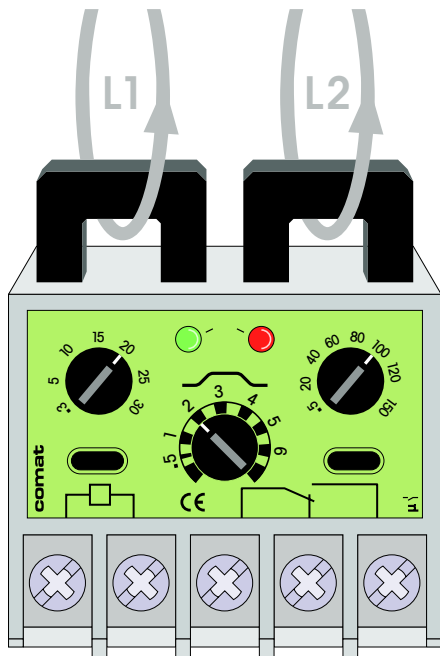
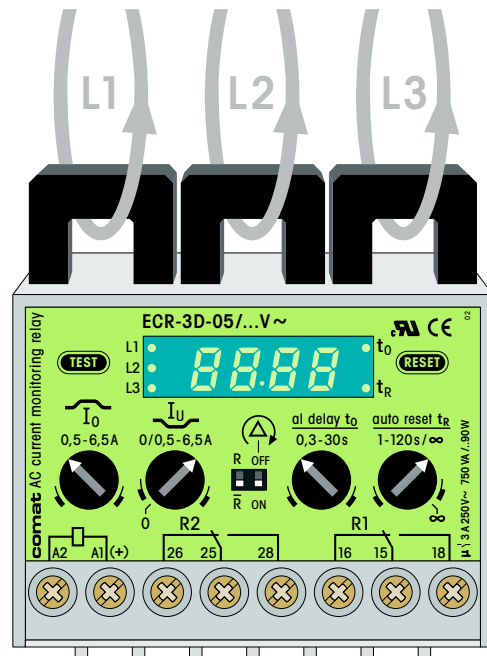


Application Note

AC Current Monitoring



EOCR-AR
EUCR-BR



ECR-3D



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Introduction

The EO-CR-AR is a two-channel **AC overcurrent relay** with integrated current loop transformers for alternating current with an adjustable alarm delay and reset time.

The EO-CR-BR is a two-channel **AC undercurrent relay** in the same style and construction as the AR.

The EO-CR-3D combines both features of the AR and BR and beyond that has real 3 phase current measuring characteristics as well as a digital display for the indication of settings and measured values.

The technical data is described in data sheets:

EO-CR-AR: 66001-02-57-400

EO-CR-BR: 66002-02-57-400

EO-CR-3D: 66005-02-57-400

Example of possible applications are shown below (they may in some cases overlap or supplement each other).

The examples shown are applicable for one, two or three-phase applications and for applications controlled by a PLC.

General notes

The device can be used without additional current transformers from approx. 0.1 to > 60 A.

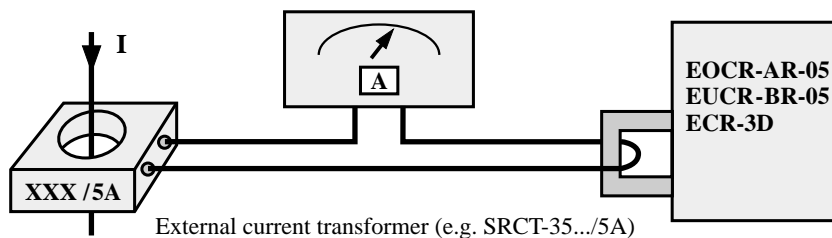
For higher currents, or design reasons external current transformers are recommended together with device version -05.

A suitable ammeter can be used as indicated below.

The EO-CR/EO-CR-BR are available in UC 24 V \approx , AC 115 V \approx or AC 230 V \approx .

The EO-CR-3D is available in UC 24 V \approx , AC 110-240 V \approx .

Principle



Note: For single phase application, with EO-CR-BR or EO-CR-3D with **undercurrent function**, the conductor cable has to be looped through all current transformers ($[I_1 \text{ and } I_2] > I = \text{ok!}$ **Respectively** $[I_1 \text{ and } I_2 \text{ and } I_3] > I = \text{ok for EO-CR-3D!}$).

Example Range Adaptation

For adapting the current range to lower values, it is possible, to loop the power cable up to 5 times, depending on the wire diameter through the current transformer.

