Considerations When Selecting an Electric Bilge Pump for the Etchells

Background

- In 2013, Hans Fogh Suggested the Etchells Class Allow an Electric Bilge Pump Similar to the Dragon Class
- Etchells Class Leadership Sponsored 2 Prototypes (in North America?)
  - However, Class-Sponsored Prototype Design and Evaluation Lessons Learned Have Not Been Made Publically Available, to my Knowledge
- Class Voted to Allow Electric Bilge Pump in Dec 2014
  - Revised Rule C.5.1 (b) (4) Permits Electric Bilge Pump as Part of Optional Portable Equipment is 1st Published in March 3, 2015 Edition of Etchells *Class Rules*

Top Level Requirements

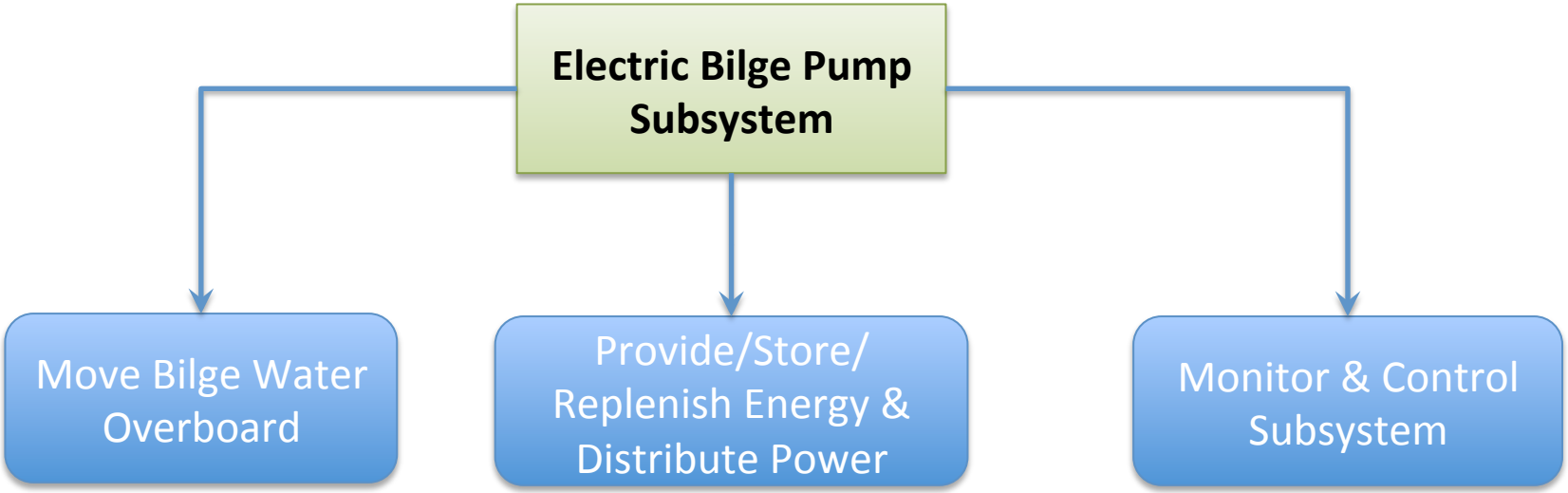
- Provide Capability to Discharge Bilge Water Overboard Using an Electric Pump
  - Does Not Replace Existing Manual Bilge Pump(s)
- Total Weight of Electric Bilge Pump Subsystem Must Not Exceed 6 Kg (13.22 Lbs)
  - Electric Bilge Pump System Weight is Not Included as Part of “Complete Boat Weight”
- Battery Must Be Securely Positioned in Port Seat Locker
  - Battery Must Be “Easily Removable” (Whatever That Means)

Additional Requirements Derived For Fleet 27 Environment

- Electric Bilge Pump Subsystem Must Be Suitable, Effective, and Available for Use Both When:
  - Sailing
  - On the Mooring
- Readily Maintainable by the Boat Owner and/or Crew

- Additional Goals
  - Minimize/Eliminate Efforts to Use/Configure/Maintain
  - Maximize Reliability
  - Minimize Cost (Purchase and Operating)
  - Minimize Adverse Effects on Boat
    - Weight and Volume

