

How to build Battery-Monitoring-Control Circuits (Update)

(12/27/2011)

This report describes how to build an energy efficient voltage monitoring-controller system for lead-acid storage batteries.

Additional lessons were learned after construction of more of these units as referenced in “Extremely_Low_Current_Usage_Battery_Voltage_Monitoring_Switching_2010.pdf”

We found that two basic circuits can be built. The “low Battery Voltage Turn on Buzzer Circuit” and the “Diversion Dump load, ventilation fan, and Charging Generator shut off Circuit”. The second one once made can then be adjusted to do any one of the three functions.

One of the R8 resistor leads would be cut to make an open circuit on this resistor to allow adjustment for a Ventilation fan use. This will lower the range of hysteresis (on-off voltage) and allow one to adjust the range for 13 to 13.2 volts.

Hysteresis range (on-off voltage) for R6 adjustment when the two R8s total to a given value in the following table: Use the table to choose the proper value of R8s.

Two R8s sum	delta Volts	R6	Usage
10Mohm	3.11	CW	Use for more range
10Mohm	2.43	CCW	Use for more range
15Mohm	2.26	CW	Dump & Gen Controller
15Mohm	1.66	CCW	Dump & Gen Controller
20Mohm	1.94	CW	Use for less range
20Mohm	1.21	CCW	Use for less range
30Mohm	1.37	CW	
30Mohm	0.88	CCW	
Open Circuit	0.55	CW	Fan & Buzzer Controller
Open Circuit	0.01	CCW	Fan & Buzzer Controller

Listed parts for each intended circuit function. Note the column “Circuit Component Use”.

REF	Quantity	Part Number	Description	Unit Price	Extended Price	Circuit component use
				USD	USD	
IC1	1	LTC1440CN 8#PBF-ND	IC COMP W/REF LP SINGLE 8-DIP	2.75	\$2.75	All
IC-SOCKET	1	A08-LC-TT-R	IC SOCKET STRAIGHT 8POS TIN	0.33	\$0.33	All
IC2	1	LM2936Z- 5.0/NOPB	IC REG ULTRA LOW CURR 5.0V TO92	2.39	\$2.39	All

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IC3	1	HUF75321P 3-ND	MOSFET N-CHAN 55V 35A TO-220AB	0.84	\$0.84	use for Fan, Dump & Gen Controller
S1	1	495-1475- ND	SURGE ARRESTER 75V GASTUBE 2PIN	1.41	\$1.41	All
S2	1	1.5KE18AG OS-ND	TVS 1500W 18V UNIDIRECT AXIAL	0.66	\$0.66	All
D1 & D2	2	1N4001FSC T-ND	DIODE GEN PURPOSE 50V 1A DO41	0.09	\$0.18	Use one for low voltage Buzzer and two for the all of the rest
R1	1	RNF1/4T14. 75MFRCT- ND	RES MF 1/4W 4.75M OHM 100PPM 1% AXIAL	0.1238	\$0.13	optional all substitution *
R1 Best	1	CMF4.75M HFCT-ND	RES 4.75M OHM 1% 50PPM 1/2W	0.91	\$0.91	All
R1 Optional	5	CFR-50JB- 4M7	RES 4.7M OHM 1/2W 5% CARBON FILM	0.058	\$0.29	optional all substitution *
R2	1	490-2882- ND	TRIMPOT CERM 200K OHM 25TRN TOP	0.86	\$0.86	All
R3	1	CMF392KH FCT-ND	RES 392K OHM 1% 50PPM 1/2W	0.1386	\$0.14	All
R3 Optional	5	CFR-50JB- 390K	RES 390K OHM 1/2W 5% CARBON FILM	0.058	\$0.29	optional all substitution *
R4	5	CFR-50JB- 430R	RES 430 OHM 1/2W 5% CARBON FILM	0.058	\$0.29	All
R5	5	CFR-50JB- 10K	RES 10K OHM 1/2W 5% CARBON FILM	0.058	\$0.29	All
R6	1	490-2889- ND	TRIMPOT CERM 50K OHM 25TRN TOP	0.86	\$0.86	All
R7	1	RNF1/4T12. 21MFRCT- ND	RES MF 1/4W 2.21M OHM 1% AXIAL	0.1156	\$0.12	All

