GENERAL INSTRUCTIONS FOR THE **LKE-DPR-TC** PROTECTION, MEASURING AND CONTROL SYSTEM

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1. GENERAL DESCRIPTION

The LKE-DPR-TC system comprises a full range of digital relays which perform protection functions and, depending on the model, can also include further local control, remote control, electrical parameter measuring, automation, etc., functions related to present and future needs for the automation, control, and protection of Transformer and Distribution Substations.

This equipment is used in CGMcosmos and CGM systems cubicles, and is integrated in circuit-breaker and fuse protection cubicles. The system has been designed for cubicle integration which leads the following advantages over conventional systems:

- Avoids the need to use additional control boxes for the electronic equipment.
- Reduces interconnection handling when the cubicles are installed; with the only connection to be performed being that of the HV cables.
- Eliminates auxiliary wiring and installation errors and minimizes commissioning time.
- Allows factory-installation, adjustment, and testing of the entire protection equipment, with a complete unit check performed of each unit before installation; final system testing is conducted prior to delivery, with the equipment integrated in the cubicle.
- Protects a wide range of power ratings with the same model.

The LKE-DPR-TC protection, measuring and control system has been designed to meet the requirements of international standards and guidelines applicable to each of the parts in the system. IEC 60255, IEC 61000-4, IEC 60298, IEC 60068, IEC 60044.

1.1 General functional features

All relays used in the LKE-DPR-TC system include a microprocessor for processing the signals from the current transformers. These microprocessors process the current measured values by eliminating the influence of transient phenomena, and calculating the quantities necessary to perform the protection functions. In addition, they determine the effective values of the electrical measurements which provide information on the instantaneous value of these parameters of the equipment. The relays are equipped with keys for local display, setup and operation of the system, as well as communication ports for remote control. A user-friendly design has been employed, so that the use of the various menus is intuitive.

Current is measured by means of current sensors with a high transformation relation, making it possible for the same equipment to protect a wide range of power ratings. These current transformers or current sensors, maintain the same accuracy class throughout the respective power ranges.

The system is equipped with an event recorder that is used to store information on the last trips performed by the protection functions. In addition, the total number of operations is also recorded, as well as the various system settings. The local, menu-driven interface provides instantaneous measured values for each phase current and for zero-sequence current, as well as the parameter settings, tripping causes, etc. These values can also be accessed through the communication ports.

1.2 System parts

The LKE-DPR-TC protection, measuring and control system contains the following parts: electronic relay, current transformers, power supply circuit and power supplying current (depending on the model), and bistable tripping device.

1.2.1 Electronic relay

The electronic relay is equipped with a display and a small keyboard, so the protection, measuring and control settings can be changed and displayed. The relay includes a seal on the «SET» key to prevent further changes in the settings once they are made unless the seal is broken.

Tripping is recorded on the display along with the tripping cause, the fault current, tripping time, and date and time at which the event occurred. System errors such as a CB fault, incorrect thermometer connection, etc., are also displayed permanently until they are reset.

The "On" LED indicates when the equipment is powered by an external source or by the self-powered transformers. Under this condition, the system is ready to perform the protection functions. If the "On" LED does not indicate, only the system settings can be displayed and/or changed.

The current inputs are conditioned internally by small, extremely precise transformers that isolate the electronic circuits from the rest of the installation.

The front RS-232 communications port of the electronic equipment is used for local setup, and the rear RS-485 port for remote control. The standard communication protocol for all models is MODBUS. Other protocols can be implemented.

1.2.2 Current transformers/Sensors.

The current transformers are toroidal-core current transformers used upon high voltage with the function of protection and power supplying. Users can set the transformation relation in the electric relay according to the type of current transformer.

All protection and power-supplying current transformers have built-in protection against opening of the secondary circuits to prevent over voltage.

1.2.3 Power supply and test circuit

The power supply circuit processes the signal from the power-supplying current transformers and converts it into a DC signal to power the equipment safely. The transformers supply power continuously to the circuit for a primary current from 5 A to 630 A. In addition, the circuit is equipped with protection to absorb excess energy from the transformers when short-circuits of up to 20 kA occur.

The card has a 230 VAC input with an insulation level of 10 kV. This input is provided so the circuit can be directly connected to the Transformer Substation LV board. It also includes a protection tripping circuit test, as well as connectors for functional testing using current injection during maintenance and check-up operations.

1.2.4 Tripping device.

The equipment provides two modes of tripping.

1. The bistable tripping device is an electromechanical actuator built into the circuit breaker and the switch-disconnector operating mechanism. It requires only a low operating energy for tripping. This energy is supplied in the form of 30 ms pulses with an amplitude of 12 V. Under fault conditions, these pulses are repeated every 100 ms in order to ensure that the circuit breaker opens.

2. Monostabtle tripping device. Here the equipment output supply with 24V voltage and the energy from tripping device is enough to break the switch-disconnector operating mechanism.

2. PROTECTION FUNCTIONS

2.1 Overcurrent

The relay has an overcurrent unit for each phase (3 x 50-51) and another unit, for ground (50N-51N). The protection curves implemented are specified in the IEC 60255 specifications.

The overcurrent functions performed by the relay are as follows.

• Multicurve overload protection for phase-to-phase faults (51)

• Multicurve protection for phase-to-ground faults (51N)

• Definite-time phase-to-phase short-circuit protection (instantaneous)(50)

• Definite-time phase-to-ground short-circuit protection (instantaneous) (50N)

The parameters of the curves for the phase-to-phase fault settings have the following meanings:

t(s) ≡ Theoretical tripping time for a fault with a constant I current value

I ≡ Actual current flowing through the phase with the largest current

In ≡ Rated current setting

l > ≡ Admissible overload increase

K ≡ Curve factor

I >> ≡ Short-circuit (instantaneous) current factor

T >> ≡ Short-circuit (instantaneous) delay time

• Pickup current value for the NI, VI, and EI curves = 1.1x In x l>

• Pickup current value of the DT curve = 1.0 x In x l>

• Instantaneous pickup current value = In x l> x I>>

In the case of the phase-to-earth settings, the parameters are similar to the phase-to- phase fault settings. Details on each one are provided below.

to(s)≡ Theoretical tripping time for a phase-to-earth fault with a constant Io current value

lo ≡ Actual current flowing to ground

ln ≡ Rated current setting for phase

lo > ≡ Admissible phase-to-ground leak factor referred to phase current.

Ko ≡ Curve factor

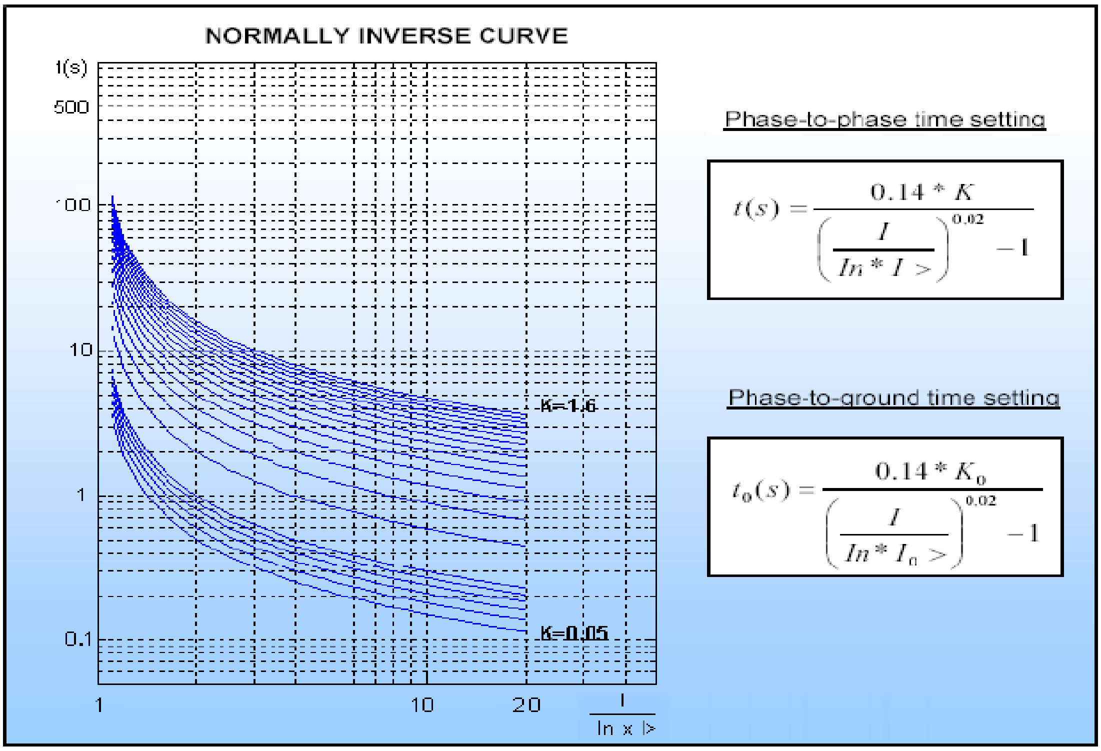
lo >> ≡ Short-circuit (instantaneous) current factor

