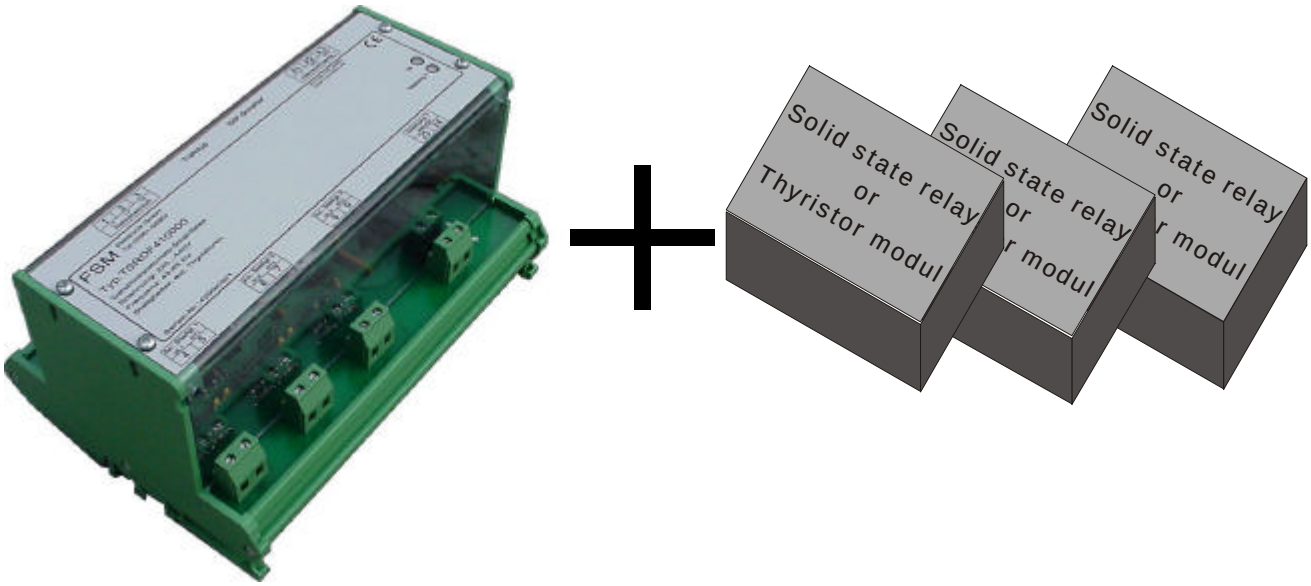
Data Sheet:
Transformer Switching Relay TSRDF

Elektronik GmbH
Kirchzarten

The TSRDF is a control module, which can be used as a control element of a transformer switching relay when used in combination with external thyristors or semiconductor relays in a three-phase current supply. Using this module **transformers can be frequently switched**, without Inrush current peaks. Applying a patented smooth switching procedure the TSRDF module controls the connected solid state control element so that either three-phase transformers and/or three single phase transformers together can be operated with 'pulse groups' either in an idle state or loaded condition without inrush current. Using the smooth switching procedure results in the elimination and not only the reduction of inrush current.
Two classes of three-phase transformers are distinguished: primary side delta or star without Mp (application D) or star configuration with Mp (application S). Applications using three single-phase transformers distinguish as to whether the transformer is operated between each phase and N (application N) or whether the transformer is operated between two phases respectively (application L), see operating instructions.
The TSRDF monitors the voltages of the three phases as well as the phase-sequence of the connected three-phase current supply.
The TSRDF can be supplied both to control external thyristors as well as for the control of various forms of instantaneous switching of semiconductor relays. The TSRDF including the control elements (semiconductor relay or thyrsistor module, or individually connected thyristors) is connected between the power supply and transformer. The TSRDF can be used to control a bypass-contactor, in which the controlling elements are bridged to reduce the power loss.



Application Areas:

The TSRDF can be used in frequently switching welding or heating transformers as well as heavy duty transformers for industrial applications, plant construction and research.

Principle:

1. DIP-Switch:
Using the DIP-switch, the following settings can be applied:
Error handling, rotation direction recognition, control inputs, message output 1, (see application instructions for details)
2. OK-Message Display:
The LED OK (green) is illuminated continuously when the TSRDF is in working order, and flashes at different rates for faults (see operating instructions).
3. Smooth Switching Procedure :
The TSRDF premagnetises the transformer using unipolar voltage impulses before complete switching-on.
3a. Three-phase Transformers:
For three-phase transformers (application D and S) the magnetic flux in the iron core of the three-phase transformer is balanced during the premagnetisation. To achieve this the width of the voltage impulse is

continuously increased from an initial value to a final value of a quarter of the mains period (5ms at 50Hz). The final value is the same for all three-phase transformers and need not be set. In order that the smooth switching procedure functions correctly, the coil connection group of the three-phase transformers must match that of the connected TSRDF.

3b. Single-phase Transformers:

For single-phase transformers (application N and L), the magnetic flux in the iron core is equal to the inflexion point of the hysteresis curve during the premagnetisation. The value of the premagnetisation required to reach the inflexion point of the hysteresis curve is the same for all transformers. The width of the required voltage impulses must be matched to the different transformer types, such as packet core transformers or toroidal mains transformers. The potentiometer (TP1) in the TSRDF is used for this purpose (see adjusting instructions). Settings for packet core transformers will be set in the factory.

4. Message Display Output 1:

The LED display ‘Message 1‘ (green) is illuminated when the relay contact between connectors 23 and 24 is closed. If the function "Fully-On Display" is activated for the Message Output 1 function (factory setting), the relay contact is closed as soon as the TSRDF has completed switching-on of the connected transformer after completion of the premagnetisation (remnance-setting).

With the function "OK Display" the relay contact is closed after the mains voltage has been switched on and successful initialisation of the TSRDF has been completed. This contact remains closed until an error occurs (see operating instructions).

The function “Error Display” causes the relay point to close in the event of a malfunction (see operatiog instructions)

The function “Bypass Contactor Selection” causes the TSRDF to switch-off the controlling elements as soon as the bypass contactor is bridged after switching-on is completed. The TSRDF switches-on the controlling element again during disconnection before the bypass contactor is switched-off. In this manner wearing of the contactor connections is avoided.

5. Message Display Output 2: (Option)

The LED display ‘Message 2‘ is an optional relay output whose function can be chosen by the customer. The LED display ‘Message 2‘ (yellow) is illuminated when the relay contact between connectors 33 and 34 is closed.

6. Rotation Direction Recognition:

The TSRDF detects the phase sequence of the three-phase network as soon as the power is switched on. DIP switch 2 can be used to determine whether the TSRDF switches the connected transformer on for a clockwise phase sequence or also for an anticlockwise phase sequence.

7. Error Handling:

The TSRDF recognises different errors which, on occurring, independently switches the transformer off (see operating instructions).

The DIP switch 1 on the TSRDF can be used to decide whether the transformer is independently switched on again as soon as the interference is eliminated, or after control input 1 has been remotely activated.

Technical Data:

(Switching-on procedure according to Patent No.: DE 42 17 866, EP 05 75 715 B1, US 005 517 380A)

Rated voltage:				
Standard:	**400V:** 320VAC – 440VAC; peak voltage max. 1200V			
Option:	**200V:** 160VAC – 230VAC; peak voltage max. 800V			
Option	**500V:** 400VAC – 550VAC; peak voltage max. 1600V			
Frequency:	45-65 Hz			
Over voltage category:	III			
Control element:				
Standard:	Semiconductor relays quick action switching, 2.5 kV Test voltage between the control and load circuit.			
	Charactistic values for the semiconductor relay:			
	Open-circuit control voltage DC		U_{HiLo}= 5V	
	DC internal resistance:		R_{HiLo}=120 Ohm	
	Maximum available control current:		I_{HiLo}=10mA	
	Maximum permissible switching-on delay:		T_{on}=0.2ms	
	Maximum permissible switching-off delay:		T_{off}=0.25ms	
Thyristors option:	Triggering through Opto-Triacs across protection resistor R_{VG} im TSRDF			
	Vrat	200 V	400 V	500 V
	R_{VG}	68 Ohm	121 Ohm	150 Ohm
	Characteristics of the Thyristors:			
	Max. available Gate current:		I_{Gt}=220mA	
	Max. pemissible trigerring delay:		t_{gd}=0.2ms	
	Max. permissible release time:		t_q=0.25ms	
	Gate cathode resistance:		R_{GK}=120 Ohm/ 0.25W	
	Gate cathode diode:		D_{GK}= for example: 1N4004	

Power line failure:	After a power line failure >= 80ms smooth switching on take place when power is returned			
Turn-on delay (50Hz):	Application D	Mains on with activated control input 1	ca. 0.42s	
		Switching on across control input 1	ca. 0.25s	
	Application S	Mains on with activated control input 1	ca. 0.46s	
		Switching on across control input 1	ca. 0.29s	
	Application N	SettingTP1	On R	On P

		Mains on with activated control input 1	ca. 0.96s	ca. 0.36s
		Switching on across control input 1	ca. 0.23s	ca. 0.09s
	Application L	Mains on with activated control input 1	ca. 0.89s	ca. 0.39s
		Switching on across control input 1	ca. 0.22s	ca. 0.1s
Switching-off delay :	On switching off across control input:	Without Bypass contactor:	ca. 0.04-0.06s	
		With Bypass contactor	ca. 0.33-0.35s	
Switching frequency:	Unlimited			
Control input 1 and 2:	Across an opto coupler in TSRDF, separate potential			
	Driver A1-A2 or A4-A5 resp.	U= 16 – 121VAC	I= 1-8.3mA	
	Driver A1-A3 or A4-A6 resp.	U= 16 – 121VAC/DC	I= 1.3 –8.1mA	
Control output 1and 2:	Relay make contact			
	Max. switching power (Ohmic load):		2000VA	
	Max. switching voltage:		380VAC	
	Max. switching current:		10A	
	Rated load (Ohmic load):		8A/250VAC, 5A/380VAC, 8A/24VDC	
	Lifetime	Mechanical	$20x10^6$	
		Electrical	$100x10^3$ at the rated loading	
Bypass-Contactor:	Max. permissible response delay:		0.3s at 50Hz, 0.23s at 60Hz	
	Max. permissible release delay:		0.3s at 50Hz, 0.23s at 60Hz	
	To suppress interference in the contactor coil it is recommended to connect an RC element parallel to the coil			
EMC (CE):	Interference immunity: EN 50082-2			
	Interference emission: EN 50081-1			
	To comply to the limits of the interference emission (crackle interference) the TSRD may be switched on and off maximum five times per minute without external mains filtering.			
Connections:	Screw terminals, connection cross-section 0.2-2.5 mm^2, tightening torque 0.5-0.6 Nm			
Fixture:	Quick connection to 35mm connection rails according to DIN EN 50 022 or DIN EN50035			
Type:	Encapsulated, housing made from insulating material			
Cleanliness class:	3			
Degree of protection:	IP20			
Protection class:	Protection class II			
Dimensions (LxWxH):	180x125x98mm			
Housing:	Material PVC and Polyamide, Flammability classUL94 V0			
Weight:	0.5kg			
Shock resistance:	10g			
Humidity max.:	95%, no condensation			
Operating temperature:	0°C to 60°C, special version: -20°C to +80°C			
Storage temperature:	-10°C to 70°C			

Ordering Key:

TSRDF

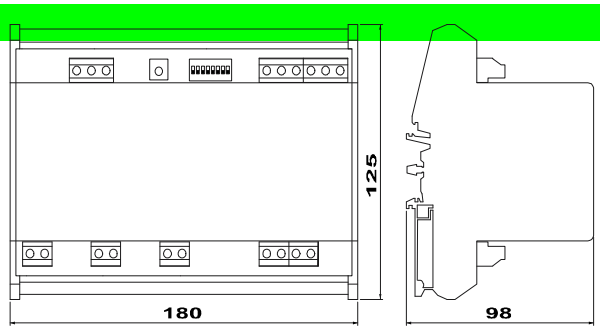
Special-Version-No.
(Ask factory)
00: Standard Version

Message Output 2:
0= No second Message Display
9= whith second Message Display
Customer specified Function

Control Input 2:
0= No second control Input
9= Whith second control Input,
Customer specified

Control Element:
2= external solid state relay
1= external Thyristor pair

Mains Voltage:
4= 400V
2= 200V; 5= 500V;
9= Non Standard Voltage



Housing:

Emeko Ing. Büro, M. Konstanzer	FSM Elektronik GmbH
Customer Services – Applications- Marketing Britzingerstr. 36 D 79114 Freiburg Telefon: 0(049)170/2410655 Telefax: 0(049)761/441888 e-mail: Emeko@t-online.de Internet: http://www.emeko.de	Development – Production – Sales Scheffelstr. 49 D 79199 Kirchzarten Telefon: 0(049)7661/9855-0 Telefax: 0(049)7661/985511 e-mail: info@fsm-elektronik.de Internet: http://www.fsm-elektronik.de