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R7 Optional	5	CFR-50JB- 2M4	RES 2.4M OHM 1/2W 5% CARBON FILM	0.058	\$0.29	optional all substitution *
R8	1	CF1/45.1MJ RCT-ND	RES MF 1/4W 5.1M OHM 5% AXIAL	0.1402	\$0.14	use one for Dump & Gen Controller
R8	1	RNF1/4T11 0MFRCT- ND	RES MF 1/4W 10M OHM 1% AXIAL	0.1402	\$0.14	use one for Dump & Gen Controller
R8 Optional	5	PPCHHJ20 MCT-ND	RES 20M OHM METAL FILM .50W 5%	0.59	\$2.95	optional substitution *
R8 Optional	5	CFR-50JB- 10M	RES 10M OHM 1/2W 5% CARBON FILM	0.058	\$0.29	optional substitution *
C1 & C2	2	P4675-ND	CAP 1UF 50V STACK METAL FILM	0.386	\$0.77	All
C3 & C4	2	493-1192- ND	CAP 10UF 250V ELECT VR RADIAL	0.44	\$0.88	All
C5	1	493-1182- ND	CAP 220UF 200V ELECT VR RADIAL	1.69	\$1.69	All
B1	1	CX-0905C	BUZZER MAG 2.73KHZ 5VDC 9.6MM	1.98	\$1.98	Low Voltage Buzzer Controller
INPUT	1	ED2580-ND	TERM BLOCK 5.08MM VERT 2POS PCB	0.28	\$0.28	All
OUTPUT	1	ED2581-ND	TERM BLOCK 5.08MM VERT 3POS PCB	0.42	\$0.42	use for Fan, Dump & Gen Controller
FUSE	2	486-1236- ND	FUSE 2A 250V 5X20 FAST GLASS	0.23	\$0.46	All
HOLDER	4	WK6242-ND	FUSECLIP 5MM 6.3A PC MNT	0.14	\$0.56	All
Order From		Most can be found at http://www.digikey.com/		SUB TOTAL =	\$23.45	
Other Items						
LED-1	1	Any Source	White or Red LED	0.2	\$0.20	All

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PC-Board	1	Radio shack or any source	.1" hole to hole PC Board (2" x 3")			All
Fan Relay	1	DC-RR002	12 volt dc contacts (12A/125V AC, 7A/250V AC)	0.5	\$0.50	use for Fan, Dump & Gen Controller, not needed for low voltage buzzer
Found at http://www.sureelectronics.net/goods.php?id=184						

* see notes in original write up on effects of temperature on carbon resistors and resulting voltage



For buzzer circuit the stand off minimum height of .75" for one 3/8" wooden square dowel and one 1/2" wooden square dowel. For all the rest used two .75" long by 1/2" x 1/2" wooden square dowel. Two #4 by 1/2" round head sheet metal screws are used to hold down the PC board. See above for how this looks once it is glued in with hot melt glue.

Note for the following picture: The jumper wires (J1 and J2) for the buzzer – Relay: For Buzzer or “low voltage measurement circuit”, make sure the center connector is shorted to the upper connector for J1 and separately the same for J2. Think of this as a double pole double throw switch that is switched to the buzzer direction. For the Relay use the two bottom connections, they need to be shorted as if the switch were switched to relay. When the relay is used the J3 will need a jumper between the center and 12V or right end. If the listed above 12v relay is used.

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The above is how the low voltage Buzzer circuit ends up looking. Note that it doesn't need to have any of the output relay circuit components filled in.



The above shows the end result for the "Diversion Dump load, ventilation fan, and Charging Generator shut off Circuit".

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Labels for boxes:

Low Voltage Buzzer

Volts & Hysteresis
12.25 Volts ON; 12.3 Volts OFF
CW to Increase

Charging Fan

Volts & Hysteresis
13.2 Volts ON; 13.0 Volts OFF
CW to Increase

Dump Load or Gen Cutoff

Volts & Hysteresis
15.1 Volts ON; 12.9 Volts OFF
CW to Increase

Note that after some testing and use, the above voltages were found to be more useful for lead acid 6 volt golf cart batteries charging at around 20 amps per battery. Two are wired in series to make 12 volts.

In an environment where one is attempting to get every ounce of energy out of the limited amount of gasoline available, then one would adjust the generator cutoff voltage to something like 14.5 to 14.9 volts depending on charging rate. The dump load cutoff would be set higher to say 15.5 volts. Over charging to equalize cells would be done less frequently and done when measurement of individual cell voltages indicated it was needed.

To equalize cells in a 12 volt batteries one must charge above 15 volts for a while. If the charging rate is higher then above controllers generator cutoff voltage then one may need to be unplugged it to allow the generator to run for longer at regular intervals.