Example:

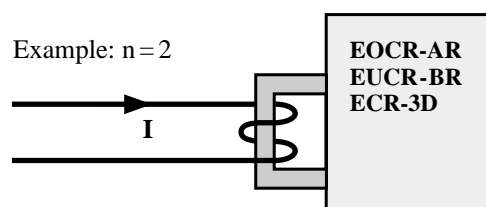
A current of $0.2 \div 2A$ is to be measured:

Version -05 should be selected and wired with 2 loops through the current transformer.

Formula:

$$I_{\text{Meas}} = \frac{I \times n}{I(\text{Setting})}$$

n = number of loops

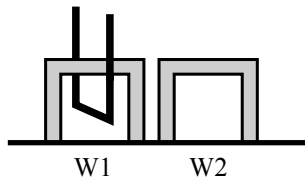


Wiring of measuring loop

Preliminary remark:

It is basically not important if the power is measured at the phase or at the neutral. If measured in the neutral conductor, there may be possibilities of an easy measurement of added currents, especially in three phase supplies.

1

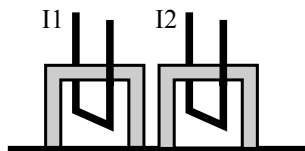


Application of over current monitoring in one current path with **EOCR-AR**.

Attention:

This set up is not possible for under current monitoring with EUCR-BR.

2



Application with **EOCR-AR**, but with two current paths.

The direction of current flow is not important.

The logic is:

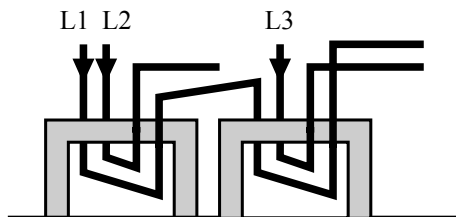
I1 or I2 to high = failure

This set up is also suitable for under current monitoring of two current paths with **EUCR-BR**.

The logic is:

I1 or I2 to low = failure.

3



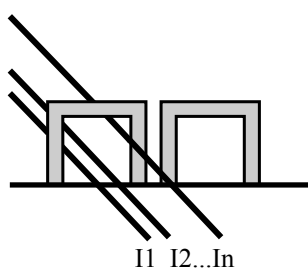
Application over/under-current monitoring in a 3-phase supply with **EOCR-AR** or **EUCR-BR**.

Direction of winding and current direction has to be correct.

The measured current is the result of the geometrical addition of currents.

If symmetrical, i.e. $IL1 = IL2 = IL3$ the result is $I = IL1 \times 1,732$.

4



Principle of accumulated current and differential current measurement.

An accumulated current total results if the flow direction in all conductors are equal.

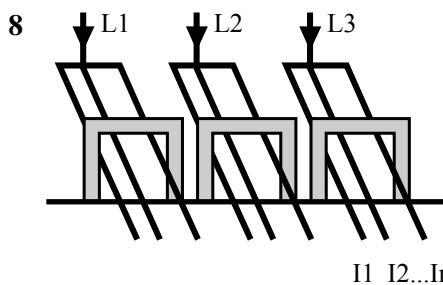
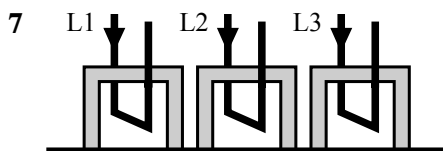
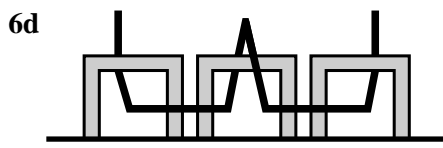
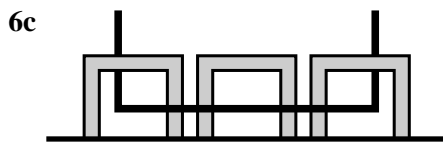
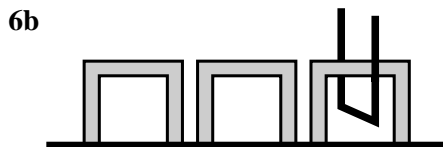
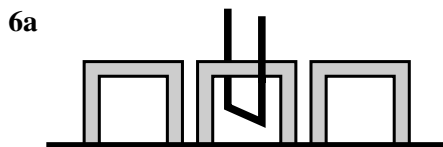
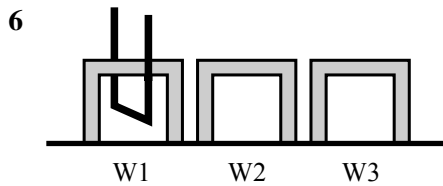
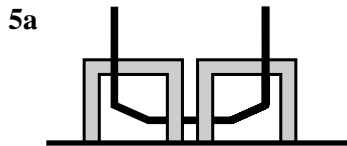
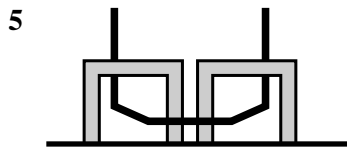
Differential current is the result if the flow direction in at least one conductor is in the opposite direction.

