The PEFLO Protection Relay

Reference Manual

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1. Introduction

The Pilot Earth Fault Lock Out (PEFLO) relay is a microprocessor controlled protection relay specifically designed to protect distribution outlets found in underground coal fiery mines. It provides sophisticated protection but at the same time remains extremely user friendly.

The PEFLO relay successfully combines Earth Fault, Earth Fault Lockout and Pilot relay functions into one relay. As an added bonus the relay incorporates Frozen Contact Protection and also allows fail-safe addition of four extra interlocks. Amongst these are dedicated overload and short circuit inputs, which allow for the automatic selection of two short circuit tripping regimes. The relay has retentive battery-backed-up indication for short circuit and frozen contact trips which is particularly useful when power is removed from the system under such fault conditions.
Pilot, earth fault, earth-fault lockout, and the external interlock inputs all have user options which can be easily preset. Industry standard values are provided, as default (others are easily supplied on request), making the relay extremely versatile and as a result, can be readily adopted as a customer standard.

The display and fault diagnostics are simple to read and colour coded which allow the user to observe settings, running and trip conditions at a glance. There is no laborious or complicated interrogation routines required to reveal the various conditions of the relay.

The PEFLO relay has been designed to be failsafe, extremely user friendly and to provide sophisticated state of the art protection with an absolute minimum of external complexity.

2. Advantages of the Dimako "PEFLO" Overload Protection Relay

The PEFLO protection relay offers the following advantages:

- Three year guarantee.
- Maximum R250-00 repair cost.
- Maximum R480-00 service exchange cost (excluding breakdown transport).
- Designed with world leading technology.
- Tested to numerous IEC specifications.
- Tested to SABS /IEC intrinsic safety.
- Combined Pilot, Earth Fault, earth fault Lockout, Frozen contact and auxiliary input control relay with indication and diagnostics in a single failsafe package.
- Excellent repeatability and stability over full operating range.
- Excellent noise immunity and harmonic rejection.
- Accredited Laboratory tested, in excess of claimed parameters, until failure, to ensure that fail to safe conditions apply.
- Extensive component selection, design architecture and mechanical construction to ensure fail to safe operation.
- Robust and light weight construction.
- Quick and Easy Installation.
- Minimal external wiring required.
- Well proven, industry standard, connection facilities.
- Ergonomic and user friendly display. All status indications visible at one instant. (no menus on liquid crystal screens to wade through to discover set parameters)
- Displays are colour coded and redundant.(healthy and trip indications are also position coded to allow for colour-blind users)
- Diagnostic assistance for fault finding. Particularly with the pilot circuit.
- Two pilot relay specifications regimes in one relay. Automatically selected by Local or Remote modes.
- Pilot specifications in accordance with BS3101.
- Automatic routing of short circuit tripping regimes.
- Frozen contact protection.
- Intrinsically safe battery backed-up indication of short circuit and frozen contact trip conditions.
- Positive feedback via front panel indication of user definable relay settings.
- Wide application base making the relay an easy standard to adopt which reduces spares stock-holding and training time / facilities for the end user.
- Relay can be employed on 120 Vac to 3.3 kV systems and limited 6.6 kV and 11 kV systems.
- Excellent historical performance service records.

4. Relay Indications

All indications provided for by the PEFLO relay are LEDs which are robust and have a very long trouble-free service life. The main status LEDs are large and back illuminate an appropriate text block designating the status.

LEDs denoting setting status and fault diagnostics are small round lights, distinguishing them from the main stream indication.

The Short Circuit Trip and Frozen Contact Trip lights are battery-backed-up since it is desirable that these are maintained during removal of primary power. The battery system is intrinsically safe, and requires replacement after 5 years of service. The user need keep no record of this as Dimako will automatically provide a suitable battery-replacement service.

