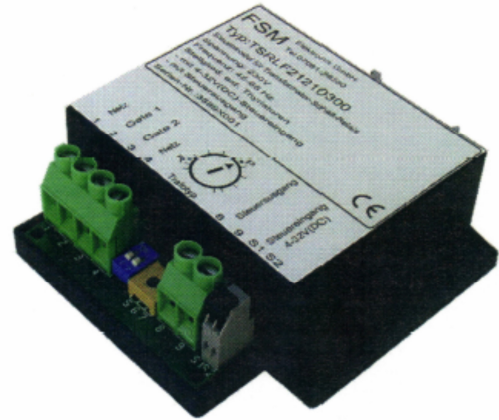
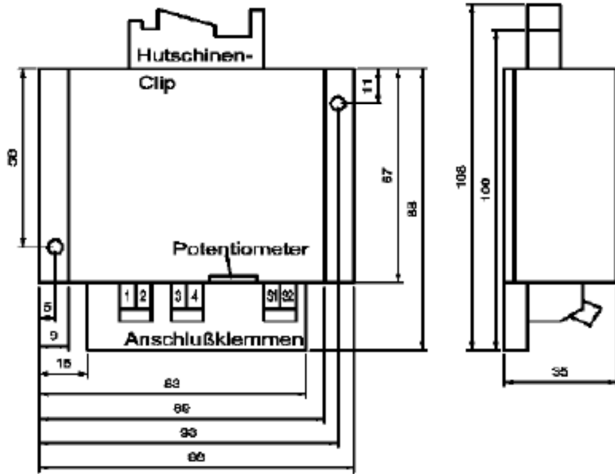


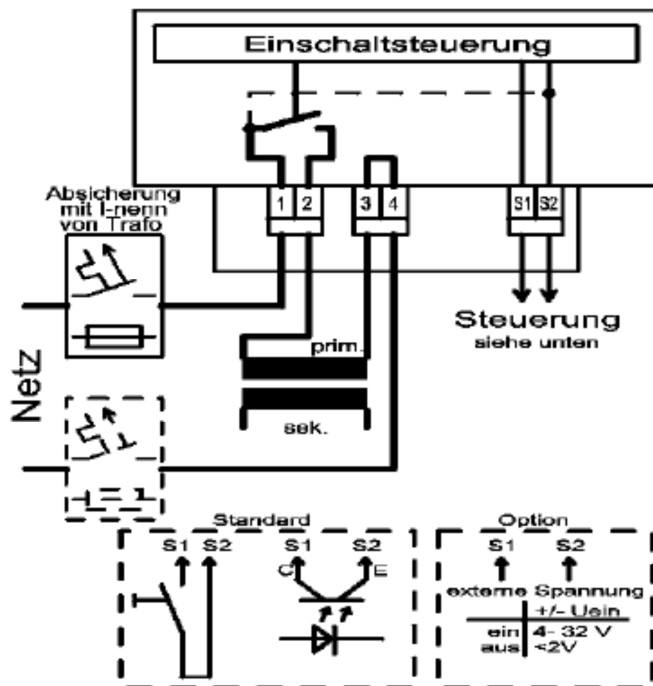
13. Transformer switch relays

13.1 Type TSRL Transformer switch relay



TSRL is an electronic relay for switching transformers. Using its patented soft start-up operation it activates one or more single – phase transformers open-circuited or on-load without inrush. By the use of the soft start-up operation the inrush is not only bordered but avoided.

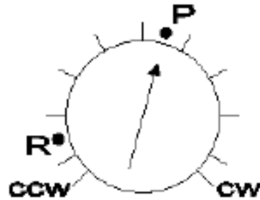
The transformers may be fused speedily on their nominal current on the primary side by the TSRL so they are optimally protected. Frequently switched transformers may now be optimised as well by the TSRL which means a laying-up with up to 1.6 tesla induction low-loss plates and low copper loss. Therefore the transformers may be planned more cost-efficient and low-loss. The TSRL gets basically connected between mains switch and transformer. However it may also be used as mains switch on its own if it is activated by the control input. No through-connection losses are generated. There is no electrical isolation in this application.



The TSRL biases the transformer for a short time before every switching-on. That happens via unipolar acting voltage pulses. The power of the bias is equal for all transformers and should reach the inflexion point of the hysteresis curve. The amplitude of the therefore necessary voltage pulses needs to be aligned to the different types of transformers like package core or toroidal transformers. For this purpose a potentiometer inside the TSRL is used.

Transformer switch relays

Type TSRL Transformer switch relay



Toroidal transformers: At the mark R.

Transformers with coil former (package core transformers):
At the mark P (factory-provided adjustment)
The right adjustment for package transformers (P) may vary between "10 and 2 o'clock".

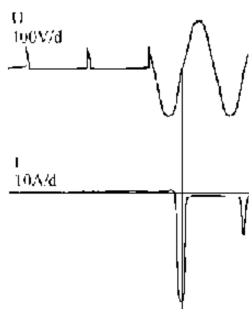
Cut band core transformers: place potentiometer between marks "P" and "R".

Adjustment aid for potentiometer: A pointer instrument for AC voltage switched in series to the TSRL (e.g. parallel to the open cut-out switch) shows if the switch-on occurs with or without current pulses. In case there are current peaks neither while nor at the end of the bias the TSRL is adjusted correctly to the transformer (The cursor stays still). Optimal adjustment: see adjusting guidelines below.

General safety indication: The TSRL needs to be installed and commissioned by electro-technical expert staff. It does not switch electrical isolated at the switching operation via control input and without mains switch because a thyristor with extra snubber-R-C chain link is connected parallel to clamp 1 and 2. Therefore it needs to be unlocked for works on the attached transformer or the load on the secondary side before the TSRL.

Caution: Do not inject external voltage into the control input (clamp S1/S2) using the standard version. The clamps S1 and S2 are mains potential afflicted so the attached contact or rather optocoupler transistor needs to be isolated and feature a proof voltage of 2.5 KV. If a wire strap is used in place of the contact between clamp S1 and S2 it has to be isolated accordingly.

Adjustments using the example of a toroidal transformer



False Adjustment:

The bias is too fragile. The potentiometer stands too far on the left. The positive magnetising current scallops are too small. A big negative inrush becomes visible (Transformer at-rest).



Correct adjustment:

The bias is just strong enough. The potentiometer stands right. There is no inrush visible (Loaded transformer).



False adjustment:

The bias is too strong. The potentiometer stands too far on the right. Big positive Magnetizing current scallops become visible (Loaded transformer).

Transformer switch relays

Type TSRL Transformer switch relay

Technical data

(Start-up operation corresponding to patent No.: DE 42 17 866 EP 05 75 715 B1 US 005 517 380A)

Nominal voltage:

Standard: 230 V; 190 VAC - 260 VAC; Peak voltage max. 800 V
Option: 110 V; 95 VAC - 135 VAC; Peak voltage max. 600 V
Option: 400 V; 350 VAC - 450 VAC; Peak voltage max. 1200 V
Option: 500 V; 410 VAC - 560 VAC; Peak voltage max. 1600 V
Option: 90 VAC - 260 VAC; Peak voltage max. 800 V
 (Half-wave failure surveillance only possible with special features)

Frequency:

45 - 65 Hz

Overvoltage

category:

III

Nominal current:

Standard:

16 A up to 50⁰ C ambient temperature. 14 A at 60⁰ C 12 A at 70⁰ C
 Maximum peak current: 400 A ($t_{peak} = 10$ ms) Leakage current 11 mA at 230 V
 Limit load integral: 800 A²s ($t = 10$ ms)

Option:

32 A up to 30⁰ C ambient temperature. 28 A up to 40⁰ C 25 A at 50⁰ C 22 A at 60⁰ C
 19 A at 70⁰ C. Maximum peak current: 500 A ($t_{spitze} = 10$ ms) Leakage current 11 mA at 230 V
 Limit load integral: 1250 A²s ($t = 10$ ms)

Power failure:

In case of power failure > 60 ms soft start-up at power recurrence

Option half-wave

failure surveillance:

In case of power failure > 2 ms soft start-up at power recurrence

Fuse:

The safety values from "Nominal voltage" need to be followed with the fuse.

Raising delay:

Adjustment TP1	to R	to P	Dim R	Dim P
Mains on with operated control input	ca. 0.88 s	ca. 0.15 s	ca. 0.95 s	ca. 0.45 s
Switch-on via control input	ca. 0.25 s	ca. 0.06 s	ca. 0.35 s	ca. 0.30 s

At switch-off via control input ca. 0.03 – 0.05 s

Frequency of operation:

Dependent on type of transformer (package transformer or toroidal transformer) typical 25 cycles of operation in succession then 60 s break required (package transformer) up to any number of cycles of operation without break (toroidal transformer).

Durability:

ca. 5 m cycles

Control input:

Standard: Via external isolated make contact or via transistor of an external optocoupler. Contact voltage 5 V; Contact current 14 mA. Clamps S1/S2 are connected with mains potential.

Option control input: Via optocoupler electrically isolated. Control voltage: 4 - 32 VDC (pole independent). Control current: 1 - 12 mA

Ext. potentiometer for attachments:

Resistance: 1 – 2.5 KOhm max. pipeline length 0.5 m $U_{cw-ccw} = 5$ VDC
 Potentiometer connected with mains potential (Proof voltage 2.5 KV)
 e.g. Timer functioning

EMV (CE):

Fault-free operation: EN 61000-6-2 transient emissions: EN 61000-6-3
 To follow the safety values for the transient emission (clicks) the TSRL without extra power supply filtering may only be switched on or off five times per minute.

Connections:

16 A Network / Load terminals: Screw-type terminals clamping range 0.2 – 2.5 mm² locked torque 0.5 – 0.6 Nm

32 A Network / Load terminals: Screw-type terminals clamping range 0.2 - 4 mm² locked torque 0.5 – 0.6 Nm

Control input: Spring terminal clamping range 0.1 - 2 mm²

Ext. potentiometer: Spring terminal clamping range 0.1 – 0.5 mm²

Anchorage:

Quick fastening on 35 mm bearing rail corresponding to DIN EN 50022 / DIN EN 50035

Wall fastening of the case via two fixing holes 4.5 mm

Circuit board mounting (without case) via three fixing holes 3.2 mm

Transformer switch relays

Type TSRL Transformer switch relay

Building type:	Capsuled in moulded case. As board: open
Degree of pollution:	In case 3; as conductor plate 2
Type protection:	IP 20 as conductor plate IP 00
Protection class:	Attachment of protection class II
Dimensions (LxBxH):	99 x 88 x 35 mm; circuit board 77.5 x 85 x 30 mm
Case:	Material ABS flammability class UL94 V0
Installation:	Minimum distance to exoergic attachments at least 10 mm
Weight:	0.2 kg
Shock strength:	10 g
Humidity:	95 % non-condensing
Operating temperature:	0°C up to + 60°C special version: - 20°C up to + 70°C
Storage temperature:	- 10°C up to + 70°C

