KMB systems, s.r.o.
Dr. M. Horákové 559, 460 06 Liberec 7, Czech Republic
tel. +420 485 130 314, fax +420 482 736 896
email : kmb@kmb.cz, internet : www.kmb.cz

TrafoSTART TS1xxx

Transformer Soft Starter

Description

The TrafoSTART is an electronic relay for the switching single-phase transformers. The magnetization of the transformer core is maintained in limits during energization. The transformer core is re-magnetized to opposite value of magnetization with exactly specified increment in each half period of the supply voltage. The increment of magnetization depends on type of transformer. The transformer starting method totally **eliminates inrush current** with **minimal start up time** (from 0,06 s for EI transformers and up to 3s for toroid transformers). This unique control procedure was patented. It has patent number CZ 296466. Magnetizing impulses are revised according to the primary voltage waveform. This principle ensures **error-free operation with any transformer secondary load**.

The TrafoSTART is suitable for **all kinds of transformers** – EI, UI, C, toroidal, at al. Parallel connected transformers of different types can be connected to one TrafoSTART. The TrafoSTART is recommended for frequently switched transformers and for low-losses transformers with high working induction.

The device is easily installed into the primary lead. The TrafoSTART **can replace transformer contactor**, when control input is used.

The embedded function of the supply voltage failure recognition allows to operate transformer with high working induction without troubles. Solution with such transformer and the TrafoSTART is then smaller in size, lighter and cheaper.

Specification

T S 1 2 1 1 1 ...

TS 1	single-phaseTrafoSTART
1	rated voltage 110 V_{AC}
2	rated voltage 230 V_{AC}
3	rated voltage440 V_{AC}
1	rated current 16 A
1	frequency 50 Hz
2	frequency 60 Hz
1	Voltage on control input switch the transformer off
2	Voltage on control input switch the transformer on
...	service information

