

# 13.2 Type TSRD Transformer switch relay



The TSRD is an electronic load contactor to switch transformers connected to the three-phase current. Using a patented soft start-up operation it switches on three-phase transformers as well as three single-phase transformers together open-circuited or on-load without inrush. The inrush is not only bordered but avoided by the soft start-up operation.

Three-phase transformers are classified in primary connection symbols triangle or star without Mp (Application D) and connection symbol star with Mp (Application S). Applications with three single-phase transformers are distinguished between transformers that are operated between every phase and N (Application N) and those that are operated between every two phases (Application L) (see operating instructions). The TSRD monitors the stress level of the three phases as well as the phase sequence of the attached three-phase current. The TSRD 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 I.

The soft start-up of the transformer occurs via thyristors which are bypassed after the full plug of an external bypass contactor to minimise the power losses inside the TSRD. The contactor is only needed in AC 1 – classes and is not included in delivery. The TSRD internally conducts a contactor pull control to be sure the thyristors are bypassed. The switch-off also occurs by the thyristors because the bypass conductor first and after that the thyristors are switched off. The transformers may be fused speedily on their nominal current on the primary side by the TSRD so they are optimally protected. Frequently switched transformers may now be optimised as well by the TSRD which means a laying-up with 1.6 tesla induction low-loss plates and low copper loss.

The TSRD is suitable e.g. with isolation - control - filament – and vehicle transformers in industry plant construction and research.



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## **Functions:**

## 1. DIP switch:

The following adjustments may be conducted via the DIP switches: Error correction – Rotation direction detection – Control inputs - Message 1 – Application

## 2. OK - LED:

The illuminating diode OK (green) illuminates when TSRD is in OK status and blinks with different velocities if there are annoyances. (see operating instructions).

## 3. Soft start-up operation:

The TSRD biases the transformer before the full plug with unipolar voltage pulses.

## 3a. Three – phase transformers:

In three-phase transformers (Applications D and S) the magnetic flux inside the iron core is balanced during the bias. To this end the voltage pulse's amplitude is increased from an initial value up to a terminal value of a quarter mains period (5 ms at 50 Hz). The terminal value is the same for all three-phase transformers and needn't be adjusted. To assure the soft start-up operation works right the three-phase transformers have to be connected winding correctly to the TSRD.

### 3b. Single – phase transformers:

In single-phase transformers (Application N and L) the magnetic flux inside the iron core is drifted into the inflexion point of the hysteresis curve during the bias. The power of the bias that is necessary to reach the reflexion point of the hysteresis curve is the same for all transformers. The amplitude of the therefore necessary voltage pulses needs to be aligned to the different types of transformers like package core or toroidal transformers. The potentiometer (TP1) inside the TSRD serves for that factory-provided adjustment for package core transformers (see operating instructions).

#### 4. Message output 1:

The illuminating diode "Meldung 1" (yellow) illuminates when the relay contact at the clamps 23 and 24 is closed. If for message output 1the function "Voll-Ein-Meldung" (factory-provided adjustment) is chosen the relay contact gets closed when the TSRD completely switched on the connected transformer after the end of bias (magnetic residual setting).

Using the function "Ok-Meldung" the relay contact gets closed after spreading the mains voltage and successful initialisation of the TSRD. The contact stays closed until an annoyance arises (see operating instructions). At the function "Fehler-Meldung" the relay contact is closed as soon as an annoyance arises (see operating instructions). If no message is chosen the relay contact will not be accessed or rather be accessed according to the client's desired function.

### 5. Message output 2: (Option)

The message output 2 is an optional relay message output whose function will be determined corresponding to the client's requirements. The illuminating diode "Meldung 2" (yellow) illuminates when the relay contact at the clamps 33 and 34 is closed.



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## 6. Rotation direction detection:

The TSRD detects the phase sequence of the three-phase current after spreading the mains voltage. By using the DIP switch 2 it may be chosen if the TSRD switches on the connected transformer only at right-handed or also at left-hand phase sequence.

## 7. Failure management:

The TSRD recognises diverse annoyances which activate a cut-out of the connected transformer (see 2). At the TSRD may be chosen via the DIP switch if it switches on the transformer autonomously when the mentioned annoyance is eliminated or not until the remote on signal at control input is applied recently.

### 8. Contactor pull control:

By using the contactor pull control it may be monitored if the bypass contactor attracts after full plug or not. To this end the tension across the thyristors inside the actuating element L3-T3 is detected. In case the tension does not become null when the bypass contactor should have bypassed the actuating elements the TSRD goes into annoyance and switches off the transformer. When the bypass conductor is attracted the thyristors inside the actuating elements L1-T1 and L2-T2 get switched off und not switched on again until the connected transformer's power down. If the current through the actuating element L3-T3 is smaller than 20 mA the TSRD does not recognize anymore if the bypass contactor did not become attracted.

