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Evaluation & Analysis of Inverter Systems on Various Batteries

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Abstract –**The main goal of the paper includes the implementation of two modes of operation: a battery discharge mode where current is being fed into the grid and a battery charging mode in which current is pulled from the grid and put into the batteries. In this paper we have different inverters used to charge and discharge the batteries , selecting the inverter, it important to calculate the total power consumption of the appliances that are going to be connected to the inverter. Choosing different inverters gives us the backup time of batteries, As we increase the ampere hour rating of batteries we get maximum backup with the inverters. when an inverter or other power load is drawing a high current from the battery, the voltage will drop. This may mean that the battery needs to be somewhere over 50% charged to avoid the inverter cutting out due to low voltage.**

Keywords *- Inverter, Battery, AC,DC, Charge, Discharge, DC current, DC voltage*.

I INTRODUCTION

Lead acid batteries are made up of cells. Each cell is approximately 2 volts, so a 12-volt battery has 6 individual cells. It turns out that a fully charged 2-volt cell has a voltage of approximately 2.15 volts. Oddly enough, a fully discharged 2-volt cell has a voltage of 1.9 volts. That's only a difference of 0.25 volts on each cell from fully charged to fully discharged. So a 12-volt battery will measure at about 12.9 volts when it's fully charged and about 11.4 volts when it is fully discharged. That's a total of 1.5 volts that represents the full range of charge on a 12-volt battery device that converts electricity from DC form to AC form using electronic circuits is known in power industry as inverter. Note that the same term is used in digital electronics for a circuit that switches the logic level of a signal. To avoid confusion, we will be referring to the device we are talking about as power inverter. It's typical application is to convert a 12V battery voltage into conventional residential voltage..

Larger inverters will generally have a facility that could be named a "Sleep Mode" to increase overall efficiency. This involves a sensor within the inverter sensing if AC power is required. If not, it will effectively switch the inverter off, continuing to sense if power is required. This can usually be adjusted to ensure that simply switching a small light on is sufficient to "turn the inverter on. DC-AC inverters are electronic devices used to produce mains voltage. AC power from low voltage DC energy (from a battery or solar panel).

Backup calculations

Number of batteries = N

Voltage of each battery = V = 12 V

Ampere-hour of each battery (AH) = X

Number of Operational hours = T

Volt-Ampere = (N * V * X)/ T

A lead acid battery can supply 100% of its rated current for 30min before the voltage drop to 10.5v and become unusable if you are looking for an hour of backup , limit your load to 60% of the battery rated capacity , 35% for 2 hours, 25% for 3 hours.

Open Circuit battery state of charge calculation:

% Charge = SOC

% Charge = ((Measured Battery Voltage – 11.4 volts) / 1.5 volts) x 100

Battery should remain at rest for at least 24 hours to get an accurate measurement

(Battery Capacity) / (Charger Current) = Hours

(Amp-Hours) / (Amps) = Hours

Equation:

Suppose I have a 50 Amp-Hour battery. That's a fairly typical size for an automotive engine start type battery. Now let's say I have a 10 Amp charger. (50 Amp-Hours) divided by (10 Amps) = 5 Hours. So we would estimate that it will take a good 10 Amp charger about 5 Hours to recharge a 50 Amp-Hour battery. Actually this rough estimate usually tells us how long it takes to recharge the battery to about 80% of its capacity. To complete the recharge of a battery to 100% it takes 3 step charger.

Step 1: Battery Charging

If a voltage is applied to the battery which is greater than the battery's voltage, a current will flow through the battery in the reverse direction to when it is supplying current, and the battery will charge.

The rate of charge or current that will flow will depend on the difference between the battery voltage and the voltage that is applied to it. Fully Charge the battery and then put a load and discharge it we get maximum back up in dry batteries as compared to wet batteries. Charging is done step by step and we get full battery voltage at minimum current value.

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Step 2: Battery Discharging

A full charged battery will have a voltage of around 14 volts. As current is drawn off and the level of charge is reduced, the voltage will fall quite quickly at first (again it would be necessary to stop drawing current for a couple of hours to be able to measure the true voltage of the battery). With further drawing of current, the rate of voltage drop slows down**.**The second step is to determine the characteristics of your load, Different loads give different backup. .

II PERFORMANCE ANALYSIS

100VA INVERTER

TRANSPARENT DISCHARGING			
FULLY CHARGED BATTERY VOLTAGE=13.33			
SR NO	TIME	VOLTAGE	CURRENT
1	0	12.21	1.49
2	5	12.11	1.48
3	10	12.05	1.46
4	15	11.96	1.45
5	20	11.86	1.43
6	25	11.68	1.41
7	30	11.48	1.39

CUT OFF VOLTAGE = 12.05
CUT OFF CURRENT = 0.11

TRANSPARENT CHARGING			
SR NO	TIME	VOLTAGE	CURRENT
1	0	12.63	1.06
2	5	12.79	0.85
3	10	12.86	0.78
4	15	12.97	0.79
5	20	13.01	0.66
6	25	13.04	0.63
7	30	13.07	0.6
8	35	13.11	0.56
9	40	13.2	0.48
10	45	13.3	0.47
11	50	13.34	0.42
12	55	13.37	0.32

TUFF BULL DISCHARGING			
FULLY CHARGED BATTERY VOLTAGE=13.05			
SR NO	TIME	VOLTAGE	CURRENT
1	0	12.25	1.6
2	5	12.19	1.58
3	10	12.12	1.56
4	15	12.05	1.55
5	20	11.99	1.54
6	25	11.95	1.53
7	30	11.89	1.51
8	35	11.85	1.5
9	40	11.79	1.49
10	45	11.74	1.49
11	50	11.66	1.49
12	55	11.6	1.48
13	60	11.54	1.47
14	65	11.47	1.46
15	70	11.39	1.45
16	75	11.31	1.44
17	80	11.22	1.41
18	85	11.11	1.41
19	90	10.94	1.38
20	95	10.69	1.36
21	100	9.96	1.29
22	105	9.73	1.26
23	110	9.36	1.24
24	115	9.26	1.22
25	120	8.99	1.2

CUT OFF VOLTAGE=10.55
CUT OFF CURRENT=0.09

TB.CHARGING			
SR NO	TIME	VOLTAGE	CURRENT
1	0	11.88	2.41
2	5	12.07	2.08
3	10	12.18	2.06
4	15	12.23	1.97
5	20	12.34	1.89
6	25	12.36	1.77
7	30	12.39	1.74
8	35	12.4	1.72
9	40	12.42	1.64
10	45	12.48	1.6
11	50	12.49	1.52
12	55	12.54	1.46
13	60	12.58	1.38
14	65	12.64	1.28
15	70	12.69	1.24
16	75	12.74	1.16
17	80	12.8	1.08
18	85	12.88	1
19	90	12.9	0.93
20	95	12.94	0.87
21	100	12.98	0.81
22	105	13.01	0.72
23	110	13.06	0.69
24	115	13.13	0.6

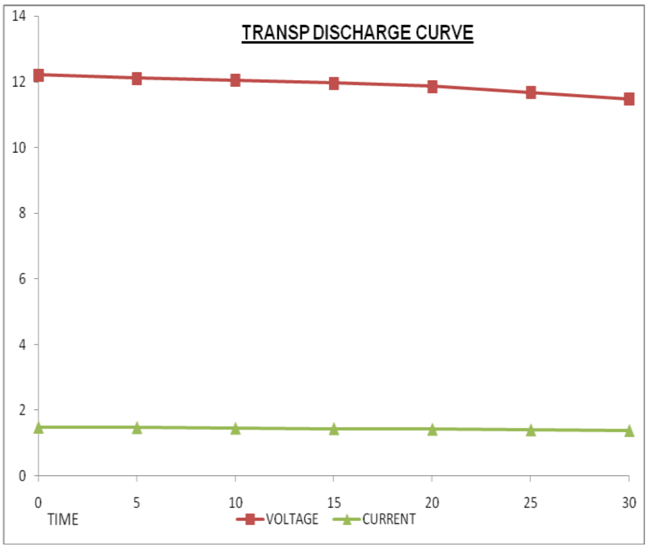

Figure 1:Transp Discharge Curve

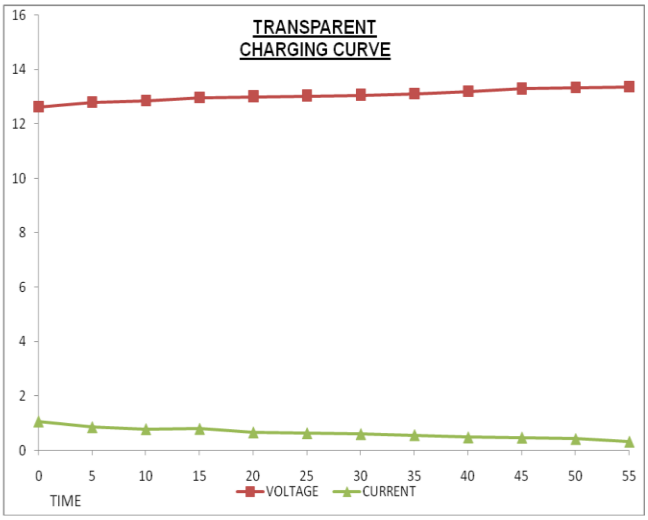

Figure 2:Transparent Charging Curve

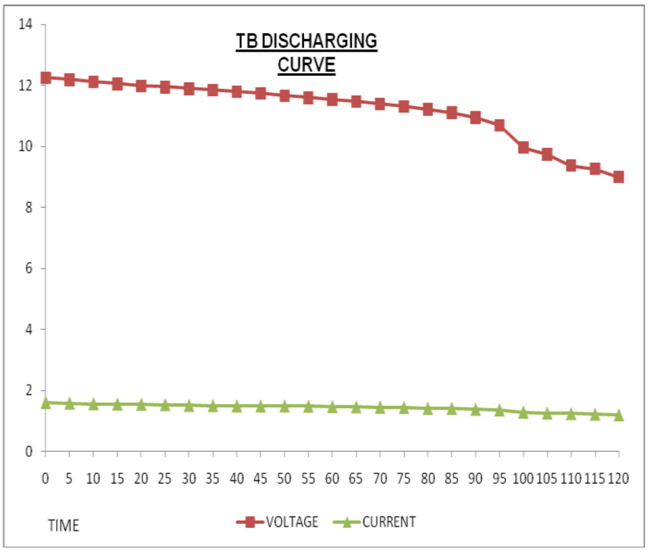

Figure 3:TB Discharging Curve

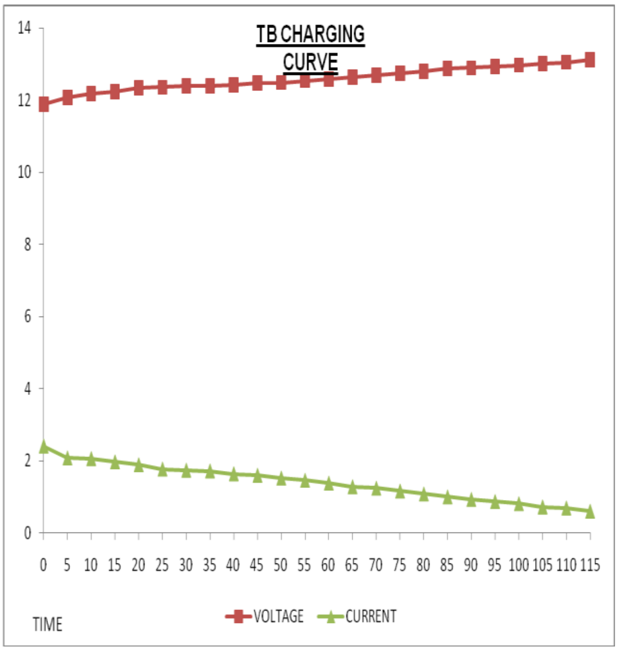

Figure 4 : TB charging Curve

AMARON DISCHARGING 40 VA

SR.NO	TIME (T)	VOLTAGE (V)	CURRENT
1	10.00	13.92	0
2	10.05	12.88	2.24
3	10.10	12.80	2.19
4	10.15	12.74	2.15
5	10.20	12.52	2.15
6	10.25	12.48	2.14
7	10.30	12.41	2.13
8	10.35	12.32	2.11
9	10.40	12.25	2.10
10	10.45	12.20	2.09
11	10.50	12.12	2.07
12	10.55	11.96	2.04
13	11.00	11.85	2.02
14	11.05	11.83	2.01
15	11.10	11.69	1.98
16	11.15	11.58	1.96
17	11.20	10.62	1.77
18	11.25	9.80	1.63
19	11.30	9.10	1.50
20	11.35	8.00	1.32

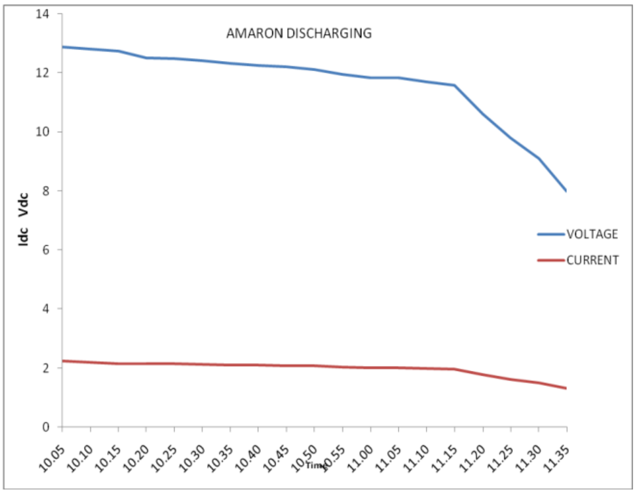

Figure 5: AMARON Discharging

AMARON CHARGING
40 VA inverter load-10 watt bulb
12V/5AH Battery

Sr.No	Time (T)	Voltage (V)	Current(I)
1	11.45	10.50	0.21
2	11.50	11.35	0.18
3	11.55	11.78	0.17
4	12.00	12.04	0.16
5	12.05	12.05	0.16
6	12.10	12.08	0.14
7	12.15	12.10	0.15
8	12.20	12.12	0.15
9	12.25	12.15	0.14
10	12.30	12.18	0.14
11	12.35	12.21	0.14
12	12.40	12.24	0.14
13	12.45	12.30	0.14
14	12.50	12.32	0.13
15	12.55	12.32	0.13
16	1.00	12.35	0.13
17	1.05	12.37	0.13
18	1.10	12.39	0.13
19	1.15	12.40	0.13
20	1.20	12.42	0.13
21	1.25	12.44	0.13
22	1.30	12.45	0.13
23	1.35	12.46	0.13
24	1.40	12.47	0.13
25	1.45	12.48	0.13
26	1.50	12.49	0.13
27	1.55	12.50	0.13
28	2.00	12.51	0.13
29	2.05	12.52	0.13
30	2.10	12.53	0.13
31	2.15	12.53	0.14
32	2.20	12.53	0.13
33	2.25	12.55	0.13
34	2.30	12.55	0.13
35	2.35	12.56	0.13
36	2.40	12.57	0.13
37	2.45	12.58	0.13
38	2.50	12.59	0.13
39	2.55	12.60	0.13
40	3.00	12.60	0.13
41	3.05	12.61	0.13
42	3.10	12.62	0.13
43	3.15	12.63	0.13
44	3.20	12.63	0.13
45	3.25	12.63	0.13
46	3.30	12.64	0.13
47	3.35	12.64	0.13
48	3.40	12.64	0.13
49	3.45	12.65	0.13
50	3.50	12.66	0.13
51	3.55	12.66	0.13
52	4.00	12.66	0.13
53	4.05	12.67	0.13
54	4.10	12.68	0.13
55	4.15	12.69	0.13
56	4.20	12.70	0.13
57	4.25	12.71	0.13
58	4.30	12.72	0.13
59	4.35	12.72	0.13
60	4.40	12.72	0.13
61	4.45	12.73	0.13
62	4.50	12.73	0.13
63	4.55	12.73	0.13
64	5.00	12.73	0.13
65	5.05	12.74	0.13
66	5.10	12.74	0.13
67	5.15	12.74	0.13
68	5.20	12.75	0.13
69	5.25	12.75	0.13
70	5.30	12.75	0.13
71	5.35	12.76	0.13
72	5.40	12.77	0.13
73	5.45	12.77	0.13

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74	5.50	12.78	0.13
75	5.55	12.79	0.13
76	6.00	12.80	0.13
77	6.05	12.82	0.13
78	6.10	12.82	0.13
79	6.15	12.83	0.13
80	6.20	12.83	0.13
81	6.25	12.83	0.13
82	6.30	12.84	0.13
83	6.35	12.84	0.13
84	6.40	12.84	0.13
85	6.45	12.84	0.13
86	6.50	12.85	0.13
87	6.55	12.85	0.13
88	7.00	12.85	0.13
89	7.05	12.85	0.13
90	7.10	12.85	0.13
91	7.15	12.86	0.13
92	7.20	12.86	0.12
93	7.25	12.86	0.12
94	7.30	12.86	0.12
95	7.35	12.87	0.12
96	7.40	12.87	0.12
97	7.45	12.88	0.12
98	7.50	12.89	0.12
99	7.55	12.89	0.11
100	8.00	12.90	0.11
101	8.05	12.90	0.11
102	8.10	12.90	0.11
103	8.15	12.91	0.10
104	8.20	12.92	0.09
105	8.25	12.93	0.09
106	8.30	12.93	0.09
107	8.35	12.94	0.09
108	8.40	12.94	0.09
109	8.45	12.94	0.09
110	8.50	12.95	0.09
111	8.55	12.95	0.09
112	9.00	12.96	0.11
113	9.05	12.96	0.11
114	9.10	12.96	0.11
115	9.15	12.96	0.11
116	9.20	12.97	0.11
117	9.25	12.97	0.11
118	9.30	12.97	0.11

119	9.35	12.97	0.11
120	9.40	12.98	0.11
121	9.45	12.98	0.11
122	9.50	12.98	0.11
123	9.55	12.98	0.11
124	10.00	12.98	0.11
125	10.05	12.98	0.11
126	10.10	12.99	0.11
127	10.15	12.99	0.11
128	10.20	12.99	0.11
129	10.25	12.99	0.11
130	10.30	13.00	0.11
131	10.35	13.00	0.11
132	10.40	13.00	0.11
133	10.45	13.01	0.11
134	10.50	13.01	0.11
135	10.55	13.01	0.11
136	11.00	13.02	0.11
137	11.05	13.02	0.11
138	11.10	13.02	0.11
139	11.15	13.02	0.11
140	11.20	13.03	0.11
141	11.25	13.03	0.12
142	11.30	13.03	0.12
143	11.35	13.03	0.11
144	11.40	13.03	0.12
145	11.45	13.04	0.12
146	11.50	13.04	0.12
147	11.55	13.04	0.11
148	12.00	13.05	0.11
149	12.05	13.05	0.11
150	12.10	13.05	0.11
151	12.15	13.05	0.12
152	12.20	13.06	0.11
153	12.25	13.06	0.10
154	12.30	13.06	0.11
155	12.35	13.07	0.11
156	12.40	13.07	0.11
157	12.45	13.07	0.11
158	12.50	13.07	0.11
159	12.55	13.08	0.11
160	1.00	13.09	0.12
161	1.05	13.09	0.11
162	1.10	13.09	0.11
163	1.15	13.09	0.11

164	1.20	13.10	0.11
165	1.25	13.10	0.11
166	1.30	13.11	0.12
167	1.35	13.11	0.12
168	1.40	13.12	0.12
169	1.45	13.12	0.11
170	1.50	13.13	0.11
171	1.55	13.13	0.11

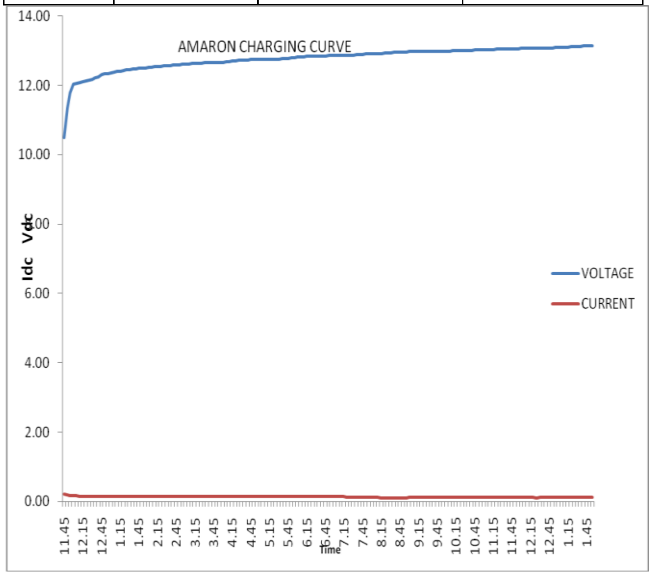

Figure 6: AMARON CHARGING CURVE

III CONCLUSION

Behaviour of inverters using discharging and charging is proposed. This paper includes plotting of different graphs, we also have equations finding ampere hour of batteries.

Important about the inverter system is its maximum peak power or surge power and steady current supply. The surge rating is usually specified at so many watts for so many seconds. This means that the inverter will handle an over load of that many watts for a short time.

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