With phase shifted currents, the result is a geometrically accumulated / differential of the various currents.

This set up is, -analogue to examples 1 and 2- is also possible with the second current transformer as well as with both current transformers at the same time.

Example:

Formation of aggregated sections in order to receive better selectivity distinctions.



As application 1, **EOCR-AR** with one current path.

The current direction is not important.

The logic is:

IW1 = IW2 to high = failure.

This set up is the easiest way for under current monitoring of one current path with the **EUCR-BR**.

The logic is:

IW1 = IW2 to low = failure.

Set ups 5 and 5a are identical.

As example 1 for over-current monitoring of one single current path but with **ECR-3D**.

Examples 6, 6a, 6b, 6c are identical.

Attention

For applications according to examples 6, 6a, 6b, 6c; under voltage monitoring has to be deactivated (Potentiometer I to be turned in anti clockwise direction to the dead stop).

As application 5, 5a for over/under current monitoring, but with **ECR-3D**.

The flow direction of the current is not important.

Application for over/under current monitoring of 3 current paths or 3-phase supply (L1, L2, L3) with **ECR-3D**.

If the phase sequence is also monitored (DIPSwitch) flow direction has to be observed as shown.

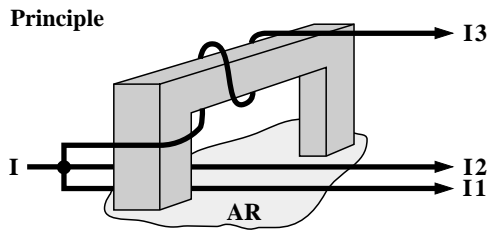
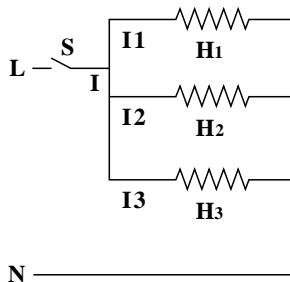
Set up similar to application 4, over/under current monitoring of 3 x n current paths in 1-, 2- or 3-phase arrangements with **ECR-3D**.

If phase sequence is also monitored (DIPSwitch), the flow direction has to be observed as shown.

Example 1: Monitoring of electrical heating systems

In an electrical heating system used in industrial operations, electrochemical plants, emergency power generating units, bakeries, injection moulding machines, etc., the individual heating sections are to be monitored for interruption.

Solution 1.1: Differential current system with EOCR-AR



ok: $I1 + I2 - 2 \times I3 = 0$

Remarks

With the AR version for example, Type..05/... a differential current ≥ 0.35 A is detected and provides a very simple, universal and economical solution.

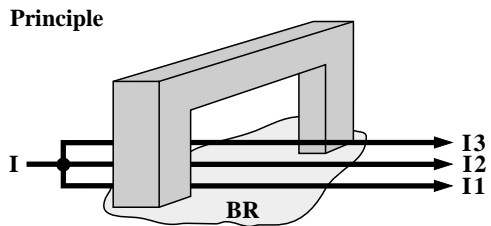
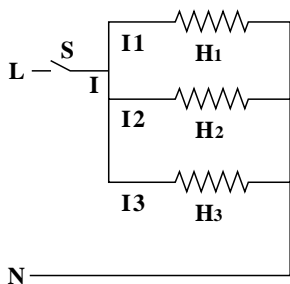
A failure is detected in case of a differential current. (Asymmetry \rightarrow Overcurrent)

Advantage: This solution is independent of the power supply and the absolute heating power.

Earth leakage can also be detected.

Disadvantage: A total interruption of the heating system is not detected.

Solution 1.2: Absolute current system with EUCR-BR



ok: $I1 + I2 + I3 = I > I_{nominal}!$

Remarks

The total current is measured. Type of monitoring relay dependent on the total current.

Disadvantage: An overcurrent or a short circuit in one heating element is not detected.

