Sailboat power management calculator wh

rev 1.1   3/5/2008
rev 1.2   11/11/08 Add effects of battery self discharge over time

Scope - user input (purple entries) of supply and usage parameters. Three analysis are provided.

　　　　section 2.1 - daily analysis of energy in vs. energy out - are you generating as much power as you use per day?
　　　　section 2.2 If boat is used for example only one day per week, can the solar panel provide all the charge needed?
　　　　section 2.3 If a solar panel is used to maintain the battery for some time period while the boat is not used, how big of panel is required?

1.0 Enter power consumption and power generation components

1.1 Power Consumption on a 24 hour basis. Note - enter power at 12V or 120V but not both (one column is zero)

Note - all purple entrees are user input and changeable. Red entrees are calculated by the spread sheet - do not try and directly enter numbers in red cells!

Item	Watts (12V)	Watts (120V)	amps	hour/day	daily amp_hr use	
VHF transmit	65	0	5.284553	0.016	0.084552846	Note 1. Battery voltage is assumed to be 12.3 volts
VHF listen when act.	10	0	0.813008	0.16	0.130081301	
VHF standby	3.3	0	0.268293	4	1.073170732	Note 2. If watts are entered at 120VAC, it is assumed
car stereo/IPOD	12.3	0	1	5	5	that a converter is used with 90% efficiency
LED main cabin light	1.845	0	0.15	4	0.6	
LED Vberth light	0.98	0	0.079675	2	0.159349593	
LED aft berth light	1.72	0	0.139837	2	0.279674797	Purple values are input (click on box and input new value)
Depth/fish finder	3.38	0	0.274797	6	1.648780488	Red values are calculated
GPS	3.38	0	0.274797	4	1.099186992	
Lap top	0	64.9	5.862692	1.5	8.79403794	
Portable DVD player	24.6	0	2	3	6	Note 3. For a 12 volt device where current consumption is
bilge pump	0	0	0	0	0	known but not watts, multiply the current by 12.3 to obtain
Nav lights (LED)	2	0	0.162602	3	0.487804878	watts. Example, if current is 0.5 amps, enter 6.15 watts (12V)
Anchor light (LED)	2	0	0.162602	7	1.138211382	
spare	0	0	0	0	0	
spare	0	0	0	0	0	

　　　　　　　　　　　　　　　　　　　Total amp-hrs used per 24 hr　　26.49485

Battery self discharge section　　　　　　　Takes into account the daily self discharge of batteries

Enter Battery self discharge　　　　Monthly % discharge　　　15 %　　　　Note - as default, use 15 for flooded wet cell batteries, use **2** for GEL and AGM type batteries

1.2 Power Generation on a 24 hour basis

Solar panel output conversion　　　　0.234 **amp*hours per day / panel watt**

Item	Watts (solar only)	Amps (outboard etc)	hour/day	Daily amp_hr Gen	
Solar panel	20			4.68	Note: solar amp hours are based on a benchmark
outboard low RPM		2	0.5	1	of measured amp/hour for a given watt panel
outboard HIGH RPM		5	0.01	0.05	The conversion is amp-hours per DAY = .234* Panel
110V bat. charger		10	0	0	Watt rating. Another benchmark with an MPPT
spare			0	0	controller listed .394 amp hours each day per panel watt
spare		0	0	0	
			Total amp-hrs gen per 24 hr	5.73	

2.0 Analysis section

Enter battery capacity	220	(in amp hours)
Enter initial battery charge (%)	100	(in per cent)

Daily loss in battery bank from self discharge   1.064516 (amp hours lost each day)

2.1 Daily Analysis. Can the battery charge be maintained on a day to day basis or how many days can you go?

Condition	Daily net amp-hours	battery amp-hr left	battery cap % left	
Before starting	0	220	100	
End of day 1	-21.82936708	198.1706329	90.07756042	Note: taking the batteries below 50% charge
End of day 2	-21.72374111	176.4468918	80.20313264	reduces the lifetime of the batteries. However, going
End of day 3	-21.61862623	154.8282656	70.37648436	below 50% occasionally may be less expensive than either adding more
End of day 4	-21.51401998	133.3142456	60.59738437	battery capacity or more power generation.
End of day 5	-21.40991988	111.9043257	50.8656026	
End of day 6	-21.30632349	90.59800224	41.18091011	
End of day 7	-21.20322838	69.39477386	31.54307903	
End of day 8	-21.10063211	48.29414175	21.95188261	

2.2 Limited use analysis. For example, if boat is used only once per week, how much solar panel is needed?

Enter number of days per usage cycle	7	days
Enter number of days boat is used per cycle	1	days

Total amp-hours generated per usage cycle	33.81	amp*hours	Note Solar panel is generating every day of the cycle but all
Total amp-hours used per usage cycle	33.94646	amp* hours	other current draw or generation are only for the actual number of days the boat is used
Net amp hour per cycle (gen - used) Negative is bad	-0.13646	amp*hours	Takes into account battery self discharge

Note. If the net amp hour per cycle (above) is positive, your system can generate all the power you need
for the cycle. If the number is negative, you are using more power than you are generating and my have to
supplement power if the cycle is regular or use less power

2.3 How large a SOLAR panel is needed to maintain a battery assuming no external power usage (takes into account ONLY battery self discharge)

Enter Solar Panel winter de-rating in percent   70 percent - purple numbers are user input   During the winter, the sun is lower and less daylight per day
                                                                                    Note - enter 100 (i.e., 100%) for no derating. Enter 70 to note that panel is getting 70% of the summer value

Calculate the MINIMUM SOLAR panel size to offset battery self discharge   6.498877 Watts (manufacture rating) red numbers are calculated by this program

                            Note - this calculation takes into account the battery amp*hour rating entered by the user (in D55 cell) and the entered battery self discharge monthly rate.