

AFR 111, AFR 131

Smart Load for reduction of Ferroresonance
rev 1.5



Description of Instrument

AFR 1xx smart load is an instrument designed to monitor and protect measuring voltage transformers (VT) against the potentially harmful effects of ferroresonance in a high voltage distribution network. Ferroresonance occurs between the inductance of the transformer and the capacitance of the MV lines or switching equipments. Ferroresonance can be initialized by switching, disconnection, ground connections or by other transient events. During the ferroresonance a significant overvoltage and concurrent current peaks can occur due to the saturation of the magnetic circuit of the VT. This often leads to a fatal destruction of the VT.

AFR 1xx acts as a protection of the VT against the unwanted effects of such events. In comparison with other protection methods AFR 1xx is only selectively activated during the occurrence of ferroresonance and stays inactive during the normal operation.

AFR 11x is intended for alone operated VTs, i. e. for single phase measuring, V connection measuring or for one pole power feeders. AFR 13x is intended for connection into open delta of auxiliary secondary windings of three VTs.

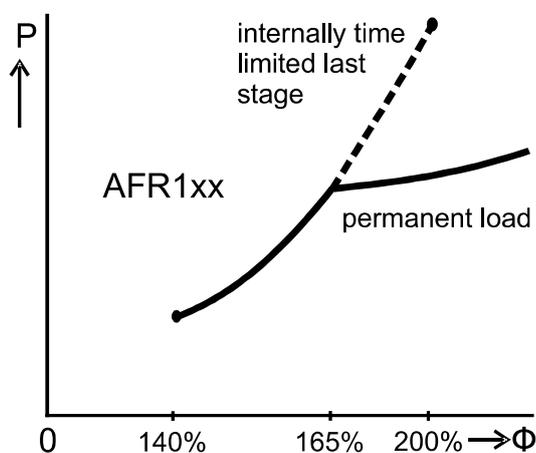
Device installation



WARNING

Installation, adjusting and maintenance may be carried out by qualified personnel only with respect to installation instructions and safety regulations. When operated in contradiction with the technical specifications, proper functionality is not guaranteed. Before any manipulation with the instrument, disconnect voltage transformers out of the network. Don't touch instrument terminals and don't use the instrument without its cover.

AFR 1xx - Feature Description of the Smart Load



The device AFR 1xx continually guards level of actual magnetic induction of the transformer core and activates itself only to decrease the energy in circuit, flowing through parasitic capacities. So that it limits the occurrence of ferroresonance. Detection algorithm evaluates transients and other voltage waveform deformations which influence the level of the transformer core magnetic excitation. The AFR is activated at 145 % of the nominal voltage U_{nom} during the steady state situation. The internal load gradually increases up to maximum for 200 % of nominal voltage.

Operation of the instrument is indicated with green signal LED light. Active state is indicated by red signal LED light. When the maximum load capacity of the AFR is reached,

the red LED light starts blinking. The activation of the upper resistive stage is internal time and temperature limited.

AFR 1xx is intended for installation on 35 mm DIN rail according to EN 50 022 and only for interior applications. It is crucially important to protect the instrument against dust, dirt and water entering the equipment.

For correct function it is important to provide enough cooling of the instrument. Inside the cabinet a correct air circulation should be kept. In close proximity to the instrument and especially below it should not be installed any other instruments and equipment which could be a source of heat. The instrument is installed as is displayed with a ventilator at the bottom and terminals on top. Typically it is installed into the cabinet aside other protection and measuring instruments.

AFR 1xx is connected to the secondary side of the voltage transformer. It can be connected in parallel with the measuring and protection instruments. Parallel wiring of the load should not influence the operation of the protection relays. Optionally it can be connected onto the separate secondary winding. It is always important to respect the nominal voltage of the AFR 1xx and the same nominal voltage of the secondary winding of the transformer.

The conductors connection the device should be protected by the B16A (characteristic B) circuit breaker in proximity to the transformer. It is recommended to use flexible isolated wire with max. 2,5 mm² cross-section. The connection wiring schema is shown below. Terminal **b** or **n** or **dn** of the load must be grounded preferably to the terminal of the transformer. Before commission make sure that this grounding is

present and is not duplicate (at the transformer sec. output and at the protection for example) . Do not short circuit the transformer. This could lead to the destruction of the VT.

It is possible to use AFR 1xx together with protection relays or measuring devices to one VT. Parallel connection of ARF does not affects function of protection relay.