The front facia is depicted in figure 1 below:

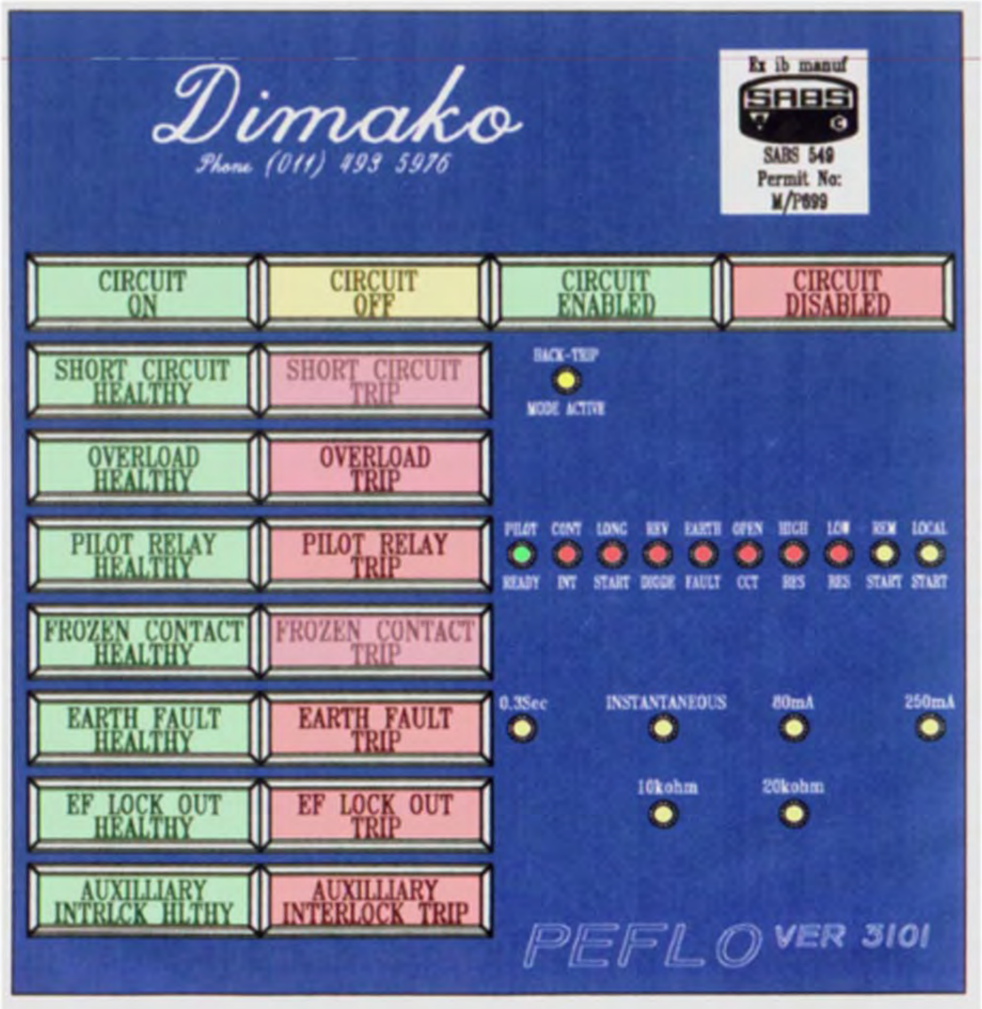

Figure 1: The general layout of the front panel of the PEFLO protection relay

The colours of the respective indications are shown.

Note: the colours shown are for information only and are not all present at the same time. Short-circuit trip and frozen-contact trip are flashing indications that require resetting via the reset button, as detailed under the section "Controls".

The following indications are provided for:

a.	Circuit On....	Green
b.	Circuit Off.....	Yellow
c.	Short-circuit Healthy...	Green
d.	Short-circuit Trip...	Red ...flashing battery backed up
e.	Short-circuit back trip mode....	Yellow