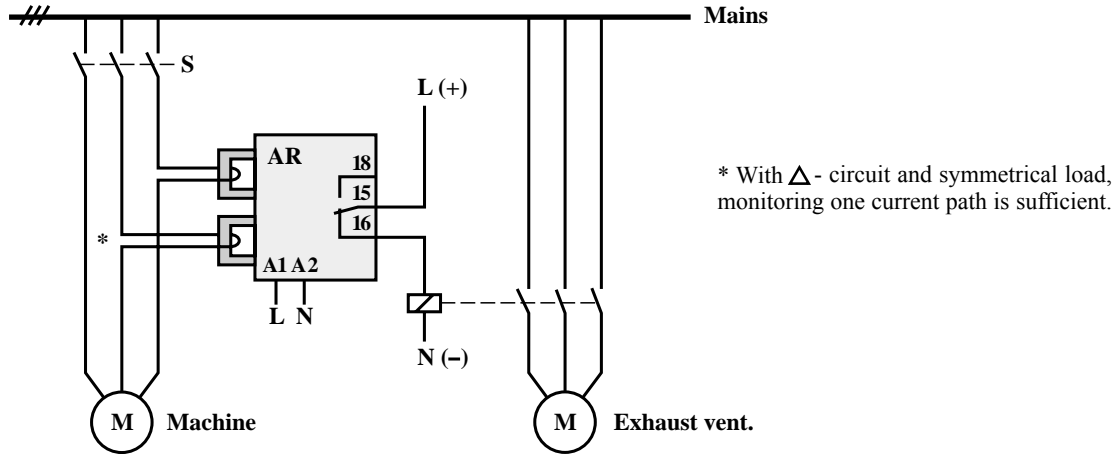
Advantage: Total power interruption is detected. Tolerances on the supply have to be considered.

Cost: Practically the same as with a EOCR-AR (solution 1.1).

Example 2: Control system for exhaust systems

When a processing machine (e.g. a grinding machine, planer, milling machine or saw, etc.) is switched on, or when an exhaust device or a conveyor (e.g. ventilator, pump, etc.) has to be activated with an ON/OFF time delay.

Solution: Overcurrent principle with EOCR-AR



Remarks

The advantage of this arrangement is that the exhaust air-ventilator actuation can be started load-dependent with a time delay, avoiding an inrush current.

Additionally the AR allows the setting of an after-running function, (off delay) of up to 120s. This can be used, for example, for suction of residual dust or exhaust gases, emptying of conveyors, etc.

The solution results in cost savings for wiring and eliminates additional control components.

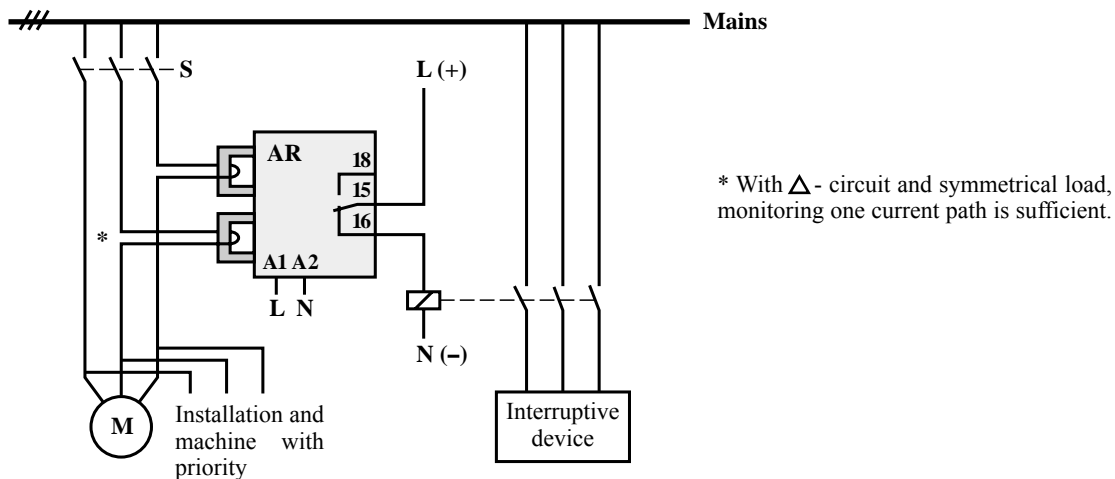
Example 3: Control of load limitation

Several devices can be operated by one supply line.

For example peak load limitation (electricity power costs), fuse protection of the supply line, when a machine is switched on with priority, or operation of other machines and devices (e.g. the heating system) with lower priority should be impeded. Such applications are typical for agricultural equipment, construction sites, other mobile installations, household (washing machines/tumblers) etc.

Solution: Overcurrent principle with EOCR-AR .