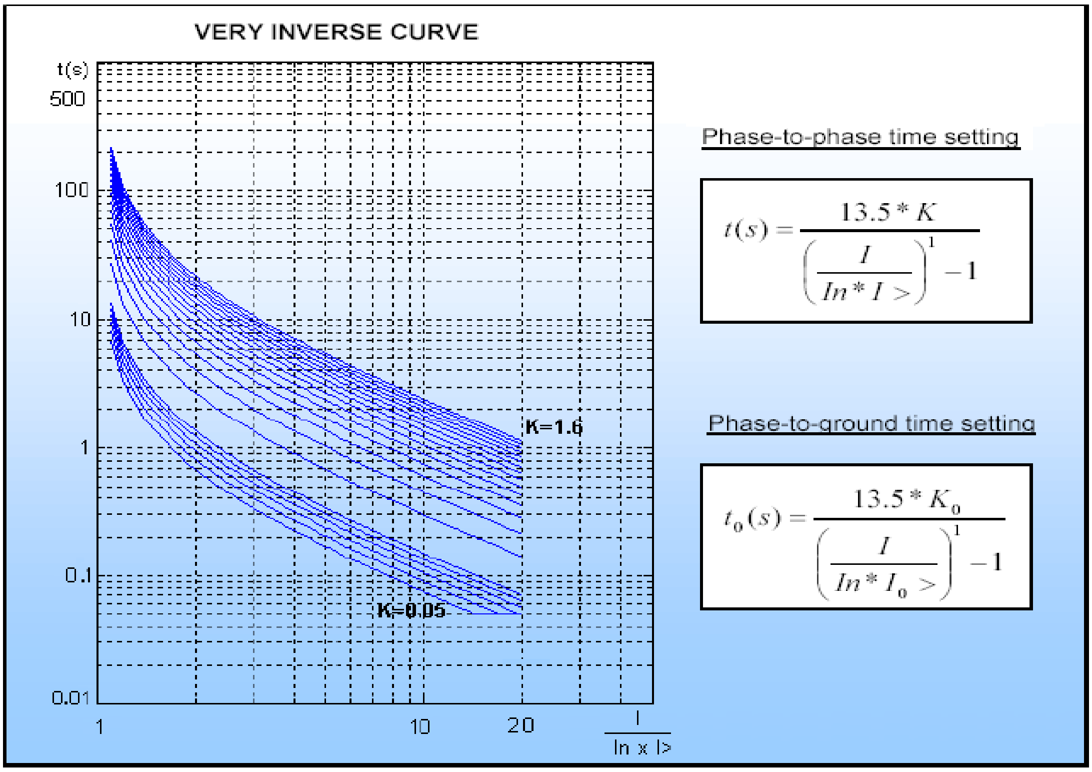
To >> ≡ Short-circuit (instantaneous) delay time

• Pickup current value of the NI, VI, and EI curves = 1.1x In x lo>

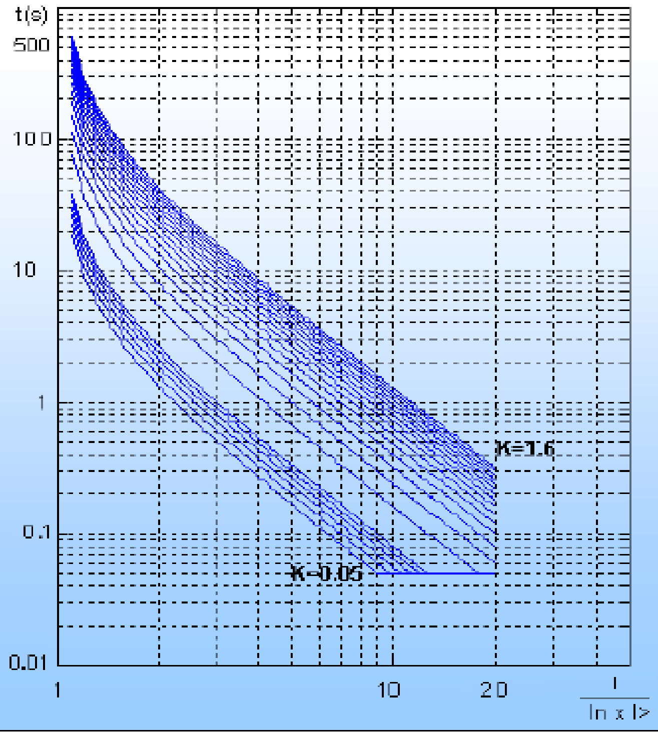
• Pickup current value of the DT curve = 1.0 x In x lo>

• Instantaneous pickup current value = In x lo> x lo>>





EXTREMELY INVERSE CURVE



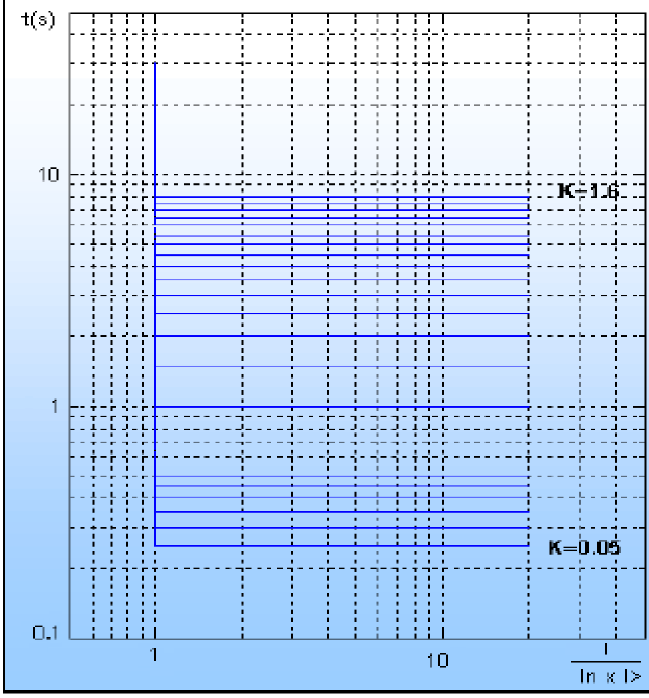
Phase-to-phase time setting

$$t(s) = \frac{80 * K}{\left(\frac{I}{In * I>}\right)^2 - 1}$$

Phase-to-ground time setting

$$t_0(s) = \frac{80 * K_0}{\left(\frac{I}{In * I_0>}\right)^2 - 1}$$

DEFINITE-TIME CURVE



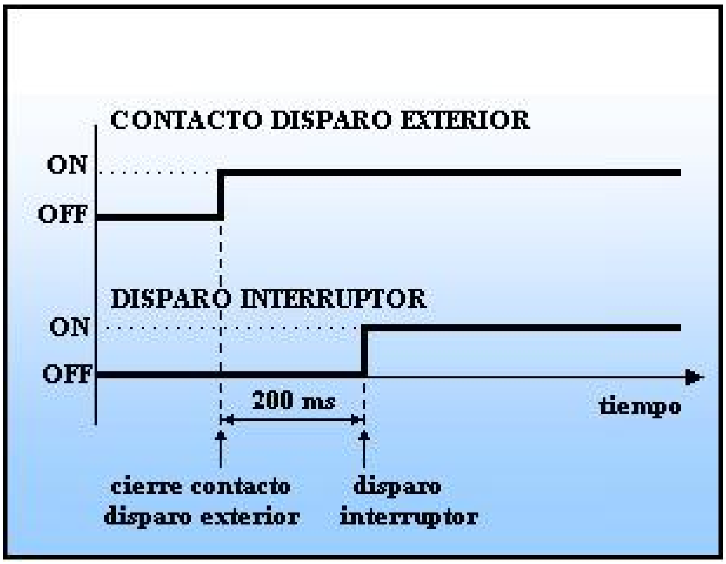
Phase-to-phase time setting

$$t(s) = 5 * K$$

Phase-to-ground time setting

$$t_0(s) = 5 * K_0$$

2.2 Thermometer (external tripping)



The equipment has a digital input for potential-free contacts in order to trip the circuit breaker.

The circuit breaker is tripped when the potential-free contact is switched on for at least 200 ms. This makes it possible to avoid untimely tripping due to outside interference. The main application of this function is transformer protection against overheating.The tripping input is associated with a thermometer contact that measures the oil temperature in the power transformer. When the maximum setpoint is reached, the Respective contact is closed, causing the Circuit breaker to trip. This has the advantage over conventional coils that there are no connections to the LV supply, which would cause overvoltages in the control circuits.

This tripping input can also be associated to output contacts for remote control terminals, alarms and auxiliary relays intended to disconnect the circuit breaker.

2.3 Sensitive earth fault protection

The sensitive earth fault protection is a particular type of overcurrent protection. It is used mainly in power systems with an isolated or compensated neutral, where the phase-to-ground fault current value depends on the capacity of the system cables and the point where the fault occurs. In general, facilities belonging to MV consumers that have short cable runs only require the determination of a minimum zero-sequence current threshold above which the protection should trip.

The phase to earth current is detected using a toroidal-core current transformer that covers all three phases. As a result, the measurement is independent from each phase current, preventing errors in the measuring transformers. As a rule, this protection should be used whenever the ground current setting is less than 10% of the rated phase current (e.g., for a phase current rating of 400 A with phase to earth faults below 40 A).

However, in the case of long cable runs (the general case of lines), the fault must be discriminated by identifying its direction (directional). If the direction of the zero-sequence current is not taken into account, tripping can occur because of capacitive current supplied by non-faulted lines.

Available curves are NI (Normally inverse), VI (Very inverse), EI (Extremely inverse) and definite-time (DT). The parameter settings are the same settings are those used for phase to earth fault overcurrent functions (Section §2.1 Overcurrent), except that the lo> factor is replaced by the value directly setting in amperes Ig. Therefore, this parameter can be adjusted to very low ground current values, independently of the current setting for phase-to-phase faults.

• Pickup current value of the NI, VI, and EI curves = 1.1x Ig

• Pickup current value of the TD curve = Ig

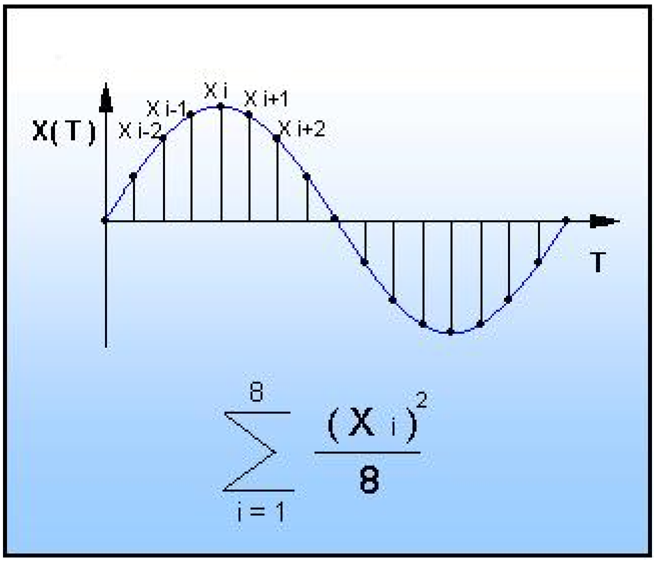
• Instantaneous pickup current value = Ig x lo>>

3. MEASUREMENT FUNCTIONS

3.1 Current.

The current values measured by the LKE-DPR-TC system correspond to the rms values of each of the phases: I1, I2 and I3. Eight samplings from a half-period are used and the mean of five consecutive half-periods is calculated. This measurement is updated every second. The precision of this measurement is Class 1 from 5 A up to 120% of the maximum rated power range of the current transformers. The zero-sequence current is measured in the same way as the phase currents.