f.	Overload Healthy....	Green
g.	Overload Trip	Red
h.	Pilot Healthy....	Green
i.	Pilot Trip	Red
j.	Pilot ready....	Green (remote mode)
k.	Contactor interlock....	Red (remote mode)
l.	Long Start...	Red (remote mode)
m.	Reverse Diode	Red
n.	Pilot Earth fault(short cct)	Red
o.	Pilot open circuit	Red
p.	Pilot High Resistance	Red
q.	Pilot Low resistance	Red (remote mode)
r.	Remote Start Mode	Yellow
s.	Local Start Mode	Yellow
t.	Frozen-contact healthy...	Green
u.	Frozen-contact trip....	Red ...flashing battery backed up
v.	Earth fault healthy..	Green
w.	Earth fault trip....	Red
x.	Earth fault time delay 300 mSec	Yellow
y.	Earth fault instantaneous	Yellow
z.	Earth fault 80mA	Yellow
aa.	Earth fault 200mA	Yellow
bb.	Earth-fault lockout healthy	Green
cc.	Earth-fault lockout trip	Red
dd.	Auxiliary Interlock healthy	Green
ee.	Auxiliary Interlock trip	Red
ff.	Circuit Enabled	Green
gg.	Circuit Disabled	Red.

The trip and healthy indications are separate but arranged in a vertical fashion with healthy on the left and trip on the right. The separation of the indication also allows colour blind personnel, who are familiar with the relay, to distinguish quickly between tripped and healthy conditions without having to read the text. This avoids the pitfall of using only colour to designate the trip status, via bi colour LEDs, with a common legend such as “pilot circuit”.

The separate indications also provide for redundancy and the user can easily tell if an LED is malfunctioning since at least one light must always be on for each parameter of the relay. Should there be no indication for the particular feature; the user can tell immediately that either the trip or healthy light is blown.

The indications are arranged so that all status parameters of the relay can be seen at a single glance (as opposed to paging through a number of menus on a liquid crystal screen, which requires a certain amount of “computer literacy” and a good comprehension of the language displayed, which normally contains numerous abbreviations). However, a number of text abbreviations have been used on the PEFLO relay: this is limited to subsidiary indications, which are generally used by more capable personnel, when either setting the relay or interpreting faults on the pilot circuit.

5. Controls

Reset button:

When the PEFLO relay has tripped with a latching function (discussed below) it can only be re-enabled with this button once the fault is removed. Obviously if the fault persists the particular protection circuit cannot be reset.

The reset push button will always require use after power up, since both earth fault and earth fault lockout will be latched in the trip state (this forms part of the fail safe feature of the relay).
When the reset push button is engaged the main interlock relay of the PEFLO is de-energised: this is to prevent the user from

- jamming the reset button in an attempt to bypass the relay’s protection features
- attempting to engage the PEFLO relay in an auto reset mode.

The reset push button can also be used to test the indication LEDs on the front of the relay. The short circuit and frozen contact trip lights are not tested with this method. When the reset button is engaged all other indication lamps are flashed alternately between the healthy and trip states.

Parameter Switches:
When the user faces the front of the relay, a small hole, in the black-plastic side of the box, can be found on the lower right hand side of the relay. This hole should have a cover cap installed. Located behind this cover is a number of small switches. These switches provide control of the following functions.

Switch No #1. Auxiliary Interlock latching or non-latching.

Switch No #2. Earth fault lockout 10 or 20 kilo-ohm.

Switch No #3. Earth leakage trip instantaneous or delayed by 300mSec

Switch No #4 Earth Leakage trip level 80 mA or 200 mA.

The various selections are obtained by turning the corresponding switch either on or off. Since the switches are small and not easily seen there may be some confusion as to whether the switch is on or off. To avoid this, visual confirmation of the selected mode is provided on the front of the relay.

The location of the of the parameter switches is shown by the red arrow in Figure 2 below.

Figure 2: The location of the parameter setting switches on the side of the PEFLO Relay

6. Outputs

The PEFLO is provided with two output relays each providing the user with a single change over contact.

- One relay is designated as the Main Interlock Relay. This relay is normally de-energised and is energised only under healthy conditions. Any fault condition detected by the PEFLO will result in the de-energisation of this relay. Considerable effort has been made to ensure the fail safe operation of this relay and some unique technology has been incorporated to accomplish this.

- The other relay is responsible for back-tripping to a protective device, which is located upstream, in the power circuit, from the device controlled by the Main Interlock Relay.
  If the PEFLO detects a frozen contact condition, on the device under control by the main interlock relay, it will always use this relay for back-tripping purposes.

