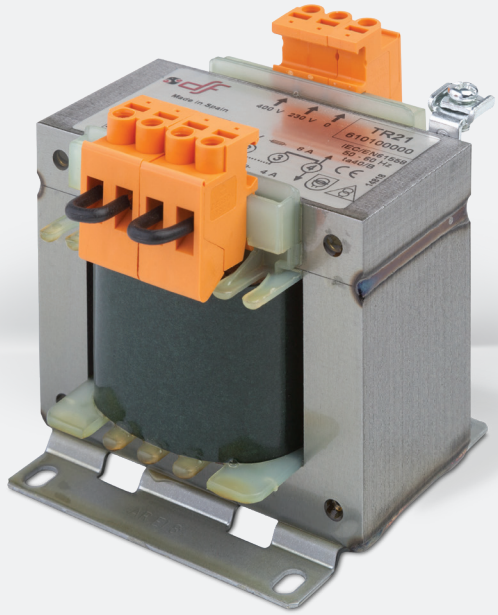
df Electric

# TRANSFORMERS

LOW VOLTAGE TRANSFORMERS · AUTOTRANSFORMERS · REACTORS



# TR21
## CONTROL
single-phase transformers

TR21

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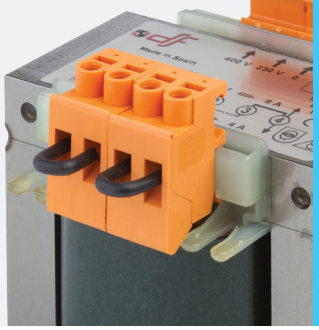


# TR21
## CONTROL
single-phase transformers

TRANSFORMERS

TR21

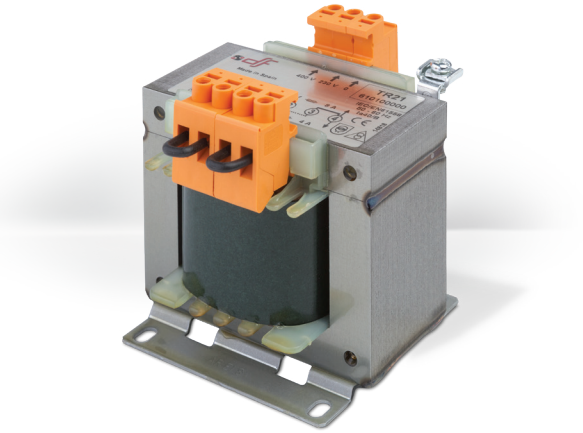
TR21

**POWER**
40VA...1000VA

**PRI VOLTAGE**
0-230-400V

**SEC VOLTAGE**
12-24V
24-48V
115-230V

**STANDARDS**
IEC/EN 61558-1
IEC/EN 61558-2-2
IEC/EN 61558-2-4
IEC/EN 61558-2-6



## TR21 CONTROL
## Single-phase transformers

TR21 type transformers are intended for use as control or signalling transformer as well as general use transformer.

The range comprises rated power between 40VA to 1000VA.

They have been designed with low impedance windings for excellent voltage regulation, and for accommodate the high momentary inrush current caused when electromechanical devices are energized.

They are sized for continuous service at 100% of power in an ambient temperature up to 40°C. For ambient temperatures above 40°C it is necessary to apply a derating.

Great versatility due to the double voltage in primary as well as secondary windings.

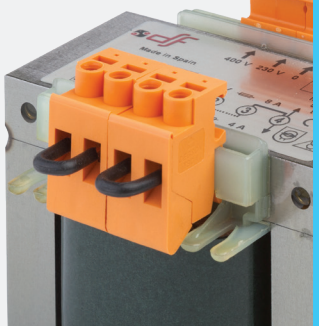
Primary voltage 230-400 V according standard values in IEC60038. These transformers can withstand an input overvoltage of up to 10%.

Secondary windings comprise two identical windings intended to serial or parallel connection, thus the user can obtain full power in any selected voltage. Possibilities are: 12-24V, 24-48V or 115-230V.

TR21 transformers are delivered with parallel connection (lower voltage).

