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Electrical Polarized Drainage EPD160R

Electrical polarized drainage EPD160R consists of DRN205 and REGDRN modules supplemented by fuse and overvoltage protection. DRN205 is transistor-based switch that works as a diode with a very low voltage drop in the forward direction. The module is supplied from an alkaline battery that is partially recharged from the differential voltage.

REGDRN module represents a controller to limit the drainage current on overrun the predetermined difference of potentials between protected pipeline and measuring Cu/CuSO₄ electrode. The current is pulse-limited and a power released in the inductance on the current commutation covers an energy consumption of electronics and a fan if used.

From electrical safety point of view the electrical polarized drainage is a device with a safe voltage.

Functional description

In DRN205R module there are MOSFET transistors being used for commuting the current. The base module also contains control logic and support circuits, a control module limits electrical current by a pulse regulation on frequency of 200 Hz. Current limit is controlled by a differential voltage between the pipeline and the measuring electrode Cu/CuSO₄.

The control circuit of the base module consists of two parts

- The operational part controls the opening of the transistors according to the differential voltage. Provided the module current flows in forward direction, the transistors are controlled to have a voltage drop of 20 mV. In a case of a current over 40A the transistors are already fully opened and the voltage drop is determined by their resistance. If there is a voltage in reverse direction on the module the transistors are closed.
- The protection part provides an overvoltage protection of the module. To limit the pulse overvoltage there are protection class III transils installed in the module. The transils are supplemented outside the module by a separating inductor and an overvoltage protection of class II for a voltage of 60 V. A shorting circuit protects against exceeding of the blocking voltage during a rail circuit fault when the overvoltage is lower, has a longer duration and a slower slope. Due to a blocking voltage overrun the transistors open and a current sensor activates. If the current pulse doesn't reach the required value for a fuse trip, the transistors disconnect when current drops below 100A.

Other supplementary functions

- Measuring of the current with an amplifier that evaluates a voltage drop on the input copper strip conductor. The copper temperature dependence is compensated in the temperature range of -20 to +70 °C. On the output of the amplifier an analogue meter is connected and its output is also available on the service connector. Measuring amplifier is not permanently switched on and is activated only for a period of 5 minutes by pressing the test button on the device or from the service connector for a measuring period. An amplifier ON-mode is indicated by a light signal.
- A circuit for a measurement of the battery charge level is activated by pressing the test button. The duration

of light signal depends on the battery voltage. In case of the voltage of 9V the signal lasts 1 second. On the voltage under 7.5 volts the light signal is OFF and battery is considered flat.

Protection

EPD160R has a constant current capacity of 160A at the temperature up to 70°C and 220A at the maximum temperature of 50 °C. Fuses 160A gG and aR have on the constant load a breaking current of 220A. For a constant load a fuse with a nominal current of 160A is suitable for temperatures upto 50 °C only. For short-time overloads a EPD current higher than the fuse breaking current, is permitted. Because of the typical character of the load when the current considerably fluctuates and it is possible to exclude practically the constant load with a maximum current, it is possible to use 160A fuse also for higher panel inner temperature.

Provided the panel is exposed to the direct sunlight and the higher temperature can be expected, we recommend a 125 A fuse. The 125A fuse also provides a higher short-circuit durability during the short-circuit in the rail circuit.

If the drainage current can exceed 1000A (for 160A gG fuse) or 1500A (for 125A gG fuse) on the short-circuit in the rail system, it is necessary to use a fast fuse for semiconductors (aR type) for the protection of EPD.

Short-time overload capacity of the module and fuse protection

Load time	DRN205 50°C	DRN205 70°C	fuse 160A gG	Fuse 125A gG	fuse 160A aR
1 ms	3400	2800	9500	7000	1600
10ms	2100	1750	3000	2200	1000
100ms	1500*	1400*	1700	1300	800
1s	1200*	1000*	900	700	680
10 s	750*	650*	550	430	490
100 s	600	500	380	300	340
1000 s	360	300	270	210	220*
constant	220	170	220	170	220*

* Insufficient data available in the data-sheets

 protection not suitable

 protection suitable up to 50°C

Service connector

EPD160R device is equipped with a service connector with all the signals necessary for performing a record of the drainage current and voltage measurement. It is possible to connect a recorder with appropriate measuring inputs. The same connector is used on device EPD160 without drainage current limiter but the recorder requirements are different.

During the measurement the current measurement amplifier shall be supplied either by external voltage of 6 to 9V from an external recorder (recommended) or from the battery in EPD160 by the jumper between pins 2 and 3 inside the connector.

XLR187-7 service connector layout

Number of pin	EPD160	EPD160R
1	GND	GND
2	bat. +9V	bat. +9V
3	input +6 to 9V/1mA current measurem.	input +6 to 9V/1mA current measurem.
4	output current 1V=100A	output current 1V=100A
5	pipe, connected to GND	pipe, an independent measuring input *
6	rail	rail *
7		measuring electrode Cu/CuSO4 *

* in case of inputs pipe – rail and pipe – electrode a galvanic separation from GND potential is necessary

Technical parameters of EPD160R

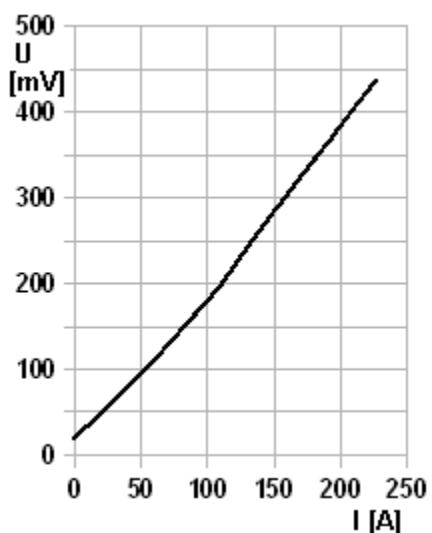
constant current capacity	160A
maximal reverse voltage	28V
resistance at 160A	2.5 mΩ
voltage drop of DRN204 module with small currents	20 mV (15 to 25)
supply current from the battery (depends on the mode)	7 to 500 μA
accuracy of current measurement	3 %
input current from electrode Cu/CuSO4	2nA
voltage pipe/SE for current limit	1.55 to 2V, adjustable
operational temperature range	-20 to +70 °C
dimensions	253 x 370 x 141 mm
weight	5 kg

Current-voltage characteristic

Forward direction

In a forward direction a voltage drop is determined by the resistance of the inductor for the coordination of the overvoltage protections, by the fuse and the jumpers and by voltage drop on the transistors.

In case of low current the regulation keeps the transistor voltage



drop approx. on 20 mV. With currents over 60A the transistors are fully opened and their resistance is 0.55 mΩ.

Reverse direction

Reverse direction current is determined by the consumption of the converter for battery regeneration. The current depends on the mode in which the EPD actually operates.

curve 1

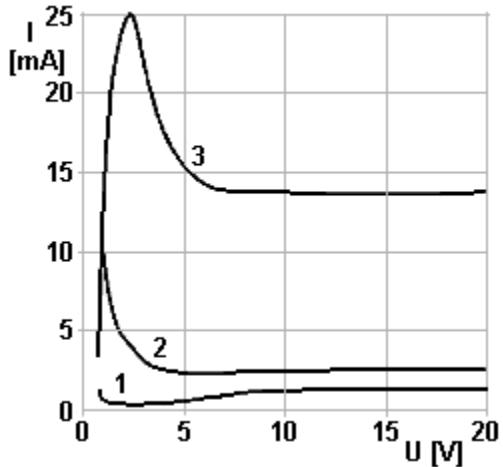
In case of direct-current voltage the consumption of the electronics is 3µA and the converter works almost with no load. Reverse current fluctuates between 0.4 and 1.3 mA depending on the voltage.

curve 2

In case of alternating current of 100A and 300 Hz, the electronics consumption is 0.4 mA and reverse current fluctuates between 2 and 10 mA depending on the voltage.

curve 3

If the battery voltage is lower than 9.2V, the converter recharges the battery with maximum current of 5 mA and a reverse current reaches the maximum of 25 mA depending on the voltage. This can happen only temporary or in case of flat battery.



Installation

Electrical polarized drainage EPD160R is designed to be installed in a switch-board panel. For cooling purposes, a free space of at least 10 cm above the module cooler shall be provided.