Hermetically sealed resistor for Rolling stock

RFK/S series is available on the railway market (rolling stock) since 2002. In the last 20 years more than 50,000 resistors have been installed worldwide on trains, high speed trains, trams, EMU, Metro, APM, LRV, LTV, Trolley bus, for a total of more than 1,7 Billions of hours.

Functional Application

RFK/S series is used in the power traction converters or auxiliary converters with the following functions: charging / discharge of capacitors, over-voltage protection, earthing resistor, crowbar, damping resistor.

Construction

RFK/S is made of 2 windings on a mica sheet coated by inorganic cement or silicon resin, filled by quartzite sand and sealed by resin. The active element is insulated to the case thanks to creepage distance and mica sheets and ceramics. The construction is made with a poka-yoke system to avoid manufacturing mistakes. The aluminum case is anodized to prevent oxidation. Wire is made of NiCr alloy with thermal coefficient between 60 ppm (NiCr8020) and 240 ppm (NiCr3020).

Standards

RFK/S complies with the standards of Railway traction field: EN 50124-1, IEC 62497-1, EN 60077-1; EN 60322; EN 61373; EN 60068-2-11; EN 44545-2 and Reach regulation.

RFK/S

600 800

CE RoHS COMPLIANT Pb Pb-Free

IP67

ELECTRICAL CHARACTERISTICS

refers to room temperature 25°C

	Model	RFK/S 600		RFK/S 800	
Parameter	**Version**	**A**	**B**	**A**	**B**
Rated insulation voltage [kV]	U_{NM} EN 60077-1 (5.1.3) U_{NM} EN 50124-1 (3.4.4) Ui EN 60322 3.13	1.8	3	1.8	3
Rated power frequency withstand voltage [kVac]	EN 60077-1 (5.1.4)	5.6	6.6	5.6	6.6
Rated power frequency withstand voltage [kVac]	EN 60322 (8.5.2.2)	6.5	9.5	6.5	9.5
Rated power frequency withstand voltage [kVac] after test	200 hrs EN 60068-2-11 EN 60322 8.6 ; 8.8	4.9	7.1	4.9	7.1
Insulation resistance @ 1000 Vdc	Typical for brand new resistor	> 1 GΩ			
Insulation resistance @ 1000 Vdc after test	200 hrs EN 60068-2-11 EN 60322 8.6 ; 8.8	> 300 MΩ			
R min [Ω]		0.5	30	1	20
R max [Ω]		1800	390k	2700	390k
Rated continuous power [W]	T_{amb} =25 °C See note	220	220	275	275

The difference between version A and B is the creepage inside the case (longer in the version B), the winding mica plates, and the assembling of the resistor element inside the case. Version A is suitable for lower ohmic values (high mass of wire), whereas version B is designed for higher ohmic values.

Power

Rated continuous power refers to a permanent temperature 24x7 (thermal steady state) of 250 °C on the case at the hottest point at ambient temperature 25 °C with the case in horizontal position (parallel to the ground), at least 150 mm of free space on all directions and altitude up to 2000 m above sea level. This temperature on the case will not impact the sealing of the resistor along its life.
The thermal time constant is 400 s for all models and versions.

Ohmic resistance

Depending on the model and the version, Fairfild can produce different range of ohmic value. Standard tolerance on ohmic value at room temperature is ± 5%.

Cables

RFK/S cables (wiring leads) are built according to the standard EN 50382-2 - Railway rolling stock high temperature power cables having special fire performance single core silicone rubber. Depending on the voltage requirement, two versions are available: 1.8/3 or 3.6/6 kV. The cable is provided with a short stripped part and a length of 500 mm ±10 mm. The choice of the cross section depends on the current and the working load condition. Fairfild available standards are: 2.5 mm^2, 4 mm^2 and 6 mm^2.