# Range

| POWER (VA) | REFERENCE 12 - 24V | 24 - 48V | 115 - 230V |
|---|---|---|---|
| 40 | **610040000** | **610040001** | **610040002** |
| 63 | **610063000** | **610063001** | **610063002** |
| 100 | **610100000** | **610100001** | **610100002** |
| 160 | **610160000** | **610160001** | **610160002** |
| 200 | **610200000** | **610200001** | **610200002** |
| 250 | **610250000** | **610250001** | **610250002** |
| 320 | **610320000** | **610320001** | **610320002** |
| 400 | **610400000** | **610400001** | **610400002** |
| 500 | **610500000** | **610500001** | **610500002** |
| 630 | **610630000** | **610630001** | **610630002** |
| 800 | **610800000** | **610800001** | **610800002** |
| 1000 | **611000000** | **611000001** | **611000002** |



# TR21 CONTROL
single-phase transformers

TRANSFORMERS

TR21

# Technical data

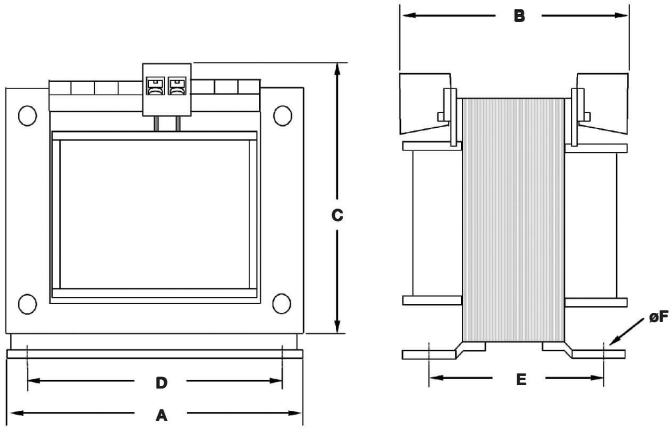
| | |
|---|---|
| **Use** | **SEC 12-24V**<br>Control and safety transformer<br>**SEC 24-48V \| 115-230V**<br>Control and isolating transformer |
| **Rated primary voltage** | 0-230-400V |
| **Rated secondary voltage** | 12-24V<br>24-48V<br>115-230V |
| **Rated power range** | 40VA ... 1000VA |
| **Protection against electric shock** | Class I |
| **Thermal class** | B (130ºC) |
| **Rated ambient temperature** | 40ºC |
| **Protection index** | IP00 |
| **Frequency** | 50/60Hz |
| **Dielectric strength between primary and secondary** | ≥4,5kV |
| **Dielectric strength between windings and metallic parts** | ≥2,5kV |
| **Ambient temperature of service *** | -20°C ... 70°C |
| **Storage temperature** | -40°C ... 85°C |

* For ambient temperatures higher than 40ºC it is necessary to apply a derating.

# Standards

**IEC/EN 61558-1** Transformers, general specifications
**IEC/EN 61558-2-2** Control transformers
**IEC/EN 61558-2-4** Isolating transformers
**IEC/EN 61558-2-6** Safety transformers
**RoHS Compliant**

# Dimensions

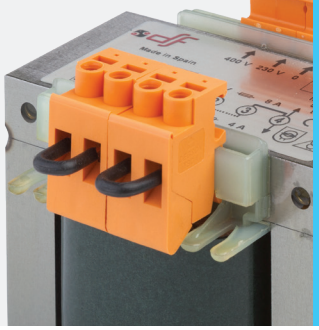



| POWER (VA) | DIMENSIONS (mm) | | | | | | WEIGHT (kg) |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | |
| **40** | 75 | 83 | 88 | 56 | 47 | 4,8 | 1,00 |
| **63** | 84 | 86 | 95 | 64 | 52 | 4,8 | 1,40 |
| **100** | 84 | 100 | 95 | 64 | 67 | 4,8 | 1,96 |
| **160** | 96 | 102 | 106 | 84 | 77 | 5,7 | 2,80 |
| **200** | 96 | 116 | 106 | 84 | 91 | 5,7 | 3,40 |
| **250** | 108 | 105 | 115 | 80,5 | 73 | 5,7 | 3,64 |
| **320** | 108 | 117 | 115 | 80,5 | 87 | 5,7 | 4,54 |
| **400** | 120 | 110(1) | 124(2) | 90 | 87 | 5,7 | 5,20 |
| **500** | 120 | 126(1) | 124(2) | 90 | 107 | 5,7 | 6,85 |
| **630** | 150 | 114(1) | 146(2) | 122 | 92 | 6,8 | 7,50 |
| **800** | 150 | 133(3) | 146(4) | 122 | 108 | 6,8 | 10,2 |
| **1000** | 150 | 156(3) | 146 (4) | 122 | 135 | 6,8 | 13,6 |