Instrument Installation

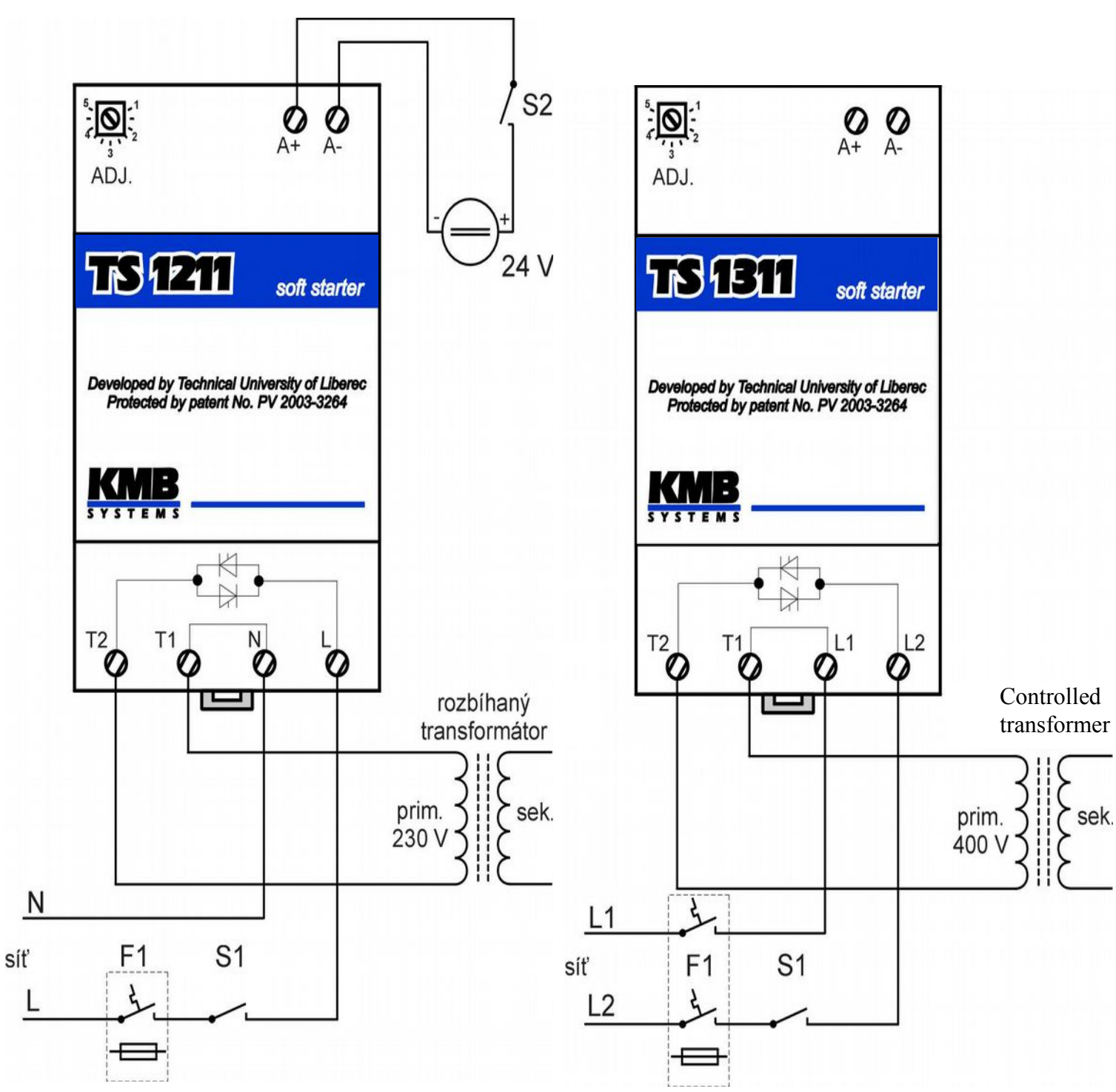
WARNING

Installation, service and device operation must be performed by a person with all required qualications for such work and this person must know in detail the operation principles of the equipment listed in this description! Protection provided by device may be compromised if used by different way than intended by manufacturer. Before manipulation with any part of the circuit where TrafoSTART is connected, it's necessary to disconnect whole circuit from power supply. TrafoSTART contains semiconductor switch, which doesn't provide safe disconnection of transformer from power supply. It's prohibited to touch the terminals with conductive elements or operate device without cover.

TrafoSTART is designed for mounting in cabinet or on transformer in any direction on 35 mm DIN rail according to DIN EN 50022. TrafoSTART is designed for indoor use. It is necessary to prevent the penetration of water into the device.

Sufficient cooling must be provided for proper operation of the device. It's necessary to ensure natural circulation of air in the cabinet. It's not recommended to install any devices or equipment that generates heat, in the immediate surrounding of the instrument (especially under the TrafoSTART).

Fig. 2: Example of installation of TS 1211 2 connected to phase voltage controlled by control voltage and TS 1311 1 connected to line voltage



F1 Circuit breaker or fuse switch with fuse for swich on/off and secure disconnection form power supply and protection against short-circuit.

S1 Control contactor/switch. It's necessary to use this contactor/swich only when there is no circuit breaker/fuse switch installed on position F1. In this case S1 have to ensure secure disconnection of power supply.

S2 Control voltage switch. It's not necessary to use with standard version TS 1xxx 1

24V Control voltage DC supply

Power supply is connected to terminal N and L in case of TS 11xx and TS 12xx. In case of TS 13xx you can connect any two phase wires from 3-phase network to terminals L1 and L2. Use flexible wires with max. cross-section of 4 mm^2 to connect the TrafoSTART.

It is recommended to use a breaker F1 with B or gR characteristics for protection. Rated current of the breaker F1 depend on transformer rated current. Rated current of the F1 cant be greater then rated current of the TrafoSTART.

More parallel connected transformers can be switching by one device up to limit of TrafoSTART rated current.

Primary side of the transformer is connected to the clamps T1 a T2. It's prohibited to connect any other devices, switches or circuit breakers between TrafoSTART and transformer. It's prohibited to connect any capacitors (i.e. for PFC) on the output of TrafoSTART. It's possible to connect them on the input of TrafoSTART or on secondary side of transformer. In compliance with speed of current rise di/dt.

Bridging relay is part of TrafoSTART. Installation of external bridging relay will compromise operation of TrafoSTART.

Switch on and switch of of the transformer is performed by connection of power supply to terminals L, N (L1, L2).