Dependent on application and philosophy of security the EUCR-BR can also be utilised.

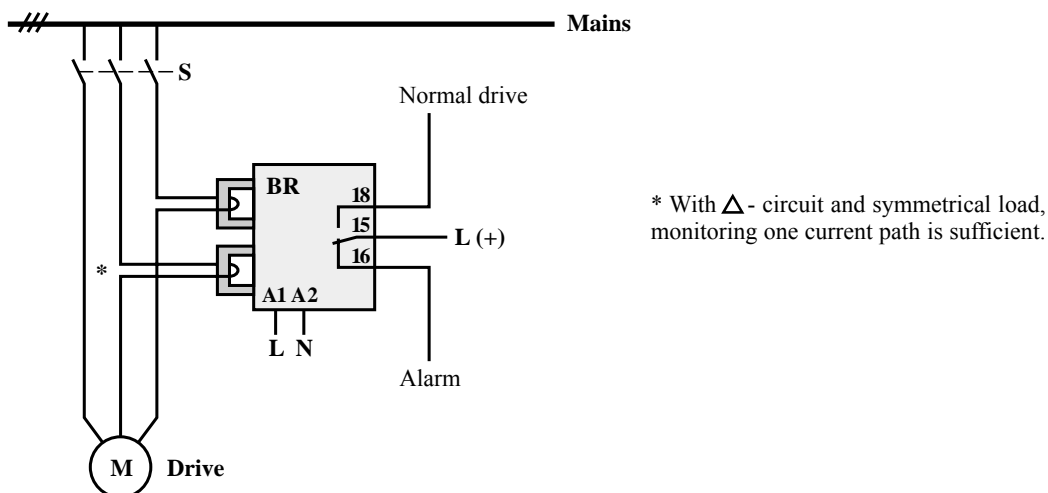


Note: This solution is also suitable for single-phase applications.

Example 4: Drive monitoring for idle running, V-belt or gear breaks

Where there is an under current in a drive mechanism, it may be assumed that, for example, in a ventilation system that the V-belt is torn, that the pump is running idle or that a shaft or gear is defective. Monitoring devices for such purposes are provided in heating, ventilation and air-conditioning technology, in general systems engineering, and in water and waste-water treatment, etc.

Solution: Undercurrent principle with the EUCR-BR.



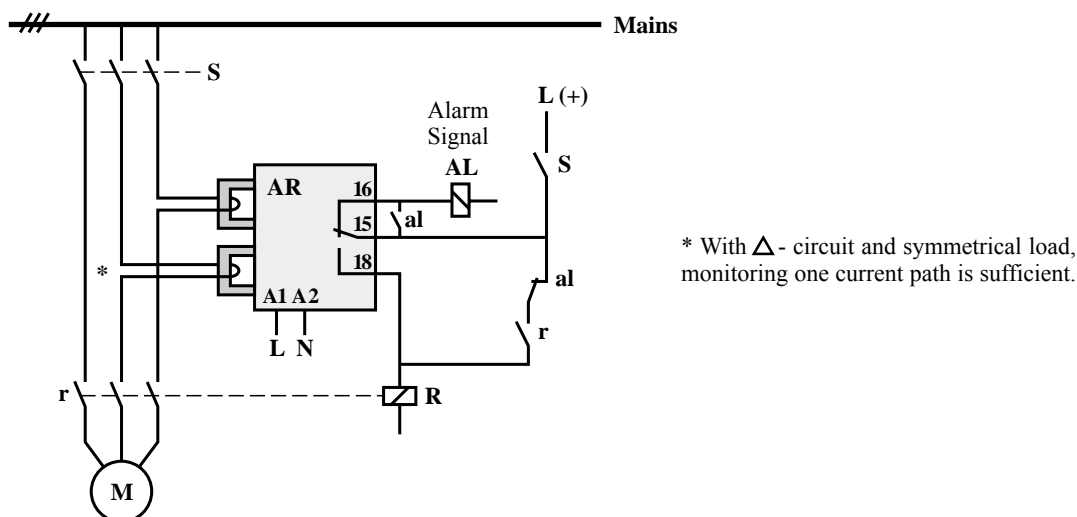
Remarks

This application can be supplemented simply and cost effectively with the additional overcurrent-monitoring device EOCR-AR.

Example 5: Simple motor, transformer or plant protection

When a specific current is exceeded for a maximum time, an alarm or possibly a disconnection should be triggered. Application: industrial plant, building technology, etc..

Solution: Overcurrent principle with EOCR-AR.