(1) SEC 12V - 24V → + 20mm
(2) SEC 12V - 24V → + 7,5mm
(3) SEC 12V - 24V / SEC 24V - 48V → + 20mm
(4) SEC 12V - 24V / SEC 24V - 48V → + 7,5mm

# Constructive characteristics

| |
|---|
| Two identical secondary winding intended for serial or parallel connection (jumpers supplied with the transformer) |
| Reinforced insulation |
| Windings in F(155°C) or H(180°C) thermal class |
| Flexible insulation Class B (130°C) |
| Impregnation Class F (155°C) |
| Connections with accidental contact protected terminal blocks |
| Screw earth connection (standard IEC/EN61558 prescribes in the clause 24 that it should not be possible to loosen the protection wire without the aid of a tool) |
| TIG welded magnetic core prevent vibration and allows small air gap to reduce the magnetization current |



# TR21 CONTROL
single-phase transformers

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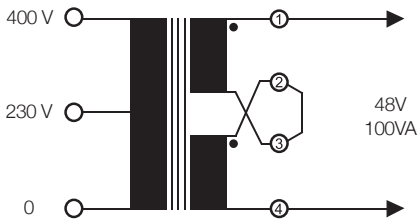
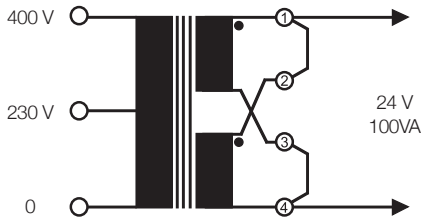
## Secondary connection

* TRANSFORMER 0-230-400V // 24-48V 100VA
REF 610100001

**SERIAL CONNECTION**




**PARALLEL CONNECTION**



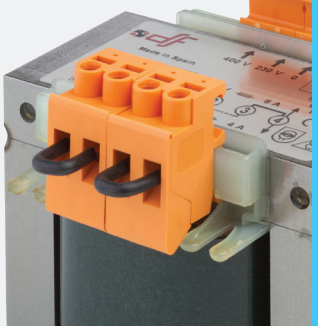

## Typical values

| RATED POWER | NO-LOAD CURRENT $I_o$ | NO-LOAD LOSSES $P_{FE}$ | TOTAL LOSSES $P_{CU} + P_{FE}$ | Ucc | EFFICIENCY | VOLTAGE DROP |
|---|---|---|---|---|---|---|
| (VA) | (% In) | (W) | (W) | (%) | (%) | (%) |
| **40** | 35 | 2,4 | 6,9 | 9,8 | 81 | 9,8 |
| **63** | 30 | 3,5 | 9,3 | 8,7 | 83 | 9,8 |
| **100** | 28 | 4,5 | 13,2 | 8,3 | 83 | 7,5 |
| **160** | 26 | 6,3 | 17,9 | 6,7 | 86 | 6,5 |
| **200** | 24 | 7,2 | 18,6 | 5,5 | 87 | 6,5 |
| **250** | 22 | 6,5 | 24,1 | 6,9 | 89 | 7,9 |
| **320** | 19 | 9,3 | 31,2 | 6,9 | 89 | 7,9 |
| **400** | 17 | 10,8 | 28,5 | 4,4 | 90 | 6,0 |
| **500** | 16 | 14,3 | 31,9 | 3,6 | 91 | 6,0 |
| **630** | 14 | 17,0 | 47,2 | 4,7 | 92 | 3,8 |
| **800** | 13 | 22,3 | 52,9 | 4,0 | 92 | 3,8 |
| **1000** | 11 | 27,1 | 59,7 | 3,3 | 94 | 3,8 |

## Instantaneous power

| RATED POWER | Cos ϕ | Cos ϕ | Cos ϕ | Cos ϕ | Cos ϕ | Cos ϕ | Cos ϕ | Cos ϕ | Cos ϕ | Cos ϕ |
|---|---|---|---|---|---|---|---|---|---|---|
| (VA) | **0,1** | **0,2** | **0,3** | **0,4** | **0,5** | **0,6** | **0,7** | **0,8** | **0,9** | **1** |
| **40** | 221 | 146 | 110 | 91 | 75 | 63 | 55 | 51 | 47 | 44 |
| **63** | 414 | 274 | 207 | 170 | 140 | 118 | 104 | 96 | 89 | 82 |
| **100** | 682 | 440 | 327 | 263 | 220 | 185 | 163 | 150 | 135 | 121 |
| **160** | 1170 | 755 | 562 | 447 | 380 | 324 | 285 | 254 | 231 | 216 |
| **200** | 1323 | 847 | 656 | 530 | 450 | 392 | 350 | 312 | 286 | 270 |
| **250** | 1912 | 1224 | 949 | 765 | 650 | 566 | 505 | 452 | 413 | 390 |
| **320** | 2500 | 1600 | 1240 | 1000 | 850 | 740 | 660 | 590 | 540 | 510 |
| **400** | 2438 | 1757 | 1389 | 1160 | 1000 | 875 | 785 | 695 | 660 | 640 |
| **500** | 3413 | 2460 | 1945 | 1625 | 1400 | 1225 | 1100 | 975 | 925 | 895 |
| **630** | 3440 | 2622 | 2145 | 1840 | 1600 | 1430 | 1294 | 1192 | 1124 | 1090 |
| **800** | 5430 | 4095 | 3283 | 2753 | 2400 | 2120 | 1906 | 1765 | 1625 | 1588 |
| **1000** | 8000 | 5850 | 4625 | 3865 | 3300 | 2970 | 2607 | 2376 | 2178 | 2112 |

Maximum output delivered at a different values of power factor (cos ϕ)
for a short time and for a output voltage of at least 0,95·Un





# Transformer protection

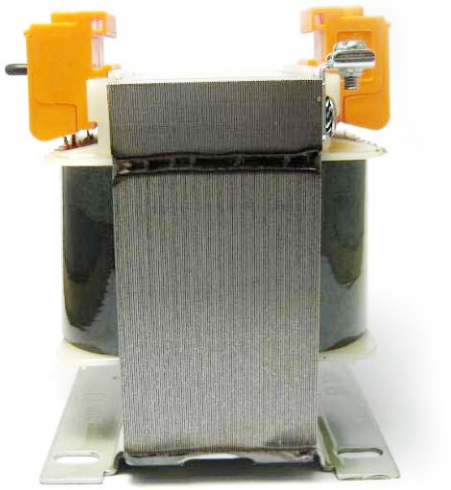
The transformers (and their lines) must be protected against overloads and/or short-circuits that they can be submitted in use, and could causes dangerous situations for persons, animals or installations.

On the primary side, rated current of fuse links should be selected to withstand high values of inrush currents.

On secondary side, rated currents of fuse links should be selected in order to guarantee protection against short-circuits as well as overloads.

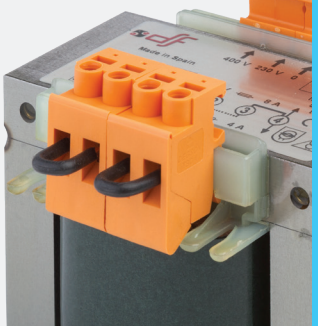
For rated currents up to and including 6,3A we can use 5x20 or 6x32 fuses according to IEC/EN60127. The characteristics (fast, slow, etc.) it depends of the load.

For rated currents above 6,3 A the adequate type of fuse links are those according to IEC/EN60269-2-1 (class gG).