TrafoSTART also supports transformer switch on/off via control inpit A+, A-. Standard model TS 1xxx 1 turns transformer off when control voltage is present. TS 1xxx 2 turns transformer on when control voltage is present on A+, A- and turns transformer off when voltage on A+, A- is not present. It's necessary to use DC voltage for control of TrafoSTART.

Please check whether voltage level and frequency complies with your TrafoSTART model before using.

Turn-on delay configuration

Potentiometer for tuning the turn-on delay is placed on top left part of the TrafoSTART. Tuning can be performed by little screwdriver. Position (1) on right margin means quick start (60 ms), position (5) on left margin means slow start (0,8–3 s it depend on the transformer secondary load).

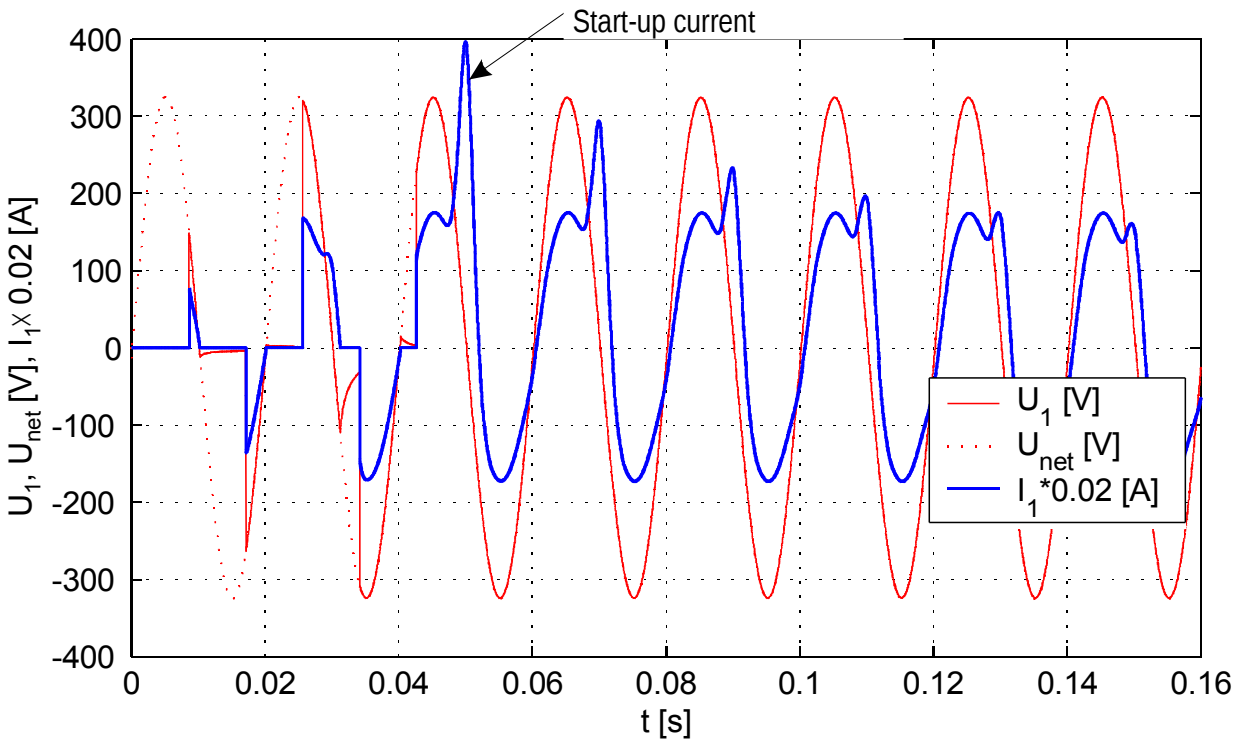
Table 1: Recommended values for quick tuning

Potentiometer possi-tion	Transformer type
1 ÷ 2	EI - transformer
2 ÷ 3	C, UI -transformer
4 ÷ 5	toroid transformers

Easiest way is to set TrafoSTART according to the table 1. Slowest start (5) is appropriate for all kind of transformers, but it's sensitive to some kind of protection relays, which can evaluate it as voltage drop. Also when there is deformed voltage waveforms, TrafoSTART can disconnect the transformer by itself.