Remarks:

For comprehensive motor protection, further suitable equipment is available, e.g. TSR19 for thermal protection of the coils (overload).

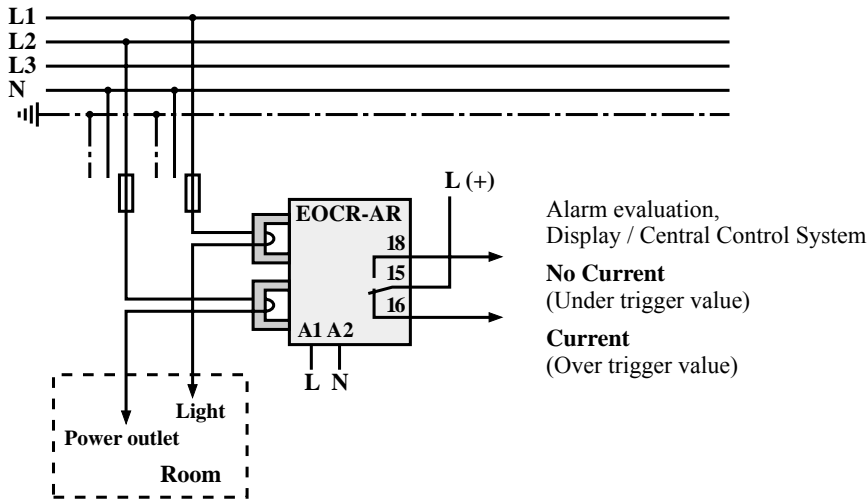
Example 6: Energy -saving and security in building automation

It is common at night or weekends for many devices to be left on. Typical examples are lighting in offices and other office equipment such as printers and computers etc. On the factory floor more critical equipment and machinery are often not switched off.

This increases unnecessary energy consumption resulting in increased maintenance costs, reduced service life and considerable safety risks such as fire.

Solution: Overcurrent principle with EOCR-AR.

With the use of an EOCR-AR the mains supply to the relevant area is monitored, and by setting the current value it is possible to switch equipment deliberately into “stand-by mode” without triggering an alarm. With the overcurrent resistance of the unit, version -05 can also be used for current of up to 13 A/16A fuse rating thus raising the low currents resolution.



Example 7: Simple reactive power-factor compensation ($\cos \varphi$)

In some smaller installations it is often the case that the chargeable constant reactive energy proportionally to the load is generated by heating pumps, ventilator fans etc.

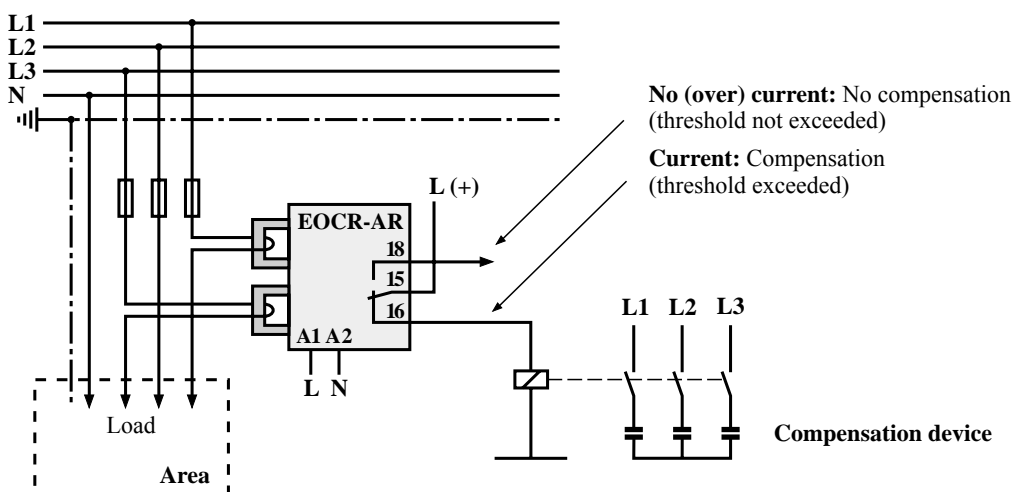
The reactive load is determined by measuring the current and the compensation device is switched on, avoiding unnecessary cost.

Solution: The overcurrent principle with EOCR-AR or the undercurrent principle with EUCR-BR. One or two phases are monitored via the two EOCR-AR current transformers. For currents >60A an external current transformer, e.g. type SRCT-35-100/5, must be installed.

When a set current threshold is exceeded, the corresponding compensation stage is switched in. In this way it is cost-effective and appropriate to have several (approx. 3) stages decentralised.