• Current measurements: I1, I2, I3 and Io



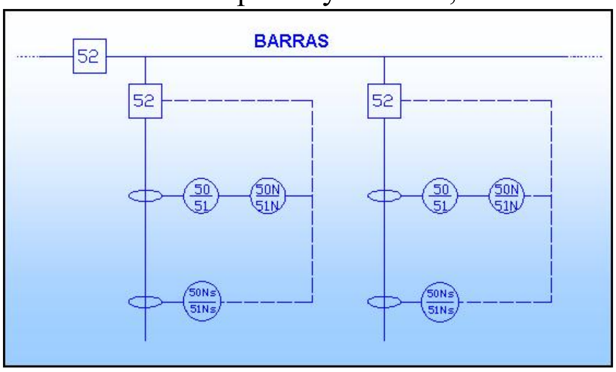
4. APPLICATIONS

4.1 Transformer protection

Distribution transformers require various protection functions. he functions depends mainly on the power rating and the level of responsibility of the facility. Generally, the protection functions that should be implemented to protect distribution transformers rated between 160 kVA and 2 MVA are as follows.

• 50 ≡ Phase-to-phase instantaneous.

Protects against phase-to-phase short-circuits in the primary circuit, or solid phase-to-phase short-circuits on the secondary side. This function is handled by the fuses when the protection cubicle does not include a circuit breaker.



• 51 ≡ Phase overload.

Protects against excessive overloads that can damage the transformer, or against short-circuits between turns of the primary winding.

• 50N≡ Phase-to-earth instantaneous.

Protects against phase-to-earth faults or short-circuits from phase to the secondary windings.

• 51N≡ Phase-to-earth fault.

Protects against small value faults from the primary to ground or to the secondary windings.

• 49T ≡ Thermometer.

Protects against oil overtemperature at the top of the transformer.

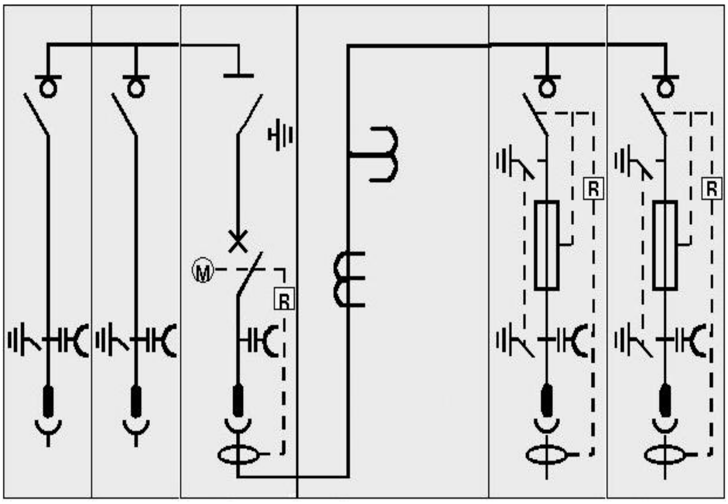
The protection systems that provide the functions indicated above are as follows:

GGMCOSMOS SYSTEM		
System	Type of cubicle	Power ratings
LKE-DPR-TC R	Switch-fuse combination	50kVA…2000kVA

CGM SYSTEM		
System	Type of cubicle	Power ratings
LKE-DPR-TC S	Switch-fuse combination	50kVA…1250kVA

4.2 General protection

Supplying power to consumers require general protection which, in the case of a fault, disconnects the system from the utility network. As a result, the utility line does not trip and does not affect the power supply to other consumers. It also protects the consumer's installation by disconnecting it from the power supply in the case of a fault.



In this type of protection, all faults detected at the primary substation must be detected at the transformer substation so they can be cleared before the line trips.

• 50 ≡ Phase-to-phase instantaneous.

Protects against phase-to-phase short-circuits

• 51 ≡ Phase overload.

Protects against excessive overloads that can damage the installation; also used as a current limiter to control the maximum power from the supply.

• 50N≡ Phase-to-ground instantaneous.

Protects against phase-to-ground faults.

• 51N≡ Phase-to-earth fault.

Protects against small value faults from the primary to ground or to the secondary windings.

4.3 Line protection

Line protection is intended to isolate the line from the network in case of a fault, without this affecting the remaining lines. In general, it handles all faults occurring between the primary substation or transformer substation and the final consumers. The types of faults occurring in these areas of the power systemdepend mainly on the nature of the line, cable or overhead line, and on the type of neutral grounding. In power systems with overhead lines, most faults are of transient nature, hence many line reclosings occur. On the other hand, these overhead lines can have phase-to-earth faults where the ground resistivity is very high and the zero-sequence currents are very low. In these cases, sensitive earth fault neutral current detection is necessary. This is not the case of underground cables where the faults are not transient. Moreover, cables have the disadvantage of the ground capacity, which means that single-phase-to-earth faults include capacitive currents. This phenomenon makes difficult the proper fault detection in power systems with an isolated or compensated neutral, making the use of directional protection necessary.

- 50 ≡ Phase-to-phase instantaneous.
  Protects against phase-to-phase short-circuits
- 51 ≡ Phase overload.
  Protects against excessive overloads that can damage the installation.
- 50N ≡ Phase-to-ground instantaneous.
  Protects against phase-to-ground faults.
- 51N ≡ Phase-to-earth fault.
  Protects against small value faults from the primary to ground or to the secondary windings.

5. CURRENT TRANSFORMERS

Wide range current transformers are designed for optimal adaptation to digital equipment technology, with a slight modification of the secondary interface. Therefore, the control, measurement, and protection equipment for these current transformers use the same algorithms and have the same consistency as conventional devices.

The main advantages of using wide range current transformer based systems are as follows:

- **Reduced volume.** The lower power rating of these transformers allows greater reduction in volume.
- **High precision.** Signal pick-up is much more precise due to high transformation ratios.
- **Wide range.** When the installation power is increased, the sensors do not require replacement with ones having higher relations.
- **Safety.** Active parts exposed to the air are no longer used, ensuring greater personal safety.
- **Reliability.** Full isolation of the entire facility offers greater degrees of protection against external agents.
- **Easy maintenance.** The current transformers do not need to be disconnected when the cable or switchgear panel is being tested.

5.1 Functional features

The current transformers are toroidal-core transformers with a high transformation relation and low precision load. These transformers are enclosed in self-extinguishing polyurethane resin.

PHASE CURRENT TRASFORMERS		
	Range 5-100A	Range 15-630A
Transformation relation	300/1	1000/1
Current range	5A to 100A Extd.130%	5P20
Protection	5P20	Class 1
Measuring	Class 1	0.2VA
Precision power rating	0.18VA	0.2VA
Thermal current	20kA	20 kA
Dynamic current	50 kA	50 kA
Saturation current	7.800A	26.000A
Frequency	50-60Hz	50-60Hz
Insulation	0.72/3 KV	0.72/3 KV
Outer diameter	139mm	139mm
Inner diameter	82mm	82mm
Height	38mm	38mm
Weight	1,350kg	1,650kg
Polarity	S1-blue,S2-brown	S1-blue,S2-brown
Enclosure	Self-extinguishing polyurethane	Self-extinguishing polyurethane
Thermal class	B(130℃)	B(130℃)
Reference standard	IEC60044-1	IEC60044-1

POWER SUPPLYING CURRENT TRANSFORMER	
Transformation relation	200/1 with tap(100+100)
Power supply range	5A to 630A
Thermal current	20KA
Dynamic current	50KA
Power rating	0.4VA to 5A
Frequency	50-60Hz
Insulation	0.72/3KV
Outer dimensions	139mm
Inner dimensions	82mm
Height	38mm
Weight	1.240kg
Polarity	S1-blue,S2-brown
Enclosure	Self-extinguishing polyurethane
Thermal class	B(130℃)

The transformers described above are connected in one of two ways, depending on whether the zero-sequence transformer is used or not. In general, a zero-sequence transformer is used when the phase-to-earth fault current is less than 10% of the phase current rating.

Note：The standard 5A current transformers are also compatible in the electronic relay produced by our company. If you have such transformers, you don’t need the ones our company provides.

6. TECHNICAL DATA

6.1 Rated values

Input power:	AC	24VAC …110VAC ±30%
	DC	24VDC …125VDC ±30%
	Selfpower,1	>5A 230VAC±30%
	Burden	<1VA
Current inputs:	Primeray phase	5A..630A(depending on modet)
	Earth	0.5A…50A(depending on modet)
	Thermal/dynamic 1	20KA/50KA
	Impedance	0.1Ohm
Accuracy:	Time setting	1%(minimum:20 ms)
	Measuring/Protection	Class 1/ 5P20
Frequency:	50Hz ; 60Hz	
Output contacts:	Voltage	380VAC,230VDC
	Current	16A(ac)
	Switching power	500VAC(resisitive load)
Temperature:	Operation	-10℃...+60℃
	Storage	-25℃...+70℃
Communications	Front DB9 port	RS-232
	Rear port RJ45	RS-485(5KV)

6.2 Insulation tests

IEC 60255-11:	Insulation resistance	500VDC:>0.7 Ω
Dielectric text		2kVAC;50Hz;1min
	Voltage pulses:common/	5 kV; 1.2/50μs; 0.5 J
	Differential mode	1 kV; 1.2/50μs; 0.5 J

6.3 Electromagnetic compatibility

IEC 60255-11	Interruption	200ms
	Ripple	12%
IEC60255-22-1:	1 MHz burst disturbance	2.5kV;1kV
IEC60255-22-2:	Elecrostatic discharges (IEC61000-4-2,class IV)	8 kV
IEC60255-22-3	Radiated electromagnetic fields (IEC61000-4-3,Class III)	10V/m
IEC60255-22-4	Fast transients disturbances (IEC61000-4-4)	2 kV
IEC61000-4-5	Overvoltage pulses	4 kV:2 kV
IEC61000-4-6	Included radio frequency Signals(EN 50082-2)	150kHz…80MHz
IEC61000-4-8:	Magnetic fields (EN 50082-2)	30A/m;50Hz
IEC61000-4-12:	Damped oscillatory waves	2 kV;1 kV
EN 50081-2/55011:	Radiated emissions Group 1,Class A	150kHz…30MHz

6.4 Climatic tests

IEC60068-2-1:	Slow temperature changes.Cold	-10℃;120min -25℃;960min
IEC60068-2-2:	Slow temperature changes.Dry Heat	+60℃;120min +70℃;960min
IEC60068-2-3:	Damp heat cycles	+40℃;92%;5760min

6.5 Mechanical testing

IEC60255-21-1:	Vibration text(Sinusoidal) Response	10-150Hz; 1g
	Vibration text(Sinusoidal) Endurance	10-150Hz; 2g
IEC60255-21-2:	Shock test. Response	11ms; 5g
	Shock test. Endurance	11ms;15g
	Bump test. Endurance	16ms; 10g

6.6 Power tests

IEC 60365:	Cable-charging circuit making and	24 kV/50 A/cos 0.1
IEC60265:	Mainly active load circuit making and breaking test	24 kV/630 A/cos 0.7
IEC60265:	Ground faults	24 kV/200 A/50 A
	No-load transformer circuit making And breaking	13.2 kV/250/1250 kVA
IEC 60056:	Earth fault making and breaking	20 kA

7. LKE-DPR-TC PROTECTION, MEASURING AND CONTROL MODELS

7.1 Description of models vs. functions

Distribution transformer protection system installed in switch-fuse protection cubicles. All protection functions are implemented by the electronic system, whit exception of the high-value phase-to-phase polyphase short-circuits in the transformer primary.

