HIGHVOLT Prüftechnik Dresden GmbH
Marie-Curie-Straße 10
01139 Dresden,
Phone +49 351 8425 700
Fax +49 351 8425 679
E-mail sales@highvolt.de
Website http://www.highvolt.de

Data Sheet 1.23/2

High-voltage reactors (in a steel tank) with tunable inductance for series resonant test systems, Types DER and DERU

Application

High-voltage (HV) resonant reactors in a steel tank with tunable inductance are used primarily in resonant systems for HV testing and partial discharge (PD) measurements on medium-voltage (MV) and HV cables in accordance with IEC 60502 and 60840. The construction and layout of the design offer the perfect conditions for space-saving installation and sensitive PD measurements in shielded test room. The HV reactor is positioned on the wall outside the test room, and its HV bushing protrudes through this wall into the interior of the shielded test room.

Operating principle

The inductance of the HV reactor can be adjusted via a variable gap in the iron core within the HV coil in a range of typically 1:20 or more (Fig. 4). The main operating range is the range up to the rated voltage of the reactor (Fig. 4: area ①, to the left of dotted line); at the same time, the expanded operating range (Fig. 4: area ②, to the right of dotted line) offers the advantage of being able to test greater capacitive loads, e.g. long cables, with a lower output voltage. Here, the maximum possible test voltage is limited by the rated current I of the HV reactor.

Design

The **magnetic circuit** comprises the movable vertical plunger core in the centre, which is surrounded by four return legs with yokes. In order to minimize losses in the ferromagnetic circuit, the cylindrical plunger core is radially laminated. The plunger core is precisely tuned via a frequency-controlled electric drive and a special gearing and spindle with zero play. Above the iron core there is a mechanically stable frame. Together with the spindle, this guarantees a vibration-free gap. This results in a very stable inductance and therefore also a stable output voltage and low noise level.
The **HV coil is insulated with oil-impregnated paper**. It is wound in layers and has paper shielding electrodes for the control of the electric field. Taps at the HV coil widen the operating range for lower voltages and higher capacitance values of the test object (Fig. 4: Tap 2). If the HV coil is equipped with only one additional tap, the reactor has two HV bushings (Fig. 1 and 2). If there are two additional taps, the HV reactor only has one HV bushing and is equipped with an electrically driven HV off-load switch (Fig. 3).
The type of **cooling** of the HV resonant reactor depends on its power output. For lower power a hermetically sealed steel tank made of corrugated sheet is used (Fig. 1), for higher power, if necessary, the tank is equipped with radiators and an oil expansion conservator (Fig. 2 and 3).
The **excitation transformer** is installed in the steel tank of the HV reactor (Fig. 2 and 3). Its rated voltage, rated power output and the number of taps are designed in accordance with the parameters of the HV reactor and the properties of the test object (capacitance and losses of the cable under test, including additional losses due to the test terminations). The appropriate tap is selected depending on the particular test scenario, and it is connected via a motor-powered switch to the HV reactor.

Table 1: General data and operating conditions

Acoustic noise level accord. IEC 60551 at a distance of 4m	dB(A)	85
Transformer oil		Mineral oil compliant with IEC 60296
Color of steel tank		RAL 7035 light grey
Temperature range Operation Transport and storage[1)]	 °C °C	 5 … 40 -10 … 50
Relative humidity	%	≤ 90 (no condensation)
Height above sea level	m	≤ 1000

[1)] storage in a dry, roofed room

Table 2: Reference atmospheric conditions for bushings

Temperature	°C	20
Absolute pressure	hPa	1013
Absolute humidity	g/m^3	11

Table 3: Main parameters

Type	Rated power	Rated voltage	Rated current	Load range[2)]					
				50 Hz			60 Hz		
				C_{min}	C_{max}	C_{exp}[3)]	C_{min}	C_{max}	C_{exp}[3)]
	kVA	kV	A	nF	nF	nF	nF	nF	nF
DER 300/50-35	300	50	6	36	382	720	30	318	500
		35	8.6	68	780	1400	57	650	970
DER 1200/80-50	1200	80	15	30	597	630	25	497	-
		50	24	76	1528	1800	64	1273	-
DER 1000/100-50	1000	100	10	16	318	400	13	265	-
		50	20	64	1273	1800	53	1061	1200
DER 2500/100-50	2500	100	25	40	796	-	33	663	-
		50	50	159	3183	-	133	2653	-
DER 2500/200-100	2500	200	12.5	10	199	230	8	166	-
		100	25	40	796	1250	33	663	800
DERU 2700/200-175-100	2700	200	13.5	11	215	-	9	179	-
		175	15.4	14	281	300	12	234	-
		100	27	43	859	1050	36	716	-
DERU 2700/200-100-45	2700	200	13.5	11	215	250	9	179	-
		100	20	43	637	1100	36	531	750
		45	30	212	2122	6200	177	1768	4300
DERU 3150/250-125-50	3150	250	12.5	13	159	325	11	133	225
		125	25	43	637	1400	36	531	950
		50	25	270	1592	9000	225	1326	6000
DERU 6000/350-150-75	6000	350	17.1	8	156	210	7	130	190
		150	17.1	28	363	950	20	300	650
		75	30	131	1273	5500	91	1060	3700
DERU 10000/350-200-100	10000	350	28.6	13	260	300	11	217	280
		200	50	48	796	1000	40	663	850
		100	50	138	1592	4000	115	1326	3800

[2)] incl. basic load (incl. HV divider, coupling capacitor, etc.)
[3)] expanded operating range with reduced output voltage

Table 4: Duty cycle, dimensions and weight (approx.)

Type	Duty cycle[4)]	Length of tank	Total length	Width	Heigth	Weight	
		L1	L	W	H	Total	Oil
		mm	mm	mm	mm	kg	kg
DER 300/50-35	0.5 h ON - 0.5 h OFF, 8 cycles per day		1650	950	2350	2450	910
DER 1200/80-50	1 h ON - 1 h OFF, 6 cycles per day	1600	2500	1600	3050	5600	1900
DER 1000/100-50	1 h ON - 1 h OFF, 6 cycles per day	1600	2500	1600	3050	5600	1900
DER 2500/100-50	1 h ON - 1 h OFF, 6 cycles per day	1900	2650	1800	3450	8700	2800
DER 2500/200-100	1 h ON - 1 h OFF, 8 cycles per day	2200	3850	2050	3800	12200	4200
DERU 2700/200-175-100	1 h ON - 1 h OFF, 8 cycles per day	3200	5200	2250	3900	17000	7300
DERU 2700/200-100-45	1 h ON - 1 h OFF, 8 cycles per day	3200	5200	2250	3900	17000	7300
DERU 3150/250-125-50	1 h ON - 1 h OFF, 8 cycles per day	3500	5850	2250	3700	19500	8000
DERU 6000/350-150-75	1 h ON - 1 h OFF, 6 cycles per day	3800	6850	2250	4050	24700	10700
DERU 10000/350-200-100	1 h ON - 1 h OFF, 6 cycles per day	3950	6900	2900	4300	33500	15000

4) other duty cycles available on request

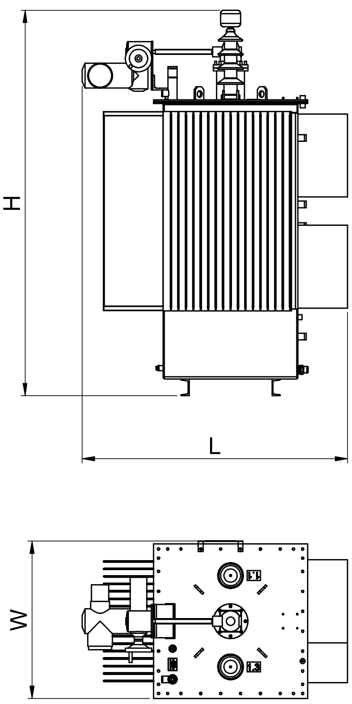

Figure 1: HV resonant reactor with corrugated sheet tank

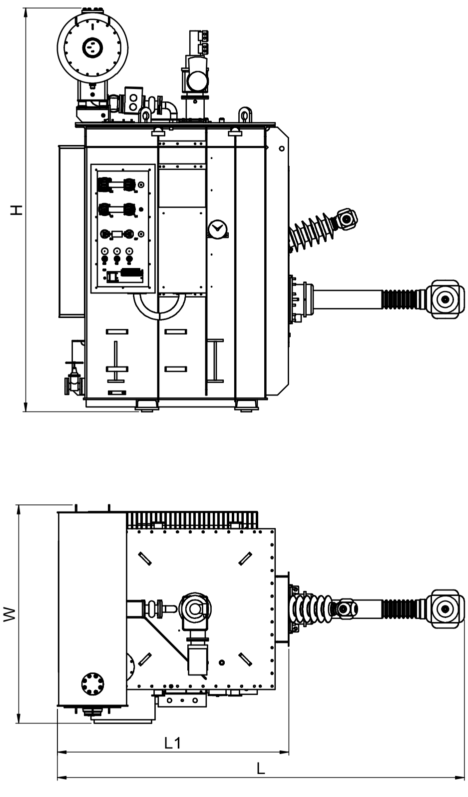

Figure 2: HV resonant reactor in a steel tank

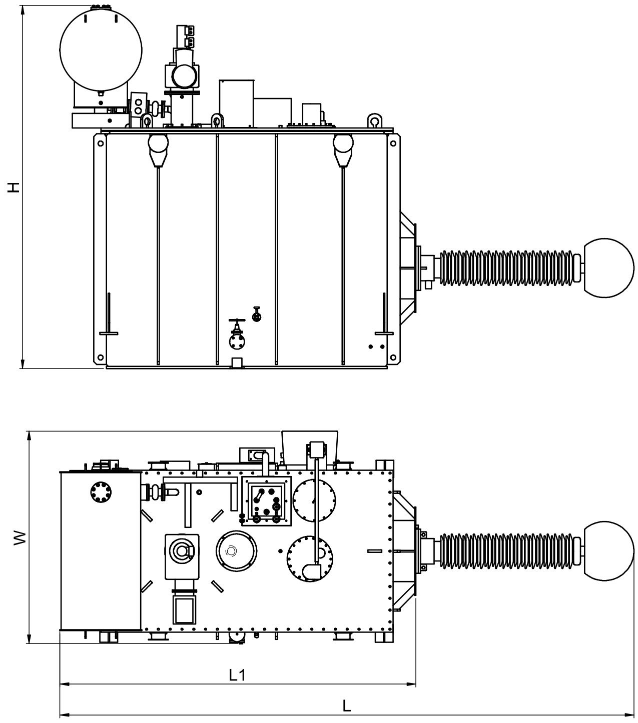

Figure 3: HV resonant reactor with off-load tap changer in a steel tank

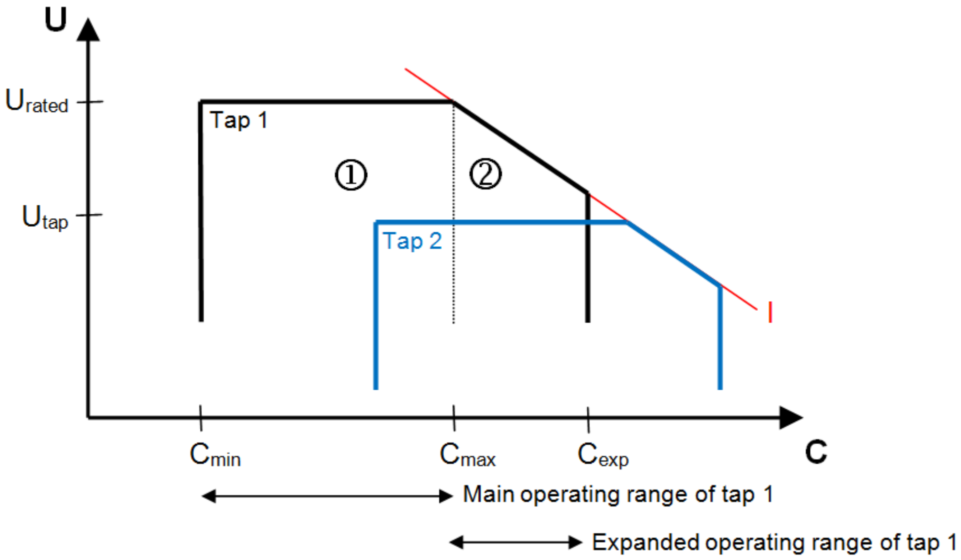

Figure 4: Operating range of a HV resonant reactor with one additional tap (logarithmic representation)

Type designation DER a/b-c or DERU a/b-c-d

DER tunable, single-phase HV reactor
U with HV switch
a = rated test power in kVA
b = rated voltage in kV at tap 1
c = rated voltage in kV at tap 2
d = rated voltage in kV at tap 3