Models of AFR 1xx S needs auxiliary voltage supply, preferably with backup, for internal electronics. It is recommended to use flexible isolated wire with max. 2,5 mm² cross-section.

Models of AFR 1x1 with memory and communication line keeps last 250 events in datalogger (activation, transformer switch on, switch off, undervoltage).

Communication line RS 485 is connected to terminals A, B and G. The usage of terminator resistors at the communication line endpoints is recommended. The cable shielding should be connected only at one point to PE wire, preferably at the side of a controller. The maximal diameter of wires is 2,5 mm².

Instrument Types and Accessories

Instrument Class

AFR 1..	Smart load to reduce ferroresonance
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Connection of protected VT

11	1 pole VT
31	3 phase measuring with open delta secondary

Extending modules

N	No extension
V	Memory for events, RS-485 communication

Power supply

N	Supply from protected VT
L	Separate, auxiliary supply voltage

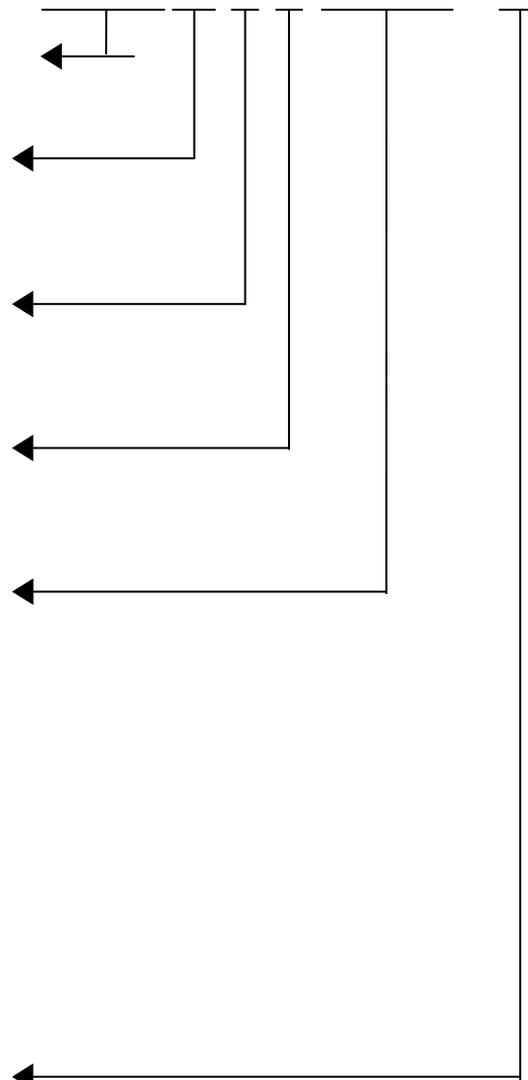
Nominal voltage of VT

100/V3	Nominal secondary voltage $100/\sqrt{3} = 57,7$ V
110/V3	Nominal secondary voltage $110/\sqrt{3} = 63,5$ V
120/V3	Nominal secondary voltage $120/\sqrt{3} = 69,3$ V
100	Nominal secondary voltage 100 V
110	Nominal secondary voltage 110 V
120	Nominal secondary voltage
220	Nominal secondary voltage 220 V, <small>only AFR 111 N N</small>
230	Nominal secondary voltage 230 V <small>only AFR 111 N N</small>
...	Other secondary voltage on request

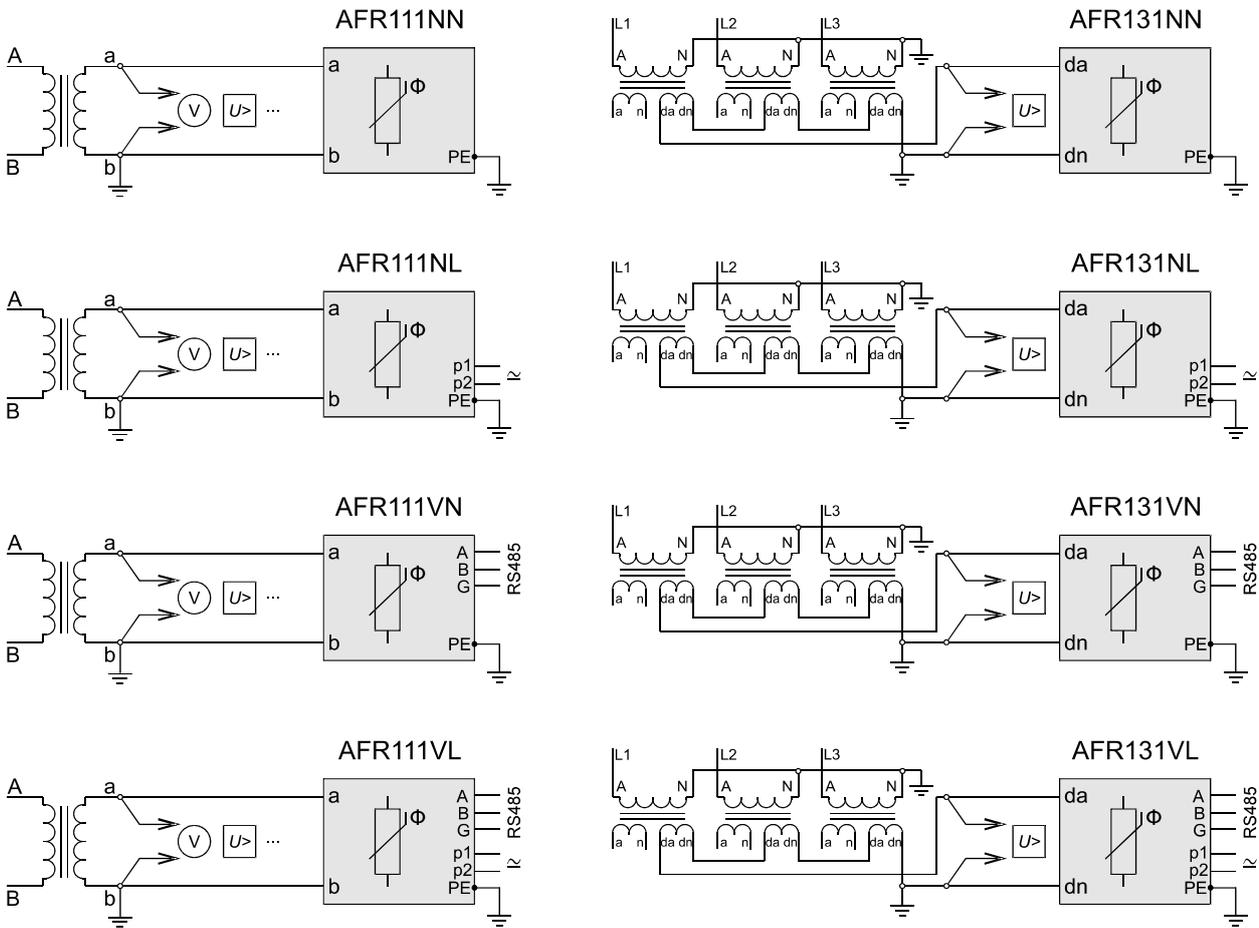
Nominal frequency

50	for 50 Hz networks
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AFR 111 N N 100/V3 - 50



Connection, description of terminals



A, B or A, N : high voltage terminals of the transformer

a, b or a, n : secondary measuring winding

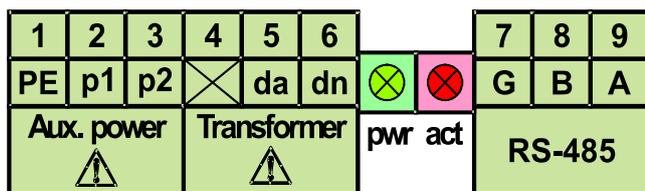
da, dn : terminals of the auxiliary winding

AFR 1xx : smart load

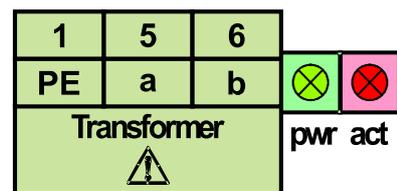
V $\text{U}>$: metering and protection equipment