In larger installations with several buildings, a basic compensation as described above can be installed in the individual buildings, a method which also relieves the load on the supply lines.

An additional small but regulated compensation device may be appropriate at the central power supply.



The other working contact has to be used if an EUCR is employed for compensation controls. In this case, compensation is only activated if the measured current is above the set value on both power path.

A to frequent switching ON and OFF can be avoided with an appropriate setting of the delay time.

With an **ECR-3D** it is possible to realise two step compensation. In this case the normal current is evaluated as step 1 and over-current as step 2. The advantage is the display of the actual current value.

Example 8: Simple lamp monitoring, also in flashing mode.

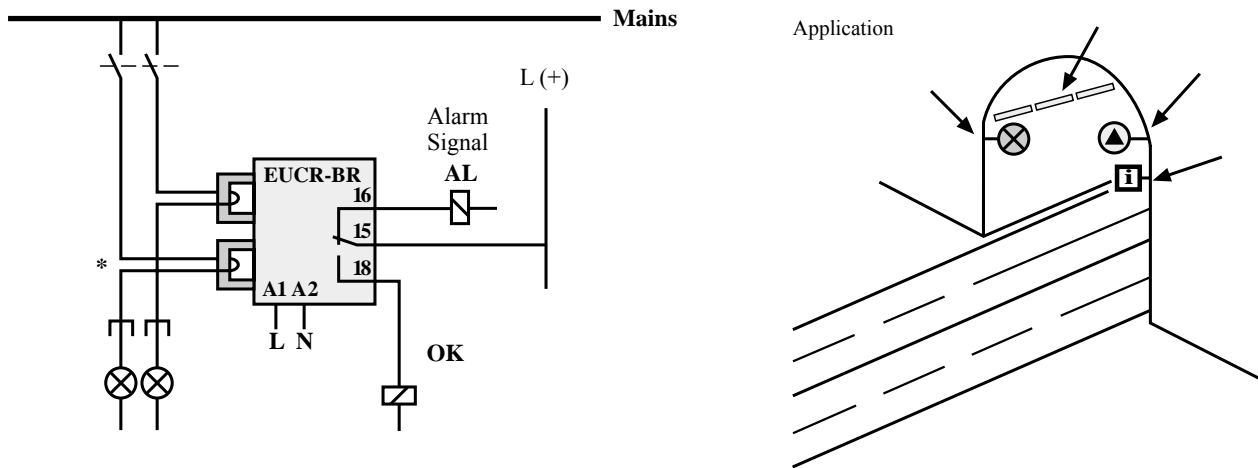
This kind of application can be found often in traffic management systems, e.g. traffic lights, tunnel illumination, railway crossings, emergency exit illumination in tunnels and buildings, etc.

Solution:

Under-current monitoring with **EUCR-BR**.

The example shows in detail an execution with two lamp circuits each with approx. 4 lamps. For more lamps, the selectivity, i.e. the detection of one defective lamp is not possible because of the various tolerances in supply voltage and lamps. In this case an alternative would be a differential current measurement with **EOCR-AR**.

This method is suitable for one or three phase circuits.



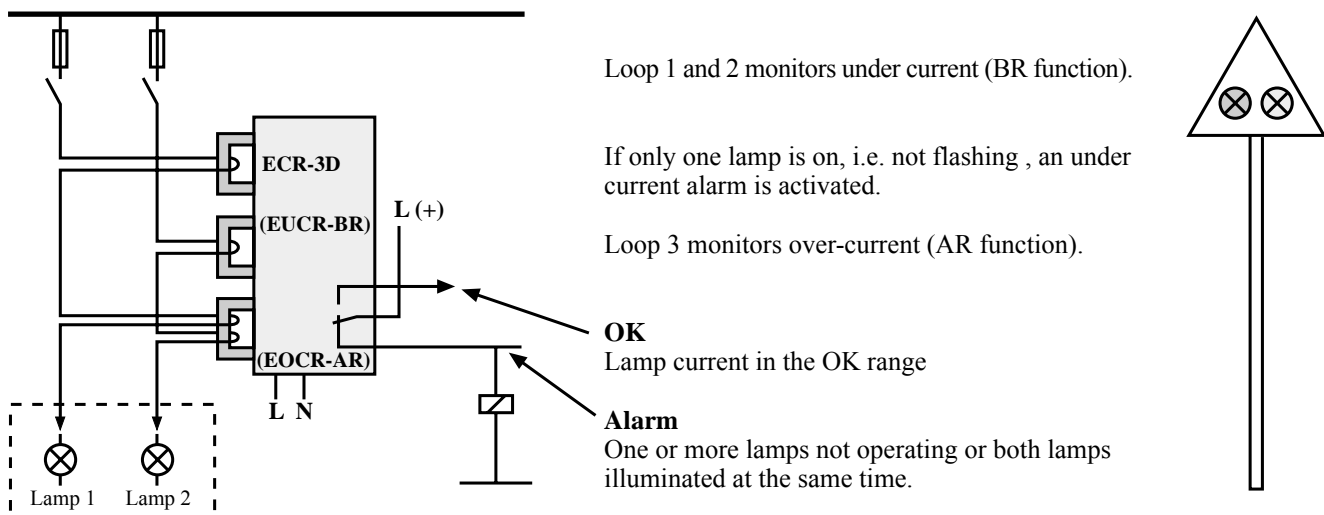
Example 9: Signalling and lamp flashing monitoring.

Monitoring of lamps in traffic management systems e.g. railway barriers or signals in tunnels. Each lamp must have the correct power consumption. The two lamps shall not be on or off at the same time.

Solution:

Over/under current monitoring with one **ECR-3D** or with one **EOCR-AR** plus one **EUCR-BR**.

The following solution covers the case of both lamps failing. It is important to adjust the time on the monitoring device according to the flashing frequency.



Loop 1 and 2 monitors under current (BR function).

If only one lamp is on, i.e. not flashing, an under current alarm is activated.

Loop 3 monitors over-current (AR function).

OK
Lamp current in the OK range

Alarm
One or more lamps not operating or both lamps illuminated at the same time.

Other applications

- * measurement of compensation current.
- * measurement of earth leakage current (ground contact).
- * monitoring of important signal lamps, even blinking operation, in traffic engineering.
- * in motive power engineering to recognize blockages and end positions.
- * the differential current procedure and the dual-channel nature of current detection opens up a further field of countless applications.

Our technical application engineers will be happy to discuss other applications and circuit designs with you.

Application of the ECR-3D devices

This series of devices has 3 integrated current transformers and an extended range of functions compared to the EOOCR-AR and EUOCR-BR.

This means that overcurrent and undercurrent can be monitored at the same time, with the possibility to deactivate the undercurrent monitoring device. The alarm reset-time can likewise be deactivated, however the failure remains stored in the device.

In principle the ECR-3D can be used in the same applications as the EOOCR-AR or EUOCR-BR, with some extended features and a four-digit LED seven segment display.

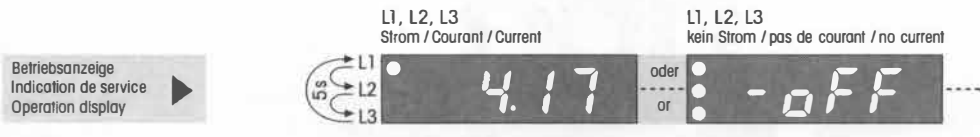
There are, however, further three-phase applications using the current transformers, for rotation (phase sequence) and differential current monitoring.

The ECR-3D devices have a four-digit LED seven-segment display, which allows precise setting of parameters (current, time) and the display of the measured current values.

Furthermore, the display offers more precise fault analysis.

The solution for professional applications!

TEST kurz drücken / presser brièvement / press shortly
TEST dauernd drücken / pression continue / press permanently



Einstellung Réglage Setting

0. — Empfohlen / Reconnaté / Recommended —> 2.
 Möglich / Possible (direct) —> 0.

I_0 Überstrom / Courant de surintensité / Overcurrent
 1 x **TEST** ? VALUE → 5.00 ← NEW VALUE I_0 (RESET) 10s ▶ AUTO-R

I_U Unterstrom / Courant de sous-intensité / Undercurrent
 2 x **TEST** ? VALUE → 3.25 ← NEW VALUE I_U 10s ▶ AUTO-R

t_0 Alarmverzögerung / Temporisation d'alarme / Alarm delay
 3 x **TEST** ? VALUE → 0 4 ← NEW VALUE t_0 delay 0,3-30s 10s ▶ AUTO-R

t_R Rückstellzeit / Temps de remise / Reset time
 4 x **TEST** ? VALUE → 1 12 ← NEW VALUE t_R auto reset 1-120s / ∞ 10s ▶ AUTO-R

TEST 4x + TEST >1s

$I_U = 0$
 $t_R = \infty$
 $I_0 < I_U$
 Erro

7E57 t_0 **TEST** < t_0
TEST > t_0 -AL-
TEST -AL- t_R **TEST** < t_0
TEST > t_0 -AL- t_R ▶ AUTO-R

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