However if the PEFLO receives a short-circuit condition, the tripping regime can be coordinated in two ways:

a. if the device under control by the main interlock relay is a circuit breaker a short circuit condition will cause this device to trip by routing the short circuit trip signal to the main interlock relay.
b. if however the device controlled by the main interlock relays is not rated to handle the full short circuit rating of the supply, then a short circuit trip condition is routed to the back trip relay. This in turn will clear an upstream device that is capable of interrupting the short circuit fault level of the supply.

The PEFLO detects which mode is required by monitoring the hard-wired status of two of the rear terminals. When the relay is in back-trip mode for short circuit conditions lamp “e” in the relay-indication list above will be illuminated.

The PEFLO Relay Terminals

The terminals used on the PEFLO relay are industry standard terminals. The contacts and their self-cleaning wiping action are well proven and have been adopted by numerous manufacturers as a standard. The contacts are well overrated for the duty for which they are employed on the PEFLO relay.

A rear view showing the terminals of the relay is depicted in figure 3 below

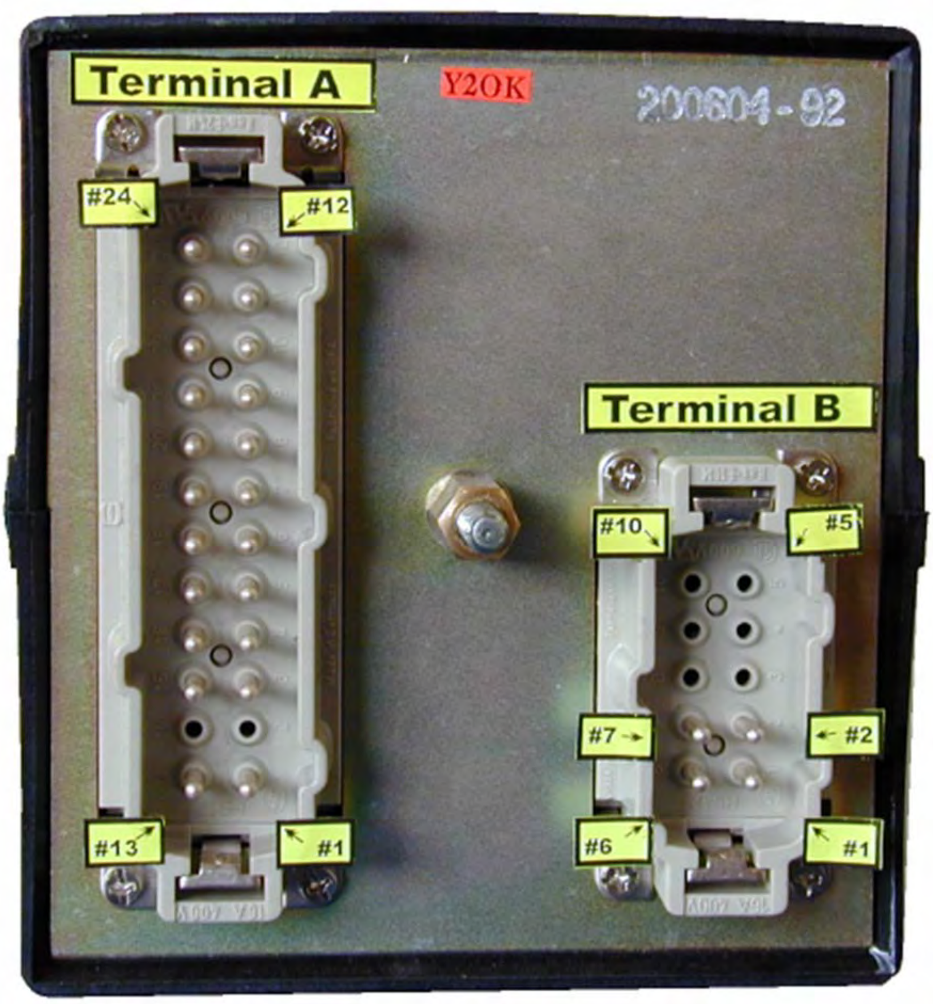

Figure 3: The rear terminal layout of the PEFLO Relay

The tables on the next page provide a quick reference guide and a brief functional description of the PEFLO relay terminals. The terminals are grouped together according to function and are colour-coded to assist with identification of the various functional categories

6.1. Terminal Descriptions

The PEFLO relay Terminal Description and Application Information

Terminal Block A	Description	Application note
#1	Power Supply	Neutral 110 Vac
#13	Power Supply	Live 110 Vac
#6	Back trip Relay : Normally closed contact	The back trip relay is normally de-energised
#7	Back trip Relay : Normally open contact	and will energise on a fault condition.
#8	Back trip Relay : Common of change over contact	See the appropriate section in the functional description section.
#9	Main Interlock Relay : Normally closed contact	The main interlock relay is fail-safe and energises when the relay is healthy
#10	Main Interlock Relay : Normally open contact	Terminals #10 and #11 are closed when the relay is healthy
#11	Main Interlock Relay : Common of change over contact	Terminals #9 and #11 are closed when the relay is NOT healthy
#15	Common connection for external interlocks	Terminal # 15 provides a common connection for terminals #16 through to #23.
#16	Contactor or Circuit breaker mode	Link to terminal #15 for Contactor mode (see functional description section.)
#17	Overload input	Connect to terminal #15 for a healthy overload condition
#18	Circuit Breaker Trip input	Connect to terminal #15 for a healthy condition
#19	Local or Remote	Connect to terminal #15 for Remote mode (described in the functional description section)
#20	Reset	Connect to terminal #15 to reset latching faults. The main interlock relay will drop off in the reset mode (regardless of relay status) and will only energise when the relay is healthy and the reset input is disengaged.
#21	Power Circuit On / Off	Connect to terminal #15 when the power circuit is connected to the load.
#22	External Auxiliary Input	Connect to terminal #15 for a healthy condition. This is a user specified input and can be used for

Terminal Block A	Description	Application note
		interlocking requirements such as “total overload”, fan interlocking, sequence starting etc.
#23	Short Circuit Input	Connect to terminal #15 for a healthy condition
#12	Core Balance CT input	This input is used for sensitive earth fault. The range of sensitivity can be selected by using different core balance CTs.
#24	Core Balance Ct input	Input sensitivity can be as low as 20 mA with the appropriate core balance CT.
#2	Not used	
#3	Not used	
#4	Not used	
#5	Not used	
#14	Not used	

Terminal Block. B	Description	Application note
#1	Earth Connection for Earth Fault Lockout	Must be connected to Earth for Intrinsic Safety
#2	Earth Fault Lockout Search Circuit	Output is Intrinsically safe: Observe accepted I/S wiring practices.
#3	Not used	
#4	Not used	
#5	Not used	
#6	Earth Connection for Pilot Circuit	Must be connected to Earth for Intrinsic Safety
#7	Pilot output	Output is Intrinsically safe: Observe accepted I/S wiring practices.
#8	Not used	
#9	Not used	

Terminal Block. B	Description	Application note
#10	Not used	

7. Functional Description of Protection Features

All of the various inputs to the PEFLO have been designed for fail safe operation. Consequently all potential free contact inputs are closed for the healthy state. Although the inputs are designed for potential free contacts they can handle severe abuse and are designed to handle inappropriate voltages of up to 250 Vac on the inputs. The Pilot and Earth fault lockout circuits can handle restricted fault level inputs of up to 1 Amp at 3300 Vac and 2.5 Amp at 1000 Vac.

7.1. Short Circuit and Overload Protection

The Short Circuit and Overload inputs allow the relay to be interfaced with all overload relays that provide such protection. The best protection is achieved when the PEFLO is used in conjunction with the microLOAD overload protection relay.

The overload function is non-latching and the trip and healthy display lamps will always follow the actual relay status. The overload trip function is interlocked with the main interlock relay of the relay, and will de-energise whatever protection device the relay controls.

However the overload input is also interlocked with the pilot relay, and when the latter is in remote start mode, the pilot will be tripped automatically (with the appropriate indication), and the relay will require a manual start signal from the pilot system even if the overload resets itself automatically. This prevents inadvertent or unexpected re-starting of the load after the overload is reset and conditions return to healthy.

The short-circuit tripping regime however is different and can be either interlocked with the main interlock relay or can be routed to the back trip relay of the PEFLO. Back trip mode is employed when the PEFLO is controlling a contactor or other device that is not rated to break the full short circuit fault level of the system. The short-circuit input logic is also non-latching (as far as the PEFLO relay logic is concerned) and the appropriate output-relay state shall persist as long as the input contact remains open or the power supply is removed (via a back trip command). The tripping regime is programmed by connecting (hard wiring) two contacts on the rear plug of the PEFLO relay. Therefore, even if the relay is removed and replaced by another relay the tripping regime is preserved.

Note: Please take note that the short circuit indication is latching and will require manual resetting; this can be done only with power on the relay. The indication will be maintained even if power is removed from the relay. The short circuit trip indication is flashed at approximately 1 Hz to conserve the backup battery. The battery is rated to run the indication continuously for one year and has a conservative five year shelf life. All installation dates and end users of the relays are recorded by Dimako and a simple exchange program will be adopted to replace the batteries. With our latest advances we have been able to extend battery life and replacement systems starting in June 2001 will have a shelf life of ten years and will be able to run for a continuous period of 2 years.

7.2. Pilot protection

Since the pilot relay is microprocessor controlled it can be programmed to most specifications. The PEFLO ver 3101 adopts the British spec BS3101 for its pilot parameters. This specification essentially has two pilot regimes:

- The standard pilot interlock which is related to the NCB P130 specification and
- The resistor proving specification which is related to the NCB BZ1 specification for remote starting regimes.

The exact detail of the actual specification is available in the specification itself and the regime will only be briefly addressed here.

The Dimako PEFLO relay adopts the P130 regime when the relay is selected in local start mode and adopts the BZ1 regime when remote start mode is selected.

Since the specifications are not very well known in this country comprehensive indication is given of the pilot status to assist the end user with system maintenance. The main indication of healthy and trip are colour coded **green** and **red**, respectively, and indicate whether the pilot is active or not.. The remaining indications are smaller, and are coloured red**, green** or **yellow**; they are interpreted as follows:

i) Pilot ready.... **Green**
This indication is used in remote mode only. It means that a 30 (thirty) ohm resistor in series with a diode connected to earth (cathode to earth) has been detected and the pilot circuit is ready to accept a start command.
- By shorting out the 30 ohm resistor with a start push button the pilot will only become active and start the circuit when the push button is released within 3 seconds of initial pressing. (Obviously all other interlocks must be healthy for the PEFLO to start.)

ii) Contactor interlock.... **Red**
In remote mode the status of the main contactor is monitored and should the latter de-energise a healthy pilot will be set to the trip state. This renders a safe condition, where inadvertent motor start up is prevented. The pilot circuit will have to be restarted when the system is healthy again.
Without this indication it can be confusing when the stoppage is investigated:
- sometimes, when auto reset equipment is employed, indication of the initial fault can be reset without the user's knowledge and he is presented only with a pilot fault. Under such circumstances the user may well conclude that the pilot circuit is faulty. However, with the PEFLO system, the "cont int" indication is latched and will inform the user of the reason for pilot trip.

iii) Long Start... **Red**
This indication is only active in the remote start mode. As detailed above under "pilot ready" a start command must be less than 3 seconds. This is done to prevent the end user from jamming the start push button, in an attempt to facilitate an auto start mode. The long-start indication is activated after a successful pilot ready status and the consequent start command is longer than 3 seconds. Releasing the start push button and repeating the process within the appropriate time frame will clear the indication and result in a pilot healthy state.

iv) Reverse Diode **Red**
The Reverse diode indication is active in both modes and means that a diode has been detected but connected the wrong way around. (Anode to earth) The pilot relay cannot be made healthy with the diode in this direction.

v) Pilot Earth fault ("pilot short cct") **Red**
When this light is illuminated it means that the pilot circuit has found conduction to earth in both positive and negative directions. This is equivalent to a pilot short to earth. A blown diode, two back to back diodes, and some zener diodes in place of the conventional diode can also result in this indication.

vi) Pilot open circuit **Red**
Pilot open circuit means that no diode at all has been detected or the pilot series resistance exceeds 100 ohms.

vii) Pilot High Resistance **Red**
Pilot high resistance means that a diode of the correct polarity has been sensed but the earth bond resistance is not low enough to satisfy the pilot specification.

viii) Pilot Low resistance **Red**
This indication is only used in the remote start mode. When illuminated it means that the resistance is below the required 30 ohm value and is preventing a pilot ready state. This status is different from the long-start mode since a pilot-ready status was never achieved. This typically happens when the PEFLO is switched from local to remote with only a diode in the pilot circuit.

ix) Remote Start Mode **Yellow**
When this light is on it means that the pilot is in the BZ1 regime for remote starting.

x) Local Start Mode **Yellow**
This mode is selected and the pilot adopts the P130 regime.

The pilot circuit in the PEFLO is very robust and can accept a phase to pilot fault on 1000 V 2.5 Amp earth fault restricted systems. Components however, do become very stressed under these conditions and it is advisable for long term reliable operation to clear this state. This can be done automatically if the relay is used in conjunction with the Dimako Pilot Transient Suppressor unit. This unit clamps the voltage from the 1000 Volt fault and in so doing blows a specially selected fuse which clears the PEFLO relay from the fault.

Application note:

It is very often found that 1 Amp fuses do not blow with a 1000 Volt to pilot fault: this can be attributed to the earth fault restriction resistor and any other series resistance that might be present in series with the fault. 500 mA fuses have been employed with a much greater degree of success; unfortunately these tend to have a rather high resistance, which detracts from the overall allowable earth bond resistance. Dimako selects special fuses with low resistance for use with the transient suppressor.

The pilot circuit has also been designed and specially adapted to work reliably and accurately under harsh and very noisy (electrical) conditions. Consequently the circuit provides trouble-free operation where induced harmonics and electrical disturbances can be troublesome.

7.3. Frozen Contactor

This aspect of protection is extremely important since human life may be endangered if it is assumed that a circuit breaker or contactor has totally cleared an outgoing circuit. In Dimako panels the protection is twofold. “Live line indication” is given on panels and in the event of a frozen contactor or circuit breaker pole the indicator will show the presence of voltage. However the PEFLO relay also incorporates protection against frozen contact. Should the circuit detect voltage on the dead side of a circuit breaker or contactor it will back trip to the nearest up stream device via the back trip relay. There is a built- in time delay depending on the magnitude of the voltage detected to prevent nuisance tripping when connecting cables and motors to the system.

The back trip relay will remain operated until the power is removed and the fault condition removed.
The indication is latching and backed-up via a battery so that the indication persists even through power failure. See the section on short circuit indication for more detail on the battery service life and its replacement.
The indication requires manual resetting when power is restored to the PEFLO relay.

7.4. Earth Fault

The earth fault protection is driven from a sensitive core balance current transformer connected to the PEFLO relay. Dimako has a number of different core-balance transformers that can be used in conjunction with the PEFLO to provide protection from 5 Amps down to 20 mA. The 20 mA range is generally used for hand held equipment such as drilling machines etc. however Dimako has a number of successful nuisance free applications where 40 mA protection is provided on power outlets up to a rating of 240 kW.

The standard set parameters provided are 80 and 200 mA, with either level set to instantaneous or 300 mSec definite trip time delay. See the section on controls for details on setting these parameters.

The actual trip level settings and time delay are displayed on the front of the relay via yellow indication LEDS. The circuit action and indication are both latching and can only be reset manually via the reset push button connected to the PEFLO terminals.

7.5. Earth Fault Lockout

The earth fault lockout circuit is intrinsically safe and is coupled to the outgoing cable connections via and inductive “false neutral”. The circuit is only activated when output power is disconnected from the load. The activation is only made 3 seconds after de-energisation of the outlet and is only made by SABS IS approved relays. This time delay is to allow cable and motor capacitances to discharge and other disturbances to decay. The input has much the same over-volt transient protection as does the pilot circuit and is very robust. However extra transient protection is not necessary here since the circuit is also protected by the impedance of the false neutral.

As a standard, earth fault lockout levels can either be set to 10 or 20 kohm: for setting see the section on controls.

The 10 kohm range is generally used for systems of 1000 V and below and the 20 kohm range is used for 3300 V systems.

The circuit action and indication are both latching and can only be reset manually via the reset push button connected to the PEFLO terminals

7.6. Auxiliary Interlock

The PEFLO relay can also accept an auxiliary interlock input. This could be from an air flow circuit, a drive sequence interlock, total overload, or any other desired control. The input must be in the form of a potential free contact or open collector type input. With the contact in closed position the circuit shall be deemed to be healthy.

The action of the input can be made to be either latching or non-latching. See the section on controls for details on setting.

For the specific protection detail provided by this input, reference can be made to the appropriate electrical drawing or to any extra labelling provided on the panel.

7.7. Circuit Enabled/Disabled

The last input is another auxiliary input that can be user defined. This circuit in non-latching. This circuit is generally used by Dimako for inputs such as Low Gas (in SF6 switches), Circuit breaker trip (on thermal/magnetic breakers), or fault inhibits (from other external diagnostic equipment).

For the specific protection detail provided by this input, reference can be made to the appropriate electrical drawing or to any extra labelling provided on the panel.

8. Dimako PEFLO relay Specification Sheet

General data:

Supply voltage	110 Vac
Internal fuse	200 mA
Operating range	80% to 120%
Brown out holding limit	60%
Frequency	50 Hz
Supply current max	130 mA
Duty cycle	continuous
Mounting	Panel mount bracket
Retaining	Single M6 stud with nylock nut
Housing	Glass filled nylon/mild steel backplate

Connection:

Type	Heavy duty self-cleaning captivated male/female
Contact resistance	1 milli-ohm typical
Rated current	10 A max.
Housing	Glass fibre filled thermoplastic
Insulation group	C
Relay connection	Male plug pin type
Panel connection	Female screw type terminal
Panel wire size	0.5 mm² to 2.5 mm²

Outputs:

Main interlock relay	1 change over contact
Back Trip relay	1 change over contact
Voltage	250 Vac / 30 Vdc
Current	10 Amp
Capacity	4 000 VA / 480 W
Contact resistance	30 milli-ohm
Service life	100 000 severe conditions 5 000 000 light duty

Insulation:

IEC 255-5	Rated insulation voltage 500 Vdc / 3 kVac
IEC 255-5	Impulse withstand voltage 5 kV

Electrostatic Discharge:

IEC 255-22-2 class 2

Fast Transient:

IEC 255-22-4 class II

Radiated Immunity:

IEC 255-22-3 class III

Performance:

Intrinsic safety	SABS 549- 1993 pilot and earth fault lock circuits
Pilot circuit	BS3101 : 1986
Earth fault	Selectable 4 or 10, 40 or 80, 80 or 200 mA, instantaneous or 300 mSec definite time delay
Earth fault lockout	Selectable 10 or 20, 20 or 40 kohm
Auxiliary Input	Selectable latching or non-latching

Environment:

Temperature range	-25ºC IEC 68-2-1 to +70ºC IEC68-2-2
Humidity	up to 95% 55ºC IEC 68-2-30 severity 6 (4.2b)
Altitude	2 000 m max
Storage temperature	-40ºC to +70ºC

Shock response	10g / 11 ms	IEC 255-21-2 class 2
Shock withstand	30g / 11 ms	IEC 255-21-2 class 2
Bumping resistance	20g / 16 ms	IEC 255-21-2 class 2
Vibration immunity	0.075mm/1g	IEC 255-21-1 class 2
Dust ingress	IP54	IEC 529 catagory 2

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