Overload conditions

The discharge resistors are typically designed with high ohmic value since they are connected in parallel to the capacitors and they are always under voltage. All other resistors are designed to dissipate peaks of energy as isolated or repetitive pulses. The capability of the resistor to withstand the energy depends on its thermal capacitance. If the pulse is very short and isolated only the mass of the wire must be considered. The mass of the wire depends on the ohmic value. Fairfild can increase the mass of wire thanks to the double winding technique. In case of cyclic load with several pulses, the mass of the other materials inside the case also plays an important role to absorb the energy. Please refer to Fairfild technical office for detailed info on the overload condition.

Non-permanent Voltages

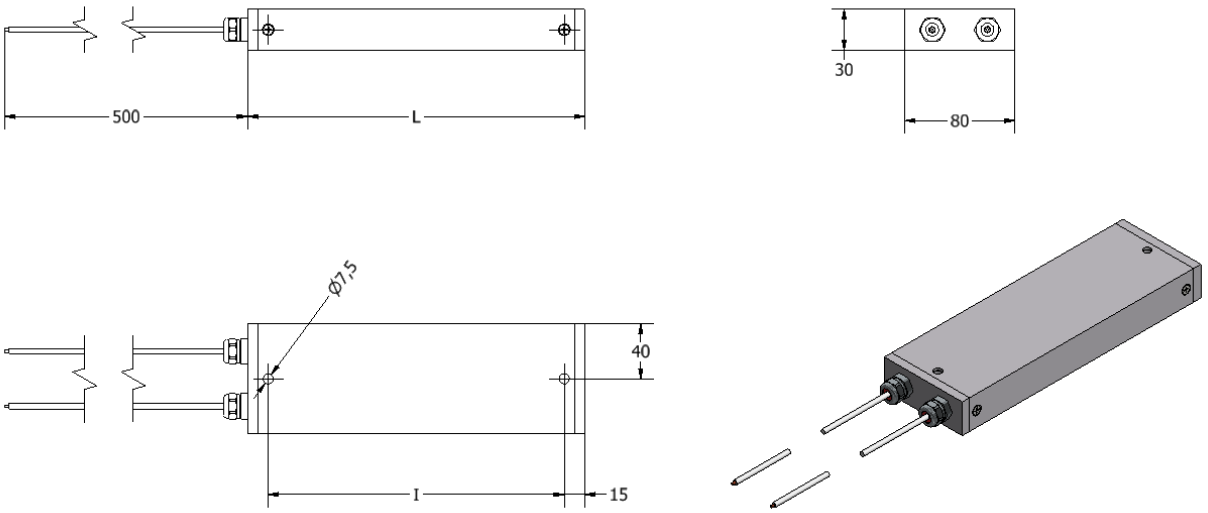
RFK/S version A is designed to withstand a rated insulation voltage of 1800 V. For Voltages applied as non-permanent, these values can be increased. Please contact Fairfild Technical Office for clarification.

FAIRFILD SRL – Via Eching, 12 20090 Trezzano sul Naviglio (MI) Italy – C.F. 03539970156 – P.ta Iva IT02736630167 – REA MI 1630934 – C.S i.v. 50.000 €

MECHANICAL DATA

Dimensions [mm]	I	L	Weight [g]
RFK/S 600	215	245	1350
RFK/S 800	280	310	1700

DRAWING



Unless otherwise specified, applicable standard of general tolerances for linear and angular dimensions is ISO 2768-1 class c; applicable standard for aluminum profile is EN 755-9:2008. The tolerance on the cable's length is ± 10 mm.

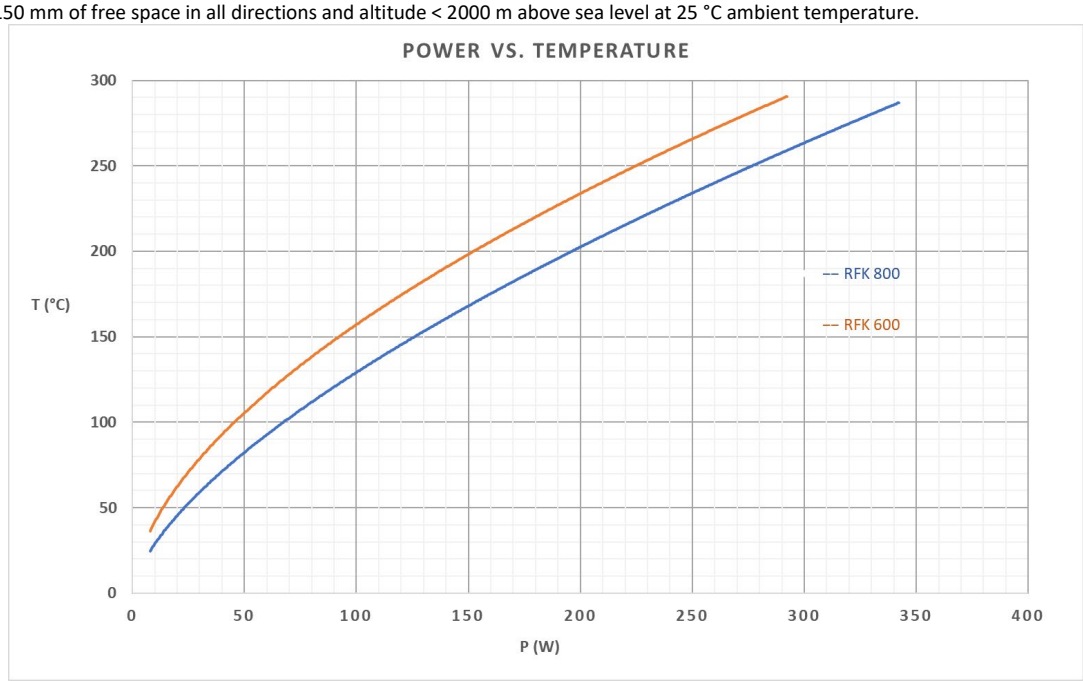
The weight of the resistor is different for version A or B, and it depends also on the mass of wire (in function of the ohmic value), the cross section and length of the cable. Data in the above table refer to version A, L = 500 mm S = 6 mm^2.

SURFACE TEMPERATURE CHARACTERISTIC

The power dissipation is influenced by:

- Mounting position and arrangement (wall, heat - sink)
- Number of resistors mounted together (grouping)
- Ambient temperature (in free air or inside an enclosure)
- Altitude

See the following graph for the external temperature corresponding to a certain continuous power. This graph refers to resistor in horizontal position (parallel to the ground) and with 150 mm of free space in all directions and altitude < 2000 m above sea level at 25 °C ambient temperature.



OVERLOAD CONDITION - NEW

The graphs below show the capability of RFK/S 600 and 800 resistors version A to withstand overload condition with a **cyclic workload.** The time of a single pulse can be between 1 and 2 seconds and can be repeated cyclically for a several times until thermal steady state.
The data in the graph are valid under these two conditions:

$$\text{Peak Power} \leq \frac{\text{Rated Continuous Power}}{ED}$$

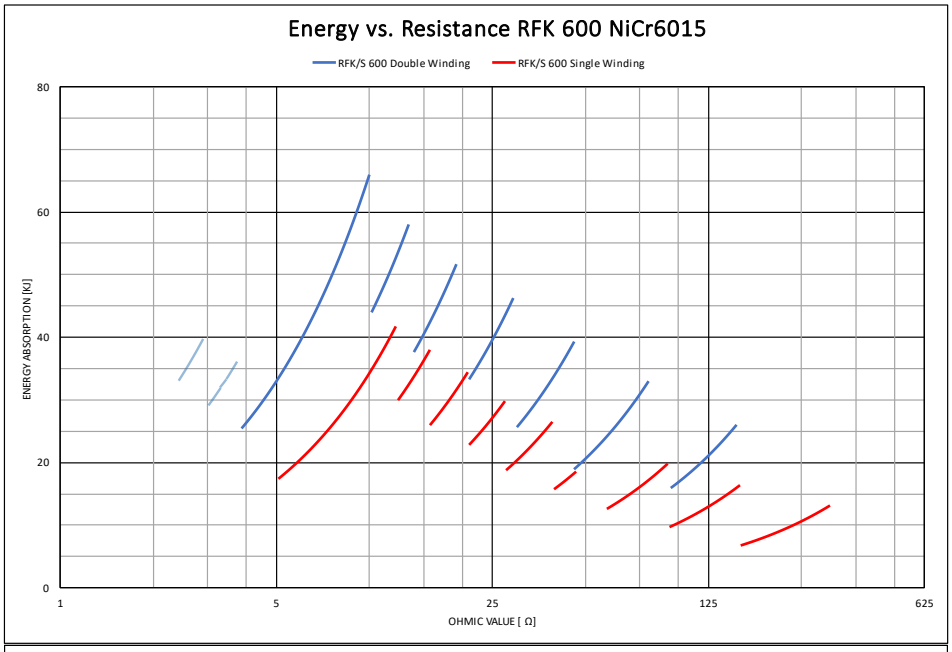
$$\text{Peak Power} * t_{on} \leq \text{Energy Absorption (indicated in the graph)}$$

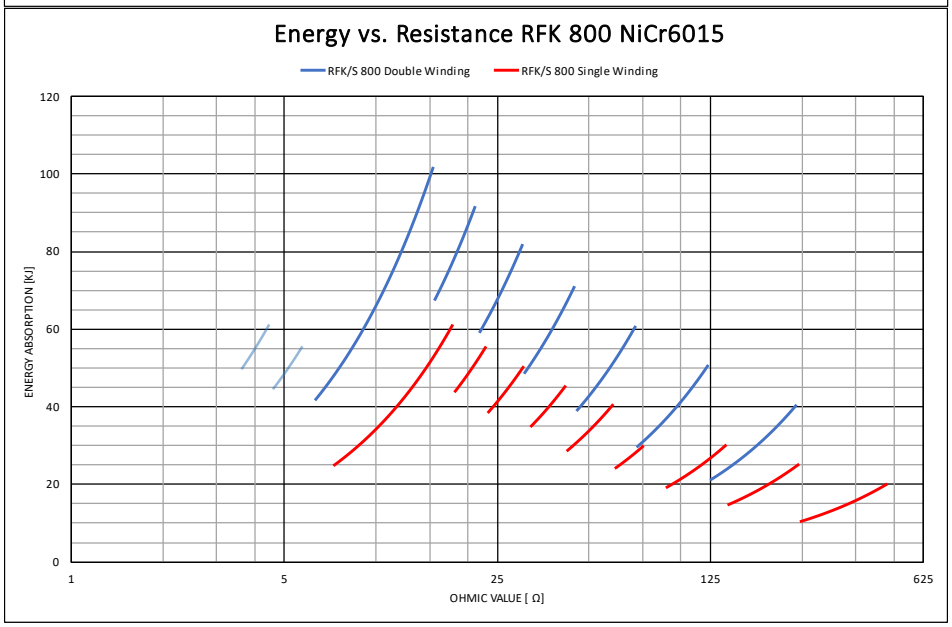
Where:
ED = t_{on} /t_{tot}
t_{on} is the duration of a single pulse
t_{tot} is the period
Peak power: for a rectangular shape of the pulse it is calculated as Energy / t_{on}
Rated continuous power: it is indicated in the table at page 1 of this datasheet

The energy in the graphs below refers to:

- Temperature Ambient 25°C
- Material of wire, Alloy NiCr6015

Two winding techniques are available: single or double winding.
For one single pulse, with duration between 1 and 2 seconds, the value below could be 2 or 4 times higher. Fairfild technical office is at your disposal for further detailed information.