Maximal start speed is limited by type of transformer. Slower start speed is necessary for transformers with high quality cores and with oriented steel material. If start speed is too quick circuit breaker can interupt the start-up because of to high start-up current. Best way is to proceed from slow start speeds and gradually increment the speed until circuit protection interrupts the start. Potentiometer is not set from production. Optimal configuration can be achieved by checking the oscillogram of start-up current. Start-up current can't exceed rated current of fuse or circuit breaker. Trend of start-up current is presented on fig. 3. When turn-on delay is too long, start -up current will be unnoticeable. If turn-of dela us too short, current spike will exceed rated current of the circuit breaker. Optimal setting is when start-up current is visible but doesn't exceed rated current of the transformer. When quick start is required, tuning where start-up current is close to ratted current of circuit breaker is allowed. When quick start-up is required, it's possible to set start-up current close to time-current curve of the circuit breaker. I.e. when type B circuit breaker is used, you can set up to 3 times the rated current of the circuit breaker.

Fig. 3: Characterictic of voltage and current during optimal configuration. Spike of turn on current doesn't exceed tripping char. of circuit breaker.



Standard Operating Procedure

1. Make sure that mains voltage and is frequency is within specified limits. Otherwise transformer start will be blocked.
2. Turn of mains power and power supply of control circuits.
3. Connect TrafoSTART according to fig. 2. During first start, disconnect equipment from secondary side of transformer.
4. Check connection of all power lines.
5. Check connection of all control lines and power supply of control circuits, if connected.
6. Set turn-on delay to slowest speed - potentiometer to most right position (5). If you don't request faster turn-on, skip to step 11.
7. Connect mains voltage and control voltage. Verify that transformer is turned on correctly. If protection element (fuse/circuit breaker) interrupts operation of TrafoSTART, then TrafoSTART is damaged or incorrectly connected. Solve the problem before continuing.
8. Disconnect mains voltage. Set desired turn-on delay by potentiometer.
9. Connect mains voltage. Verify that transformer turned on correctly. If circuit breaker interrupts the operation, Turn-on delay is to small.
10. Repeat steps 8 and 9 until transformer starts reliably.
11. Disconnect mains and control voltage. Connect your equipment to the secondary side of the transformer.
12. Verify that transformer turns on and off correctly with load connected.

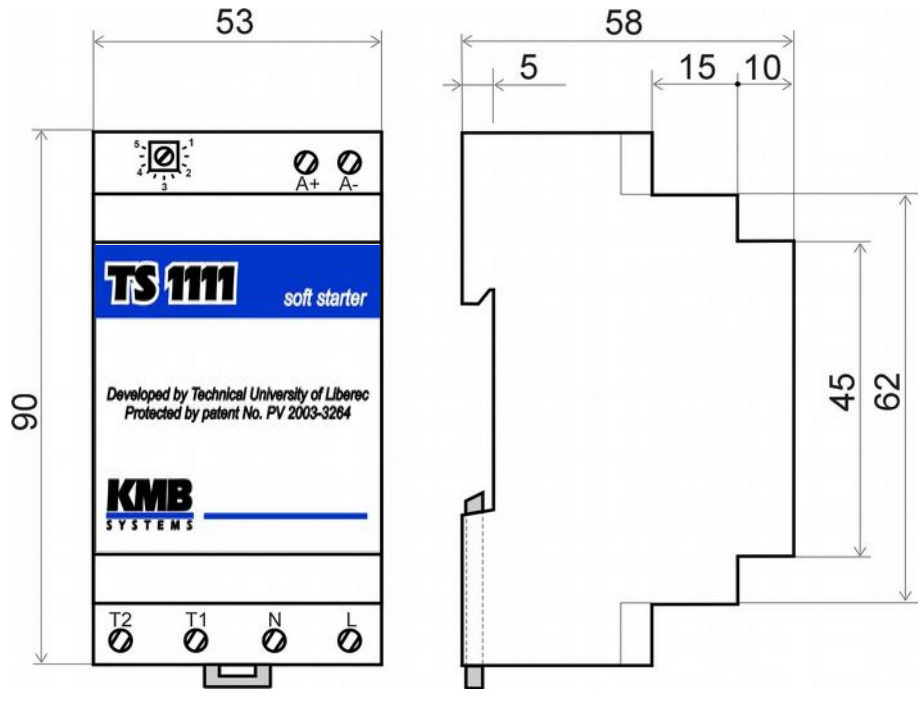


Fig. 4: Dimmensions in mm

Technical parameters

Model	TS 11xx	TS 12xx	TS 13xx
Rated voltage	110 V_{AC} (95 – 135 V_{AC})	230 V_{AC} (190 – 260 V_{AC})	400 V_{AC} (350 – 450 V_{AC})
Overvoltage cat.	II ČSN 33 0420-1 (IEC 664A)		
Note	Transformer start is blocked when voltage is outside of stated range.		
Note	The TrafoSTART contains triac. When TrafoSTART is turned off there is no galvanic separation between transformer and mains supply.		

Model	TS 1x1x
Rated current	16 A
Max. peak current	400 A (t_{peek} = 10 ms)
Protection	breaker 16 A with B char. according to EN 60 898 when I^2t is less then 800 A^2s.
	melting fuse with **gR** characteristics

Model	TS 1xx1	TS 1xx2
Frequency	50 Hz (47,5 – 52,5 Hz)	60 Hz (57 – 63 Hz)
Note	Transformer start is blocked when frequency is outside of stated range.	

Turn-off delay	< 0,03 s (via control input)
Power supply failure detection	>2 ms
Note	Smooth switching-on takes place after power recovery. Inrush current is eliminated even during half-wave failure.
Switching frequency	1× in 15 s
Lifetime	1 million switching
Control voltage	9 – 32 V_{DC} - galvanically isolated from power supply
Control current	5 – 35 mA
Model TS 1xxx 1 –	Voltage on control input switch the transformer off. It's not necessary to use this input. Standard model.
Model TS 1xxx 2 –	Voltage on control input switch the transformer on.
Protection	IP20
Protection class	II
Pollution degree	2
Operating temp.	0 °C ÷ 50 °C
Storage. temp	-10°C ÷ 70°C
Max. humidity	90 % non-condensing
Dimensions	53 × 96 × 60 mm
Weight	0,2 kg
Material	polycarbonate
Mounting	35 mm DIN-rail, according DIN EN 50 022
Connection	power terminals: conductor cross-section 0,2 – 4 mm^2 control terminals: conductor cross-section 0,2 – 2,5 mm^2

Maintenance, Service, Warranty

For reliable operation it is only necessary to meet the operating conditions specified and not expose the instrument to violent handling and contact with water or chemicals which could cause mechanical damage.
The device must be kept clean, in particular, ensure cleanliness of the cooling vents for good heat dissipation. If the dirt collects remove it with a clean dry cloth or soft brush. The unit is in operation under hazardous voltage. Maintenance work should be performed by qualified personnel. Repairs can be carried out only by the manufacturer or an authorized service center.
In the case of failure or a breakdown of the product, you should contact the supplier at their address:

Supplier :

Manufacturer :

KMB systems , s.r.o.
Dr. M. Horákové 559
460 06 LIBEREC 7
tel. 485 130 314, fax 482 736 896
e-mail : kmb@kmb.cz ,

url : www.kmb.cz

The product must be in proper packaging to prevent damage during transit. A description of the problem or its symptoms must be delivered together with the product.

If a warranty repair is claimed, the warranty certificate must be sent in. In case of an out-of-warranty repair you have to enclose an order for the repair.

Warranty certificate

Warranty period of 24 months from the date of purchase is provided for the instrument, however, no longer than 30 months from the day of dispatch from the manufacturer. Problems in the warranty period, provably because of faulty workmanship, design or inconvenient material, will be repaired free of charge by the manufacturer or an authorized servicing organization.

The warranty ceases even within the warranty period if the user makes unauthorized modifications or changes to the instrument, connects it to out-of-range quantities, if the instrument is damaged due to ineligible or improper handling by the user, or when it is operated in contradiction with the technical specifications presented.

Type of product:....**TrafoSTART TS**..... SN.....

Date of dispatch: .....

Final quality inspection: ….....

Manufacturer's seal:

Date of purchase: .....

Supplier's seal: