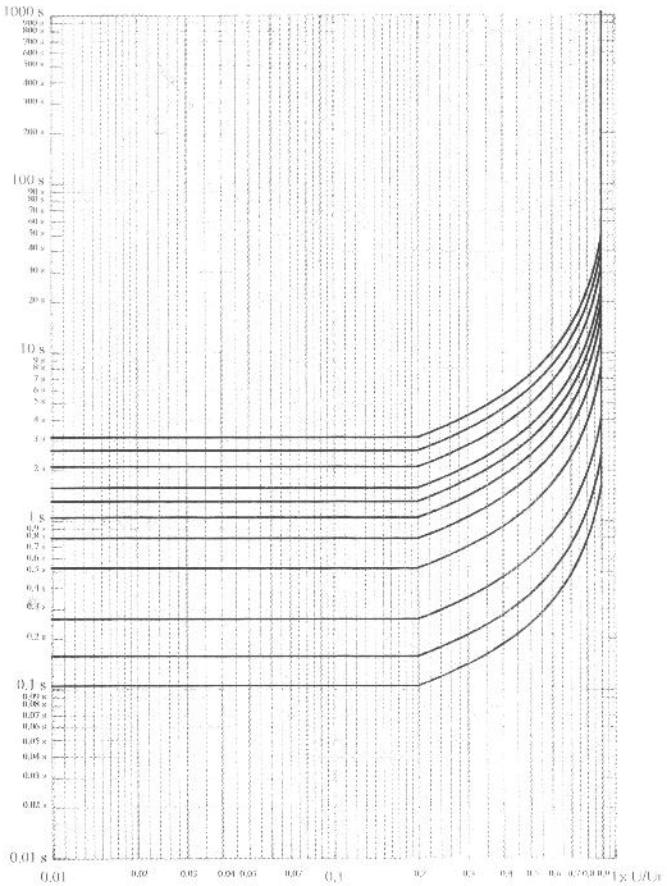


Fig. 1 - Under voltage
Inverse curve

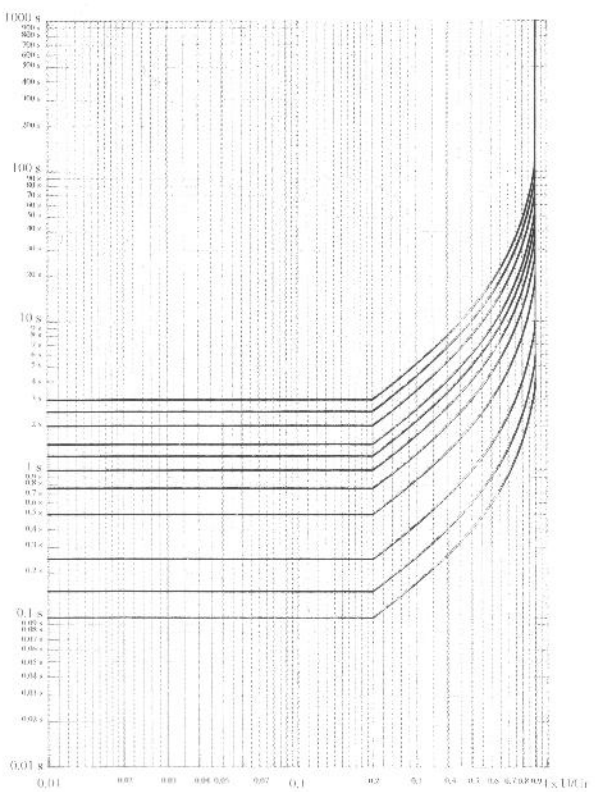


Fig. 2 - Under voltage
Very inverse curve

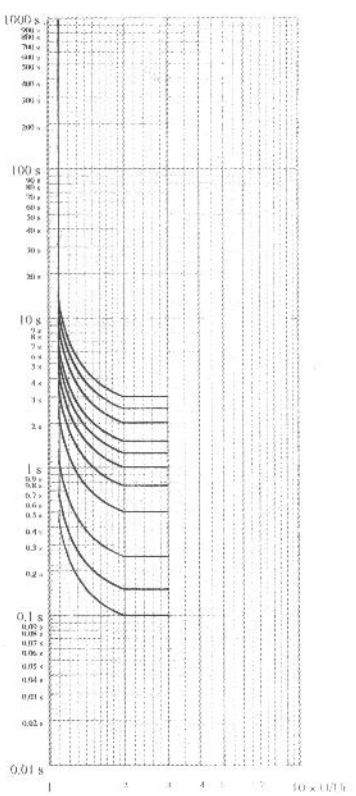


Fig. 3 - Over voltage
Extremely inverse curve

Style number identification

TMS 7003 – A – B – C – D – E – F

Frequency	50 Hz	a
	60 Hz	b
Rated Voltage	100 V	a
	110 V	b
	120 V	c
Residual Voltage	100 V	a
	110 V	b
	$100/\sqrt{3}$ V	c
	$110/\sqrt{3}$ V	d
Auxiliary supply dc/ac	20.....66 V	a
	38.....250 V	b
Contacts	relay A : 1 NO - relay B : 1NO	a
	relay A : 1 NO - relay B : 1NC	b
Case R3	projecting rear connection	a
	flush rear connection	b

TMS 7004 – A – B – C – D – E – F

Frequency	50 Hz	a
	60 Hz	b
Rated Voltage	$100\ V/\sqrt{3}$	a
	$110\ V/\sqrt{3}$	b
	$120\ V/\sqrt{3}$	c
	$400\ V/\sqrt{3}$	d
Residual Voltage	100 V	a
	110 V	b
	$100/\sqrt{3}$ V	c
	$110/\sqrt{3}$ V	d
Auxiliary supply dc/ac	20.....66 V	a
	38.....250 V	b
Contacts	relay A : 1 NO - relay B : 1NO	a
	relay A : 1 NO - relay B : 1NC	b
Case R3	projecting rear connection	a
	flush rear connection	b

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