# Rated current of fuse links

| | PROTECTION ON PRIMARY SIDE | | PROTECTION ON SECONDARY SIDE | | | | |
|---|---|---|---|---|---|---|---|
| POWER | INPUT VOLTAGE | | OUTPUT VOLTAGE | | | | |
| (VA) | 230V | 400V | 12V | 24V | 48V | 115V | 230V |
| **40** | T630 mA | T315 mA | 3,15 A | 1,6A | 800mA | 315mA | 160mA |
| **63** | T1 A | T500 A | 5A | 2,5A | 1,25A | 500mA | 250mA |
| **100** | T1,6 A | T800 mA | 8A | 4A | 2A | 800mA | 400mA |
| **160** | T2,5 A | T1,25 A | 12A | 6,3A | 3,15A | 1,25A | 630mA |
| **200** | T3,15 A | T1,6 A | 16A | 8A | 4A | 1,6A | 800mA |
| **250** | T4 A | T2 A | 20A | 10A | 5A | 2A | 1A |
| **320** | T5 A | T2,5 A | 25A | 12A | 6,3A | 2,5A | 1,25A |
| **400** | T6,3 A | T3,15 A | 32A | 16A | 8A | 3,15A | 1,6A |
| **500** | 8A gG | T4 A | 40A | 20A | 10A | 4A | 2A |
| **630** | 10A gG | T5 A | 50A | 25A | 12A | 5A | 2,5A |
| **800** | 12A gG | T6,3 A | 63A | 32A | 16A | 6,3A | 3,15A |
| **1000** | 16A gG | 8A gG | 80A | 40A | 20A | 8A | 4A |





# Selection guide

## Determination of rated power of the transformer in control applications

For the correct sizing of a control transformer we must consider the continuous power as well as the inrush power due to the high momentary inrush current caused when electromechanical devices such as contactors or relays are energized.

During the normal operation of control circuit the transformer must supply a high instantaneous power for a short time.

From the thermal point of view this is not a problem due to the very short time, however, this situation could be problematic due to the reduction of output voltage in the transformer.

If the secondary voltage decreases in excess, some devices might not operate and the control circuit won't work properly.

Thus, in every control circuit we will take into account several facts:

- The maximum power in a given moment (inrush power)
- Continuous power requirement
- Power factor
- Minimum admissible voltage

An exhaustive study in each situation could be very complex due to the particularities on every application, however there are simple rules to determine the correct size of a transformer.

We can suppose that the power factor is cos $\phi$ = 0,5 during the operation of contactors.

The instantaneous power will be:

$$P_{inst} = \Sigma P_m + \Sigma P_s + P_a$$

$\Sigma P_m$ → sum of the sealed power of the contactors
$\Sigma P_s$ → sum of the power of the signalling lamps
$P_a$ → Inrush power of the biggest contactor

With the continuous power requirement and the instantaneous power required by the circuit, we are able to choose the adequate size of transformer (see the **maximum instantaneous power of TR21 transformers**).

## Example

This example assumes the following:

- **4 contactors for motor**
  sealed power: 8 VA
- **2 contactors for motor**
  sealed power: 18 VA
- **1 contactors for motor**
  sealed power: 22 VA
  Inrush power: 280 VA
- **3 signalling lamps of 2 VA**

The total sealed power will be:

4 x 8 VA = 32 VA
2 x 18 VA = 36 VA
1 x 22 VA = 22 VA
$\Sigma P_m$ = **90 VA**

Sum of the signalling lamps power:

$\Sigma P_s$ = 3 x 2 VA = **6 VA**

Inrush Power of the biggest contactor:

$P_a$ = **280 VA**

The instantaneous power will be:

$P_{inst.}$ = 90 VA + 6 VA + 280 VA = **376 VA**

Continuous power:

P = 90 VA + 6 VA = **96 VA**

With this information we can select the adequate size of transformer. In this example the **rated power will be 160 VA** (the 100 VA transformer does not have enough instantaneous power).

**HEAD OFFICE AND FACTORY**
SILICI, 67-69
08940 CORNELLA DE LLOBREGAT
BARCELONA
SPAIN
Tel. +34 93 377 85 85
Fax +34 93 377 82 82

**INTERNATIONAL SALES**
Tel. +34 93 475 08 64
Fax +34 93 480 07 75
export@dfelectric.es

**NATIONAL SALES**
Tel. 93 475 08 64
Fax 93 480 07 76
comercial@dfelectric.es

**dfelectric.es**

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