LT-01-1943

COMPARATIVE BREAKDOWN TESTS

BETWEEN ORIGINAL AND RECENT

SEGMENTED DIVERTER STRIP DESIGNS

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For

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Purchase Order No. LDS8502

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References:

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1.0 INTRODUCTION

Tests were conducted on several diverter strip designs to obtain comparative performance data.

2.0 SUMMARY

LDS10-01-05 diverters had breakdowns at greater than 235 kV. Breakdowns of 65 to 70 kV were obtained for the LDS10-01-34 diverter strips. Withstands at 160 kV were obtained for the LDS10-01-48 diverter strips. Breakdowns of 75 and 105 kV, with one withstand at 160 kV, were obtained for the LDS10-01-39 diverter strips.

LDS10-01-64 had breakdowns of 58 to 70 kV for small round buttons, and breakdowns of 27 to 60 kV for both the ovals and the large round buttons.

3.0 TEST ITEMS

Tests were performed on the following LDS numbers:

Initial Designs

LDS10-01-05	0.125 dia. Buttons, Low Shunt Res.
LDS10-01-34	0.125 dia. Buttons, High Shunt Res.
LDS10-01-48	0.060 x .200 Oval, High Shunt Res.
LDS10-01-39	0.060 dia. Button, High Shunt Res.

Recent Designs

LDS 10-01-64-0-LR-00-W-39.4	(0.125 dia.)
LDS 10-01-64-0-OV-00-W-39.4	(.060 x .200)
LDS 10-01-64-0-SR-00-W-39.4	(.060 dia.)

4.0 TEST PROCEDURES

Tests were conducted by applying fast rising impulse voltages across a one-meter length of the diverter strip. The diverter strips were attached to a 3.5 inch diameter PVC pipe for testing. The voltage to breakdown and the current conducted after breakdown was monitored. The impulse voltage was delivered from a 5-stage Marx circuit (0.05 μF) and a 2.5 nF load capacitor. A 100 ohm resistor was connected between the load capacitor and the diverter strip to control discharge current. The applied voltage was monitored on the resistive voltage divider and the current was monitored with a pulse current transformer. The measurements were displayed and recorded on a digital storage oscilloscope (DSO). All reported data was taken form the DSO.

The circuit supplied a nominal 350 kV/μs voltage rate-of-rise. Typical applied voltage and current oscillograms are given in Figure 1.

All measurements were made using equipment calibrated in accordance with the requirements of MIL-STD-45662A. A list of test equipment is given in Table 1, which includes calibration data where appropriate.

5.0 TEST RESULTS

The segmented strip breakdown voltage test results are given in Table 2.

LDS10-01-05 diverters had breakdown levels greater than 235 kV.

Tests on the LDS10-01-34 diverters had breakdowns of 65 to 70 kV. The LDS10-01-48 diverters had breakdown levels greater than 160 kV. The LDS10-01-39 diverters had breakdowns of 75 and 105 kV with one withstand at 160 kV.

The LDS10-01-64 group had no withstands with breakdowns ranging from 25 to 70 kV. The .060 dia. (SR) buttons had the highest breakdowns, ranging from 58 to 71 kV. Both the 0.125 dia. (LR) buttons and the ovals (OV) had very similar breakdown ranges of 27 to 60 kV.

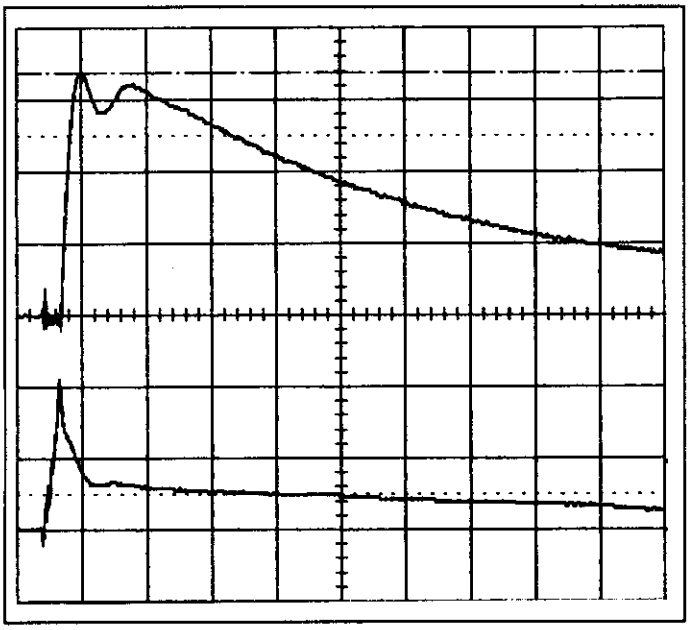
The LDS10-01-64 group data reflects the application of several tests to the same sample. If only the first two tests on each sample are considered, the breakdown range drops considerably for the (LR) and (OV) segment diverters. Both are in the range of 22 to 30 kV.

Table 1 - Test Equipment List

Description	Manufacturer	Model No.	Serial No.	Calibration	
				Date	Due Date
Digital Storage Oscilloscope	LeCroy	9310M	2306	09 Oct. 2000	09 Oct. 2001
Pulse Current Transformer	Pearson	110	Serial No. Not Recorded	All Pearson PCTs are Calibrated on a One Year Cycle	
Resistive Voltage Divider	LTI	--	Calibrate Prior to Use		
HV dc Probe	Fluke	80k-40	Calibration not Required		
Digital VOM	Fluke	--	Calibration not Required		
Marx Generator	LTI	--	Calibration not Required		

Table 2 - Segmented Strip Breakdown Voltage Test Results

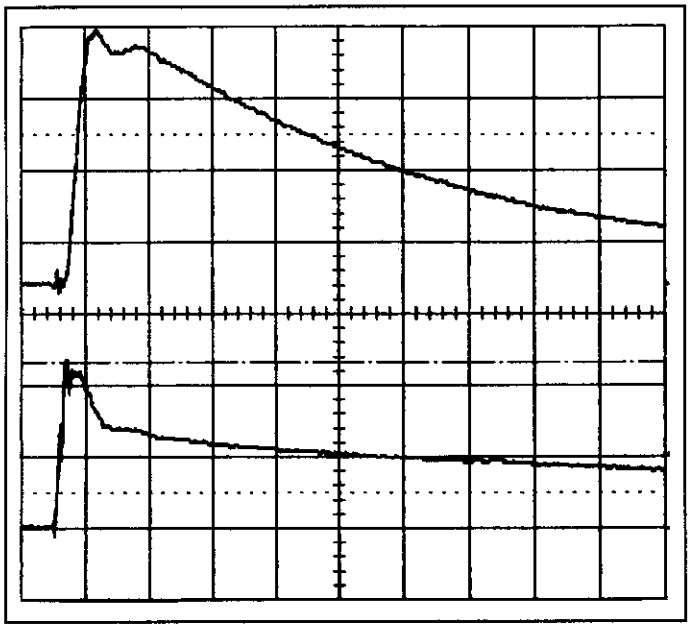
Test No.	Sample No.	V_p (kV)	I_p (kA)	Remarks
Generator Open-Circuit Voltage Verification – No Sample				
1	-	150	-	345 kV/µs
Part No. LDS10-01-05				
2	8-1	>160	Withstand	
3	8-1	>235	Withstand	
Part No. LDS10-01-34				
4	5-1	71.0	1.35	350 kV/µs
5	5-1	65.5	1.35	
Part No. LDS10-01-48				
6	6-1	>160	Withstand	
7	6-2	>160	Withstand	
Part No. LDS10-01-39				
8	4-1	76.0	1.15	
9	4-1	>160	Withstand	
10	4-1	105	1.20	
Part No. LDS 10-01-64-0-LR-00-W-39.4				
12	2-7	29.0	0.12	
13	2-7	31.0	0.14	
14	2-7	48.5	0.14	
15	2-7	52.5	0.14	
16	2-7	60.5	0.14	
17	2-1	29.5	0.14	
18	2-1	28.0	0.14	
Part No. LDS 10-01-64-0-OV-00-W-39.4				
19	3-5	25.5	1.5	
20	3-5	27.0	1.5	
21	3-5	39.0	1.4	
22	3-5	48.5	1.4	
23	3-5	49.0	1.4	
24	3-5	50.5	1.4	
25	3-12	22.0	1.5	
26	3-12	27.5	1.5	
Part No. LDS 10-01-64-0-SR-00-W-39.4				
27	1-7	64.0	1.1	
28	1-7	62.0	1.1	
29	1-7	65.0	1.2	
30	1-7	71.0	1.1	
31	1-7	70.0	1.2	
32	1-7	71.0	1.1	
33	1-2	68.5	1.2	
34	1-2	59.5	1.1	
35	1-2	58.0	1.1	



Test No. 4

400 A/div.
1 µs/div.
1350 A_P

33 kV/div.
1 µs/div.
71 kV_P



Test No. 13

400 A/div.
1 µs/div.
1400 A_P

13 kV/div.
1 µs/div.
31 kV_P

Figure 1 – Typical Applied Voltage and Current Waveforms