Marking

The resistor is marked on the aluminum case with laser printing that assures very high contrast for the whole life of the component and it is indelible.

The following data are printed (example):

FAIRFILD ITALY WW/YY RFK/S 600 R = 10 Ω ± 5% U_{NM} = 1.8 kV

WW/YY stands for Week Year, it is the batch number.

Installation

Warning: When mounted in the vertical orientation, the terminals must not be positioned at the top.

The unit must be fixed with 2 screws M6 with tightening torque of 8 Nm.

A minimum of 150 mm of free space must be provided in all directions around the resistor. Different installation conditions can be agreed with Fairfild technical office.

Packing

The resistor is packed in a way to prevent incidental damages due to transport. To avoid damage do not handle by cables. Upon customer's request Fairfild can pack the resistors individually.

Disclaimer

Every effort has been made to ensure that the information in this datasheet is accurate. Fairfild is not responsible for printing or clerical errors. All properties and characteristics mentioned in this datasheet are only for informational purposes. The information in this datasheet is offered solely for your consideration and should not be taken as a warranty or representation for which we assume legal responsibility. The customer bears all responsibility for use and application of Fairfild products. There is no responsibility of the manufacturer for any damage to persons and properties in case of improper use. Fairfild reserves the right to change specifications without prior notice.

Aesthetic imperfections

Fairfild is committed to assure the best appearance of the resistor case. In consideration of the multiple steps in the production manufacturing and handling from the extrusion of the aluminum profile to the packing of the resistor, some small imperfections may be present on the aluminum case. Fairfild established and applies a procedure to assess aesthetic defects. This procedure is available for the customer upon request.

Fail safe - new

Upon specific request from the customer, RFK/S version A may be equipped with a special feature that open the circuit in a safe manner.

Fairfild technical office is available for clarification.

Behavior in humid environment

RFK/S is designed to withstand critical and severe environmental conditions for 30 years.

The customer should communicate to Fairfild if the units are installed externally (both on the roof or under the body).

The value of the insulation resistance and the leakage current of the dielectric withstand test depend on the quantity of humidity inside and where it is more concentrated. Thanks to the correct designing of creepage and the use of right insulation materials we can assure electrical insulation for the life of the component.

At the end of the manufacturing process, before final check and packing, there is the process of the de-humidification whose aim is to expel the humidity out of the case. Thanks to this step, the insulation resistance of the brand-new resistors is extremely high. From the moment of the shipment to the entering in function of the rolling stock on which the resistor is installed, many months can pass. Depending on how the resistor is stored during this time, some humidity may enter into the case. The reason why this happen is due to the physical phenomenon of capillarity: the two systems (case and ambient) want to reach thermal and moisture equilibrium. When the ambient is humid and the resistor inside is dry, the humidity will penetrate through the little gaps between case and plug and resin and through the cable. The sealing construction takes into account that the hot air must be expelled when the resistor is supplied, because the air inside will expand its volume due to its thermal expansion. The direct consequence of this construction is that the quantity of humidity inside the case is not constant during the life of the component, and it is not homogenously spread in the inner volume. For this reason, Fairfild made tests in climatic chamber and rain test to define a minimum value of insulation resistance and dielectric withstand that is compliant with the use of the component on the rolling stock.

Copyright

Ordering information

Please specify the following when ordering:

- Model: 600 or 800
- Version: A or B
- Installation: indoor or outdoor
- Ohmic value at room temperature (standard tolerance ± 5%)
- Cable withstand voltage:1.8/3 kV or 3.6/6 kV
- Cable cross section: 2.5 mm^2 or 4 mm^2 or 6 mm^2
- Cable length: 500 mm, 1000 mm; 2000 mm

FAIRFILD SRL – Via Eching, 12 20090 Trezzano sul Naviglio (MI) Italy – C.F. 03539970156 – P.ta Iva IT02736630167 – REA MI 1630934 – C.S i.v. 50.000 €