A single system can protect power ratings from 50 kVA to2000 kVA, in CGMcosmos system cubicles and from 50 kVA to 1250 kVA in CGM system cubicles.

MODELS OF THE LKE-DPR-TC PROTECTION, MEASURING AND CONTROL SYSTEM

GENERAL		
Phase current sensors	3	3
Earth(Zero-sequence) current sensor	Op	Op
Digital inputs	2	2
Digital outputs	2	2
Power 24VDC…125VDC/24VAC…1110VAC	Op	Op
Self-power	Op	Op
COMMUNICATIONS		

MODBUS-RTU	Yes	Yes
RS-232 configuration port	Yes	Yes
RS-485 remote control port	Yes	Yes
EkorSOFT setup and monitoring program	Yes	Yes
PROTECTION		
Phase overcurrent (50-51)	Yes	Yes
Earth-overcurrent (50N-51N)	Op	Op
Sensitive earth fault (50Ns-51Ns)	Op	Op
Thermometer (49T)	Yes	Yes
INDICATIONS		
Tripping cause indication	Yes	Yes
Error indication	Op	Op
VERIFICATION (TEXT)		
Test block for current injection	Yes	Yes
Test output contact	Yes	Yes
MEASURING		
Current	Yes	Yes

Op-Optional

7.2 Selection and ordering data

LKE-DPR-TC—[ ] [ ] [ ] [ ]

Type:

S – For vacuum circuit breaker cubicle

R – For fused protection cubicle

Protection functions:

10 – 3 x 50/51

20 – 3 x 50/51 + 50N/51N

Communication mode

0 – Without communication port

1 – 232 communication mode

2 – 485 communication mode

Power supply:

A – Self-power supply

B – Auxiliary power (Battery, UPS, etc)

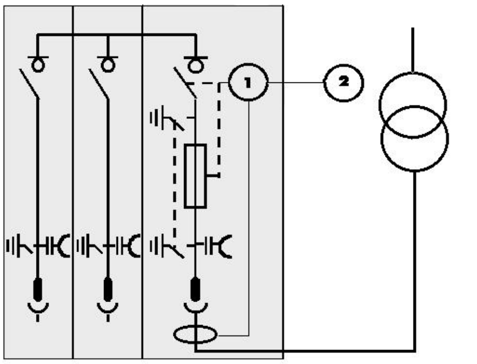
Example: For vacuum circuit breaker with a self-powered LKE-DPR-TC relay, with 3 x 50/51 + 50N/51N functions and 232 communication function, the ordering data would be: LKE-DPR-TC **-S-301A**

7.3 LKE-DPR-TC system

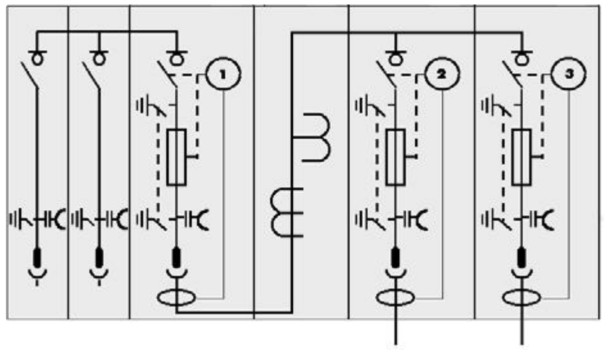
7.3.1 Functional description

The LKE-DPR-TC system has been designed for the protection of distribution transformers. It is installed in fused protection cubicles, with all protection functions performed by the electronic system with the exception of high-value phase-to-phase short-circuits cleared by fuses.

When an overcurrent within the values of the breaking capacity of the switch-disconnector is detected, the relay activate on a low-energy bistable release that opens the switch. If the fault current is higher than the switch-disconnector breaking capacity[(1)], tripping is blocked so the fuses can blow. In addition, the faulting equipment is disconnected, preventing the fuses from remaining with voltage.



TRANSF ORMER PROTECTION



GENERAL PROTECTION
(power supply to HV consumers)

7.3.2 Technical data

The LKE-DPR-TC system is used to protect the following transformer ratings

CGMCOSMOS SYSTEM					
Network voltage [kV]	Rated fuse Voltage [kV]	MINIMUM Transformer power		MAXIMUM Transformer power	
		Fuse rating [A]	[kVA]	Fuse rating [A]	[kVA]
6,6	3/7,2	16	50	160 [(1)]	1250
10	6/12	16	100	160 [(1)]	1250
13,8	10/24	16	100	125	1250
15	10/24	16	125	125 [(2)]	1600
20	10/24	16	160	125	2000

[(1)]mm cartridge

[(2)] SIBA SSK 125A fuse

The process used to choose the protection settings for the LKE-DPR-TC system in CGMcosmos-P cubicles is described below.

1. Calculate the rated machine current In = S/√3xUn.

2. Define the overload level in continuous duty, I>. Typical values in transformers up to 2000 kVA are 20% for distribution systems and 5% in generation systems.

3. Select the transient overload curve. The relay and the LV fuse curves are coordinated with the EI curve type.

4. Define the transient overload delay, K. This parameter is defined accordingly the thermal constant of the transformer. Thus, the higher this constant is, the longer it will take for the transformer temperature to rise in the event of an overload, and therefore the longer it will take for the protection to trip. A K value of 0.2 is normally used for distribution transformers; this implies tripping within 2 s if the overload is 300% on the EI curve.

5. Short-circuit current, I>>. Determine the maximum value of the magnetizing current for the transformer. The current peak occurring when a no-load transformer is energized because of core magnetization is several times higher than the rated value. This peak of up to 12 times the rated value (ten-times for transformers of more than 1000 kVA) has a very high content in harmonics, such that its 50 Hz fundamental component is much lower. Thus, a normal value for this setting is between 7 and 10.

6. Instantaneous time setting, T>>. This value corresponds to the tripping time of the protection in the case of short-circuit and depends on the coordination with other protections, with typical values between 0.1 and 0.5 s. In the case that the short- circuit has a high value, the fuses will blow within the time determined by their characteristic curve.

7. Determine the current value in the case of a solid secondary three-phase short-circuit. This fault must be cleared by the fuses, and corresponds to the maximum value of the intersection point between the relay and the fuse curves. If the intersection point is greater than the secondary solid short-circuit value, the settings must be changed to comply with this requirement.

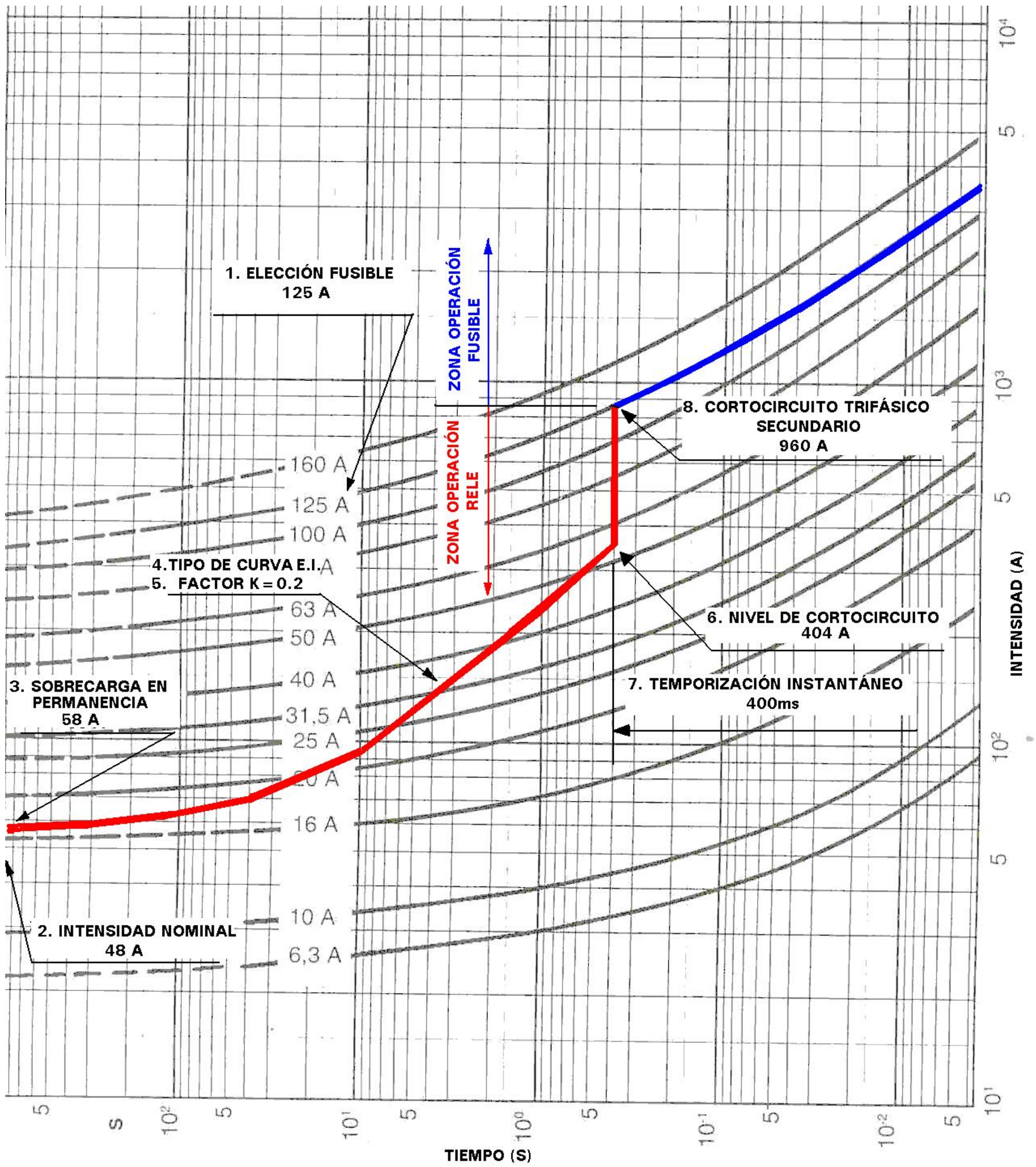
In CGMcosmos system cubicles, when protecting a transformer with the following characteristics:

S= 1250 kVA, Un =15 kV and Uk = 5%

The steps to be followed for proper coordination between the fuses and the protection relay are as follows:

- Choosing a fuse according to IG-078. 10/24 kV 125 A fuse
- Rated current In = S/√3xUn = 1250 kVA/√3x15kV ≅ 48 A
- Max overload in continuous duty 20%. In x I> = 48 A x 1.2 ≅ 58 A
- Extremely inverse curve type E.I.
- Transient overload factor. K = 0.2
- Short-circuit level. In x I> x I>> = 48 A x 1.2 x 7 ≅ 404 A
- Instantaneous time setting T>> = 0.4s
- Secondary short-circuit. Ics = In x 100/ Uk = 48 A x 100 / 5 ≅ 960 A

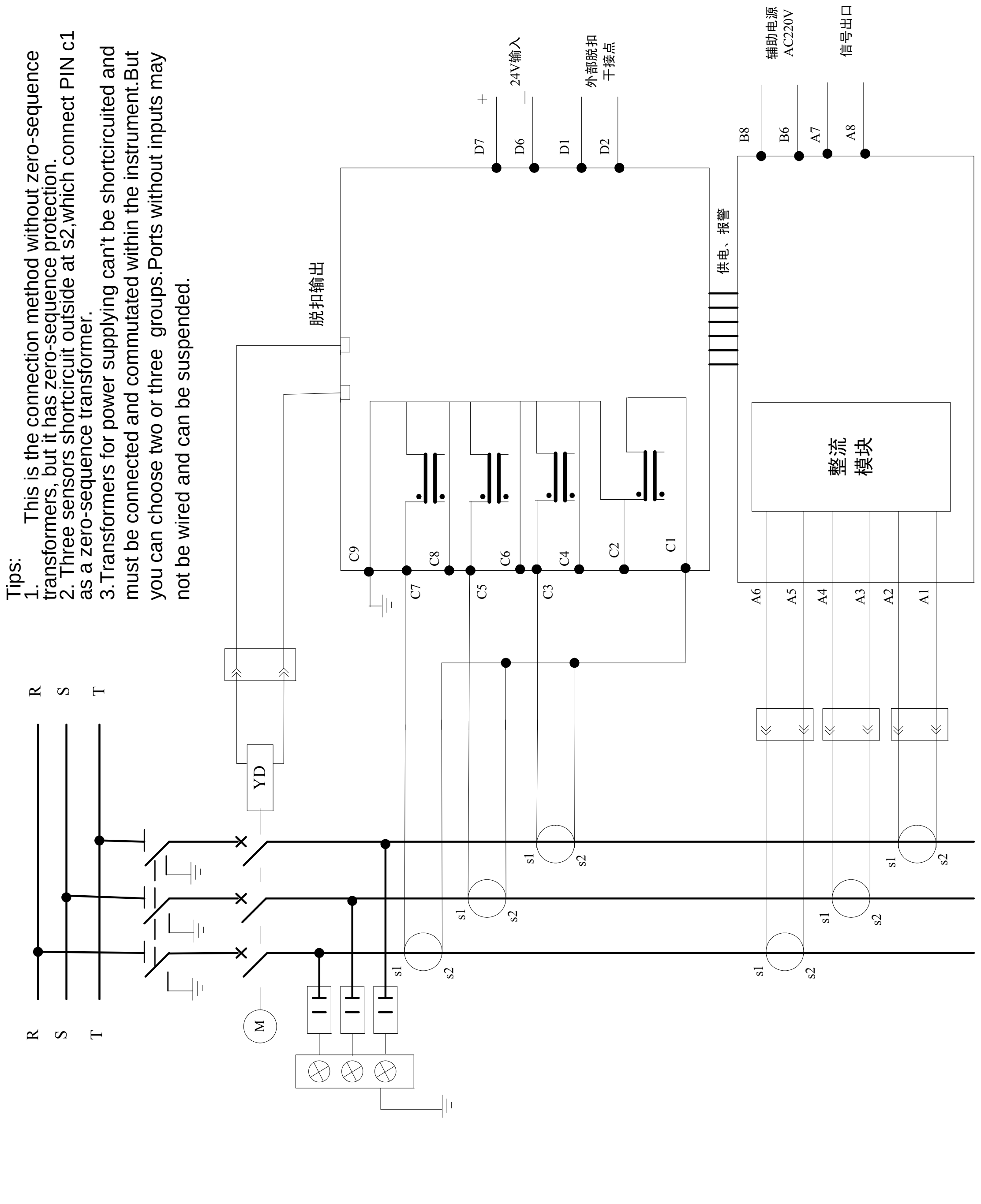
The phase-to-earth fault protection unit settings depend on the characteristics of the power system where the equipment is installed. In general, phase-to-earth fault values are high enough

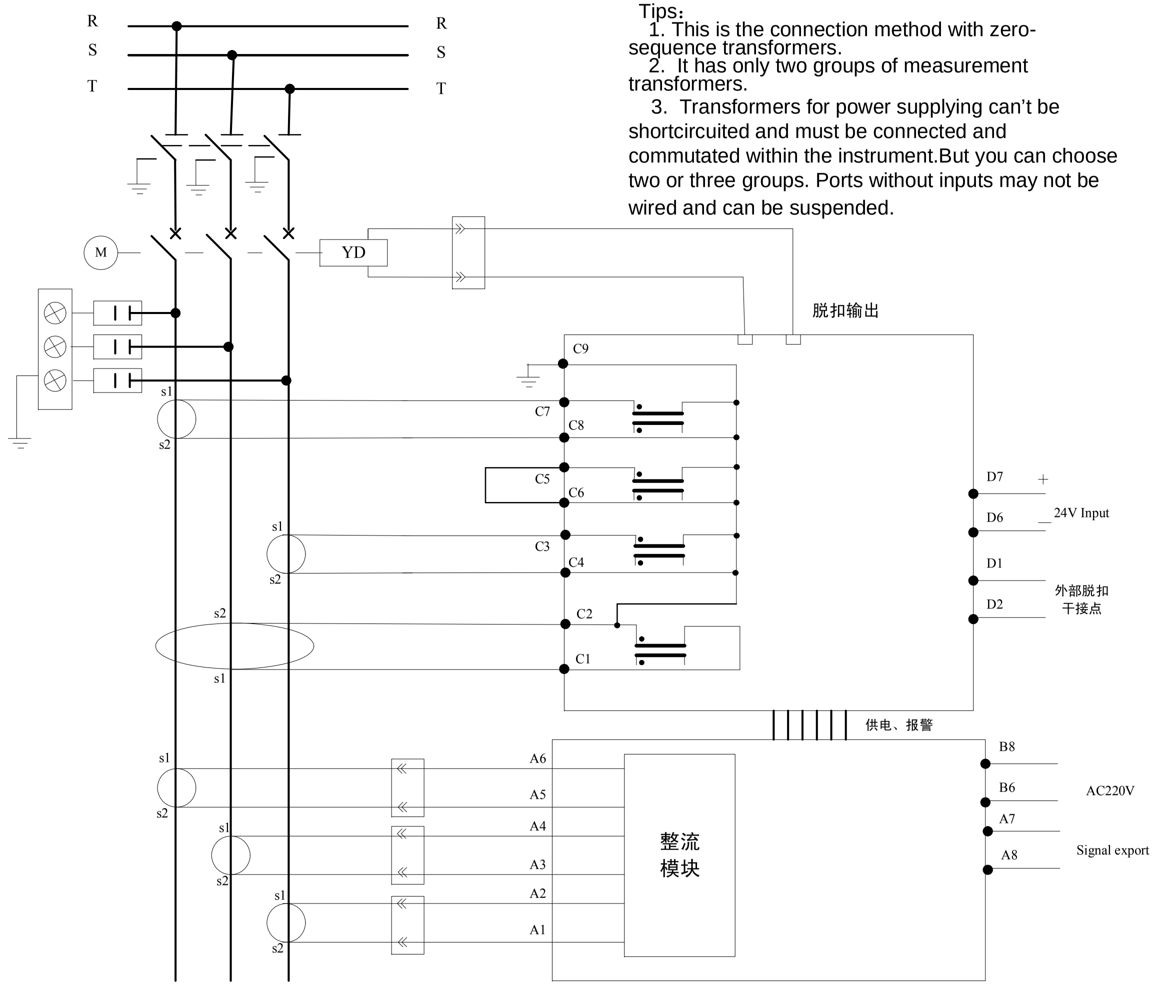


to be detected as overcurrent. Even in power systems with an isolated or compensated neutral, the fault current in transformer protection equipment is clearly discriminated from the lines capacitive currents. Therefore, the LKE-DPR-TC transformer protection system is used in isolated-neutral power systems with no need for directionality. The setting values must ensure the selectivity with respect to the substation protections. Due to the variety of protection criteria and the types of neutrals in power systems, it is impossible to recommend a single set of parameters applicable to every case. In general, for machines up to 2000 kVA, thesettings indicated below are provided as a guideline. Nevertheless, they should be checked to ensure that they coordinate properly with existing primary protective devices (general, infeed, other substation protections, etc.).

PHASE-TO-PHASE FAULT SETTING	Ratee Current	Curve	Instantaneous	I>	K	I>>	T>>
	In=S/√3xUn =48A	EI	DT	1.2	0.2	7	0.4
	Type of neutral	Curve	Instantaneous	Io>	Ko	Io>>	To>>
GROUND FAULT SETTING	Solid or Impedance	NI	DT	0.2	0.2	5	0.4
	Isolated or Compensated	NI	DT	0.1	0.2	5	0.4

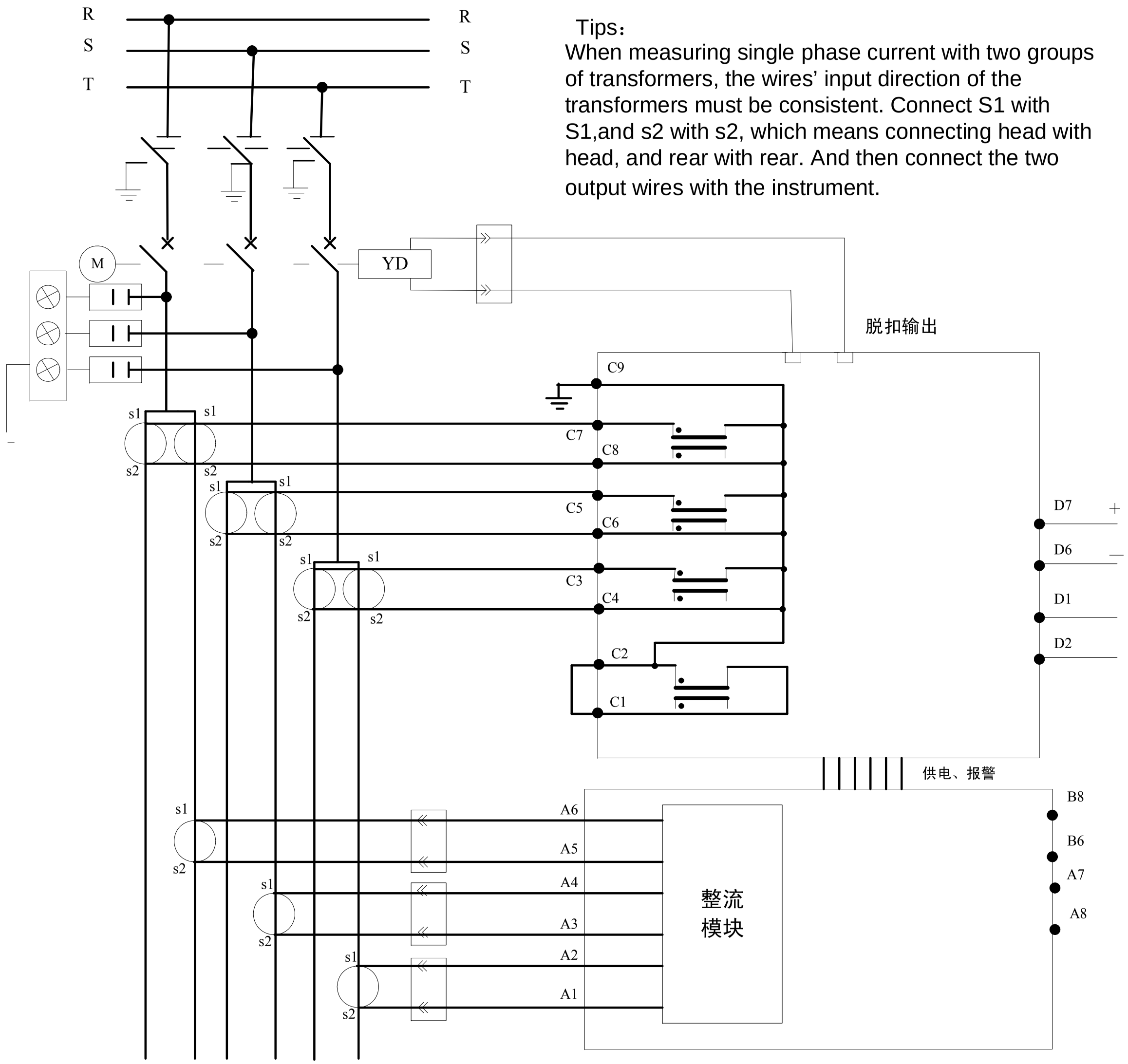
7.3.3 Scheme Diagram





Tips：

1. This is the connection method with zero-sequence transformers.
2. It has only two groups of measurement transformers.
3. Transformers for power supplying can't be shortcircuited and must be connected and commutated within the instrument.But you can choose two or three groups. Ports without inputs may not be wired and can be suspended.



Tips：

When measuring single phase current with two groups of transformers, the wires' input direction of the transformers must be consistent. Connect S1 with S1,and s2 with s2, which means connecting head with head, and rear with rear. And then connect the two output wires with the instrument.

7.3.4 Testing and maintenance

The LKE-DPR-TC protection, measuring and control system has been designed such that the necessary operation tests can be performed during commissioning, as well as maintenance tests. A distinction can be made between several testing levels, making it possible not to interrupt service and access the HV cable compartment of the cubicle.

Primary current tests.

This case corresponds to tests performed on the equipment when it is completely out of service, since it involves operating the switch-disconnector and earthing the cubicle outgoing cables. In this case, current is injected through the toroidal transformers to check that the protection opens the switch-disconnector within the preset time. In addition, the trip information being displayed is checked and the events recorded stores all events.

To perform this check, follow the steps indicated below:

- Open the switch-disconnector in the cubicle, then earth the outgoing cables.
- Access the cable compartment, then insert a test cable through the current transformers.
- Connect the test cable to the test current injection equipment.
- Connect the J3 connector of the power supply circuit to the timer stop input of the test equipment.
- Disconnect the grounding switch and operate it to the closed position. Charge the spring and remove the operating lever to prepare the cubicle for tripping.
- Inject the test currents, and check that the tripping times are correct. Check that the trips which occurred are correctly displayed.

For phase-to-earth fault tripping, the test cable must go through two toroidal transformers. The cable must go through each one of them in opposite directions. In other words, if the current flows top down in the first, in the other it must flow bottom up so the sum of the two currents is zero and no phase-to-earth fault tripping occurs. For phase-to-ground fault tripping, the test cable goes through only one toroidal transformer. Tripping tests must be done in all toroidal transformers to check the operation of the complete system.

8. SETUP MENU AND HANDLING

8.1 Keys and alphanumeric display

The relays of the LKE-DPR-TC protection, measuring and control system have a total of six keys:

- **SET:** This key allows access to the "Parameter Setting" mode. In addition, the SET button has a confirmation function within the various menus of the "Parameter Setting" mode; this function will be explained in greater detail in this section.
- **ESC**: This key allows the user to return to the main screen ("Display mode") from any screen without saving changes made to the settings up to this point.
- **Scrolling keys:** The "up" and "down" arrows allow the user to scroll through the various

menus and change the values. The "right" and "left" arrows allow values in the "Setup" menu to be selected for modification, as detailed later.

In addition to these keys, the relays have a large alphanumeric display that is directly related to key usage and makes it easier to perform relay operations. To save energy, the relay has a standby mode (display off) that starts to operate whenever the relay receives no external signal (key stroke, except for “SET” key, or RS-232 communication) for one minute, or two minutes if the user is changing the settings in the "Parameter Setting" mode. In addition, if either type of external signal is received, the relay will exit the standby mode and return to its active status.

8.2 Display

The "Display" mode is the normal mode of the relay while operational. Its main function is to allow the user to display various system settings; these settings can be divided into four main groups:

- Current measuring
- Setting display
- Values at last and next-to-last trip
- Current date and time

By default, the "Display" mode appears in the relay when it is turned on or has been on standby, or when the ESC key is pressed from any screen. In this operating mode, the "up" and "down" arrow keys are active, allowing the user to scroll throughout the various settings on the "Display" mode. The SET key enters the "Parameter Setting" mode. As shown in the figure, the screens in the relay display are composed of two lines of data. The first indicates the parameter for the screen in question; the second establishes the value of this setting.

A table with the sequence of the settings for the "Display" mode is shown below. This includes the text appearing on the first line of the relay display, along with an explanation of the respective setting

PARAMETER	FUNCTION
I1.A	Phase 1 current measurement
I2.A	Phase 2 current measurement
I3.A	Phase 3 current measurement
Io.A	Zero-sequence current measurement
I>	Type of phase curve(NI,VI,EI,DT,disabled)
Io>	Type of zero-sequence curve(NI,VI,EI,DT,disabled)
I>>	Instantaneous phase unit enabled/disabled
Io>>	Instantaneous zero-sequence unit enabled/disabled
In.A	Full-load phase current
I>	Phase overload factor
K	Phase multiplying constant
I>>	Instantaneous phase multiplier
T>>	Instantaneous phase time setting
Io>	Phase-to-earth fault factor
Ko	Zero-sequence multiplier constant

Io>>	Instantaneous zero-sequence multiplier
To>>	Instantaneous zero-sequence time setting
H2.A	Current at last trip
H2.	Cause of last trip
H2.TM	Time at last trip,from pickup to trip
H2.DT	Date at last trip
H2.YE	Year at last trip
H2.HR	Time and minute at last trip
H2.SE	Seconds at last trip
H1.A	Current at next-to-last trip
H1.	Cause at next-to-last trip
H1.TM	Time at next-to-last trip,from pickup to trip
H1.DT	Date at next-to-last trip
H1.YE	Year at next-to-last trip
H1.HR	Time and minute at next-to-last trip
H1.SE	Seconds at next-to-last trip
DATE	Current date
YEAR	Current year
HOUR	Current hour
SEC.	Current seconds
PROP	Transformation relation

8.3 Parameter setting

The "Parameter Setting" menu can be accessed from any screen of the "Display" menu by pressing the SET key.

As a precautionary measure, the "Parameter Setting" menu is password-protected; this password must be entered whenever access to the menu is required. By default, all relays of the LKE-DPR-TC system have a password of 0000. This password may be modified by the user as explained below.

The function of this menu is to allow the user to make changes in various relay settings. These parameters can be grouped as follows:

- Protection settings
- Date and time
- Information on the number of trips
- Password modification

In order for the user to quickly identify the current menu, an arrow is displayed at the lower left of the screen for the relay whenever the relay is in the "Parameter Setting" menu.

8.3.1 Protection settings

The relays of the LKE-DPR-TC system have two methods for selecting the setting parameters: manual and automatic.

The manual method consists of individually entering each protection parameter.

In contrast, the automatic method is intended to help the user by facilitating and speeding up the entry of settings. In this method, the user enters only two values:

Rated system transformer power (Pt) and system voltage (Tr). The relay takes these two values and then assigns the following settings:

$$In=Pt/(Tr\times\sqrt{3})$$

The full-load current value selected is always obtained by rounding the value up.

All other settings are fixed, as observed in the following table. Nevertheless, the user can change any of the values selected by the program in the manual mode.

PHASE-TO-PHASE PROTECTION		PHASE-TO-PHASE PROTECTION	
SETTING	AUTOMATIC VALUE	SETTING	AUTOMATIC VALUE
Overload factor	120%	Earth leak factor	20%
Type of curve	EI	Type of cure	NI
Multiplier constant	0,2	Multiplier constant	0,2
Short-circuit factor	10 (*)	Short-circuit factor	5
Time at trip	0.1 (*)	Time at trip	0.1 (*)
Tripping enabled	DT	Tripping enabled	DT

(*) In the case of LKE-DPR-TC protection with 5-100 A range current transformers, the short-circuit factor is 7 and the instantaneous tripping time is 0.4.

8.3.2 Parameter setting menu

When the "Parameter Settings" menu is accessed through the SET key, the relay prompts the user to enter a password. Once the password has been checked to make sure it is correct, the system enters the area for entering the settings. At this time, the user must select manual setup (MENU) or automatic setup (AUTO). The "right" and "left" keys can be used to toggle the option; to select the mode, use the SET key. The sketch on the right explains this process graphically.

Once inside either of the areas for entering the settings, the user can move from one setting to another with the "up" and "down" keys, as was done in the "Display" mode. To exit from the menu, press the ESC or SET key to immediately access the "Display" menu. The ESC key will disregard all previously made changes in the settings, whereas the SET key will save all data before continuing.

To change a setting, proceed as follows:

1. Display the setting to be changed on the screen.
2. Press the "left" or "right" keys. The data will start to flash.
3. Adjust the value with the "up" and "down" keys. If the setting is numeric, the flashing number can be changed with the "left" and "right" keys.
4. To exit, press SET (save and exit), or ESC (disregard changes and quit).

The password can be modified by first entering the current password. The process is explained graphically in the diagram on the right. As shown in this diagram, password modification consists of four steps.

The following two tables list the protection settings on the "Parameter Setting" menu, along with an explanation of each one and the values they can have. This information is shown for both setting modes (manual and automatic).

Manual Setup Menu

PARAMETER	FUNCTION	RANGE
I>	Type of phase-to-phase curve/disable unit	OFF,NI,VI,EI,DT
Io>	Type of zero-sequence curve/Disable unit	OFF,NI,VI,EI,DT
I>>	Enabling of phase instantaneous unit	OFF,DT
Io>>	Enabling of ground instantaneous unit	OFF,DT
In.A	Full-load phase current	Depends on model
I>	Phase overload factor	1.00-1.30
K	Phase multiplier constant	0.05-1.6
I>>	Inst.phase mutiplier	1-25
T>>	Inst.phase –to-phase time setting	0.05-2.5
Io>(*)	Ground leak factor	0.1-0.8
Ko	Zero-sequence multiplier constant	0.05-1.6
Io>>	Inst.zero-sequence multiplier	1-25
To>>	Inst.phase-to-phase time setting	0.05-2.5
DATE	Current day and month	1-31/1-12
YEAR	Current year	2000-2059
HOUR	Current time	00:00-23:59
SEC.	Current seconds	0-59
DT.AD	Day and month on which the last setting was made	Cannot be changed
YE.AD	Year in which the last setting was made	Cannot be changed
HR.AD	Time at which the last setting was made	Cannot be changed
SE.AD	Second at which te last setting was made	Cannot be changed
NTP	Number of phase-to-phase fault trips	Cannot be changed
NTE	Number of external trips	Cannot be changed
PASW	Password modification	0000-9999

Automatic Setup Menu

Parameter	SIGNIFICANCE	RANGE
TPOW	Transformer powerrating(kVA)	50,100,160,200,250,315,400,500,630,800,1000,1250,1600,2000
Tr	Network voltage(kV)	6.6,10,13.8,15,20,25,30
DATE	Current day and month	1-31/1-12
YEAR	Current year	2000-2059
HOUR	Current time	00:00-23:59
SEC.	Current seconds	0-59
DT.AD	Day and month on which the last setting was made	Cannot be changed
YE.AD	Year in which the last setting was made	Cannot be changed
HR.AD	Time at which the last setting was made	Cannot be changed
SE.AD	Second at which the last setting was made	Cannot be changed
NTP	Number of phase-to-phase fault trips	Cannot be changed
NTG	Number of phase-to-ground fault trips	Cannot be changed
NTE	Number of external trips	Cannot be changed
PASW	Password modification	0000-9999

8.4 Tripping indication

Whenever a trip occurs, the relay immediately accesses the "Trip Indication" menu. This menu can be readily recognized by a flashing arrow at the top of the display, right below the name of the function which caused the trip. The relays of the EP system can trip for one of five reasons:

- Phase time overcurrent protection **I>**
- Instantaneous phase overcurrent protection **I>>**
- Ground time overcurrent protection **I_0>**
- Instantaneous ground overcurrent protection **I_0>>**
- External tripping **Ext**

To quit the "Trip Indication" menu, press the ESC key on any of the menu screens.

The relay acknowledges that the user has checked the trip, then returns to the first screen of the "Display" menu. In any case, the tripping data will continue to be available for the user from the "Display" menu until two new trips have occurred.

The various screens of the "Trip Indication" menu provide two types of information. The initial screen indicates the current detected at the time of the phase-to-phase or phase-to-ground fault tripping, based on the tripped unit. Subsequent "Trip Indication" screens show the date and time of the trip, along with the time elapsed since pickup of the unit until the trip.

The following table shows the sequence in which the data appear. As in the rest of menus, the "up" and "down" keys are used to scroll throughout the data.

PARAMETER	FUNCTION
I_xA	Current at the time of the trip
IxTM	Time since the unit was started until the trip
IxDT	Day and month on which the trip occurred
IxYE	Year in which the trip occurred
IxHR	Time at which the trip occurred
IxSE	Second at which the trip occurred

Where the subscript x depends on the reason for the trip(phase A, phase B, phase C or zero-sequence).

8.5 Menu map (quick access)

The menu map is a summary table that shows all submenus for the LKE-DPR-TC system relays, as well as a small explanation of each one.

9. LKE-DPR-TC SOFT PROGRAM

The LKE-DPR-TC SOFT program is a software tool designed to help the user change and monitor the settings of the relays used in the EPT protection, measuring and control system.

As described below, the program is a user-friendly, easy-to-learn application that runs under MS windows.

9.1 System requirements

The minimum system requirements for the installation and execution of the LKE-DPR-TC SOFT software are as follows:

- Microprocessor: Pentium II
- RAM memory: 32Mb
- Operating system: MS WINDOWS
- CD-ROM reader
- Serial Port RS-232

9.2 Installation

The LKE-DPR-TC SOFT software can be installed from the CD-ROM which comes with each relay of the LKE-DPR-TC system. The “LKE-DPR-TC SOFT Installation” folder contains the setup.exe file. This program will guide the user through a series of screens to properly install the program.

9.3 Initial screen

Once the program is installed, an access to the LKE-DPR-TC SOFT program is created in the tool bar.

When the program is started, the user is asked to enter the password, 0000. In the next screen the user can select the working mode: connection or emulation.

• The connection mode is used to communicate with a relay connected to the PC.

• The emulation mode is used when no relay is connected to the PC.

The working mode selection screen has also the following functions

• Password modification

• Communication parameter modification (§ 9.4.2)

When the working mode is selected the initial screen appears. This screen is composed of a series of menus at the top, which allow access to the various program options.

• Display

• User settings

• Events

• Exit

9.4 Communications

9.4.1 Relay connection

All menus except the "Communications" menu require that the computer on which the software is installed is connected to a relay. Communication between the PC and the relay is established by a serial communication cable (DB9 male for the relay and DB9 female for the PC) that joins one of the serial ports of the PC with the faceplate port of the relay for the LKE-DPR-TC system. The following figure shows the setup of the communications cable.

9.4.2 Communications setup

The first step for communicating with the relay is proper configuration of the communication settings. Through the "Communications" menu, the user must establish a series of parameters to adapt them to those configured in the relay, thereby achieving communication.

The figure shows the setup menu for the communication settings, accessible from the main screen of the program through the button with the "Communications" menu.

The parameters can be set in one of two different ways: automatic and manual.

- **Automatic mode**: By pressing the "**SEARCH**" command, the program will start a process to search for the settings automatically. The relay of the LKE-DPR-TC protection, measuring and control system connected to the computer (with an appropriate cable), is detected by the LKE-DPR-TC SOFT software that tests various configurations.
- **Manual mode:** The user is responsible for defining the settings that will ensure proper communication with the relay

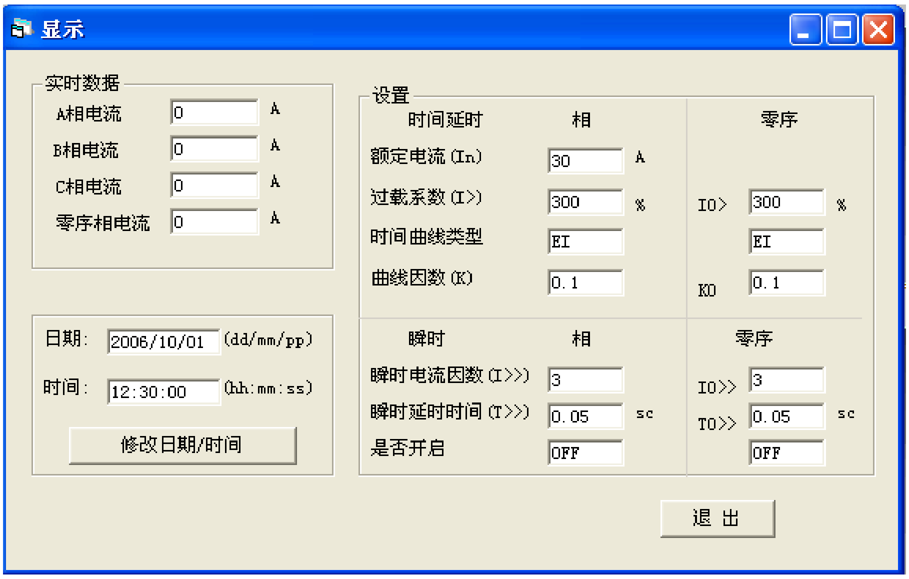
PARAMETER	SETTING RANGE	DEFAULT VALUE
Peripheral No.	1-32	0
Port	COM 1,COM 2	COM2
Baud rate	1200,1400,4800,9600,19200	9600
Parity	NO,ODD,EVEN	NO
WORD LENGTH	7 bits, 8 bits	8 bits
Stop bit(s)	1,2	1

Except for the port setting, all other settings are internal to the relay. By default, the relays have the same settings as the program. The peripheral number 0 is reserved or "broadcast" messages.

Once the communication settings are properly set and the cable is connected, the user can access the remaining menus from the main screen.

9.5 Display

The first of these menus is the "Display" menu which, as its name indicates, allows the user to display different values of the system. The following figure shows the menu window.



9.5.1 Current reading

The "Display" menu shows the real-time current measurements (for the three phases and zero-sequence) recorded by the relay, when connection mode is selected.If the emulation mode is selected, there is no read value from the relay.

9.5.2 Date and time

In this window, the user can check the date and time of the relay, as well as modify it.

9.5.3 Settings

The "Display" menu provides a list of the values that have been set; at this time, these are the protection settings of the relay. The setting values cannot be modified (only displayed) from this window.

9.6 User settings

The next menu is the "User Settings" menu. This menu provides access and allows the protection settings (which are password-protected in communications mode) of the relay to be changed. The relays are factory-set with a password of 0000.

Once the correct password has

been entered, the "用户设置" window appears. The user can change the protection settings, as well as the relay date and time, and display some of the system parameters from this screen.

The user can print the settings in a table, as well as the protection curve resulting from these settings: These operations can be done with the "打印数据" and "打印曲线" buttons, respectively.

9.6.1 Protection

This window contains the protection settings that can be changed. The meaning of each setting, along with the range of values for each one, is described in Section §8.3.2 Parameter Setting Menu. There are two basic modes for configuring the protection settings: manual and automatic The manual mode allows the user to enter the values. The automatic mode, which is intended to help the user, can be used by pressing the "表格设置" button.

A window appears, prompting the user to enter two basic data for the equipment: Rated system transformer power (Pt) and system voltage (Tr). When these settings are entered, the program calculates the most appropriate protection settings for the equipment. In any case, the user can modify the values as desired once these values have been obtained.

The program uses a fixed pattern to select the protection values in automatic mode. First of all, the value of full-load current is selected. In this case, the rated current that results from the transformer power and the system voltage selected is calculated with the following expression:

$$In=Pt/(Tr\times\sqrt{3})$$

The value is rounded up to the next-highest integer number to obtain the full-load current.

All other settings are fixed, as shown in the following table. The user can change any of the values selected by the program in automatic mode.

PHASE-TO-PHASE PROTECTION		PHASE-TO-GROUND PROTECTION	
SETTING	AUTOMATIC VALUE	SETTING	AUTOMATIC VALUE
Overload factor	120%	Earth leak factor	20%
Type of curve	EI	Type of curve	NI
Multiplier constant	0.2	Multiplier constant	0.2
Short-circuit factor	10 (*)	Short-circuit factor	5
Time at trip	0.1 (*)	Time at trip	0.1 (*)
Tripping enabled	DT	Tripping enabled	DT

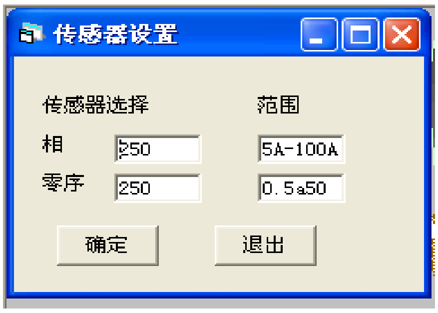
(*) In the case of LKE-DPR-TC protection with 5-100 A range current transformers, the short-circuit factor is 7 and the instantaneous tripping time is 0.4.

As in the case of the "显示菜单" window, the protection settings can be printed from the "用户设置" window in table format or as the resulting curve.

9.6.2 Current sensors

The value of some of the general data of the relay can be checked from this screen.

- Rated phase transformer current (300/1 or 1000/1)
- Zero-sequence current transformer
- Current range for phase-to-phase protection
- Current range for phase-to-ground protection



9.7 Events

The "Events" menu shows the information stored by the relay in relation to various aspects of the protection system.

9.7.1 Trip events log

The relays of the LKE-DPR-TC system store information on the last two trips. For each of the two trips (designated "last" and "next-to-last"), the stored data are as shown in the following table.

DATA	POSSIBLE VALUES	DESCRIPTION
Trip	Zero-sequence,Phase,External trip	Tripped unit
Current	N/A	Current at the time of the trip
Cause	Overload,Short-circuit	Cause of trip
Time	N/A	Time between pickup and trip
Date	N/A	Date on which the trip occurred
Hour-minute	N/A	Time at which the trip occurred

9.7.2 Trip counters

In addition, the user can retrieve information on the number of trips caused by the relay, differentiating between phase-to-phase, zero-sequence, and external trips.

9.7.3 Date and time at last setting

All relays keep information on the date and time of the last time the settings were changed.

Appendix

To commission the equipment properly, follow the steps indicated below:

1. Check the power rating that needs to be protected:

CGMCOSMOS SYSTEM			
Network voltage	Rated fuse Voltage	MINIMUM Transformer power	MAXIMUM Transformer power

[kV]	[kV]	Fuse rating [A]	[kVA]	Fuse rating [A]	[kVA]
6,6	3/7,2	16	50	160 (1)	1250
10	6/12	16	100	160 (1)	1250
13,8	10/24	16	100	125	1250
15	10/24	16	125	125 (2)	1600
20	10/24	16	160	125	2000

CGM SYSTEM					
Network Voltage [kv]	Rated fuse Voltage [kv]	MINIMUM Transformer power		MAXIMUM Transformer power	
		Fuse rating [A]	[KVA]	Fuse rating [A]	[KVA]
6,6	3/7,2	16	50	160 (1)	1000
10	6/12	16	100	125	1250
13,8	10/24	10	100	63	800
15	10/24	16	125	63	1000
20	10/24	16	160	63	1250
25	24/36	25	200	400	1000
30	24/36	25	250	40	1250

2. Current Transformers

The current transformers installed on the cable.

The earthing shield must **NOT** go through the inside of the toroidal transformer when it comes out of the part of cable situated below the toroidal transformer. The earthing shield **MUST** go through the inside of the toroidal transformer when it comes out of the part of cable situated above the toroidal transformer. In this case, the earth connection goes through the inside of the toroidal transformer before it is connected to the ground bus of the cubicle. Make sure that the earth conductor does not touch any metal part such as the cable clamp or other areas in the cable compartment before connecting the earth bus of the cubicle.

3. **Set the relay**

Automatic mode:

kV and kVA of facility

Manual mode:

Settings: l>, I_0>, I>>

Table of settings:

PHASE-PHASE	In=S/（U_N×	Curve	Instantaneous	I>	K	I>>	T>>

FAULT SETTING	√3）	EI	TD	1.2	0.2	7	0.4
PHASE-TO-EARTH FAULT SETTING	Type of neutral	Curve	Instantaneous	Io>	Ko	Io>>	To>>
	Solid or impedance	NI	TD	0.2	0.2	5	0.4
	Isolated or compensated	NI	TD	0.1	0.2	5	0.4

4. **Tripping test with current injection**

Open the earthing switch, and then close the circuit breaker.

• Remove 230 VAC (G1-G2) to check that self-power supply works properly.

• Inject the test current:

- Through two testing points for phase-to-phase fault tripping
- Through one testing points for phase-to-ground fault tripping

• Repeat for I1, I2 and I3.

5. **External tripping test.**

Shortcircuit J1

6. **Commissioning.**

• Check $\mathbf{I_1 \approx I_2 \approx I_3}$.

• Check $\mathbf{I_0 \approx 0}$.

7. **What to do if:**

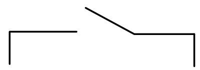
ERROR	**REASON**	**POSSIBLE CAUSES**
Error 01	Thermometer	➢ Thermometer connected to 230 VAC
Error 03	Circuit breaker	➢ Circuit breaker mechanically locked ➢ Relay tripping wiring fault ➢ Auxiliary contacts fault
I0≠ 0	Fault, cable screen not properly connected or secondary circuit disconnected	➢ Check that cable screen and/or secondary circuits are not poorly connected
I2≠ I	Unbalance	➢ System unbalance ➢ Improper connection of current transformers ➢ Check secondary circuits
I123 > 5A and ‘On’ LED is off	Self power	➢ Power supplying current transformers poorly connected ➢ Relay wiring not properly connected
Relay tripping due toI0>> when closing circuit breaker	insufficient time T_0 >>	➢ Real fault exists ➢ Check if T_0 >> sufficient, considering vector sum error of toroidal transformers
Relay tripping due to I>> when closing circuit breaker	Insufficient I >>	➢ Real fault exists ➢ Check I >> setting, considering transformer

		current peak (10 times In)
Relay does not communicate	Communication fault	➢ Communication cable is not properly connected ➢ Relay in energy-saving mode. Press a relay key. ➢ Wrong communication settings

A

1	2	3	4	5	6	7	8
GIA1	GIA2	GIB1	GIB2	GIC1	GIC2	-	+
Phase A self-power supplying		Phase B self-power supplying		Phase C self-power supplying		Self-power supplying	

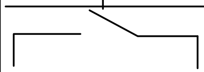
B

1	2	3	4	5	6	7	8
GND					L		N
Ground			Faults warning		AC input		AC input

C

1	2	3	4	5	6	7	8	9
I01	I02	Ic1	Ic2	Ib1	Ib2	Ia1	Ia2	GND
Zero-sequence current		Phase C Current		Phase B Current		Phase C Current		Ground

D

1	2	3	4	5	6	7	8	
								
				DC24V		485 communications port		