\perp : PE protective earth

p1 p2 \perp : auxiliary power supply



Voltage version $U_n \leq 150 V$

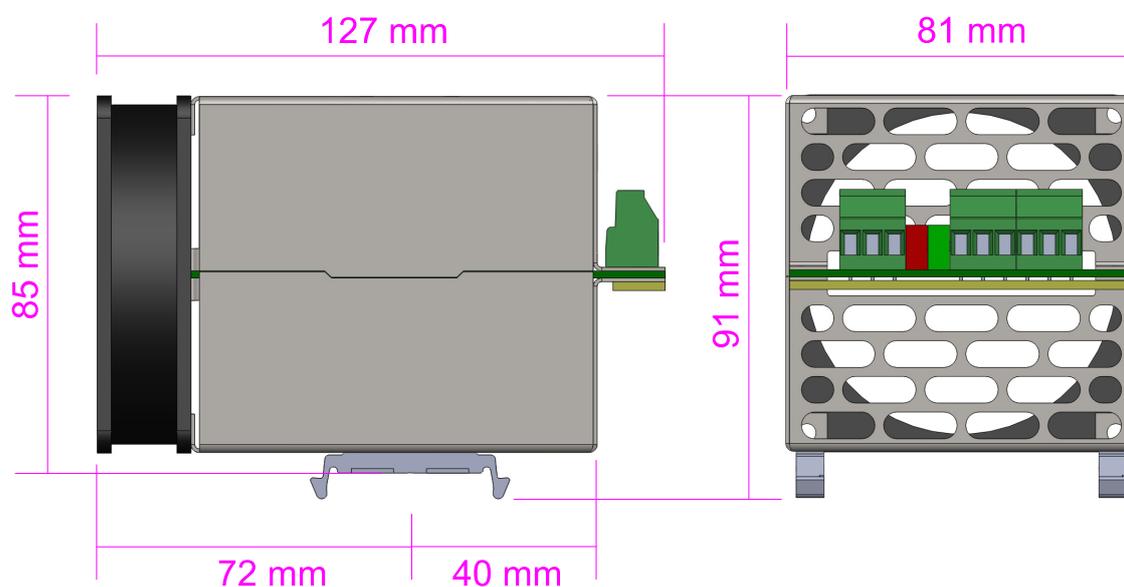


Voltage version $U_n > 150 V$

Technical Parameters and Specifications

Nominal voltage U_n	options for: $100/\sqrt{3}$, $110/\sqrt{3}$, $120/\sqrt{3}$, 100, 110, 120, V_{AC} 220, $230V_{AC}$, (other ranges on request)
Nominal frequency	50 Hz or 60 Hz
Activation voltage level, Activation delay	140% U_n to 200% U_n , 0 s
Recommended protection	B16A circuit breaker or equivalent fuse
Overtoltage class	150V/CAT.III , (300V/CAT.III for 220V, 230V)
Auxiliary supply voltage (option „L“)	15 to 265 V_{AC} / 40 to 70 Hz or 15 to 265 V_{DC}
Input power of auxiliary supply	3 VA or 3 W
Overtoltage category of aux. supply	300V/CAT.II
Communication line	RS 485, galvanically isolated
Protocol	Modbus RTU, 4.8-230.4 kBd, 8bit, selectable parity (default 19.2 kBd, 8-bit, even)
Protection class	IP20
Climatic category	40/060/02
Working / storage temp.	-40 °C to 60 °C / -40 °C to 70 °C
Max. moisture	95% non-condensing
Dimension / weight	width 80 × depth 90 × height 126 mm / 0,52 kg
Enclosure material	stainless steel
Installation	35 mm DIN rail acc. DIN EN 50 022
Wiring	terminal, wire cross-section 0,5–2,5 mm ²

Mechanical Dimensions and Terminals



Maintenance, Service

For reliable operation you only have to comply with the operating conditions specified and prevent mechanical damage to the instrument and not expose it to water or chemicals. For sufficient cooling, the ventilation slots must be kept free – an eventual impurities or dust must be removed with a dry wiper or a paintbrush. The instrument is during operation under hazardous voltage. Maintenance work should be performed only by qualified personnel.

In the event of the product’s breakdown, you have to return it to the supplier at their address.

Supplier:

Manufacturer :

KMB systems, s.r.o.
559 Dr. M. Horákové
460 06, Liberec 7

Czech Republic
tel. 485 130 314, fax 482 736 896
e-mail : kmb@kmb.cz , url : www.kmb.cz

The product must be packed properly to prevent damage in transit. Description of the problem or its symptoms must be sent along with the product. If warranty repair is claimed, the warranty certificate must be sent in too. If after-warranty repair is requested, a written order must be included.

Warranty Certificate

Warranty period of 24 months from the date of purchase is provided for the instrument, however, no longer than 36 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: **AFR** Serial number.....

Date of dispatch: Final quality inspection:

Manufacturer’s seal:

Date of purchase: Supplier’s seal: