APPENDIX A

METHODOLOGY BASED ON DST

Belief in A: Bel(A)

○ The belief in an element A of the power set is the sum of the massess of elements which are subsets of A (including A itself).

○ e.g., given A = {q1, q2, 3}

Bel (A) = m (q1) + m(q2) + m(q3) + m({q1, q2}) + m({q2, q3}) + m({q3, q1}) + m ({q1, 2, q3})

PLAUSIBILITY OF A : pl(A)

○ The plausibility of an element A, pl(A) is the sum of all the masses of sets that intersect with the set A.

○ e.g., pl({B,J}) = m(B) + m(J) + m(B, J) + m(B, S) + m(J, S) + m(B, J, S)

DISBELIEF OR DOUBT IN A: dis(A)

○ The disbelief in A is simply bel(-A). It is calculated by summing all masses of elements which do not intersect with A. The plausibility of A is thus 1- dis (A).

○ pl(A) = 1 – dis(A).

BELIEF INTERVAL OF A:

○ The certainty associated with a given subset A is defined by the belief interval.

○ [bel(A) pl(A)]

APPENDIX B

OBSERVATIONS OF BATTERIES

DATE	TIME (am)	Temp. (°C)	ampere hour (Ah)	Vol. (V)	Current (mA)	Resistant (R)	Watthour (Wh)
01-09-2014	10:30	31	100	13.9	0.14	99	1390
		31	100	13.6	0.14	99	1360
		31	100	13.6	0.14	99	1360
		31	100	13.1	0.14	99	1310
		31	100	13.6	0.14	99	1360
02-09-2014	10:45	32	100	13.5	0.14	99	1350
		32	100	13.1	0.14	99	1310
		32	100	13.6	0.14	99	1360
		32	100	13.3	0.14	99	1330
		32	100	13.5	0.14	99	1350
03-09-2014	10:30	31	100	13.8	0.14	99	1380
		31	100	13.9	0.14	99	1390
		31	100	13.5	0.14	99	1350
		31	100	13.8	0.14	99	1380
		31	100	13.9	0.14	99	1390
04-09-2014	10:30	31	100	13.9	0.14	99	1390
		31	100	13.6	0.14	99	1360
		31	100	13.6	0.14	99	1360
		31	100	13.8	0.14	99	1380
		31	100	13.7	0.14	99	1370
05-09-2014	10:30	31	100	13.5	0.14	99	1350
		31	100	13.8	0.14	99	1380
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
		31	100	13.9	0.14	99	1390
06-09-2014	11:00	31	100	13.8	0.14	99	1380
		31	100	13.6	0.14	99	1360
		31	100	13.9	0.14	99	1390
		31	100	13.8	0.14	99	1380
		31	100	13.7	0.14	99	1370
07-09-2014	10:30	31	100	13.33	0.14	99	1333
		31	100	13.5	0.14	99	1350
		31	100	13.46	0.14	99	1346
		31	100	13.21	0.14	99	1321
		31	100	13.65	0.14	99	1365

08-09-2014	10:40	31	100	13.4	0.14	99	1340
		31	100	13.5	0.14	99	1350
		31	100	13.6	0.14	99	1360
		31	100	13.91	0.14	99	1391
		31	100	13.22	0.14	99	1322
09-09-2014	10:30	31	100	13.9	0.14	99	1390
		31	100	13.52	0.14	99	1352
		31	100	13.45	0.14	99	1345
		31	100	13.8	0.14	99	1380
		31	100	13.72	0.14	99	1372
10-09-2014	10:45	31	100	13.51	0.14	99	1351
		31	100	13.4	0.14	99	1340
		31	100	13.24	0.14	99	1324
		31	100	13.8	0.14	99	1380
		31	100	13.6	0.14	99	1360
11-09-2014	10:50	31	100	13.55	0.14	99	1355
		31	100	13.85	0.14	99	1385
		31	100	13.53	0.14	99	1353
		31	100	13.58	0.14	99	1358
		31	100	13.62	0.14	99	1362
12-09-2014	10:30	31	100	13.54	0.14	99	1354
		31	100	13.45	0.14	99	1345
		31	100	13.56	0.14	99	1356
		31	100	13.66	0.14	99	1366
		31	100	13.78	0.14	99	1378
13-09-2014	10:50	31	100	13.56	0.14	99	1356
		31	100	13.62	0.14	99	1362
		31	100	13.86	0.14	99	1386
		31	100	13.62	0.14	99	1362
		31	100	13.55	0.14	99	1355
14-09-2014	10:30	31	100	13.66	0.14	99	1366
		31	100	13.58	0.14	99	1358
		31	100	13.25	0.14	99	1325
		31	100	13.65	0.14	99	1365
		31	100	13.9	0.14	99	1390
15-09-2014	10:15	32	100	13.6	0.14	99	1360
		32	100	13.58	0.14	99	1358
		32	100	13.63	0.14	99	1363
		32	100	13.9	0.14	99	1390
		32	100	13.54	0.14	99	1354
16-09-2014	10:55	31	100	13.8	0.14	99	1380
		31	100	13.54	0.14	99	1354
		31	100	13.32	0.14	99	1332
		31	100	13.4	0.14	99	1340

		31	100	13.85	0.14	99	1385
17-09-2014	10:30	31	100	13.46	0.14	99	1346
		31	100	13.64	0.14	99	1364
		31	100	13.85	0.14	99	1385
		31	100	13.8	0.14	99	1380
		31	100	13.6	0.14	99	1360
18-09-2014	10:35	31	100	13.44	0.14	99	1344
		31	100	13.6	0.14	99	1360
		31	100	13.9	0.14	99	1390
		31	100	13.6	0.14	99	1360
		31	100	13.6	0.14	99	1360
19-09-2014	10:30	31	100	13.9	0.14	99	1390
		31	100	13.48	0.14	99	1348
		31	100	13.3	0.14	99	1330
		31	100	13.8	0.14	99	1380
		31	100	13.6	0.14	99	1360
20-09-2014	10:55	31	100	13.9	0.14	99	1390
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
21-09-2014	10:30	32	100	13.6	0.14	99	1360
		32	100	13.4	0.14	99	1340
		32	100	13.8	0.14	99	1380
		32	100	13.7	0.14	99	1370
		32	100	13.5	0.14	99	1350
22-09-2014	10:25	31	100	13.6	0.14	99	1360
		31	100	13.2	0.14	99	1320
		31	100	13.7	0.14	99	1370
		31	100	13.77	0.14	99	1377
		31	100	13.5	0.14	99	1350
23-09-2014	10:50	31	100	13.7	0.14	99	1370
		31	100	13.8	0.14	99	1380
		31	100	13.4	0.14	99	1340
		31	100	13.6	0.14	99	1360
		31	100	13.2	0.14	99	1320
24-09-2014	10:30	31	100	13.6	0.14	99	1360
		31	100	13.4	0.14	99	1340
		31	100	13.7	0.14	99	1370
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
25-09-2014	10:50	31	100	13.9	0.14	99	1390
		31	100	13.7	0.14	99	1370
		31	100	13.4	0.14	99	1340

		31	100	13.9	0.14	99	1390
		31	100	13.6	0.14	99	1360
26-09-2014	10:30	31	100	13.4	0.14	99	1340
		31	100	13.8	0.14	99	1380
		31	100	13.7	0.14	99	1370
		31	100	13.6	0.14	99	1360
		31	100	13.7	0.14	99	1370
27-09-2014	10:30	31	100	13.5	0.14	99	1350
		31	100	13.6	0.14	99	1360
		31	100	13.7	0.14	99	1370
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
28-09-2014	10:50	31	100	13.9	0.14	99	1390
		31	100	13.6	0.14	99	1360
		31	100	13.7	0.14	99	1370
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
29-09-2014	10:35	31	100	13.4	0.14	99	1340
		31	100	13.7	0.14	99	1370
		31	100	13.6	0.14	99	1360
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
30-09-2014	10:30	31	100	13.7	0.14	99	1370
		31	100	13.9	0.14	99	1390
		31	100	13.5	0.14	99	1350
		31	100	13.4	0.14	99	1340
		31	100	13.8	0.14	99	1380
01-10-2014	10:40	31	100	13.9	0.14	99	1390
		31	100	13.6	0.14	99	1360
		31	100	13.45	0.14	99	1345
		31	100	13.6	0.14	99	1360
		31	100	13.8	0.14	99	1380
02-10-2014	10:35	32	100	13.2	0.14	99	1320
		32	100	13.8	0.14	99	1380
		32	100	13.9	0.14	99	1390
		32	100	13.7	0.14	99	1370
		32	100	13.8	0.14	99	1380
03-10-2014	10:50	31	100	13.7	0.14	99	1370
		31	100	13.2	0.14	99	1320
		31	100	13.45	0.14	99	1345
		31	100	13.6	0.14	99	1360
		31	100	13.7	0.14	99	1370
03-10-2015	11:00	31	100	13.6	0.14	99	1360
		31	100	13.5	0.14	99	1350

		31	100	13.7	0.14	99	1370
		31	100	13.9	0.14	99	1390
		31	100	13.7	0.14	99	1370
04-10-2014	10:35	31	100	13.5	0.14	99	1350
		31	100	13.9	0.14	99	1390
		31	100	13.1	0.14	99	1310
		31	100	13.4	0.14	99	1340
		31	100	13.6	0.14	99	1360
05-10-2014	10:45	31	100	13.9	0.14	99	1390
		31	100	13.7	0.14	99	1370
		31	100	13.9	0.14	99	1390
		31	100	13.2	0.14	99	1320
		31	100	13.7	0.14	99	1370
06-10-2014	10:40	31	100	13.5	0.14	99	1350
		31	100	13.7	0.14	99	1370
		31	100	13.8	0.14	99	1380
		31	100	13.6	0.14	99	1360
		31	100	13.5	0.14	99	1350
07-10-2014	11:00	31	100	13.2	0.14	99	1320
		31	100	13.7	0.14	99	1370
		31	100	13.9	0.14	99	1390
		31	100	13.5	0.14	99	1350
		31	100	13.2	0.14	99	1320
08-10-2014	10:25	31	100	13.32	0.14	99	1332
		31	100	13.7	0.14	99	1370
		31	100	13.9	0.14	99	1390
		31	100	13.1	0.14	99	1310
		31	100	13.4	0.14	99	1340
09-10-2014	10:00	31	100	13.75	0.14	99	1375
		31	100	13.6	0.14	99	1360
		31	100	13.5	0.14	99	1350
		31	100	13.8	0.14	99	1380
		31	100	13.7	0.14	99	1370
10-10-2014	10:35	31	100	13.8	0.14	99	1380
		31	100	13.45	0.14	99	1345
		31	100	13.6	0.14	99	1360
		31	100	13.5	0.14	99	1350
		31	100	13.4	0.14	99	1340
11-10-2014	10:50	31	100	13.2	0.14	99	1320
		31	100	13.9	0.14	99	1390
		31	100	13.4	0.14	99	1340
		31	100	13.5	0.14	99	1350
		31	100	13.7	0.14	99	1370
12-10-2014	10:30	31	100	13.8	0.14	99	1380

		31	100	13.2	0.14	99	1320
		31	100	13.6	0.14	99	1360
		31	100	13.4	0.14	99	1340
		31	100	13.5	0.14	99	1350
13-10-2014	10:35	31	100	13.7	0.14	99	1370
		31	100	13.6	0.14	99	1360
		31	100	13.55	0.14	99	1355
		31	100	13.8	0.14	99	1380
		31	100	13.32	0.14	99	1332
14-10-2014	10:40	31	100	13.5	0.14	99	1350
		31	100	13.4	0.14	99	1340
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
		31	100	13.9	0.14	99	1390
15-10-2014	10:30	31	100	13.2	0.14	99	1320
		31	100	13.4	0.14	99	1340
		31	100	13.3	0.14	99	1330
		31	100	13.7	0.14	99	1370
		31	100	13.9	0.14	99	1390
16-10-2014	10:55	31	100	13.6	0.14	99	1360
		31	100	13.7	0.14	99	1370
		31	100	13.2	0.14	99	1320
		31	100	13.8	0.14	99	1380
		31	100	13.9	0.14	99	1390
17-10-2014	10:30	31	100	13.2	0.14	99	1320
		31	100	13.9	0.14	99	1390
		31	100	13.1	0.14	99	1310
		31	100	13.45	0.14	99	1345
		31	100	13.5	0.14	99	1350
18-10-2014	10:30	31	100	13.8	0.14	99	1380
		31	100	13.6	0.14	99	1360
		31	100	13.4	0.14	99	1340
		31	100	13.7	0.14	99	1370
		31	100	13.6	0.14	99	1360
19-10-2014	11:00	31	100	13.2	0.14	99	1320
		31	100	13.4	0.14	99	1340
		31	100	13.3	0.14	99	1330
		31	100	13.8	0.14	99	1380
		31	100	13.2	0.14	99	1320
20-10-2014	10:35	31	100	13.6	0.14	99	1360
		31	100	13.9	0.14	99	1390
		31	100	13.7	0.14	99	1370
		31	100	13.6	0.14	99	1360
		31	100	13.4	0.14	99	1340

21-10-2014	10:30	31	100	13.6	0.14	99	1360
		31	100	13.7	0.14	99	1370
		31	100	13.1	0.14	99	1310
		31	100	13.5	0.14	99	1350
		31	100	13.7	0.14	99	1370
22-10-2014	10:50	31	100	13.8	0.14	99	1380
		31	100	13.65	0.14	99	1365
		31	100	13.7	0.14	99	1370
		31	100	13.8	0.14	99	1380
		31	100	13.45	0.14	99	1345
23-10-2014	10:15	31	100	13.6	0.14	99	1360
		31	100	13.5	0.14	99	1350
		31	100	13.4	0.14	99	1340
		31	100	13.6	0.14	99	1360
		31	100	13.9	0.14	99	1390
24-10-2014	10:30	31	100	13.1	0.14	99	1310
		31	100	13.8	0.14	99	1380
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
		31	100	13.4	0.14	99	1340
25-10-2014	10:35	31	100	13.4	0.14	99	1340
		31	100	13.6	0.14	99	1360
		31	100	13.5	0.14	99	1350
		31	100	13.6	0.14	99	1360
		31	100	13.8	0.14	99	1380
26-10-2014	10:30	31	100	13.74	0.14	99	1374
		31	100	13.5	0.14	99	1350
		31	100	13.7	0.14	99	1370
		31	100	13.6	0.14	99	1360
		31	100	13.6	0.14	99	1360
27-10-2014	10:40	31	100	13.3	0.14	99	1330
		31	100	13.1	0.14	99	1310
		31	100	13.9	0.14	99	1390
		31	100	13.7	0.14	99	1370
		31	100	13.5	0.14	99	1350
28-10-2014	10:30	31	100	13.6	0.14	99	1360
		31	100	13.32	0.14	99	1332
		31	100	13.8	0.14	99	1380
		31	100	13.5	0.14	99	1350
		31	100	13.9	0.14	99	1390
29-10-2014	10:20	31	100	13.2	0.14	99	1320
		31	100	13.4	0.14	99	1340
		31	100	13.5	0.14	99	1350
		31	100	13.9	0.14	99	1390

		31	100	13.4	0.14	99	1340
30-10-2014	10:40	32	100	13.8	0.14	99	1380
		32	100	13.1	0.14	99	1310
		32	100	13.5	0.14	99	1350
		32	100	13.9	0.14	99	1390
		32	100	13.4	0.14	99	1340
31-10-2014	10:20	31	100	13.6	0.14	99	1360
		31	100	13.32	0.14	99	1332
		31	100	13.8	0.14	99	1380
		31	100	13.9	0.14	99	1390
		31	100	13.5	0.14	99	1350
DATE	**TIME (pm)**	**Temp (°C)**	**ampere hour (Ah)**	**Vol.(V)**	**Current (I)**	**Resistant (R)**	**Watthour (Wh)**
01-09-2014	09:30	28	100	9.74	0.1	97	974
		28	100	9.56	0.1	97	956
		28	100	10.02	0.11	97	1002
		28	100	9.27	0.1	97	927
		28	100	9.65	0.1	97	965
02-09-2014	09:30	28	100	9.78	0.1	97	978
		28	100	9.69	0.1	97	969
		28	100	9.53	0.1	97	953
		28	100	9.66	0.1	97	966
		28	100	9.86	0.1	97	986
03-09-2014	09:00	28	100	9.38	0.1	97	938
		28	100	9.76	0.1	97	976
		28	100	9.66	0.1	97	966
		28	100	9.78	0.1	97	978
		28	100	9.43	0.1	97	943
04-09-2014	09:30	28	100	8.99	0.1	97	899
		28	100	9.3	0.1	97	930
		28	100	9.21	0.1	97	921
		28	100	9.18	0.1	97	918
		28	100	9.78	0.1	97	978
05-09-2014	09:45	28	100	9.3	0.1	97	930
		28	100	8.98	0.1	97	898
		28	100	9.14	0.1	97	914
		28	100	9.23	0.1	97	923
		28	100	8.78	0.1	97	878
06-09-2014	09:15	28	100	9.5	0.1	97	950
		28	100	9.25	0.1	97	925
		28	100	8.96	0.1	97	896
		28	100	9.31	0.1	97	931
		28	100	8.89	0.1	97	889

07-09-2014	09:30	28	100	9.54	0.1	97	954
		28	100	9.31	0.1	97	931
		28	100	9.05	0.1	97	905
		28	100	8.83	0.1	97	883
		28	100	9.21	0.1	97	921
08-09-2014	09:30	28	100	9.32	0.1	97	932
		28	100	9.21	0.1	97	921
		28	100	9.05	0.1	97	905
		28	100	9.41	0.1	97	941
		28	100	9.23	0.1	97	923
09-09-2014	09:30	28	100	9.23	0.1	97	923
		28	100	9.56	0.1	97	956
		28	100	9.35	0.1	97	935
		28	100	9.15	0.1	97	915
		28	100	9.44	0.1	97	944
10-09-2014	09:36	28	100	8.82	0.1	97	882
		28	100	9.52	0.1	97	952
		28	100	9.55	0.1	97	955
		28	100	9.25	0.1	97	925
		28	100	9.41	0.1	97	941
11-09-2014	09:20	28	100	9.24	0.1	97	924
		28	100	9.14	0.1	97	914
		28	100	9.12	0.1	97	912
		28	100	9.56	0.1	97	956
		28	100	8.9	0.1	97	890
12-09-2014	09:30	28	100	9.87	0.1	97	987
		28	100	9.65	0.1	97	965
		28	100	9.24	0.1	97	924
		28	100	9.85	0.1	97	985
		28	100	9.66	0.1	97	966
13-09-2014	09:15	28	100	9.32	0.1	97	932
		28	100	9.62	0.1	97	962
		28	100	9.45	0.1	97	945
		28	100	9.41	0.1	97	941
		28	100	9.31	0.1	97	931
14-09-2014	09:45	28	100	9.2	0.1	97	920
		28	100	9.41	0.1	97	941
		28	100	9.31	0.1	97	931
		28	100	9.7	0.1	97	970
		28	100	9.1	0.1	97	910
15-09-2014	09:30	28	100	9.12	0.1	97	912
		28	100	9.3	0.1	97	930
		28	100	9.32	0.1	97	932
		28	100	9.45	0.1	97	945

		28	100	8.7	0.1	97	870
16-09-2014	09:15	28	100	9.23	0.1	97	923
		28	100	9.2	0.1	97	920
		28	100	9.5	0.1	97	950
		28	100	9.4	0.1	97	940
		28	100	9.21	0.1	97	921
17-09-2014	09:30	28	100	9.12	0.1	97	912
		28	100	9.32	0.1	97	932
		28	100	9.1	0.1	97	910
		28	100	9.8	0.1	97	980
		28	100	9.5	0.1	97	950
18-09-2014	09:25	28	100	8.5	0.1	97	850
		28	100	9.32	0.1	97	932
		28	100	9.47	0.1	97	947
		28	100	9.35	0.1	97	935
		28	100	9.32	0.1	97	932
19-09-2014	09:15	28	100	9.52	0.1	97	952
		28	100	9.25	0.1	97	925
		28	100	9.45	0.1	97	945
		28	100	9.46	0.1	97	946
		28	100	8.69	0.1	97	869
20-09-2014	09:30	28	100	9.21	0.1	97	921
		28	100	9.3	0.1	97	930
		28	100	9.5	0.1	97	950
		28	100	9.4	0.1	97	940
		28	100	9.69	0.1	97	969
21-09-2014	09:35	28	100	9.4	0.1	97	940
		28	100	9.6	0.1	97	960
		28	100	9	0.1	97	900
		28	100	9.8	0.1	97	980
		28	100	9.6	0.1	97	960
22-09-2014	09:30	28	100	9.55	0.1	97	955
		28	100	8.8	0.1	97	880
		28	100	9.24	0.1	97	924
		28	100	9.88	0.1	97	988
		28	100	9.41	0.1	97	941
23-09-2014	09:45	28	100	9.28	0.1	97	928
		28	100	9.32	0.1	97	932
		28	100	9.54	0.1	97	954
		28	100	9.56	0.1	97	956
		28	100	9.6	0.1	97	960
24-09-2014	09:30	28	100	9	0.1	97	900
		28	100	8.9	0.1	97	890
		28	100	9.2	0.1	97	920

		28	100	8.94	0.1	97	894
		28	100	9.5	0.1	97	950
25-09-2014	09:35	28	100	8.6	0.1	97	860
		28	100	9.4	0.1	97	940
		28	100	9.21	0.1	97	921
		28	100	10.01	0.1	97	1001
		28	100	9.4	0.1	97	940
26-09-2014	09:30	28	100	9.32	0.1	97	932
		28	100	9.5	0.1	97	950
		28	100	9.2	0.1	97	920
		28	100	8.75	0.1	97	875
		28	100	9.32	0.1	97	932
27-09-2014	09:45	28	100	9.85	0.1	97	985
		28	100	9.32	0.1	97	932
		28	100	9.5	0.1	97	950
		28	100	9.6	0.1	97	960
		28	100	10.02	0.1	97	1002
28-09-2014	09:30	28	100	9.2	0.1	97	920
		28	100	9.5	0.1	97	950
		28	100	9.7	0.1	97	970
		28	100	9.55	0.1	97	955
		28	100	9.7	0.1	97	970
29-09-2014	09:30	28	100	9.6	0.1	97	960
		28	100	9.56	0.1	97	956
		28	100	9.87	0.1	97	987
		28	100	9.28	0.1	97	928
		28	100	9.7	0.1	97	970
30-09-2014	09:45	28	100	9.25	0.1	97	925
		28	100	9.4	0.1	97	940
		28	100	9.7	0.1	97	970
		28	100	9.14	0.1	97	914
		28	100	8.96	0.1	97	896
01-10-2014	09:40	28	100	8.9	0.1	97	890
		28	100	8.85	0.1	97	885
		28	100	9.4	0.1	97	940
		28	100	8.9	0.1	97	890
		28	100	8.75	0.1	97	875
02-10-2014	09:30	28	100	9.5	0.1	97	950
		28	100	8.65	0.1	97	865
		28	100	9.1	0.1	97	910
		28	100	9.32	0.1	97	932
		28	100	9.82	0.1	97	982
03-10-2014	09:30	28	100	9.74	0.1	97	974
		28	100	9.8	0.1	97	980

		28	100	9.3	0.1	97	930
		28	100	9.4	0.1	97	940
		28	100	9.8	0.1	97	980
03-10-2015	09:45	28	100	9.1	0.1	97	910
		28	100	9.51	0.1	97	951
		28	100	9.2	0.1	97	920
		28	100	9.5	0.1	97	950
		28	100	9.3	0.1	97	930
04-10-2014	09:30	28	100	9.7	0.1	97	970
		28	100	9.1	0.1	97	910
		28	100	9.3	0.1	97	930
		28	100	9.45	0.1	97	945
		28	100	9.7	0.1	97	970
05-10-2014	09:15	28	100	9.2	0.1	97	920
		28	100	9.3	0.1	97	930
		28	100	9.7	0.1	97	970
		28	100	9.5	0.1	97	950
		28	100	9.3	0.1	97	930
06-10-2014	09:30	28	100	9.3	0.1	97	930
		28	100	9.77	0.1	97	977
		28	100	10.03	0.1	97	1003
		28	100	9.4	0.1	97	940
		28	100	9.7	0.1	97	970
07-10-2014	09:30	28	100	9.8	0.1	97	980
		28	100	9.3	0.1	97	930
		28	100	9.7	0.1	97	970
		28	100	9.41	0.1	97	941
		28	100	9.74	0.1	97	974
08-10-2014	09:40	28	100	9.32	0.1	97	932
		28	100	9.11	0.1	97	911
		28	100	9.33	0.1	97	933
		28	100	9.41	0.1	97	941
		28	100	9.5	0.1	97	950
09-10-2014	09:30	28	100	9.14	0.1	97	914
		28	100	9.75	0.1	97	975
		28	100	9.25	0.1	97	925
		28	100	9.45	0.1	97	945
		28	100	9.54	0.1	97	954
10-10-2014	09:25	28	100	9.65	0.1	97	965
		28	100	9.87	0.1	97	987
		28	100	9.54	0.1	97	954
		28	100	9.14	0.1	97	914
		28	100	9.5	0.1	97	950
11-10-2014	09:40	28	100	9.7	0.1	97	970

		28	100	9.2	0.1	97	920
		28	100	9.7	0.1	97	970
		28	100	9.25	0.1	97	925
		28	100	9.5	0.1	97	950
12-10-2014	09:30	28	100	9.45	0.1	97	945
		28	100	9.64	0.1	97	964
		28	100	9.5	0.1	97	950
		28	100	9.8	0.1	97	980
		28	100	9.2	0.1	97	920
13-10-2014	09:45	28	100	9.34	0.1	97	934
		28	100	9.8	0.1	97	980
		28	100	9.7	0.1	97	970
		28	100	9.74	0.1	97	974
		28	100	9.32	0.1	97	932
14-10-2014	09:30	28	100	9.47	0.1	97	947
		28	100	9.5	0.1	97	950
		28	100	9.68	0.1	97	968
		28	100	9.8	0.1	97	980
		28	100	9.7	0.1	97	970
15-10-2014	09:30	28	100	9.65	0.1	97	965
		28	100	9.47	0.1	97	947
		28	100	9.47	0.1	97	947
		28	100	9.54	0.1	97	954
		28	100	8.9	0.1	97	890
16-10-2014	09:35	28	100	8.99	0.1	97	899
		28	100	9.01	0.1	97	901
		28	100	9.58	0.1	97	958
		28	100	9.74	0.1	97	974
		28	100	9.87	0.1	97	987
17-10-2014	09:30	28	100	9.64	0.1	97	964
		28	100	8.99	0.1	97	899
		28	100	9.35	0.1	97	935
		28	100	9.45	0.1	97	945
		28	100	9.65	0.1	97	965
18-10-2014	09:40	28	100	10.05	0.1	97	1005
		28	100	9.45	0.1	97	945
		28	100	9.2	0.1	97	920
		28	100	9.8	0.1	97	980
		28	100	9.4	0.1	97	940
19-10-2014	09:30	28	100	9.6	0.1	97	960
		28	100	9.78	0.1	97	978
		28	100	9.65	0.1	97	965
		28	100	9.5	0.1	97	950
		28	100	9.8	0.1	97	980

20-10-2014	09:35	28	100	9.7	0.1	97	970
		28	100	9.9	0.1	97	990
		28	100	8.96	0.1	97	896
		28	100	9.8	0.1	97	980
		28	100	9.54	0.1	97	954
21-10-2014	09:30	28	100	9.4	0.1	97	940
		28	100	9.8	0.1	97	980
		28	100	9.6	0.1	97	960
		28	100	9.7	0.1	97	970
		28	100	9.5	0.1	97	950
22-10-2014	09:45	28	100	9.8	0.1	97	980
		28	100	9.8	0.1	97	980
		28	100	9.7	0.1	97	970
		28	100	9.64	0.1	97	964
		28	100	9.8	0.1	97	980
23-10-2014	09:40	28	100	9.7	0.1	97	970
		28	100	9.6	0.1	97	960
		28	100	9.7	0.1	97	970
		28	100	9.5	0.1	97	950
		28	100	9.6	0.1	97	960
24-10-2014	09:15	28	100	9.7	0.1	97	970
		28	100	9.4	0.1	97	940
		28	100	9.7	0.1	97	970
		28	100	9.2	0.1	97	920
		28	100	8.98	0.1	97	898
25-10-2014	09:30	28	100	9.7	0.1	97	970
		28	100	9.4	0.1	97	940
		28	100	9.7	0.1	97	970
		28	100	9.5	0.1	97	950
		28	100	9.7	0.1	97	970
26-10-2014	09:30	28	100	9.6	0.1	97	960
		28	100	9.2	0.1	97	920
		28	100	9.7	0.1	97	970
		28	100	9.4	0.1	97	940
		28	100	9.3	0.1	97	930
27-10-2014	09:30	28	100	9.2	0.1	97	920
		28	100	9.1	0.1	97	910
		28	100	10.01	0.1	97	1001
		28	100	9.87	0.1	97	987
		28	100	9.41	0.1	97	941
28-10-2014	09:40	28	100	9.31	0.1	97	931
		28	100	9.74	0.1	97	974
		28	100	9.1	0.1	97	910
		28	100	9.24	0.1	97	924

		28	100	9.7	0.1	97	970
29-10-2014	09:25	28	100	9.1	0.1	97	910
		28	100	9.6	0.1	97	960
		28	100	9.3	0.1	97	930
		28	100	9.7	0.1	97	970
		28	100	9.58	0.1	97	958
30-10-2014	09:40	28	100	9.6	0.1	97	960
		28	100	9.2	0.1	97	920
		28	100	9.4	0.1	97	940
		28	100	9.3	0.1	97	930
		28	100	8.95	0.1	97	895
31-10-2014	09:35	28	100	9.3	0.1	97	930
		28	100	8.96	0.1	97	896
		28	100	9.3	0.1	97	930
		28	100	9.5	0.1	97	950
		28	100	9.4	0.1	97	940

12 AL 65Ah Sealed MF Rechargeable Lead Acid battery readings

DATE	TIME (am)	Temp. (°C)	ampere hour (Ah)	Vol.(V)	Current (mA)	Resistant (R)	Watthour (Wh)
01-09-2014	10:30	31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	12.5	0.13	100	812.5
		31	65	13.2	0.13	100	858
		31	65	12.7	0.13	100	825.5
02-09-2014	10:45	31	65	13.1	0.13	100	851.5
		31	65	13	0.13	100	845
		31	65	12.9	0.13	100	838.5
		31	65	12.7	0.13	100	825.5
		31	65	13.1	0.13	100	851.5
03-09-2014	10:30	31	65	13.3	0.13	100	864.5
		31	65	13.4	0.13	100	871
		31	65	12.9	0.13	100	838.5
		31	65	12.6	0.13	100	819
		31	65	12.5	0.13	100	812.5
04-09-2014	10:30	31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.1	0.13	100	851.5
		31	65	12.8	0.13	100	832

05-09-2014	10:30	31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	12.9	0.13	100	838.5
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
06-09-2014	11:00	31	65	13.3	0.13	100	864.5
		31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
		31	65	12.9	0.13	100	838.5
		31	65	13.2	0.13	100	858
07-09-2014	10:30	31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	12.8	0.13	100	832
		31	65	12.9	0.13	100	838.5
		31	65	13.1	0.13	100	851.5
08-09-2014	10:40	31	65	13.2	0.13	100	858
		31	65	13.4	0.13	100	871
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	12.98	0.13	100	843.7
09-09-2014	10:30	31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.4	0.13	100	871
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
10-09-2014	10:45	31	65	13.3	0.13	100	864.5
		31	65	13.2	0.13	100	858
		31	65	13.4	0.13	100	871
		31	65	13.1	0.13	100	851.5
		31	65	12.6	0.13	100	819
11-09-2014	10:50	31	65	13.4	0.13	100	871
		31	65	12.9	0.13	100	838.5
		31	65	13.6	0.13	100	884
		31	65	13.5	0.13	100	877.5
		31	65	13.4	0.13	100	871
12-09-2014	10:30	31	65	12.95	0.13	100	841.75
		31	65	12.98	0.13	100	843.7
		31	65	13.2	0.13	100	858
		31	65	13.5	0.13	100	877.5
		31	65	13.4	0.13	100	871
13-09-2014	10:50	31	65	13.4	0.13	100	871
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.3	0.13	100	864.5

		31	65	13.2	0.13	100	858
14-09-2014	10:30	31	65	13	0.13	100	845
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.3	0.13	100	864.5
		31	65	13.2	0.13	100	858
15-09-2014	10:15	31	65	13.2	0.13	100	858
		31	65	13	0.13	100	845
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.4	0.13	100	871
16-09-2014	10:55	31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
17-09-2014	10:30	31	65	13.3	0.13	100	864.5
		31	65	12.88	0.13	100	837.2
		31	65	13.01	0.13	100	845.65
		31	65	12.95	0.13	100	841.75
		31	65	12.6	0.13	100	819
18-09-2014	10:35	31	65	12.8	0.13	100	832
		31	65	13	0.13	100	845
		31	65	12.9	0.13	100	838.5
		31	65	13.4	0.13	100	871
		31	65	12.8	0.13	100	832
19-09-2014	10:30	31	65	12.7	0.13	100	825.5
		31	65	13.2	0.13	100	858
		31	65	12.8	0.13	100	832
		31	65	13.4	0.13	100	871
		31	65	13.2	0.13	100	858
20-09-2014	10:55	31	65	13.4	0.13	100	871
		31	65	12.8	0.13	100	832
		31	65	13.1	0.13	100	851.5
		31	65	13.5	0.13	100	877.5
		31	65	13.2	0.13	100	858
21-09-2014	10:30	31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
		31	65	12.6	0.13	100	819
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
22-09-2014	10:25	31	65	13.2	0.13	100	858
		31	65	12.9	0.13	100	838.5
		31	65	13.5	0.13	100	877.5

		31	65	13.4	0.13	100	871
		31	65	13.2	0.13	100	858
23-09-2014	10:50	31	65	13.5	0.13	100	877.5
		31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
		31	65	13.5	0.13	100	877.5
		31	65	13.2	0.13	100	858
24-09-2014	10:30	31	65	13.2	0.13	100	858
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.5	0.13	100	877.5
		31	65	13.4	0.13	100	871
25-09-2014	10:50	31	65	13.1	0.13	100	851.5
		31	65	13.1	0.13	100	851.5
		31	65	12.9	0.13	100	838.5
		31	65	13.2	0.13	100	858
		31	65	12.8	0.13	100	832
26-09-2014	10:30	31	65	12.4	0.13	100	806
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.4	0.13	100	871
		31	65	12.9	0.13	100	838.5
27-09-2014	10:30	31	65	13.4	0.13	100	871
		31	65	12.1	0.13	100	786.5
		31	65	13.4	0.13	100	871
		31	65	12.8	0.13	100	832
		31	65	13.2	0.13	100	858
28-09-2014	10:50	31	65	13.1	0.13	100	851.5
		31	65	12.9	0.13	100	838.5
		31	65	13.4	0.13	100	871
		31	65	13.1	0.13	100	851.5
		31	65	12.5	0.13	100	812.5
29-09-2014	10:35	31	65	12.8	0.13	100	832
		31	65	13.4	0.13	100	871
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.22	0.13	100	859.3
30-09-2014	10:30	31	65	12.8	0.13	100	832
		31	65	12.7	0.13	100	825.5
		31	65	13	0.13	100	845
		31	65	13.5	0.13	100	877.5
		31	65	13.4	0.13	100	871
01-10-2014	10:40	31	65	13.2	0.13	100	858
		31	65	13.2	0.13	100	858

		31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
		31	65	13.1	0.13	100	851.5
02-10-2014	10:35	31	65	13.5	0.13	100	877.5
		31	65	13.2	0.13	100	858
		31	65	13.3	0.13	100	864.5
		31	65	13.1	0.13	100	851.5
		31	65	13.4	0.13	100	871
03-10-2014	10:50	31	65	13.2	0.13	100	858
		31	65	12.8	0.13	100	832
		31	65	12.9	0.13	100	838.5
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
03-10-2015	11:00	31	65	13.1	0.13	100	851.5
		31	65	13.3	0.13	100	864.5
		31	65	12.8	0.13	100	832
		31	65	13.3	0.13	100	864.5
		31	65	13.2	0.13	100	858
04-10-2014	10:35	31	65	12.9	0.13	100	838.5
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.5	0.13	100	877.5
05-10-2014	10:45	31	65	13.4	0.13	100	871
		31	65	12.9	0.13	100	838.5
		31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
		31	65	13.5	0.13	100	877.5
06-10-2014	10:40	31	65	13.1	0.13	100	851.5
		31	65	13.4	0.13	100	871
		31	65	13.2	0.13	100	858
		31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
07-10-2014	11:00	31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	12.9	0.13	100	838.5
08-10-2014	10:25	31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.4	0.13	100	871
		31	65	13.1	0.13	100	851.5
		31	65	13.3	0.13	100	864.5
09-10-2014	10:00	31	65	13.2	0.13	100	858

		31	65	13.1	0.13	100	851.5
		31	65	13.5	0.13	100	877.5
		31	65	13.1	0.13	100	851.5
		31	65	13.4	0.13	100	871
10-10-2014	10:35	31	65	13.2	0.13	100	858
		31	65	13.3	0.13	100	864.5
		31	65	13	0.13	100	845
		31	65	13.2	0.13	100	858
		31	65	12.9	0.13	100	838.5
11-10-2014	10:50	31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
		31	65	13.2	0.13	100	858
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
12-10-2014	10:30	31	65	12.9	0.13	100	838.5
		31	65	13.2	0.13	100	858
		31	65	13.5	0.13	100	877.5
		31	65	13.1	0.13	100	851.5
		31	65	13.4	0.13	100	871
13-10-2014	10:35	31	65	12.9	0.13	100	838.5
		31	65	13.4	0.13	100	871
		31	65	13.2	0.13	100	858
		31	65	12.9	0.13	100	838.5
		31	65	13.2	0.13	100	858
14-10-2014	10:40	31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	12.9	0.13	100	838.5
		31	65	13.2	0.13	100	858
15-10-2014	10:30	31	65	12.8	0.13	100	832
		31	65	12.7	0.13	100	825.5
		31	65	12.9	0.13	100	838.5
		31	65	13.3	0.13	100	864.5
		31	65	12.8	0.13	100	832
16-10-2014	10:55	31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.3	0.13	100	864.5
		31	65	12.9	0.13	100	838.5
		31	65	13.1	0.13	100	851.5
17-10-2014	10:30	31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
		31	65	13.2	0.13	100	858
		31	65	13.4	0.13	100	871
		31	65	13.1	0.13	100	851.5

18-10-2014	10:30	31	65	12.8	0.13	100	832
		31	65	13.1	0.13	100	851.5
		31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
		31	65	13.1	0.13	100	851.5
19-10-2014	11:00	31	65	13.5	0.13	100	877.5
		31	65	13.1	0.13	100	851.5
		31	65	12.9	0.13	100	838.5
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
20-10-2014	10:35	31	65	12.9	0.13	100	838.5
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.4	0.13	100	871
		31	65	12.7	0.13	100	825.5
21-10-2014	10:30	31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
22-10-2014	10:50	31	65	13.1	0.13	100	851.5
		31	65	13.4	0.13	100	871
		31	65	12.9	0.13	100	838.5
		31	65	12.8	0.13	100	832
		31	65	13.1	0.13	100	851.5
23-10-2014	10:15	31	65	12.9	0.13	100	838.5
		31	65	13.1	0.13	100	851.5
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.4	0.13	100	871
24-10-2014	10:30	31	65	12.9	0.13	100	838.5
		31	65	13.1	0.13	100	851.5
		31	65	12.8	0.13	100	832
		31	65	13.1	0.13	100	851.5
		31	65	13.5	0.13	100	877.5
25-10-2014	10:35	31	65	13.4	0.13	100	871
		31	65	12.8	0.13	100	832
		31	65	13.5	0.13	100	877.5
		31	65	13.4	0.13	100	871
		31	65	12.8	0.13	100	832
26-10-2014	10:30	31	65	12.9	0.13	100	838.5
		31	65	13.1	0.13	100	851.5
		31	65	12.8	0.13	100	832
		31	65	13.9	0.13	100	903.5

		31	65	13.4	0.13	100	871
27-10-2014	10:40	31	65	12.8	0.13	100	832
		31	65	13.3	0.13	100	864.5
		31	65	13.4	0.13	100	871
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
28-10-2014	10:30	31	65	12.9	0.13	100	838.5
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	12.98	0.13	100	843.7
		31	65	12.8	0.13	100	832
29-10-2014	10:20	31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.4	0.13	100	871
		31	65	12.9	0.13	100	838.5
		31	65	13.2	0.13	100	858
30-10-2014	10:40	31	65	12.9	0.13	100	838.5
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
31-10-2014	10:20	31	65	13.1	0.13	100	851.5
		31	65	13.2	0.13	100	858
		31	65	13.2	0.13	100	858
		31	65	13.1	0.13	100	851.5
		31	65	13	0.13	100	845

Date	Time (pm)	Temp. (°C)	ampere hour (Ah)	Vol. (V)	Current (mA)	Resistance (R)	Watthour (Wh)
01-09-2014	09:30	28	65	6.87	0.05	137	446.55
		28	65	6.89	0.05	137	447.85
		28	65	6.98	0.05	137	453.7
		28	65	7.02	0.05	137	456.3
		28	65	6.9	0.05	137	448.5
02-09-2014	09:30	28	65	7.02	0.05	137	456.3
		28	65	6.98	0.05	137	453.7
		28	65	6.99	0.05	137	454.35
		28	65	7.06	0.05	137	458.9
		28	65	6.48	0.05	137	421.2
03-09-2014	09:00	28	65	6.89	0.05	137	447.85
		28	65	6.88	0.05	137	447.2
		28	65	6.84	0.05	137	444.6
		28	65	6.74	0.05	137	438.1

		28	65	6.98	0.05	137	453.7
04-09-2014	09:30	28	65	7.01	0.05	137	455.65
		28	65	6.83	0.05	137	443.95
		28	65	7.02	0.05	137	456.3
		28	65	6.72	0.05	137	436.8
		28	65	6.8	0.05	137	442
05-09-2014	09:45	28	65	6.89	0.05	137	447.85
		28	65	6.91	0.05	137	449.15
		28	65	7.03	0.05	137	456.95
		28	65	7.01	0.05	137	455.65
		28	65	6.84	0.05	137	444.6
06-09-2014	09:15	28	65	6.75	0.05	137	438.75
		28	65	6.8	0.05	137	442
		28	65	6.97	0.05	137	453.05
		28	65	7.03	0.05	137	456.95
		28	65	6.92	0.05	137	449.8
07-09-2014	09:30	28	65	7.01	0.05	137	455.65
		28	65	6.65	0.05	137	432.25
		28	65	6.92	0.05	137	449.8
		28	65	6.85	0.05	137	445.25
		28	65	6.9	0.05	137	448.5
08-09-2014	09:30	28	65	7.03	0.05	137	456.95
		28	65	7.02	0.05	137	456.3
		28	65	6.92	0.05	137	449.8
		28	65	6.84	0.05	137	444.6
		28	65	6.8	0.05	137	442
09-09-2014	09:30	28	65	6.75	0.05	137	438.75
		28	65	6.94	0.05	137	451.1
		28	65	7.02	0.05	137	456.3
		28	65	7.03	0.05	137	456.95
		28	65	6.98	0.05	137	453.7
10-09-2014	09:36	27	65	6.8	0.05	137	442
		27	65	6.74	0.05	137	438.1
		27	65	6.9	0.05	137	448.5
		27	65	7.02	0.05	137	456.3
		27	65	6.9	0.05	137	448.5
11-09-2014	09:20	27	65	7.01	0.05	137	455.65
		27	65	6.8	0.05	137	442
		27	65	7.02	0.05	137	456.3
		27	65	6.88	0.05	137	447.2
		27	65	6.7	0.05	137	435.5
12-09-2014	09:30	27	65	6.88	0.05	137	447.2
		27	65	6.9	0.05	137	448.5
		27	65	6.87	0.05	137	446.55

		27	65	6.9	0.05	137	448.5
		27	65	7.03	0.05	137	456.95
13-09-2014	09:15	27	65	6.84	0.05	137	444.6
		27	65	6.9	0.05	137	448.5
		27	65	7.01	0.05	137	455.65
		27	65	7.03	0.05	137	456.95
		27	65	6.87	0.05	137	446.55
14-09-2014	09:45	27	65	6.84	0.05	137	444.6
		27	65	7.02	0.05	137	456.3
		27	65	6.95	0.05	137	451.75
		27	65	6.8	0.05	137	442
		27	65	6.75	0.05	137	438.75
15-09-2014	09:30	27	65	6.75	0.05	137	438.75
		27	65	6.84	0.05	137	444.6
		27	65	6.88	0.05	137	447.2
		27	65	6.74	0.05	137	438.1
		27	65	6.99	0.05	137	454.35
16-09-2014	09:15	27	65	7.03	0.05	137	456.95
		27	65	7.02	0.05	137	456.3
		27	65	6.85	0.05	137	445.25
		27	65	6.78	0.05	137	440.7
		27	65	6.64	0.05	137	431.6
17-09-2014	09:30	27	65	7.03	0.05	137	456.95
		27	65	7.01	0.05	137	455.65
		27	65	6.95	0.05	137	451.75
		27	65	6.82	0.05	137	443.3
		27	65	6.93	0.05	137	450.45
18-09-2014	09:25	27	65	6.82	0.05	137	443.3
		27	65	7.01	0.05	137	455.65
		27	65	7.03	0.05	137	456.95
		27	65	6.9	0.05	137	448.5
		27	65	6.89	0.05	137	447.85
19-09-2014	09:15	27	65	6.85	0.05	137	445.25
		27	65	6.95	0.05	137	451.75
		27	65	7.02	0.05	137	456.3
		27	65	6.85	0.05	137	445.25
		27	65	6.96	0.05	137	452.4
20-09-2014	09:30	27	65	6.78	0.05	137	440.7
		27	65	7.01	0.05	137	455.65
		27	65	6.98	0.05	137	453.7
		27	65	7	0.05	137	455
		27	65	6.84	0.05	137	444.6
21-09-2014	09:35	27	65	6.77	0.05	137	440.05
		27	65	6.9	0.05	137	448.5

		27	65	7.02	0.05	137	456.3
		27	65	6.88	0.05	137	447.2
		27	65	6.9	0.05	137	448.5
22-09-2014	09:30	27	65	6.7	0.05	137	435.5
		27	65	6.8	0.05	137	442
		27	65	7.02	0.05	137	456.3
		27	65	7.03	0.05	137	456.95
		27	65	6.85	0.05	137	445.25
23-09-2014	09:45	27	65	6.75	0.05	137	438.75
		27	65	6.9	0.05	137	448.5
		27	65	7.03	0.05	137	456.95
		27	65	6.85	0.05	137	445.25
		27	65	7.01	0.05	137	455.65
24-09-2014	09:30	27	65	6.88	0.05	137	447.2
		27	65	7.01	0.05	137	455.65
		27	65	6.71	0.05	137	436.15
		27	65	7.02	0.05	137	456.3
		27	65	7	0.05	137	455
25-09-2014	09:35	27	65	6.99	0.05	137	454.35
		27	65	6.85	0.05	137	445.25
		27	65	6.7	0.05	137	435.5
		27	65	6.74	0.05	137	438.1
		27	65	6.7	0.05	137	435.5
26-09-2014	09:30	27	65	6.99	0.05	137	454.35
		27	65	6.85	0.05	137	445.25
		27	65	7.01	0.05	137	455.65
		27	65	6.85	0.05	137	445.25
		27	65	6.99	0.05	137	454.35
27-09-2014	09:45	27	65	7.02	0.05	137	456.3
		27	65	6.87	0.05	137	446.55
		27	65	6.95	0.05	137	451.75
		27	65	7.01	0.05	137	455.65
		27	65	7.03	0.05	137	456.95
28-09-2014	09:30	27	65	6.98	0.05	137	453.7
		27	65	6.88	0.05	137	447.2
		27	65	6.9	0.05	137	448.5
		27	65	6.74	0.05	137	438.1
		27	65	7.01	0.05	137	455.65
29-09-2014	09:30	27	65	7.02	0.05	137	456.3
		27	65	6.84	0.05	137	444.6
		27	65	6.98	0.05	137	453.7
		27	65	6.87	0.05	137	446.55
		27	65	6.9	0.05	137	448.5
30-09-2014	09:45	27	65	7	0.05	137	455

		27	65	7.01	0.05	137	455.65
		27	65	6.87	0.05	137	446.55
		27	65	6.89	0.05	137	447.85
		27	65	6.85	0.05	137	445.25
01-10-2014	09:40	27	65	7.02	0.05	137	456.3
		27	65	6.99	0.05	137	454.35
		27	65	6.85	0.05	137	445.25
		27	65	7.01	0.05	137	455.65
		27	65	6.8	0.05	137	442
02-10-2014	09:30	27	65	7.01	0.05	137	455.65
		27	65	6.95	0.05	137	451.75
		27	65	6.8	0.05	137	442
		27	65	6.9	0.05	137	448.5
		27	65	7.03	0.05	137	456.95
03-10-2014	09:30	27	65	6.87	0.05	137	446.55
		27	65	6.67	0.05	137	433.55
		27	65	6.87	0.05	137	446.55
		27	65	6.89	0.05	137	447.85
		27	65	6.7	0.05	137	435.5
03-10-2015	09:45	27	65	6.8	0.05	137	442
		27	65	6.87	0.05	137	446.55
		27	65	6.78	0.05	137	440.7
		27	65	6.9	0.05	137	448.5
		27	65	7.02	0.05	137	456.3
04-10-2014	09:30	27	65	7	0.05	137	455
		27	65	6.98	0.05	137	453.7
		27	65	6.93	0.05	137	450.45
		27	65	6.94	0.05	137	451.1
		27	65	6.83	0.05	137	443.95
05-10-2014	09:15	27	65	6.73	0.05	137	437.45
		27	65	6.8	0.05	137	442
		27	65	6.9	0.05	137	448.5
		27	65	6.87	0.05	137	446.55
		27	65	6.7	0.05	137	435.5
06-10-2014	09:30	27	65	6.8	0.05	137	442
		27	65	6.75	0.05	137	438.75
		27	65	6.85	0.05	137	445.25
		27	65	6.91	0.05	137	449.15
		27	65	6.82	0.05	137	443.3
07-10-2014	09:30	27	65	6.85	0.05	137	445.25
		27	65	6.91	0.05	137	449.15
		27	65	6.82	0.05	137	443.3
		27	65	6.7	0.05	137	435.5
		27	65	6.81	0.05	137	442.65

08-10-2014	09:40	27	65	6.74	0.05	137	438.1
		27	65	6.81	0.05	137	442.65
		27	65	6.71	0.05	137	436.15
		27	65	6.75	0.05	137	438.75
		27	65	6.94	0.05	137	451.1
09-10-2014	09:30	27	65	6.82	0.05	137	443.3
		27	65	7.01	0.05	137	455.65
		27	65	7	0.05	137	455
		27	65	6.89	0.05	137	447.85
		27	65	6.94	0.05	137	451.1
10-10-2014	09:25	27	65	6.83	0.05	137	443.95
		27	65	6.76	0.05	137	439.4
		27	65	6.97	0.05	137	453.05
		27	65	7.02	0.05	137	456.3
		27	65	6.81	0.05	137	442.65
11-10-2014	09:40	27	65	6.81	0.05	137	442.65
		27	65	7.02	0.05	137	456.3
		27	65	6.92	0.05	137	449.8
		27	65	6.94	0.05	137	451.1
		27	65	7.01	0.05	137	455.65
12-10-2014	09:30	27	65	7	0.05	137	455
		27	65	6.87	0.05	137	446.55
		27	65	6.92	0.05	137	449.8
		27	65	6.87	0.05	137	446.55
		27	65	6.74	0.05	137	438.1
13-10-2014	09:45	27	65	6.82	0.05	137	443.3
		27	65	6.97	0.05	137	453.05
		27	65	6.75	0.05	137	438.75
		27	65	6.94	0.05	137	451.1
		27	65	6.74	0.05	137	438.1
14-10-2014	09:30	27	65	6.96	0.05	137	452.4
		27	65	6.74	0.05	137	438.1
		27	65	6.85	0.05	137	445.25
		27	65	6.91	0.05	137	449.15
		27	65	6.74	0.05	137	438.1
15-10-2014	09:30	27	65	6.75	0.05	137	438.75
		27	65	6.86	0.05	137	445.9
		27	65	9.74	0.05	137	633.1
		27	65	6.94	0.05	137	451.1
		27	65	6.87	0.05	137	446.55
16-10-2014	09:35	27	65	7	0.05	137	455
		27	65	7.02	0.05	137	456.3
		27	65	6.81	0.05	137	442.65
		27	65	9.75	0.05	137	633.75

		27	65	6.71	0.05	137	436.15
17-10-2014	09:30	27	65	6.91	0.05	137	449.15
		27	65	6.81	0.05	137	442.65
		27	65	6.91	0.05	137	449.15
		27	65	6.75	0.05	137	438.75
		27	65	6.91	0.05	137	449.15
18-10-2014	09:40	27	65	6.78	0.05	137	440.7
		27	65	6.81	0.05	137	442.65
		27	65	6.64	0.05	137	431.6
		27	65	6.81	0.05	137	442.65
		27	65	6.74	0.05	137	438.1
19-10-2014	09:30	27	65	6.76	0.05	137	439.4
		27	65	6	0.05	137	390
		27	65	6.87	0.05	137	446.55
		27	65	9.75	0.05	137	633.75
		27	65	7	0.05	137	455
20-10-2014	09:35	27	65	6.96	0.05	137	452.4
		27	65	6.71	0.05	137	436.15
		27	65	6.78	0.05	137	440.7
		27	65	6.71	0.05	137	436.15
		27	65	6.95	0.05	137	451.75
21-10-2014	09:30	27	65	6.87	0.05	137	446.55
		27	65	6.82	0.05	137	443.3
		27	65	7	0.05	137	455
		27	65	6.72	0.05	137	436.8
		27	65	6.82	0.05	137	443.3
22-10-2014	09:45	27	65	6.71	0.05	137	436.15
		27	65	7.02	0.05	137	456.3
		27	65	7	0.05	137	455
		27	65	6.84	0.05	137	444.6
		27	65	6.78	0.05	137	440.7
23-10-2014	09:40	27	65	6.87	0.05	137	446.55
		27	65	6.82	0.05	137	443.3
		27	65	6.98	0.05	137	453.7
		27	65	6.74	0.05	137	438.1
		27	65	6.87	0.05	137	446.55
24-10-2014	09:15	27	65	6.75	0.05	137	438.75
		27	65	7.02	0.05	137	456.3
		27	65	6.74	0.05	137	438.1
		27	65	9.75	0.05	137	633.75
		27	65	6.94	0.05	137	451.1
25-10-2014	09:30	27	65	7	0.05	137	455
		27	65	6.96	0.05	137	452.4
		27	65	6.85	0.05	137	445.25

		27	65	6.78	0.05	137	440.7
		27	65	6.71	0.05	137	436.15
26-10-2014	09:30	27	65	6.74	0.05	137	438.1
		27	65	6.94	0.05	137	451.1
		27	65	6.69	0.05	137	434.85
		27	65	6.87	0.05	137	446.55
		27	65	6.8	0.05	137	442
27-10-2014	09:30	27	65	6.85	0.05	137	445.25
		27	65	6.7	0.05	137	435.5
		27	65	6.9	0.05	137	448.5
		27	65	6.69	0.05	137	434.85
		27	65	6.82	0.05	137	443.3
28-10-2014	09:40	27	65	6.71	0.05	137	436.15
		27	65	6.84	0.05	137	444.6
		27	65	7.02	0.05	137	456.3
		27	65	6.82	0.05	137	443.3
		27	65	6.96	0.05	137	452.4
29-10-2014	09:25	27	65	6.87	0.05	137	446.55
		27	65	6.82	0.05	137	443.3
		27	65	6.84	0.05	137	444.6
		27	65	9.75	0.05	137	633.75
		27	65	7	0.05	137	455
30-10-2014	09:40	27	65	6.94	0.05	137	451.1
		27	65	6.85	0.05	137	445.25
		27	65	6.94	0.05	137	451.1
		27	65	6.82	0.05	137	443.3
		27	65	6.87	0.05	137	446.55
31-10-2014	09:35	27	65	6.96	0.05	137	452.4
		27	65	6.78	0.05	137	440.7
		27	65	7.02	0.05	137	456.3
		27	65	6.94	0.05	137	451.1
		27	65	6.71	0.05	137	436.15

APPENDIX C

CORRELATION GRAPHS

A. For 100Ah Pb-acid battery

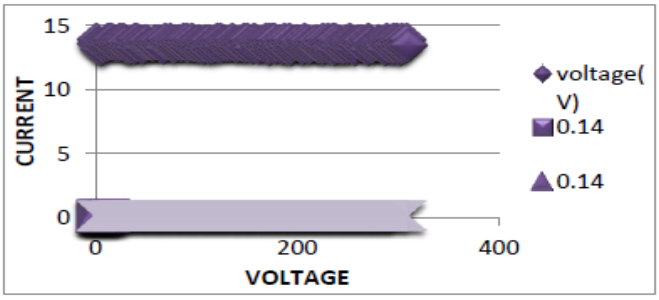


Fig. C.1 100Ah Charging I-V Graph

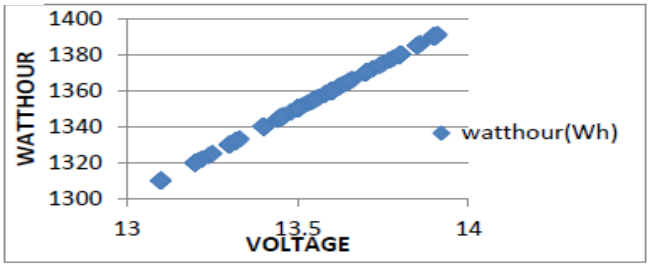


Fig. C.2 100Ah Charging Wh-V Graph

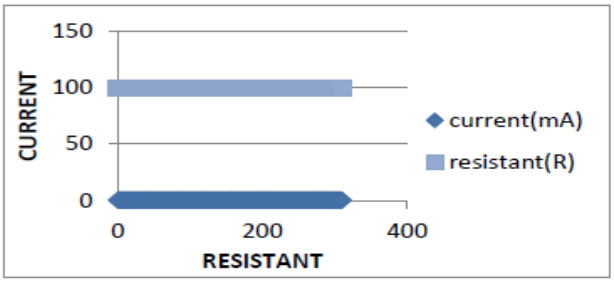


Fig. C.3 100Ah Charging I-R Graph

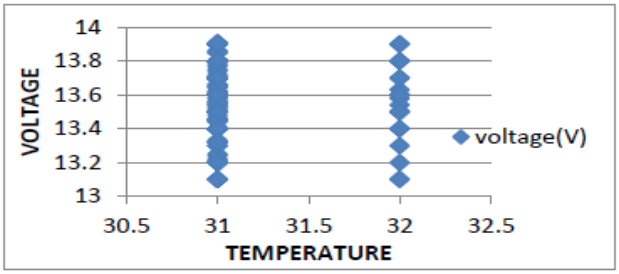


Fig. C.4 100Ah Charging V-T Graph

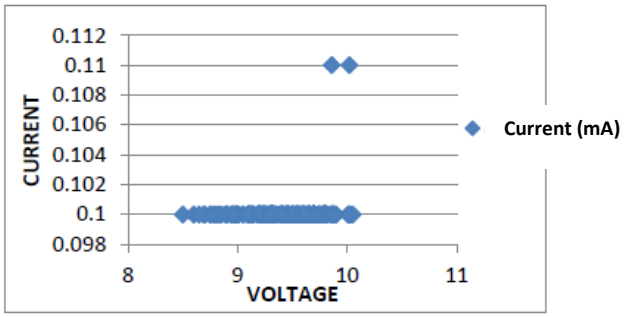


Fig. C.5 100Ah Discharging I-V Graph

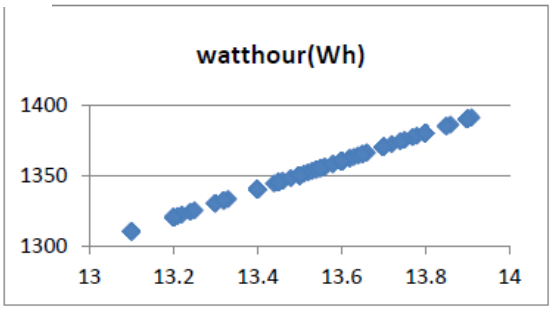


Fig. C.6 100Ah Discharging Wh-V Graph

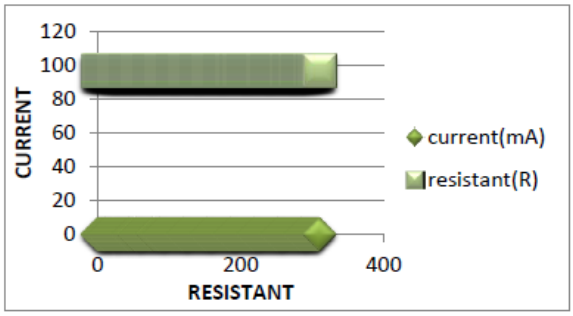


Fig. C.7 100Ah Discharging I-R Graph

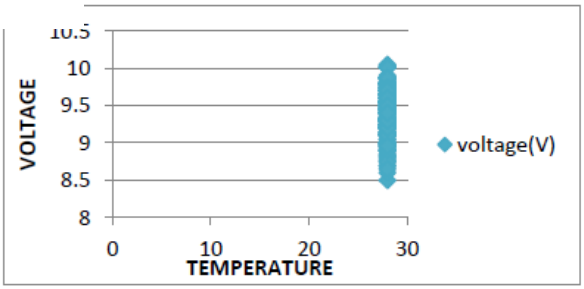
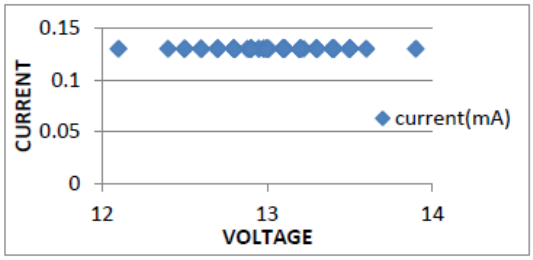


Fig. C.8 100Ah Discharging V-T Graph

B. For 65Ah Pb-acid battery



] **Fig. C.9 65Ah Charging I-V Graph**

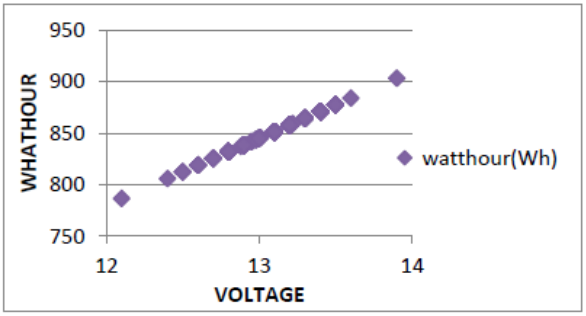
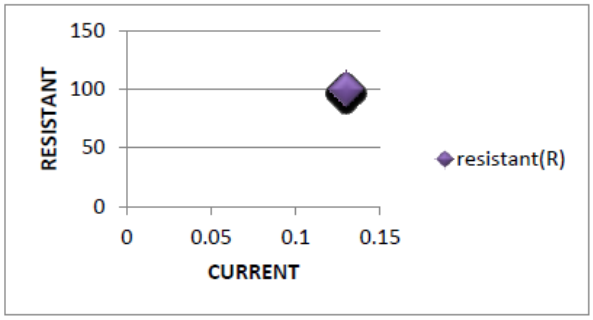


Fig. C.10 65Ah Charging Wh-V Graph



] **Fig. C.11 65Ah Charging R-I Graph**

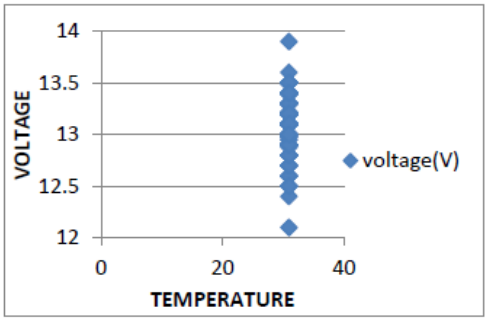


Fig. C.12 65Ah Charging V-T Graph

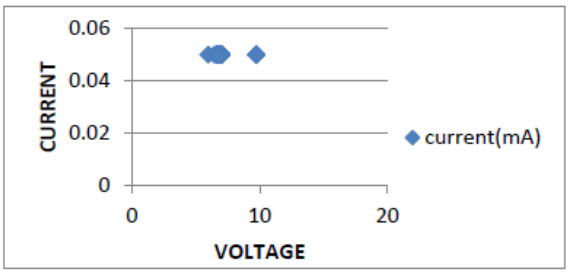


Fig. C.13 65Ah Discharging I-V Graph

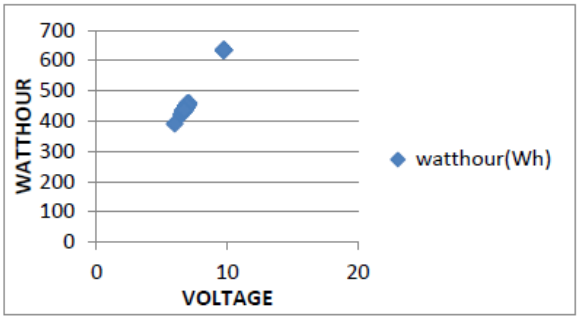


Fig. C.14 65Ah Discharging Wh-V Graph

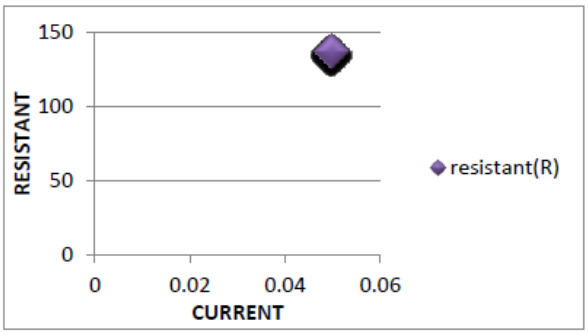


Fig. C.15 65Ah Discharging R-I Graph

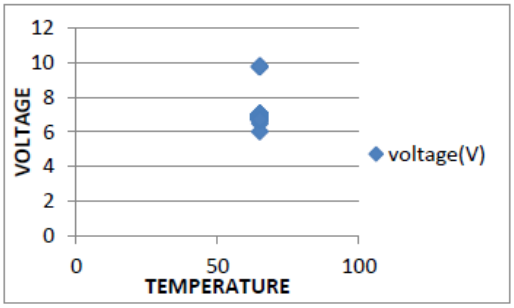


Fig. C.16 65Ah Discharging V-T Graph

APPENDIX D

WIRELESS POWER TRANSMISSION USING CAPACITOR BANK

An electromagnetic pulse is a burst of electromagnetic energy. It may occur in the form of a radiated, electric or magnetic pulse (EMP) depending on the source.

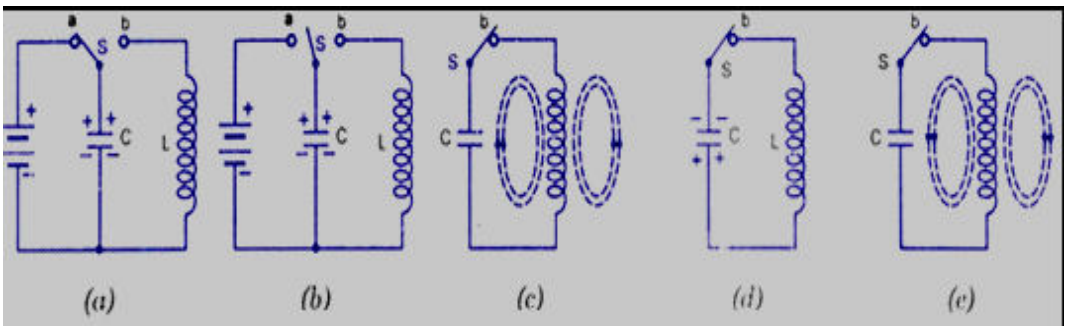


Fig. D. 1 Generation of magnetic pulse using L – C circuit

Here, to generate a electromagnetic pulse having enough power and range so that can induce enough amount of circulating current or induced voltage to transfer power wirelessly. It is to generate such pulse by charging a capacitor with high DC voltage and then discharging it into an air core inductor or a solenoid coil. This R-L-C circuit is designed so that it operates in under damped condition and hence can generate a high power steep impulse of a magnetic field. Figure given above shows the charging of capacitor through a DC source and discharging of the same in a L-C tank circuit. In the figure given below, two different units are discriminated from each other. One is the charging circuit and other is a Discharging circuit.

Charging circuit contains 230 Volts AC source, Step-up transformer, a full wave bridge rectifier and a capacitor connected through an ammeter and a switch. The charging circuit charges the capacitor at certain voltage in the time equals to its time constant. Energy stored in the charging circuit = ½ C V^2

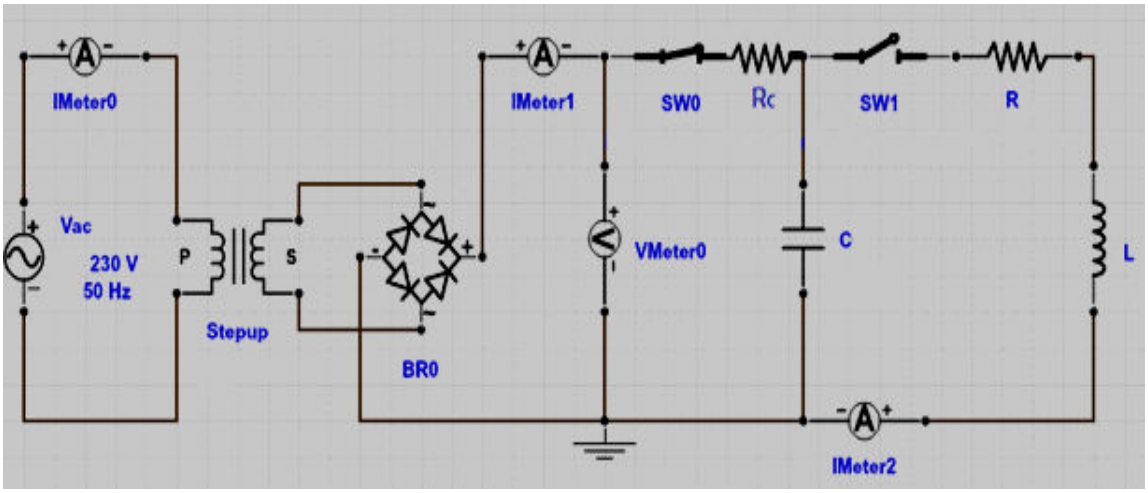


Fig. D. 2 Circuit Diagram for EMP pulse Generator

Discharging circuit contains an inductor or a solenoid coil connected in parallel with the capacitor through an ammeter and a discharging resistor and a switch. Energy in the discharging circuit = $I^2R + ½ L I^2$

So this stored energy gets dissipated in the inductor and it generates an impulse of Magnetic field is given by:

ηB = (Energy) / (Volume) = $½ B^2 / \mu$

An impulse is created by designing the circuit such a way that it works in an under damped condition and its characteristic by changing the Damping ratio. According to Faraday's law induced EMF in a loop is given by the equation:

$\varepsilon = - d\Phi_m / dt$

So by the steep impulse of magnetic field can induce enough amount of EMF to generate circulating current that could destroy or create a malfunctioning in electronic equipments. To obtain the results and simulate the circuit, an arrangement is made to check the induced voltage in a separate conducting loop at the certain distance from the Circuit inductor. X_1 and X_2 are the distances on axis, from the ends of the solenoid to the magnetic field measurement point, in meters.

A_R = Area of receiving loop.

A_L = Area of Inductor loop.

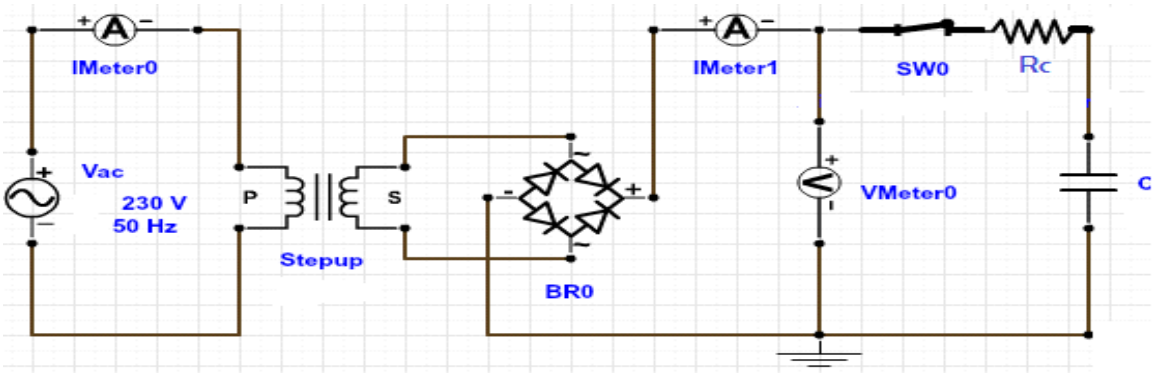


Fig. D. 3 Charging Circuit of Capacitor Bank

A series circuit containing only a resistor, a capacitor, a switch and a constant DC source of voltage V_0 is known as a charging circuit.[16] If the capacitor is initially uncharged while the switch is open, and the switch is closed at t_0, it follows from Kirchhoff's voltage law that:

$$V_o = v_{resistor}(t) + v_{capacitor}(t) = i(t)R + \frac{1}{c}\int_{t_o}^{t} i(\tau)d\tau$$

At t = 0, the voltage across the capacitor is zero and the voltage across the resistor is V_0. The initial current is then I(0) =V_0/R. With this assumption, solving the differential equation yields:

$$I(t) = \frac{V_0}{R}e^{-\frac{t}{\tau_0}}$$

$$V(t) = V_0\left(1 - e^{-\frac{t}{\tau_0}}\right)$$

Where τ_0 = RC is the time constant of the system. As the capacitor reaches equilibrium with the source voltage, the voltages across the resistor and the current through the entire circuit decays exponentially. The case of discharging a charged capacitor likewise demonstrates exponential decay, but with the initial capacitor voltage replacing V_0 and the final voltage being zero.

Induced voltage in receiving loop is given by:

$$E = \frac{d\Phi}{dt} = \frac{dB}{dt}$$

Now from Bio Savart's law magnetic flux density at the distance from an inductor on its axis is given by:

$$B = \mu_o H = \frac{\mu_o I N r^2}{2(r^2+x^2)^{\frac{3}{2}}}$$

Thus, $$\frac{dB}{dt} = \frac{\mu_o N r^2}{2(r^2+x^2)^{\frac{3}{2}}} \frac{dI}{dt}$$

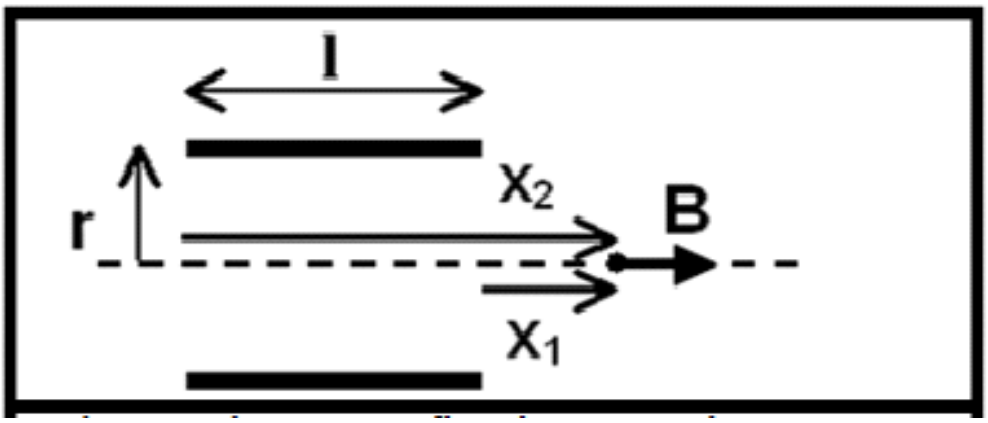


Fig. D. 4 Magnetic Flux Density at the point on the axis of the solenoid

So, it can be concluded that induced EMF in the receiving loop is given by,

$$E = A_R (dB/dt) = (dI/dt) \ X \ A_R = A_R \frac{\mu_o N r^2}{2(r^2+x^2)^{\frac{3}{2}}} \frac{dI}{dt}$$

Under damped RLC circuit Equations:

Homogeneous equations for the simple RLC circuit:

$$0 = s^2 + s\frac{R}{L} + \frac{1}{LC}$$

For Natural response, Initial Conditions but no driving voltage or current applied there after and hence general solution:

$$s = -\frac{R}{2L} \pm \left[\left(\frac{R}{2L}\right)^2 - \frac{1}{LC}\right]^{1/2}$$

For under damped the Descriminant < 0. i.e., $\left[\left(\frac{R}{2L}\right)^2 - \frac{1}{LC}\right]^{1/2} < 0$.

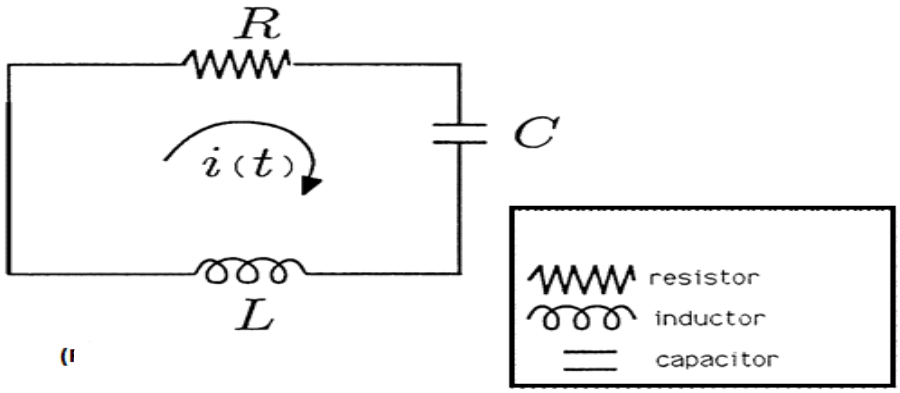


Fig. D. 5 RLC Series Circuit

The Damping Factor, α= R/2L.

Natural Angular Frequency of the Circuit = $w_n^2 = 1/LC$.

The Damped frequency is: $\omega^2 = \omega_n^2 - \alpha^2$

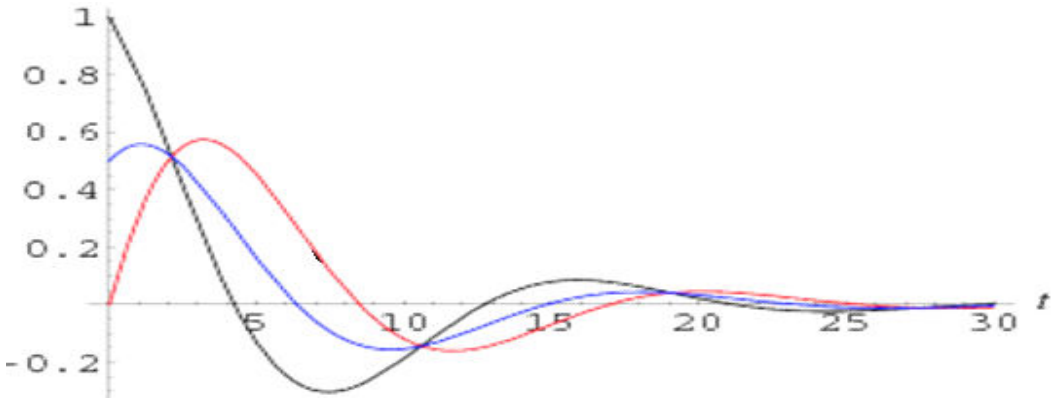


Fig. D. 6 Underdamped Simple Harmonic Motion

Table D. 1 Optimization of the Values R, L, C and frequency

R	L (mH)	C (μF)	α=R/2L	$\omega_n = 1/\sqrt{LC}$	ω (Hz)
1	1	76	500	3627.38	3592.75
1	0.2	76	2500	8111.07	7716.18
0.5	0.22	78.3	1136.364	7619.17	7533.95
1	0.001	3	500000	577350.26	288675.1
3	0.22	0.76	6818.182	7733.60	3649.79
3	0.22	0.0783	6818.182	7619.17	3400.61
3	0.22	0.0783	6818.182	7619.17	3400.61
1	0.22	0.0783	2272.727	7619.17	7272.31
0.5	0.22	0.304	1136.364	3866.80	3696.05
1.57	0.068	0.0721	11544.12	14281.63	8408.23
0.2	0.068	0.0721	1470.588	14281.63	14205.72
0.2	0.068	0.288	1470.588	7145.77	6992.81

Values of circuit parameters are obtained by simulating the circuit in MATLAB. By circuit simulation the optimum values of circuit are to be obtained and the circuit is put into the manufacturing procedure. Determining the optimum value for R-L-C components for maximum induced EMF. Table D.1 represents the data using which a suitable value of frequency to obtain higher rate of change of current (di/dt) corresponding to circuit component`s values are selected. To obtain maximum (di/dt), there are two ways either to increase pick value of current or to decrease time which is done by increasing frequency.

The optimum values found with our convenience are highlighted in the Table D.1 which are:
R=0.2 Ω, L= 0.068 mH, C=72.1μF.

Inductor design: Base cylinder with maximum allowable radius to minimize number of turns: The number of turns required to be wound for given inductance value decreases with increase in the loop radius further reducing the length of inductor and hence also reduces the total length of winding conductor. So here the selected PVC pipe cylinder is used as a base for winding to reduce the labor and cost of the inductor.

Choice of wire: the inductor is in the discharging circuit which has to withstand the impulse current of 150A to 200A pick value. So, decided to select a copper wire of 10 mm^2 size having the continuous current capacity of 50A.

Design parameters: To design an air cored inductor, have to determine its number of turns, it`s length and inductance.

A PVC cylinder of 15 cm radius has been taken as a base, so the total radius of the loop including thickness of cylinder and half the diameter of wire be r = (15 + 1 +0.25) = 16.25 cm.

While doing trial and error calculations, got a final value of 12 turns corresponding to l = 7.5 cm length of the winding.

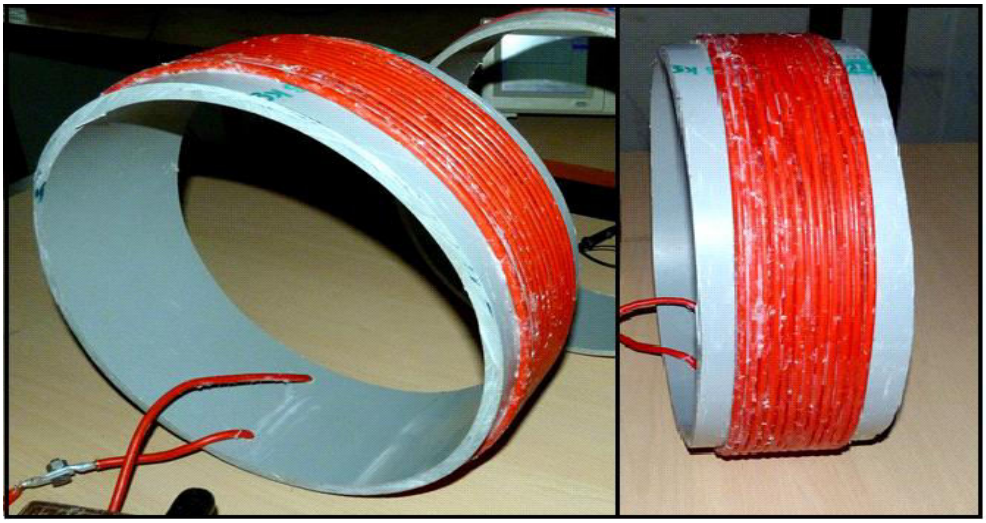


Fig. D. 7 Inductor 0.068 mH

Design of short air cored inductor:-

The conversion of radius and length in Inch is: r = 16.25 cm, l = 7.5 cm. So, the value of inductance be, L = 0.06765 mH. After designing the inductor when its value measure using L-C-R meter, it was found to be around 0.068 mH. So, our theoretical value was almost equal to the pragmatic value.

Capacitor design: As previously mentioned, the optimum value of the capacitor should be 72 µF for the project, suiting our availability of capacitors. Now, have procured eight capacitors each of 36 µf and to obtain the value need is to design a capacitor bank. So, to design a capacitor bank, 4 capacitors are connected in parallel manner. And by connecting two such groups in series can obtain the value of 72 µF.

Fig. D. 8 Capacitor Bank

Capacitance: Eight capacitors each having capacitance of C = 36 µf. Now, each group having 4 capacitances is connected in parallel. So, the resultant capacitance of the two groups is equal to four times the each capacitance. So, C1 = C2 = 144µF.

Now, these two groups are then connected in series combination. So, empirical value of the resultant capacitance be C = 72µF.

By measuring the value of obtained capacitor found it to be 72.1 µF.

Resistor design:-In order to minimize the damping factor and to obtain oscillations sustained for considerable time period require the lowest value for the resistor.

Measured value of internal resistance of the inductor came out to be 0.2 Ω, so further minimization of the series resistance was not possible. So, no external series resistance is connected. Charging resistor: In order to minimize the charging current, 20 KΩ-charging resistor is taken to control the charging current to 10 mA at maximum.

Receiving loop: Receiving loop is the coil of wire by which measure the value of induced EMF. The impulse oscillating current in the inductor also creates a changing flux in the proximity. The receiving loop cuts this changing flux and hence according to farad's law a voltage induce in the

loop.

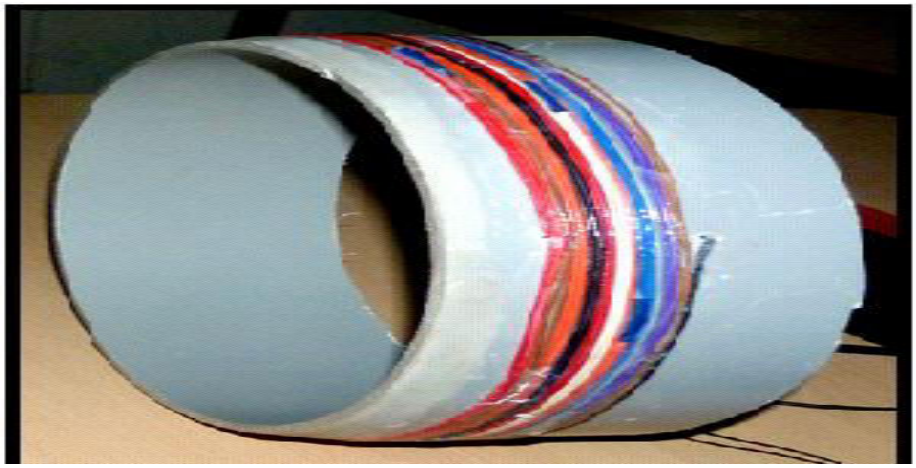


Fig. D. 9 Receiving Coil

This loop is made of 21 turns of thin wire, as there is no current passing in this wire so it is kept thin. After measuring the values of components: the calculations for the various factors like, damping factor (α), damping frequency (ω_0), damped frequency (ω), applied DC voltage (V_C), Maximum peak current (I_{Max}), waveform for current in inductor, and maximum value of dI/dt are calculated and tabulated as shown in Table D.2.

The values for R-L-C and applied DC voltage are taken as: R= 0.2 Ω, L=0.068 mH, C=72.1 μF, V_C= 200 Volts.

Table D. 2 Optimized Value for dI / dt

T (sec)	$e^{-\alpha t}$	Ωt	sin ωt	I(amp)	cos ωt	dI / dt
0.00E+00	1.0000	0.0000	0.0000	0.0000	1.0000	2941166
1.00E-06	0.9985	0.0142	0.0142	2.9367	0.9999	2932229
2.00E-06	0.9971	0.0284	0.0284	5.8643	0.9996	2922721
3.00E-06	0.9956	0.0426	0.0426	8.7820	0.9991	2912645
4.00E-06	0.9941	0.0568	0.0568	11.6894	0.9984	2902006
5.00E-06	0.9927	0.0710	0.0710	14.5858	0.9975	2890808
6.00E-06	0.9912	0.0852	0.0851	17.4708	0.9964	2879053
7.00E-06	0.9898	0.0994	0.0993	20.3438	0.9951	2866746
8.00E-06	0.9883	0.1136	0.1134	23.2041	0.9935	2853892
9.00E-06	0.9869	0.1279	0.1275	26.0514	0.9918	2840495
1.00E-05	0.9854	0.1421	0.1416	28.8849	0.9899	2826558
1.10E-05	0.9840	0.1563	0.1556	31.7043	0.9878	2812086
1.20E-05	0.9825	0.1705	0.1696	34.5089	0.9855	2797085
1.30E-05	0.9811	0.1847	0.1836	37.2983	0.9830	2781557
1.40E-05	0.9796	0.1989	0.1976	40.0719	0.9803	2765509
1.50E-05	0.9782	0.2131	0.2115	42.8291	0.9774	2748945

The graphs obtained from the data are in Fig. D.10 and D.11. It is concluded from the graphs that the maximum value of the current is 176.9 A which decreases to its 5% value in about 2 milliseconds. The maximum value for dI / dt is found to be 2941166.

The induced EMF in the receiving loop is directly proportional to the value of dI/dt, by putting the value of dI/dt in the equation of induced EMF the obtained data for values of induced EMF at different distances between the inductor and receiving loop is as tabulated below.

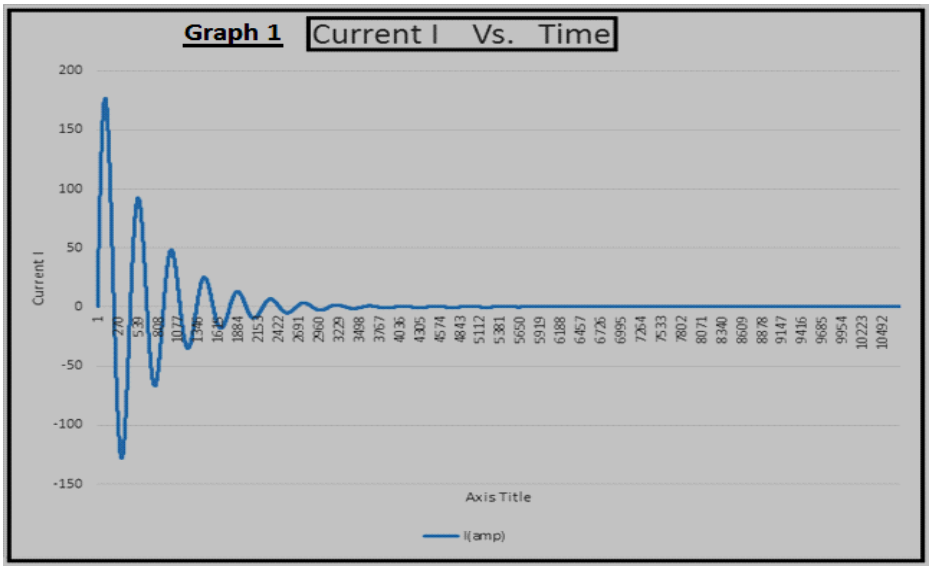


Fig. D. 10 Graph of Current Vs Time

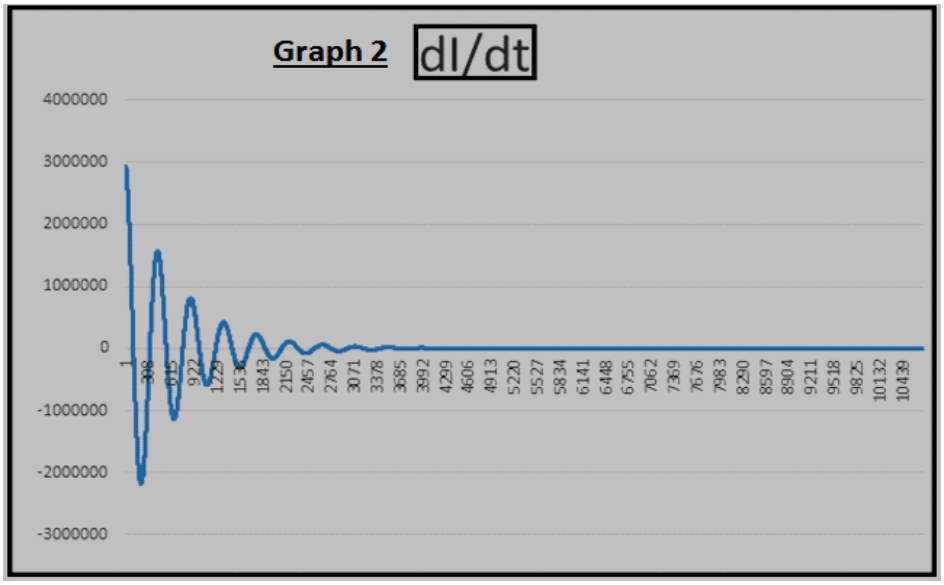


Fig. D. 11 Graph for the plot of dI / dt

HARDWARE:-

In below figure, the lab setup is shown of the EMP generator.

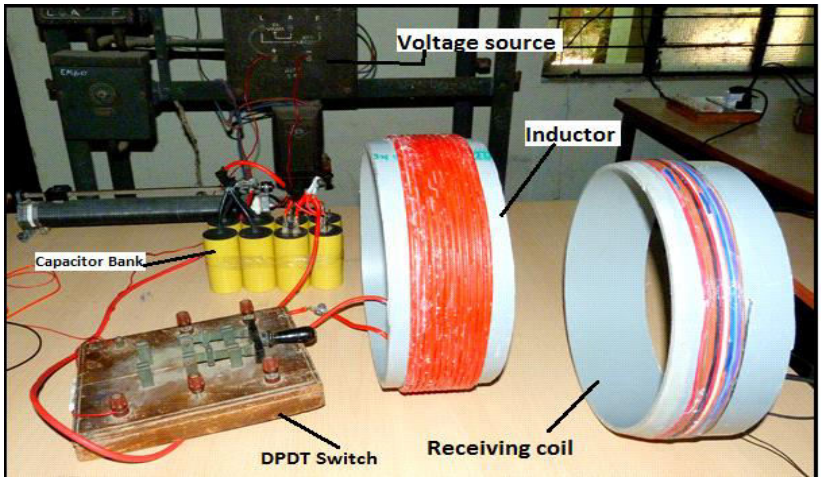


Fig. D. 12 Practical Lab Setup

The output, i.e the induced EMF in the receiving loop is measured by Digital Storage Oscilloscope (DSO) and waveforms for induced EMF are observed.

By running the practical at different applied DC voltage and at different distances of the receiving loop from the inductor observe that the value obtained in actual practical is very close to the theoretical value that obtained manual calculations and simulations.

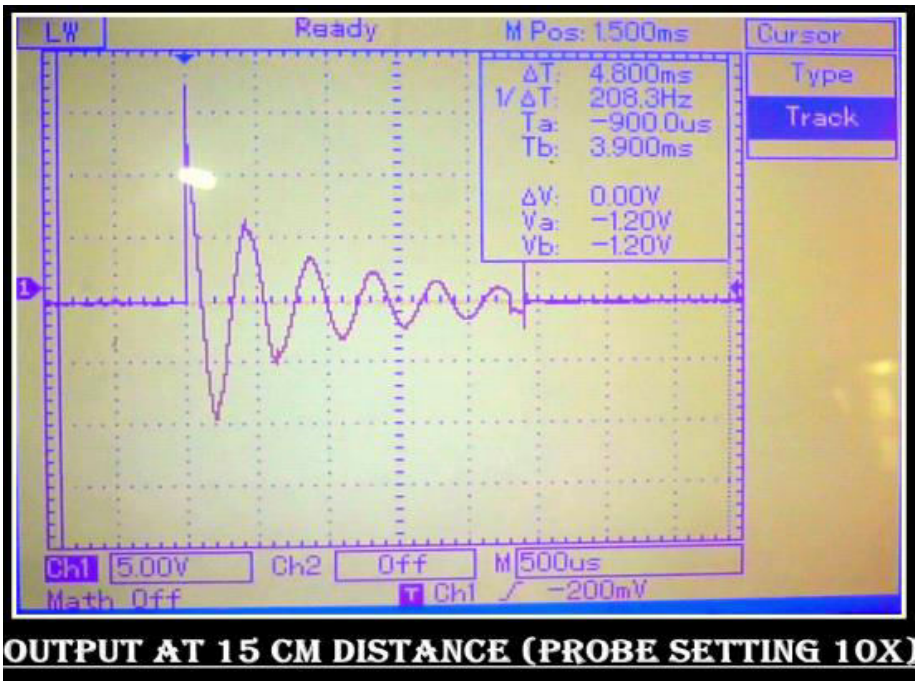


Fig. D. 13 DSO observation - 1

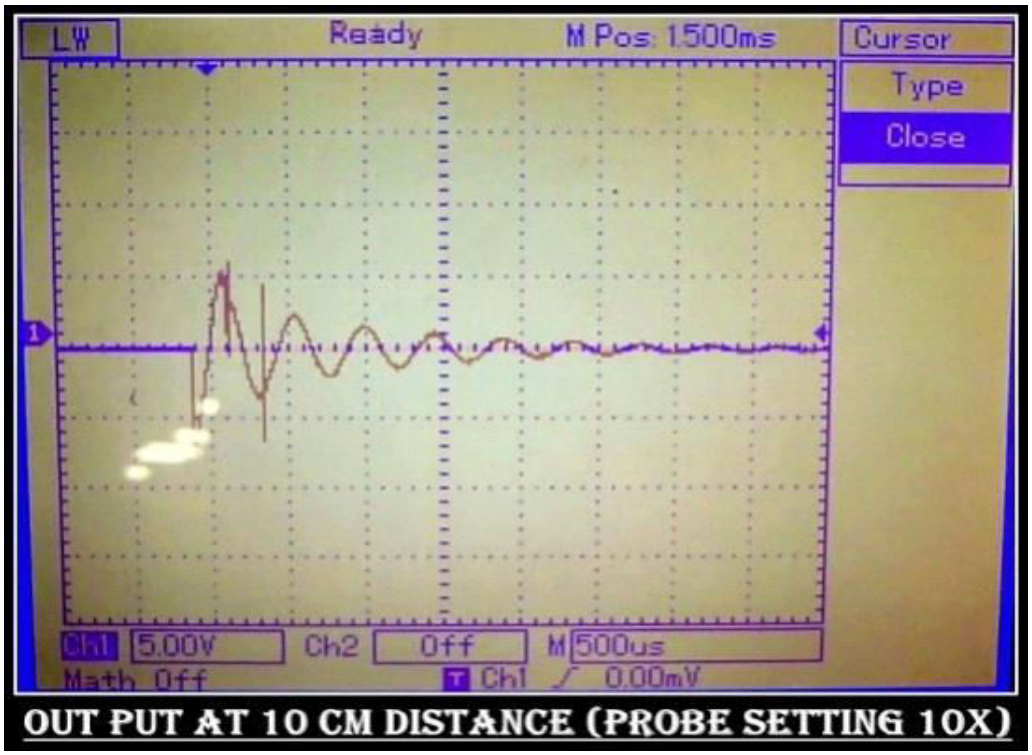


Fig. D. 14 DSO observation - 2

Here are the two observed induced voltage waveforms with 200 V DC applied voltage and at the distance of 15 and 10 cm between the center of inductor and the receiving loop. Closeness of the actual induced voltage waveform and the derived voltage waveform is observed by comparing them. Good amount of power is transferred using this EMP technique. The variation is observed based on the different angle between the two coils and it also depends on the shape of the coil.

APPENDIX E

HARDWARE TESTING RESULTS

Observations for two wheeler

ATMsp_DFS_HCKEISLA_23_DKVBN_KLM_003
12182015220927 TWO WHEELER
STSSL
MRDTSL09LDILS892214
4583432STFMSSL

D_ate	T_ime	dn..dt	di..dt	i	v	c..cc	b..ccd	ib	ic	Watt	Watt.sec	
		speed rate	current rate			status of c	status of b	battery cur	capacitor current			
12_11_2015	03:37:41	0	0	-2.5	42.6	chrg.on.	chrg.off.	0	0	-106.50	#DIV/0!	Error
12_11_2015	03:45:00	0	0	-2.7	42.6	chrg.on.	chrg.off.	0	0	-115.02	#DIV/0!	Error
12_11_2015	03:49:19	0	0	-2.6	42.6	chrg.on.	chrg.off.	0	0	-110.76	#DIV/0!	Error
12_11_2015	03:50:38	0	0	-2.6	42.6	chrg.on.	chrg.off.	0	0	-110.76	#DIV/0!	Error
12_11_2015	03:54:57	0	0	-2.8	42.6	chrg.on.	chrg.off.	0	0	-119.28	#DIV/0!	Error
12_11_2015	03:59:16	0	0	-2.5	42.6	chrg.off.	chrg.off.	0	0	-106.50	#DIV/0!	Error
12_11_2015	04:03:35	0	0	-2.3	42.6	chrg.off.	chrg.off.	0	0	-97.98	#DIV/0!	Error
12_11_2015	04:07:54	0	0	-2.8	42.6	chrg.off.	chrg.off.	0	0	-119.28	#DIV/0!	Error
12_11_2015	04:12:13	0	0	-2.4	42.6	chrg.off.	chrg.off.	0	0	-102.24	#DIV/0!	Error
12_11_2015	04:16:32	0	0	-2.6	42.6	chrg.on.	chrg.off.	0	0	-110.76	#DIV/0!	Error
12_11_2015	04:23:51	0	0	-2.2	42.6	chrg.on.	chrg.off.	0	0	-93.72	#DIV/0!	Error
12_11_2015	04:28:10	0	0	-2.1	42.6	chrg.on.	chrg.off.	0	0	-89.46	#DIV/0!	Error
12_11_2015	04:30:29	0	0	-2.2	42.6	chrg.on.	chrg.off.	0	0	-93.72	#DIV/0!	Error
12_11_2015	04:33:48	0	0	-2.2	42.6	chrg.off.	chrg.off.	0	0	-93.72	#DIV/0!	Error
12_11_2015	04:38:02	0	0	-2	42.6	chrg.off.	chrg.off.	0	0	-85.20	#DIV/0!	Error
12_11_2015	04:42:24	0	0	-2.2	42.6	chrg.off.	chrg.off.	0	0	-93.72	#DIV/0!	Error
12_11_2015	04:46:42	0	0	-2.8	42.6	chrg.off.	chrg.off.	0	0	-119.28	#DIV/0!	Error
12_15_2015	17:40:21	5.2	-3.11	-5.6	48.2	chrg.on.	chrg.off.	0	0	-269.92	-486.03	-486.03
12_15_2015	17:45:26	3.4	-2.2	-4.4	48.2	chrg.on.	chrg.off.	0	0	-212.08	-424.16	-424.16
12_15_2015	17:56:22	0.4	-0.24	-0.6	48.2	chrg.off.	chrg.off.	0	0	-28.92	-72.3	-72.3
12_15_2015	18:07:30	4.8	-1.81	-3.8	48.2	chrg.on.	chrg.off.	0	0	-183.16	-384.535	-384.535
12_15_2015	18:12:32	3.7	-2	-4.8	48.2	chrg.on.	chrg.off.	0	0	-231.36	-555.264	-555.264
12_15_2015	18:23:33	5.7	-1.8	-3.6	48.2	chrg.on.	chrg.off.	0	0	-173.52	-347.04	-347.04
12_15_2015	18:29:36	4.6	-2.4	-4.8	48.2	chrg.on.	chrg.off.	0	0	-231.36	-462.72	-462.72
12_15_2015	18:36:33	4.4	-3.11	-5.6	48.2	chrg.on.	chrg.off.	0	0	-269.92	-486.03	-486.03
12_15_2015	18:45:40	3.7	-1.9	-3.8	48.2	chrg.on.	chrg.off.	0	0	-183.16	-366.32	-366.32
12_15_2015	18:52:41	4.7	-1.84	-4.6	48.2	chrg.on.	chrg.off.	0	0	-221.72	-554.3	-554.3
12_15_2015	19:01:44	4.4	-1.81	-3.8	48.2	chrg.on.	chrg.off.	0	0	-183.16	-384.535	-384.535
12_15_2015	19:08:46	3.6	-1.58	-3.8	48.2	chrg.on.	chrg.off.	0	0	-183.16	-440.511	-440.511
12_15_2015	19:18:47	3.8	-1.7	-3.4	48.2	chrg.on.	chrg.off.	0	0	-163.88	-327.76	-327.76
12_15_2015	19:24:50	4.6	-2.1	-4.2	48.2	chrg.on.	chrg.off.	0	0	-202.44	-404.88	-404.88
12_15_2015	19:37:52	2	-2.11	-3.8	48.2	chrg.on.	chrg.off.	0	0	-183.16	-329.862	-329.862
12_15_2015	19:40:50	0.6	-1.9	-3.8	48.2	chrg.on.	chrg.off.	0	0	-183.16	-366.32	-366.32
12_15_2015	19:48:56	3.8	-1.44	-3.6	48.2	chrg.on.	chrg.off.	0	0	-173.52	-433.8	-433.8
12_15_2015	19:59:23	2.8	-2.29	-4.8	48.2	chrg.on.	chrg.off.	0	0	-231.36	-484.947	-484.947
12_15_2015	20:08:00	2	-1.5	-3.6	48.2	chrg.on.	chrg.off.	0	0	-173.52	-416.448	-416.448
12_18_2015	09:12:23	1.6	-0.29	-0.7	46.8	chrg.on.	chrg.off.	0	0	-32.76	-79.0759	-79.0759
12_18_2015	09:18:42	1.8	-0.4	-0.8	46.8	chrg.on.	chrg.off.	0	0	-37.44	-74.88	-74.88
12_18_2015	09:27:07	1.6	-0.6	-1.2	46.8	chrg.on.	chrg.off.	0	0	-56.16	-112.32	-112.32
12_18_2015	09:40:23	1.8	-0.78	-1.4	46.8	chrg.on.	chrg.off.	0	0	-65.52	-117.6	-117.6
12_18_2015	09:47:44	1.6	-0.6	-1.2	46.8	chrg.on.	chrg.off.	0	0	-56.16	-112.32	-112.32
12_18_2015	09:56:03	2	-0.32	-0.8	46.8	chrg.on.	chrg.off.	0	0	-37.44	-93.6	-93.6
12_18_2015	10:00:23	1.8	-0.38	-0.8	46.8	chrg.on.	chrg.off.	0	0	-37.44	-78.8211	-78.8211
12_18_2015	10:06:42	1.8	-0.29	-0.7	46.8	chrg.on.	chrg.off.	0	0	-32.76	-79.0759	-79.0759
12_18_2015	10:13:03	2	-0.4	-0.8	46.8	chrg.on.	chrg.off.	0	0	-37.44	-74.88	-74.88
12_18_2015	10:19:21	2	-0.3	-0.6	46.8	chrg.on.	chrg.off.	0	0	-28.08	-56.16	-56.16

Continue….

12_18_2015	10:25:45	2	-0.44	-0.8	46.8	chrg.on.	chrg.off.	0	0	-37.44	-68.0727	-68.0727
12_18_2015	10:32:03	2	-0.4	-0.8	46.8	chrg.on.	chrg.off.	0	0	-37.44	-74.88	-74.88
12_18_2015	10:38:24	2	-0.32	-0.8	46.8	chrg.on.	chrg.off.	0	0	-37.44	-93.6	-93.6
12_18_2015	10:44:42	2	-0.38	-0.8	46.8	chrg.on.	chrg.off.	0	0	-37.44	-78.8211	-78.8211
12_18_2015	10:51:03	2	-0.33	-0.8	46.8	chrg.on.	chrg.off.	0	0	-37.44	-90.7636	-90.7636
12_18_2015	10:57:21	0.8	-0.2	-0.4	46.8	chrg.off.	chrg.off.	0	0	-18.72	-37.44	-37.44
12_18_2015	11:03:42	1.8	-0.3	-0.6	46.8	chrg.on.	chrg.off.	0	0	-28.08	-56.16	-56.16
12_18_2015	11:10:03	1.6	-0.33	-0.6	46.8	chrg.on.	chrg.off.	0	0	-28.08	-51.0545	-51.0545
12_18_2015	13:40:05	4.8	-1.6	-3.2	46.8	chrg.on.	chrg.off.	0	0	-149.76	-299.52	-299.52
12_18_2015	13:45:27	5.2	-1.36	-3.4	46.8	chrg.on.	chrg.off.	0	0	-159.12	-397.8	-397.8
12_18_2015	13:50:49	0.4	-1.71	-3.6	46.8	chrg.on.	chrg.off.	0	0	-168.48	-354.695	-354.695
12_18_2015	13:56:11	5.2	-1.42	-3.4	46.8	chrg.on.	chrg.off.	0	0	-159.12	-380.992	-380.992
12_18_2015	14:01:32	5.2	-1.6	-3.2	46.8	chrg.on.	chrg.off.	0	0	-149.76	-299.52	-299.52
12_18_2015	14:06:55	5.4	-1.7	-3.4	46.8	chrg.on.	chrg.off.	0	0	-159.12	-318.24	-318.24
12_18_2015	14:12:16	5.2	-2	-3.6	46.8	chrg.on.	chrg.off.	0	0	-168.48	-303.264	-303.264
12_18_2015	14:17:39	5.4	-1.16	-3.6	46.8	chrg.on.	chrg.off.	0	0	-168.48	-522.869	-522.869
12_18_2015	14:23:01	0.3	0	0	46.8	chrg.off.	chrg.off.	0	0	0.00	0	Error
12_18_2015	14:28:22	5.2	-1.85	-4.8	46.8	chrg.on.	chrg.off.	0	0	-224.64	-582.85	-582.85
12_18_2015	14:33:45	4.8	-1.74	-4	46.8	chrg.on.	chrg.off.	0	0	-187.20	-430.345	-430.345
12_18_2015	14:39:08	4.8	-1.68	-4.2	46.8	chrg.on.	chrg.off.	0	0	-196.56	-491.4	-491.4
12_18_2015	14:44:29	4.8	-1.54	-4	46.8	chrg.on.	chrg.off.	0	0	-187.20	-486.234	-486.234
12_18_2015	14:49:50	5	-2	-4.4	46.8	chrg.on.	chrg.off.	0	0	-205.92	-453.024	-453.024
12_18_2015	14:55:13	0.8	-0.11	-0.2	46.8	chrg.off.	chrg.off.	0	0	-9.36	-17.0182	-17.0182
12_18_2015	15:00:36	5.8	-2.09	-4.6	46.8	chrg.on.	chrg.off.	0	0	-215.28	-473.822	-473.822
12_18_2015	15:05:58	5.8	-2.09	-4.6	46.8	chrg.on.	chrg.off.	0	0	-215.28	-473.822	-473.822
12_18_2015	15:11:19	5.8	-2	-4.6	46.8	chrg.on.	chrg.off.	0	0	-215.28	-495.144	-495.144
		4.43888889	-1.53611	-3.48889	46.8			0	0	-163.28	-376.698	-398.856

Observations for three wheeler

ATMsp_DFS_HCKEISLA_23_DKVBN_KLM_003
12252015131838 THREE WHEELER
STSSL
MRDTSL09LDILS892214
4583432STFMSSL

D_ate	T_ime	dn..dt	di..dt	i	v	c..cc	b..ccd	ib	ic	Watt	Watt-sec
		speed rate	current rate			status of ca	status of ba	battery currer	capacitor current		
12_23_2015	08:16:38	12.78	14.36	21.73	51.6	chrg. On	chrg. Off	18.56	-20.43	1121.27	1696.74
12_23_2015	08:28:41	10.83	12.31	21.20	51.6	chrg. On	chrg. Off	18.73	-19.92	1093.92	1883.92
12_23_2015	08:44:20	10.38	14.25	21.06	51.6	chrg. On	chrg. Off	18.68	-19.80	1086.70	1606.02
12_23_2015	08:52:00	9.44	14.50	22.16	51.6	chrg. On	chrg. Off	18.03	-20.45	1143.46	1747.52
12_23_2015	09:08:43	12.87	14.70	21.80	51.6	chrg. On	chrg. Off	18.31	-20.49	1124.88	1668.19
12_23_2015	09:10:03	12.50	12.04	22.20	51.6	chrg. On	chrg. Off	18.18	-20.87	1145.52	2112.17
12_23_2015	09:25:28	11.12	12.87	21.60	51.6	chrg. On	chrg. Off	18.77	-20.31	1114.56	1870.59
12_23_2015	09:39:46	1.07	0.82	2.00	51.6	chrg. Off	chrg. Off	18.31	-1.98	103.20	251.71
12_23_2015	09:50:27	7.25	16.27	21.89	51.6	chrg. On	chrg. Off	18.61	-21.76	1129.52	1519.69
12_23_2015	10:06:52	9.16	11.20	21.39	51.6	chrg. On	chrg. Off	18.40	-21.23	1103.72	2107.92
		9.74	12.33	19.70	51.60			18.46	-18.72	1016.67	1646.45

Observations for four wheeler

ATMsp_DFS_HCKEISLA_23_DKVBN_KLM_003
12222015112648 FOUR WHEELER
STSSL
MRDTSL09LDILS892214
4583432STFMSSL

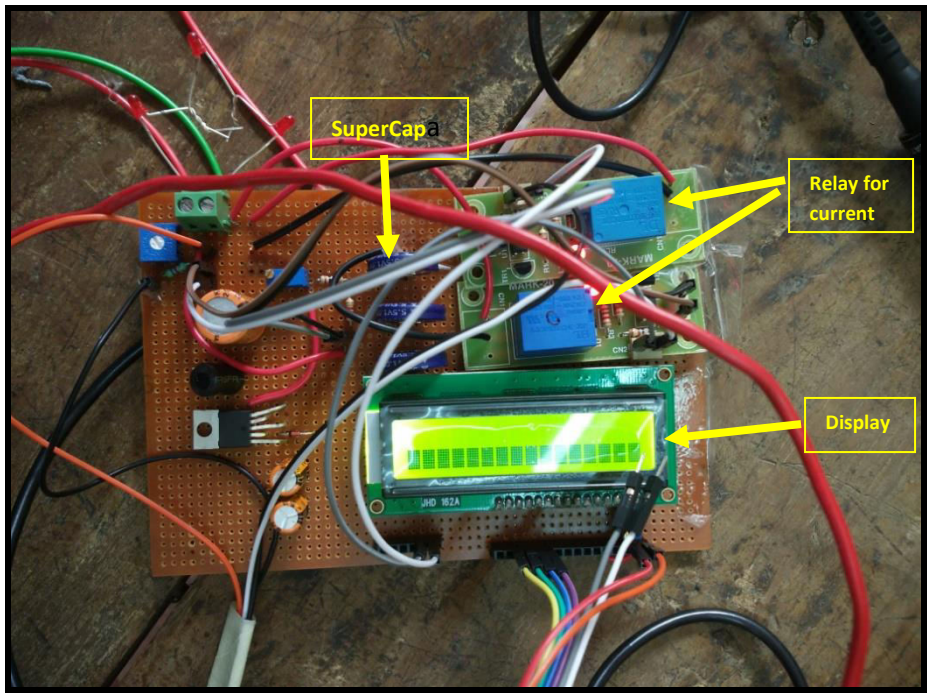
D_ate	T_ime	dn..dt speed rate	di..dt current rate	i	v	c..cc status of ca	b..ccd status of ba	ib battery cur	ic capacitor current	watt	watt.sec
12_20_2015	13:21:32	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	0.00	0.00	0.00	#DIV/0!
12_20_2015	13:32:52	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	0.00	0.00	0.00	#DIV/0!
12_20_2015	13:57:12	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	22.09	0.00	0.00	#DIV/0!
12_20_2015	14:15:32	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	24.30	0.00	0.00	#DIV/0!
12_20_2015	14:18:52	0.00	0.00	1.70	48.60	chrg.off.	chrg.off.	23.14	-1.70	82.62	#DIV/0!
12_20_2015	14:32:12	0.00	0.00	1.60	48.60	chrg.off.	chrg.off.	24.30	-1.60	77.76	#DIV/0!
12_20_2015	14:45:32	0.00	0.00	1.60	48.60	chrg.off.	chrg.off.	23.14	-1.60	77.76	#DIV/0!
12_20_2015	14:58:52	0.00	0.00	1.60	48.60	chrg.off.	chrg.off.	24.30	-1.60	77.76	#DIV/0!
12_20_2015	15:12:12	0.00	0.00	1.60	48.60	chrg.off.	chrg.off.	22.09	-1.60	77.76	#DIV/0!
12_20_2015	15:25:32	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	21.99	0.00	0.00	#DIV/0!
12_20_2015	15:38:52	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	21.13	0.00	0.00	#DIV/0!
12_20_2015	15:52:12	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	22.40	0.00	0.00	#DIV/0!
12_20_2015	16:05:32	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	23.14	0.00	0.00	#DIV/0!
12_20_2015	16:18:52	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	24.06	0.00	0.00	#DIV/0!
12_20_2015	16:32:12	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	22.71	0.00	0.00	#DIV/0!
12_20_2015	16:45:32	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	24.42	0.00	0.00	#DIV/0!
12_20_2015	16:58:52	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	20.33	0.00	0.00	#DIV/0!
12_20_2015	17:12:12	0.00	0.00	0.00	48.60	chrg.off.	chrg.off.	21.41	0.00	0.00	#DIV/0!
12_21_2015	12:24:20	6.20	12.10	20.40	46.73	chrg.on.	chrg.off.	26.32	-20.40	953.29	1607.20
12_21_2015	12:32:42	6.80	13.06	23.50	46.73	chrg.on.	chrg.off.	26.48	-23.50	1098.16	1976.68
12_21_2015	12:40:15	6.84	13.35	26.70	46.73	chrg.on.	chrg.off.	25.22	-26.70	1247.69	2495.38
12_21_2015	12:47:48	5.60	11.14	24.50	46.73	chrg.on.	chrg.off.	23.30	-24.50	1144.89	2518.75
12_21_2015	12:55:21	6.20	12.04	23.12	46.73	chrg.on.	chrg.off.	21.40	-23.12	1080.40	2074.36
12_21_2015	13:02:54	5.80	11.60	24.35	46.73	chrg.on.	chrg.off.	25.54	-24.35	1137.88	2389.54
12_21_2015	13:10:27	5.60	11.10	22.42	46.73	chrg.on.	chrg.off.	23.40	-22.42	1047.69	2116.33
12_21_2015	13:18:00	6.88	13.76	26.70	46.73	chrg.on.	chrg.off.	21.00	-26.70	1247.69	2420.52
12_21_2015	13:25:33	5.44	10.65	24.50	46.73	chrg.on.	chrg.off.	26.21	-24.50	1144.89	2633.24
12_21_2015	13:33:06	6.40	13.10	20.56	46.73	chrg.on.	chrg.off.	26.34	-20.56	960.77	1507.89
12_21_2015	13:40:39	5.32	10.39	18.70	46.73	chrg.on.	chrg.off.	24.56	-18.70	873.85	1572.93
12_21_2015	13:48:12	4.82	9.30	18.60	46.73	chrg.on.	chrg.off.	24.62	-18.60	869.18	1738.36
12_21_2015	13:55:45	4.63	7.86	17.30	46.73	chrg.on.	chrg.off.	24.86	-17.30	808.43	1778.54
12_21_2015	14:03:18	5.60	13.98	26.85	46.73	chrg.on.	chrg.off.	22.46	-26.85	1254.70	2409.02
12_21_2015	14:12:51	3.40	11.72	24.61	46.73	chrg.on.	chrg.off.	21.87	-24.61	1150.03	2415.05
12_21_2015	14:18:24	4.60	11.22	22.67	46.73	chrg.on.	chrg.off.	25.32	-22.67	1059.37	2139.93
12_21_2015	14:28:57	4.50	14.33	27.80	46.73	chrg.on.	chrg.off.	23.72	-27.80	1299.09	2520.24
12_21_2015	14:39:30	4.80	8.09	18.60	46.73	chrg.on.	chrg.off.	23.00	-18.60	869.18	1999.11
12_21_2015	14:41:03	6.40	14.10	17.80	46.73	chrg.on.	chrg.off.	21.58	-17.80	831.79	1050.07
12_21_2015	14:49:36	5.20	9.89	17.80	48.20	chrg.on.	chrg.off.	22.68	-17.80	857.96	1544.33
12_21_2015	14:57:09	4.98	9.30	18.60	48.20	chrg.on.	chrg.off.	26.16	-18.60	896.52	1793.04
12_21_2015	15:03:42	5.60	12.64	27.80	48.20	chrg.on.	chrg.off.	25.43	-27.80	1339.96	2947.91
12_21_2015	15:11:15	6.50	14.02	26.92	48.20	chrg.on.	chrg.off.	23.32	-26.92	1297.54	2491.28
12_21_2015	15:18:48	3.70	12.22	25.67	48.20	chrg.on.	chrg.off.	24.72	-25.67	1237.29	2598.32
12_21_2015	15:26:21	5.30	11.61	23.45	48.20	chrg.on.	chrg.off.	22.26	-23.45	1130.29	2283.19
12_21_2015	15:33:54	6.50	12.70	24.64	48.20	chrg.on.	chrg.off.	24.87	-24.64	1187.65	2304.04
12_21_2015	15:41:27	4.80	11.01	25.32	48.20	chrg.on.	chrg.off.	21.28	-25.32	1220.42	2806.98
12_21_2015	15:49:00	4.80	15.10	20.50	48.20	chrg.on.	chrg.off.	21.63	-20.50	988.10	1341.46
12_21_2015	15:59:33	4.60	11.51	20.71	48.20	chrg.on.	chrg.off.	22.62	-20.71	998.22	1796.80

Continue….

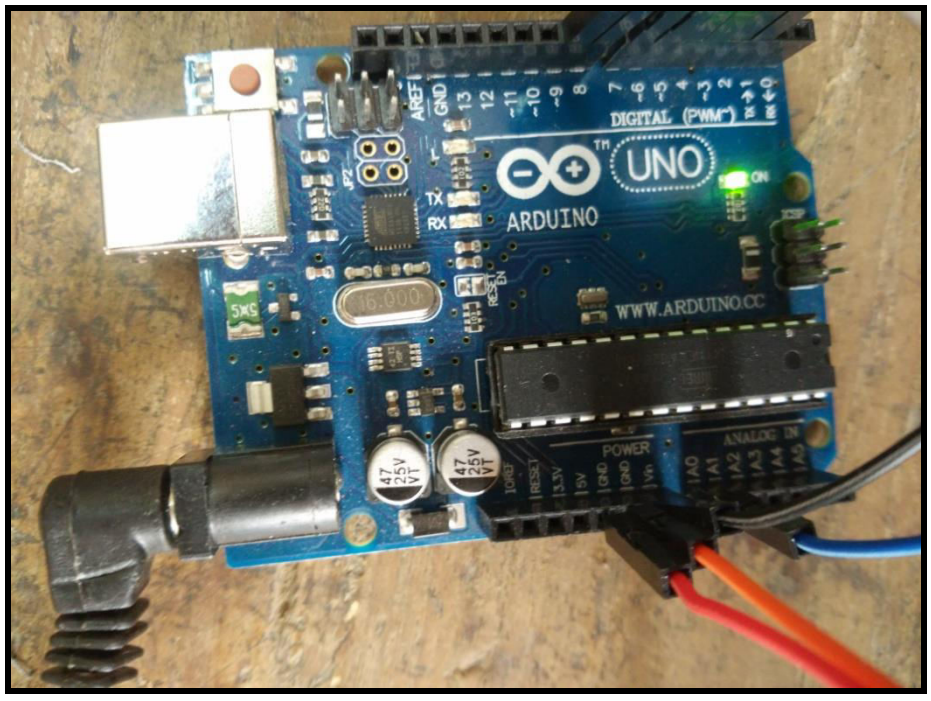
ATMsp_DFS_HCKEISLA_23_DKVBN_KLM_003
12262015233206
STSSL FOUR WHEELER
MRDTSL09LDILS892214
4583432STFMSSL

12_24_2015	07:51:36	6.20	17.40	20.88	51.3	chrg.on.	chrg.off	27.54	-20.88		1071.14	1285.37
12_24_2015	08:04:29	5.80	13.04	20.87	51.3	chrg.on.	chrg.off	25.47	-20.87		1070.63	1713.01
12_24_2015	08:17:22	4.70	11.02	20.93	51.3	chrg.on.	chrg.off	27.42	-20.93		1073.71	2040.05
12_24_2015	08:30:15	4.32	9.91	20.81	51.3	chrg.on.	chrg.off	25.63	-20.81		1067.55	2241.86
12_24_2015	08:43:08	5.70	12.76	20.41	51.3	chrg.on.	chrg.off	24.53	-20.41		1047.03	1675.25
12_24_2015	08:56:01	5.30	12.40	20.46	51.3	chrg.on.	chrg.off	22.82	-20.46		1049.60	1731.84
12_24_2015	09:08:54	5.90	13.30	20.62	51.3	chrg.on.	chrg.off	24.76	-20.62		1057.81	1639.60
12_24_2015	09:21:47	5.10	11.90	20.94	51.3	chrg.on.	chrg.off	25.38	-20.94		1074.22	1890.63
12_24_2015	09:34:40	4.80	11.43	20.80	50.8	chrg.on.	chrg.off	23.73	-20.80		1056.64	1923.08
12_24_2015	09:47:33	5.02	12.61	20.81	50.8	chrg.on.	chrg.off	24.61	-20.81		1057.15	1744.29
12_24_2015	10:00:26	4.21	10.16	20.53	50.8	chrg.on.	chrg.off	23.43	-20.53		1042.92	2106.71
12_24_2015	10:13:19	5.24	13.16	20.80	50.8	chrg.on.	chrg.off	26.18	-20.80		1056.64	1669.49
12_24_2015	10:26:12	6.15	14.34	20.80	50.8	chrg.on.	chrg.off	22.82	-20.80		1056.64	1532.13
12_24_2015	10:39:05	4.86	11.49	20.46	50.8	chrg.on.	chrg.off	24.72	-20.46		1039.37	1850.08
12_24_2015	10:51:58	4.22	10.20	20.90	50.6	chrg.on.	chrg.off	26.72	-20.90		1057.54	2167.96
12_24_2015	11:04:51	6.14	14.42	20.91	50.6	chrg.on.	chrg.off	23.37	-20.91		1058.05	1534.17
12_24_2015	11:17:44	5.84	12.48	20.72	50.6	chrg.on.	chrg.off	23.34	-20.72		1048.43	1740.40
12_24_2015	11:30:37	4.78	11.02	20.82	50.6	chrg.on.	chrg.off	22.68	-20.82		1053.49	1991.10
12_25_2015	14:51:36	6.20	17.82	21.38	50.4	chrg.on.	chrg.off	24.54	-21.38		1077.552	1293.062
12_25_2015	15:10:28	5.80	13.36	21.37	50.4	chrg.on.	chrg.off	25.47	-21.37		1077.048	1723.277
12_25_2015	15:15:34	4.70	10.59	20.12	50.4	chrg.on.	chrg.off	24.42	-20.12		1014.048	1926.691
12_25_2015	15:20:40	4.32	10.15	21.31	50.4	chrg.on.	chrg.off	25.63	-21.31		1074.024	2255.45
12_25_2015	15:27:46	5.70	12.39	19.82	50.4	chrg.on.	chrg.off	24.53	-19.82		998.928	1598.285
12_25_2015	15:31:52	5.30	12.02	19.83	50.4	chrg.on.	chrg.off	23.82	-19.83		999.432	1649.063
12_25_2015	15:45:58	5.90	13.30	20.62	50.4	chrg.on.	chrg.off	24.76	-20.62		1039.248	1610.834
12_25_2015	15:48:04	5.10	11.90	20.94	50.4	chrg.on.	chrg.off	25.38	-20.94		1055.376	1857.462
12_25_2015	15:52:10	4.80	10.64	19.36	50.4	chrg.on.	chrg.off	23.73	-19.36		975.744	1775.854
12_25_2015	16:11:16	5.02	11.73	19.36	50.4	chrg.on.	chrg.off	24.61	-19.36		975.744	1609.978
12_25_2015	16:26:22	4.21	10.07	20.35	50.4	chrg.on.	chrg.off	23.43	-20.35		1025.64	2071.793
12_25_2015	18:12:44	5.24	13.16	20.80	51.2	chrg.on.	chrg.off	22.18	-20.80		1064.96	1682.637
12_25_2015	18:27:37	6.15	14.68	21.28	51.2	chrg.on.	chrg.off	23.82	-21.28		1089.536	1579.827
12_25_2015	18:30:52	4.86	11.49	20.46	51.2	chrg.on.	chrg.off	24.72	-20.46		1047.552	1864.643
12_25_2015	18:36:18	4.22	10.48	21.48	51.2	chrg.on.	chrg.off	22.72	-21.48		1099.776	2254.541
12_25_2015	18:44:20	6.14	14.81	21.48	51.2	chrg.on.	chrg.off	23.37	-21.48		1099.776	1594.675
12_25_2015	18:52:36	5.84	11.91	19.77	51.2	chrg.on.	chrg.off	23.34	-19.77		1012.224	1680.292
12_25_2015	18:58:28	4.78	10.49	19.82	51.2	chrg.on.	chrg.off	23.68	-19.82		1014.784	1917.942
		5.24	12.33	20.64	50.84	#DIV/0!	#DIV/0!	24.43	-20.64	#DIV/0!	1049.44	1789.54

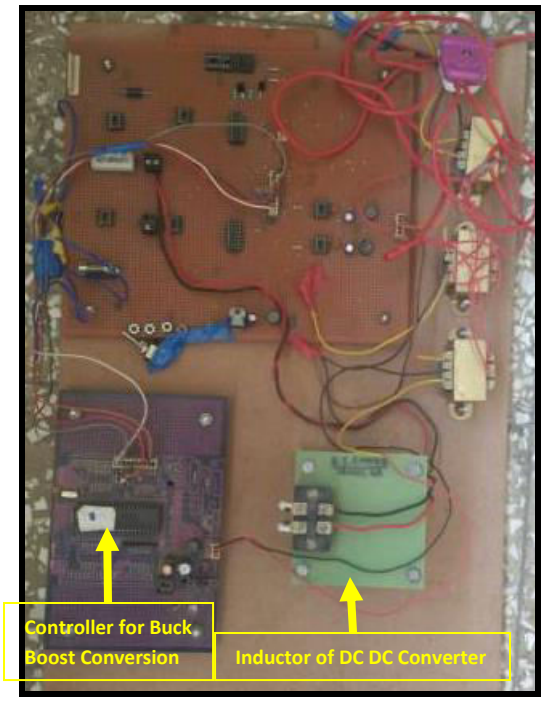
APPENDIX F
PHOTO GALLERY



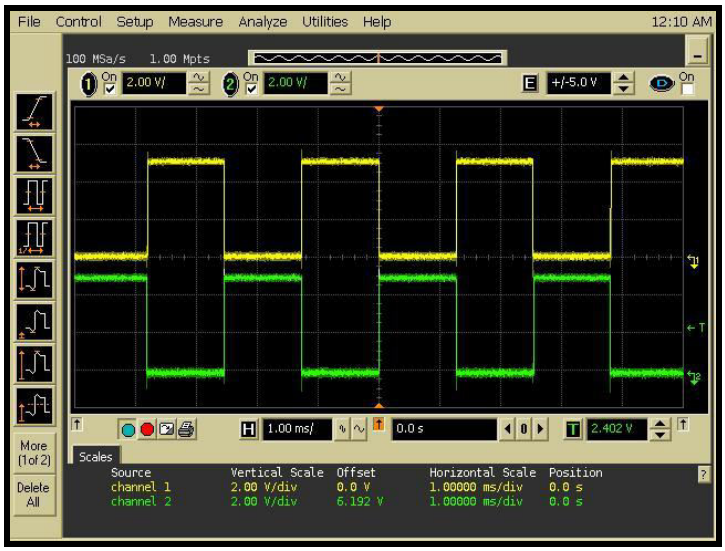
Photograph 1 Controller with Display



Photograph 2 Controller ARDUINO used for DST Programming



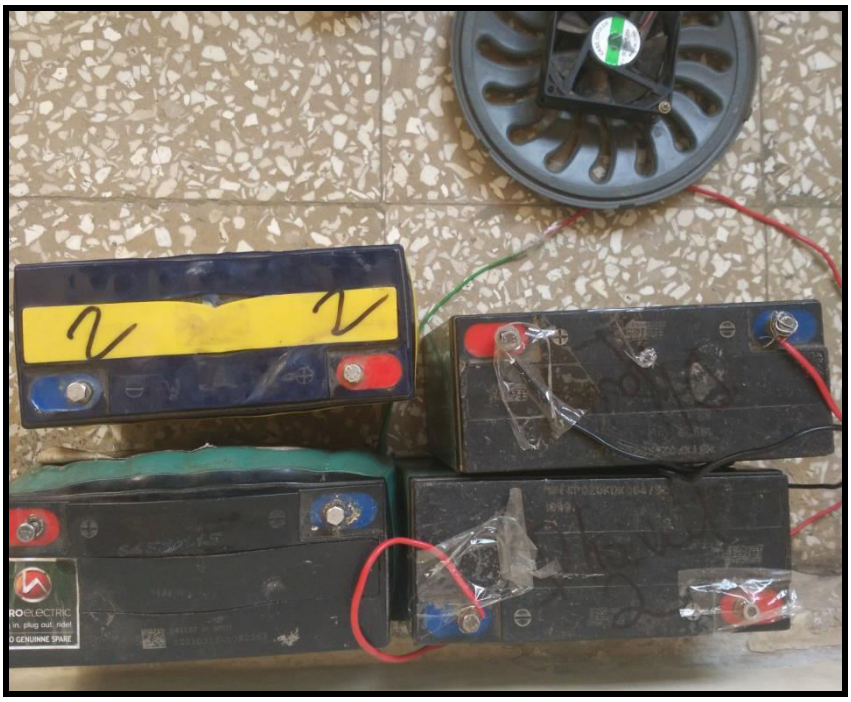
Photograph 3 Two wheeler – DC DC Converter with controller



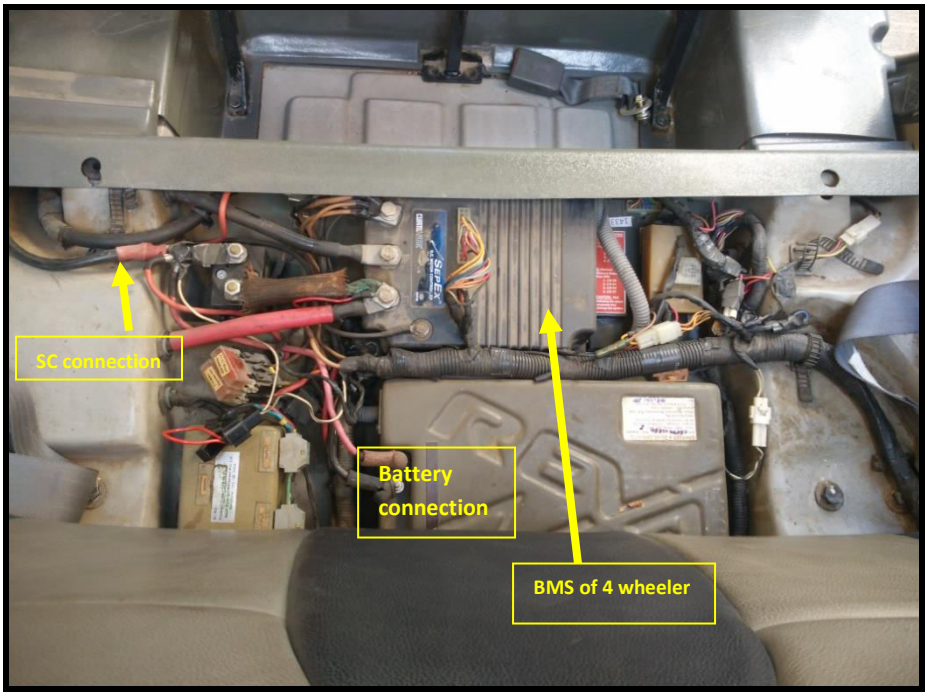
Photograph 4 Output of the controller

Photograph 5 Output of the optocoupler

Photograph 6 SC Bank Sheet with Resistor & SUPER Capacitor.



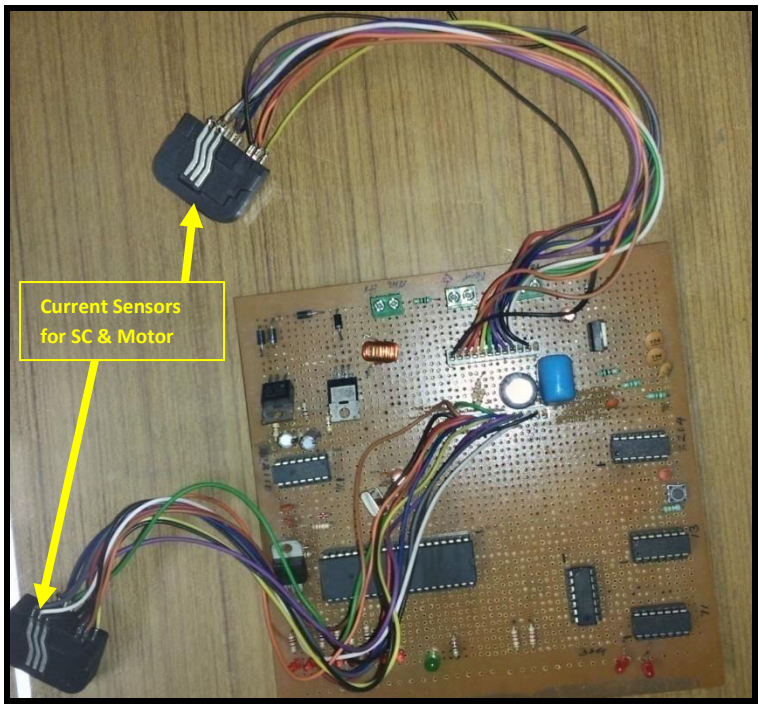
Photograph 7 Battery Bank of 48 V used for EV Testing.



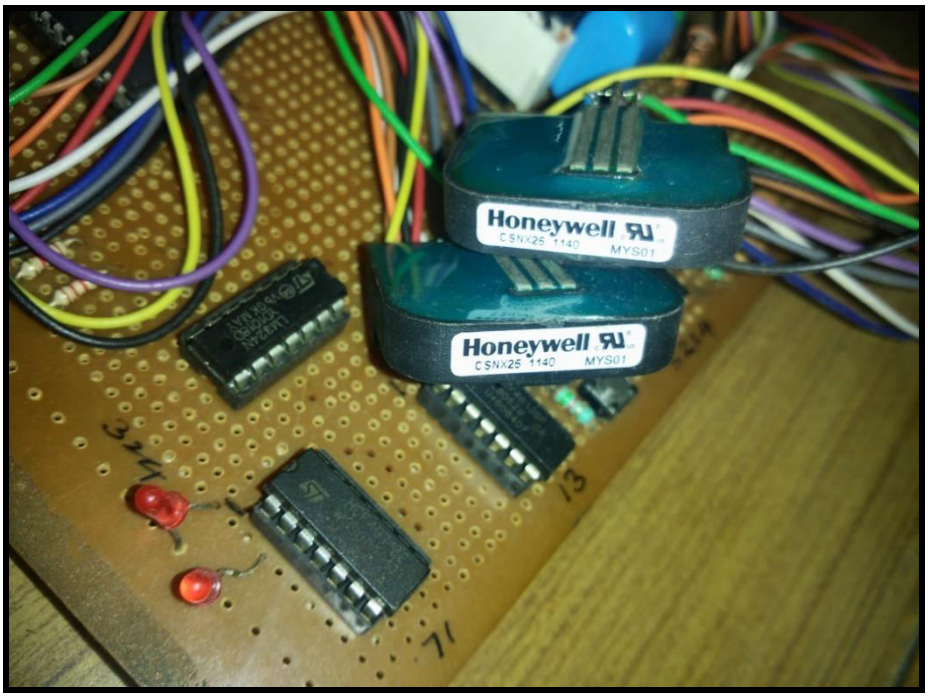
Photograph 8 Four wheeler inside controller with BMS

Photograph 9 Current protection Relay with switching style

Photograph 10 Fuse block for the protection of Devices



Photograph 11 Measurement PCB for dI/dt, dN/dt and Voltage Direction

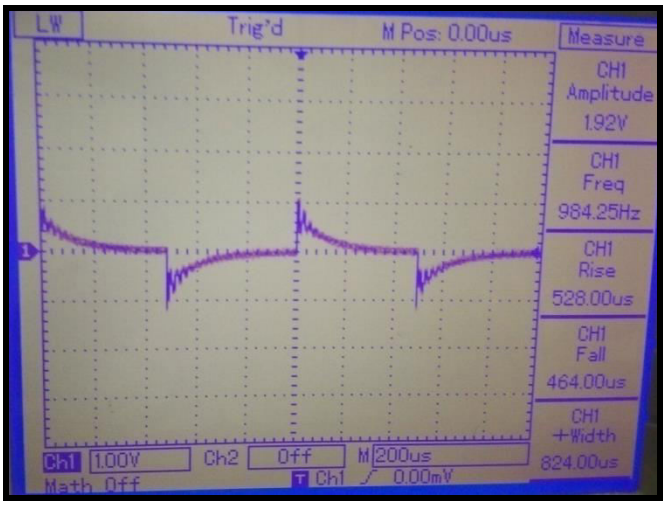


Photograph 12 Current sensors for measurement of ΔI

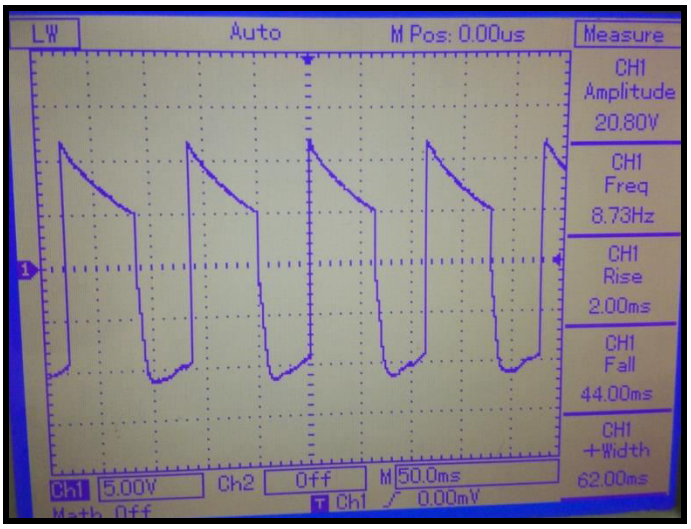
Photograph 13 Four Wheeler Used.

Photograph 14 Two wheeler Used.

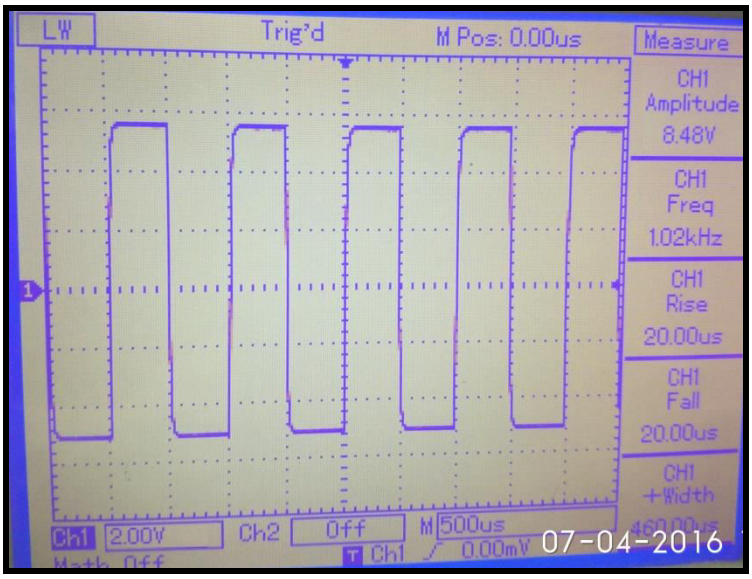
Photograph 15 Speed changer using Potention Meter



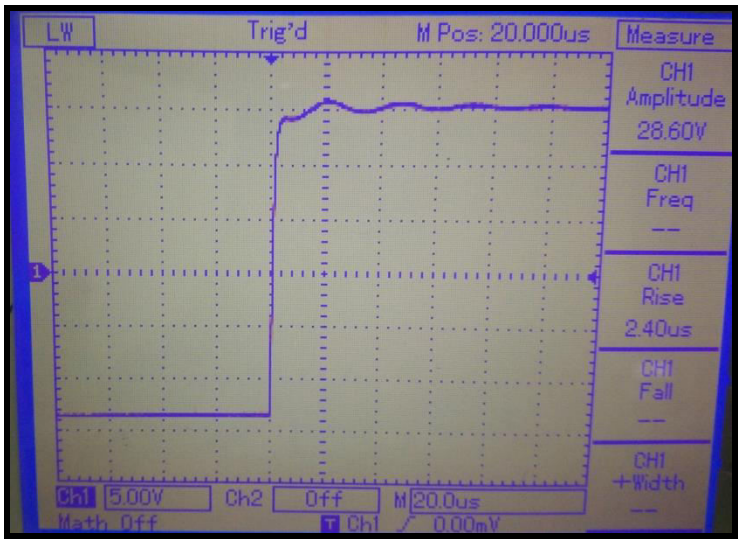
Photograph 16 Charging & Discharging of single R- Supercapacitor Combination



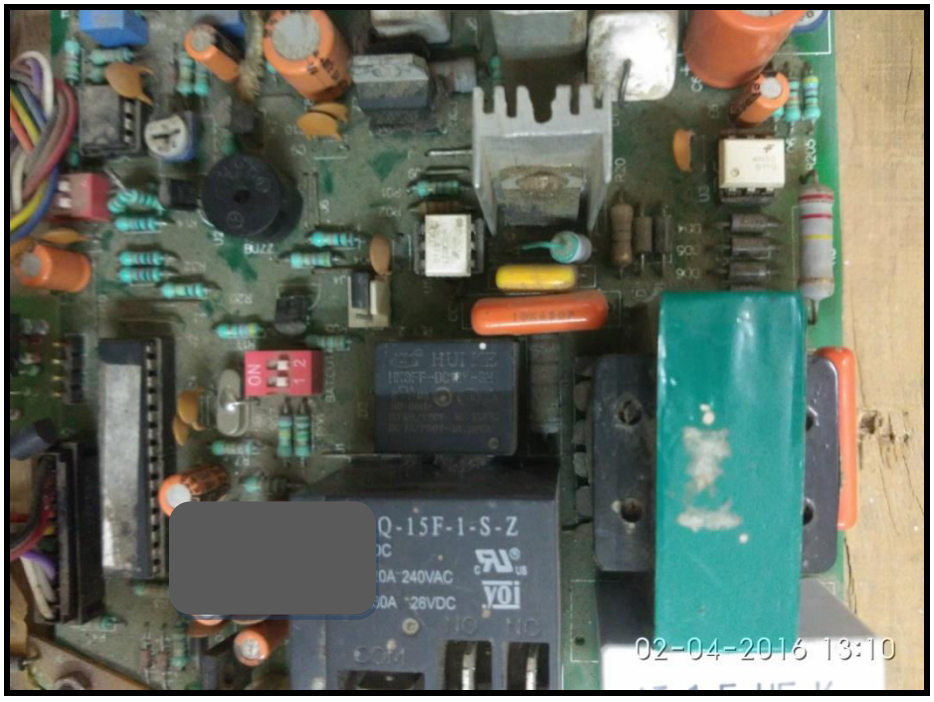
Photograph 17 Discharging of the R-C Bank Sheet parallel to Battery Bank



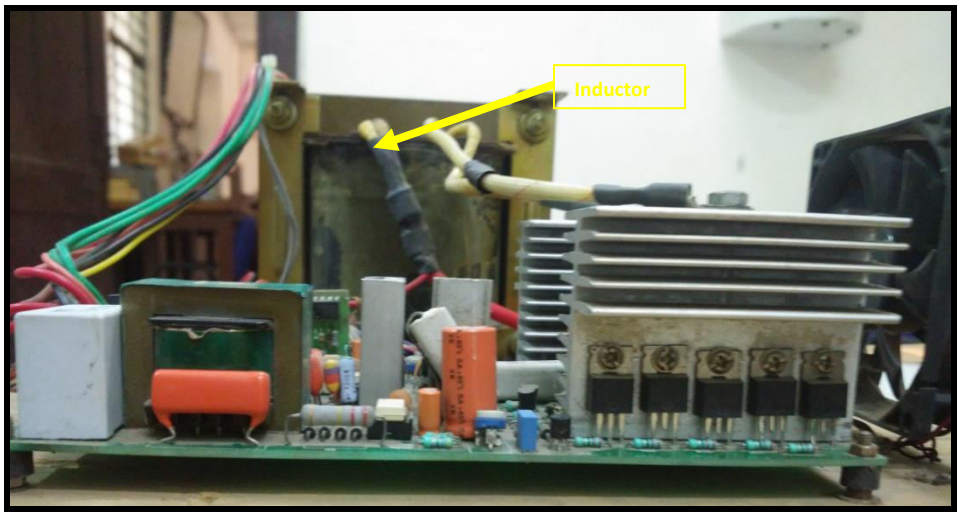
Photograph 18 Control pulses with 50% duty cycle for DC DC Conversion.



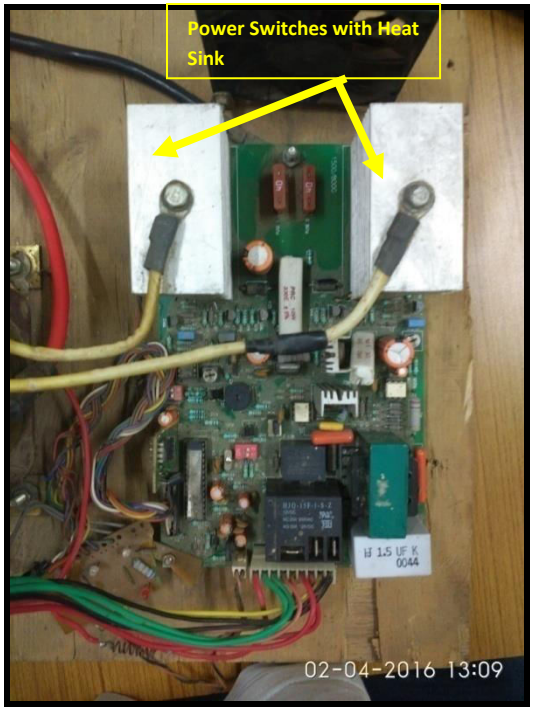
Photograph 19 Manual Breaking Sensing – Voltage Conversion.



Photograph 20 DC DC Converter for three wheeler and four wheeler

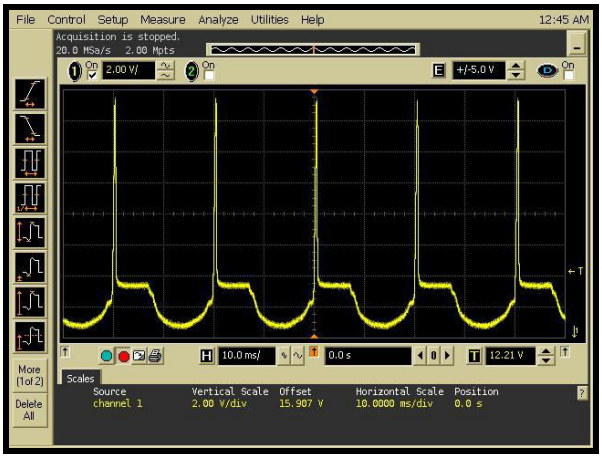


Photograph 21 DC DC Converter side view with power switches



Photograph 22 DC DC Converter top view with power switches

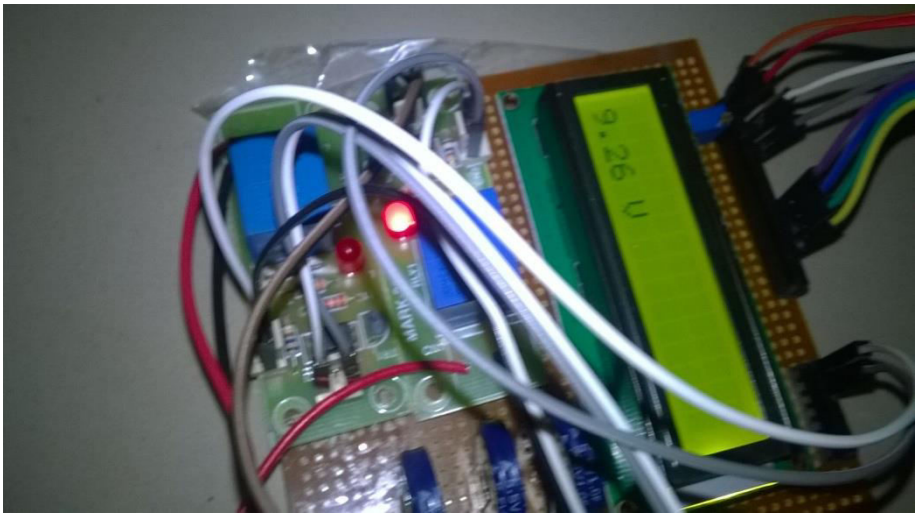
Photograph 23 The Inductor Designed.



Photograph 24 output across motor without SC in Acceleration Mode

Photograph 25 Manual Braking Operation

Photograh 26 Three wheeler used for testing



Photograph 27 Capacitor Charging Reading

1st and 2nd photographs show the controller with the relay for current control and supercapacitor single unit. ARDUINO is used to for DST programming; the data is required to be fetched time to time due to its limited memory. 3rd and 4th photographs shows the converter used in case of two wheeler and the respective control signal output on the DSO captured during testing. 5th and 6th photo give idea about the SC bank created and the output of the control signal from optocoupler. 7th and 8th photographs shows the battery bank of 48 Volt used for the four wheeler, three wheeler and two wheeler as well as the BMS and DC/DC converter for the four wheeler fitted in the REVA model of 2002. 9th and 10th photographs show the relay and fuses for the current protection in HSS side. 11th and 12th represents the current sensor for the battery and supercapacitor side. 13th and 14th show the pictures of the four wheeler and two wheeler used for testing purpose. 15th and 16th shows the speed controller modified as well as charging and discharging of the single SC-R unit. 17th is the waveform for the R-C Bank single sheet. 18th shows the control pulses at 50% duty cycle of the DC/DC Converter. 19th is the manual braking and its voltage converted signal on the DSO. 20th is the DC/DC Converter used for three and four wheeler. Photographs 21 to 23 are different views of the DC/DC Converter used for three wheeler and four wheeler vehicle testing. 24th photograph is of the output across the motor without SC in acceleration mode. 25th shows the manual braking of the two wheeler operation based on Suburban cycle. 26th is the three wheeler used for testing – BEUT made. 27th shows the capacitor charging of the two wheeler circuit during the braking of the photograph 24th operation.

APPENDIX G

PAPERS PUBLISHED / PRESENTED

International Conferences:

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