## **Technical data**

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

Nominal voltages: Standard: Option: Option: Frequency: Overvoltage category:	400 V; 320 VAC - 200 V; 160 VAC - 500 V; 400 VAC - 45 - 65 Hz III	– 440 VAC; Peak – 230 VAC; Peak – 550 VAC; Peak	voltage max. 1200 voltage max. 800 voltage max. 1600	) V V ) V		
Nominal current:						
Standard:	32 A. Maximum p	eak voltage: 400	A (t <sub>peak</sub> = 10 ms) le	eakage ci	urrent on dis	sabled state
	12 mA at 400 V. I	imit load control:	800 A <sup>2</sup> s (t = 10 ms	5)		
Option:	50 A. Maximum p	eak current: 600	A (t <sub>peak</sub> = 10 ms) le	eakage cu	urrent on dis	abled state
	12 mA at 400 V. I	imit load control:	1800 A <sup>2</sup> s (t = 10 m	ıs)		
Power failure:	In case of power failure $\geq$ 80 ms soft start-up at power recurrence					
Fuse:	The safety values from "Nominal voltage" need to be followed with the fuse.					
Raising delay: (50 Hz)	Application D	Mains on with op Switch-on via cor	erated control inpunted inpunted input 1 ca. 0.2	ut 1 ca. 0. 25 s	.42 s	
. ,	Application S	Mains on with op	erated control inpu	ut 1 ca. 0.	.46 s	
	Application N	Adjustment TP1	ittor input i ca. 0.2	203	at R	at P
		Mains on with op Switch-on via cor	erated control inpu ntrol input 1	ut 1	ca. 0.96 s ca. 0.23 s	ca. 0.36 s ca. 0.09 s
	Application L	Mains on with op	erated control inpu	ut 1	ca. 0.89 s	ca. 0.39 s
		Switch-on via co	ntrol input 1		ca. 0.22 s	ca. 0.1 s
Falling delay:	At switch-off via c	control input 1:	Application D	ca. 0.07	- 0.09 s	
(50Hz)		•	Application S	ca. 0.08	- 0.10 s	
. ,			Application N	ca. 0.08	- 0.10 s	
			Application L	ca. 0.08	- 0.10 s	
Frequency of operation:	Optional					
Durability:	Dependant on the contact load of the control relay for the bypass contactor (Clamps 13/14)				or	
Control input 1 and 2:	Via optocoupler inside the TSRD isolated					
- <b>-</b>	Activation A1-A2 or A4-A5 U= 16 – 121 VAC/DC I= 1 – 8.3 mA					
	Activation A1-A3	or A4-A6	U= 93 - 550 VAC	C I= 1.3 -	8.1 mA	



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Option control output 1 + 2 bypass contactor Activation	Relay closing contact max. breaking capacity (Ohm resistive load): 2000 VA Max. switching voltage 380VAC Max. switching current: 10A 8A/250VAC 5A/380VAC Nominal load (Ohm resistive load) 8A/ 24 VDC. Durability mechanical 20x 10 <sup>6</sup> . Electrical 100x 10 <sup>3</sup> at nominal load			
Bypass contactor:	Max. allowable on-delay: 0.29 s at 50 Hz 0.24 s at 60 Hz			
	Max. allowable on-delay: 0.36 s at 50 Hz 0.28 s at 60 Hz			
	To dejam the contactor coil it is advisable to connect the coil in parallel to an RC-			
Internal consumption:	1.7 W			
EMV (CE):	Fault-free operation: EN 50082-2 transient emissions: EN 50081-1			
	To follow the safety values for the transient emission (clicks) the TSRD without extra			
•	Power supply filtering may only be switched on or off five times per minute.			
Connections:	<u>^</u>			
32 A Network / Load terminals: Screw-type terminals clamping range 0.2 – 4 mm <sup>2</sup> locked torque 0.5 – 0.6 Nm				
50 A Network / Load terminals: Screw-type terminals clamping range 0.5 - 10 mm <sup>2</sup> locked torque 1.2 - 1.5 Nm				
Control in-/outputs:	Screw-type terminals clamping range 0.2 – 2.5 mm <sup>2</sup> locked torque 0.5 – 0.6 Nm			
Anchorage:	Quick fastening on 35 mm bearing rail corresponding to DIN EN50022 / DIN EN50035			
Building type:	capsuled in moulded case			
Degree of pollution:	3			
Type protection	IP 20			
Protection class:	Attachment of protection class II			
Dimensions (LxBxH):	180 x 125 x 98 mm			
Case:	Material PVC and polyamide flammability class UL94 V0			
Weight:	0.8 kg			
Shock strength:	10 g			
Humidity:	95 % non-condensing			
Operating temperature:	0° C up to + 60° C extra version: - 20° C up to +80° C			
Storage temperature:	- 10° C up to + 70° C			