Top Level Functions of Electric Bilge Pump Subsystem

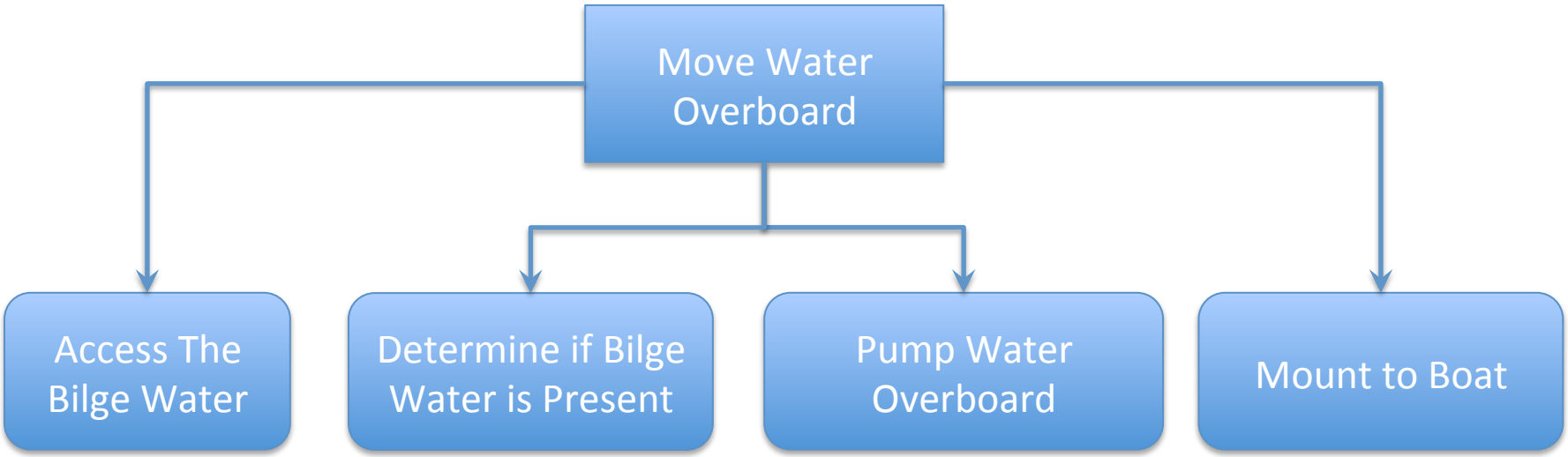


Some Activities within these Functions May be Provided by the Electric Bilge Pump Subsystem OR By the Crew – That is Part of What I Intend to Explore

Approach

- Determine Performance Requirements
- Develop Suitable Schematics for Alternate Designs
  - "Gucci" No Maintenance (in Theory)
  - Modified "Gucci"
  - Conventional
  - Minimalist
- Evaluate Each Against Requirements

Move Water Overboard Functions



OPTIONS CONSIDERED:

- Centrifugal or Positive Displacement Pump
- Pump and Suction Locations
- Water Discharge Path Through Boat
- Automated or Manual Activation

Pump Capacity Requirements

- The Case for a ***Large*** Capacity Pump:
  - Match Existing Manual Pump
    - Whale Gusher Titan Rated for 28 GPM (1680 GPH)
    - Rule 1500 or 2000 GPH Pumps are Comparable
- The Case for a ***Medium*** Capacity Pump:
  - Pump Out Bilge Flooded Up to Floorboards
    - Volume of Bilge Below Floorboard is About 200 gal
    - 600 GPH at ~6 ft Head Will Discharge in ~20 minutes
    - Rule 27D 1100 GPH Pump is Suitable
- The Case for a ***Small*** Capacity Pump:
  - Small Rule 24 360 GPH or Whale Gulper 220 GPH are Sufficient for Rain Water and Usual Sailing Conditions
  - Manual High Capacity Pump is There for Emergency
  - Could Consider 3 Small Pumps, One in Sump, 1 Each Port and Starboard

A Small Capacity Pump at ~3.7 or ~6 GPM is Adequate for Rainwater and for Water that Splashes in During Racing

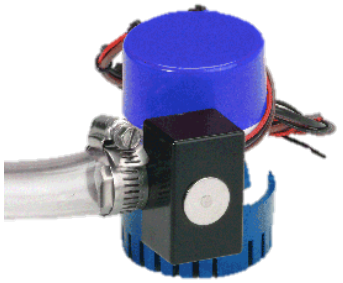
Automated or Manual Pump

- Bilge Switch May Be Used to Activate Bilge Pump When Bilge Water Sensed
  - Required for Subsystem To Work Correctly When Unattended on Mooring
  - Options Include Float Switch, Dielectric Constant Switch, Pump with Built-in Switch
    - Dielectric Constant Switch May Not Be Reliable in Rainwater
  - Rule Automatic Pumps Not Recommended
    - These Pumps Automatically Cycle on Every 2-1/2 Minutes… Makes Noise and Uses Battery
- While Sailing, Pump Could Just Be Switched On Manually by Crew

Many Pump & Switch Options

Selected Whale Gulper 220

Selected Water Witch model 101



More About the Whale Gulper 220 Pump

Gulper® 220

Gulper valve technology handles shower waste such as hair and gel

No clog, no filter waste pump built on more than a decade of market leading pump technology

Product code: see table

Also available
Gulper 320 High Capacity
for multiple drains
See page 92

Reliably Pumps Shower Waste Including Hair and Gels

- Up to 14 ltrs (3.7 US gals) per minute*
- Will run dry without damage and pump a mixture of air and water
- Virtually non-choke valves - No filter to unblock
- Reliable operation - Self-priming up to 3 m (10 ft)
- Easy to install in confined spaces
- Double outlet valve ensuring continuous flow
- Multi directional head - for ease of installation
- Low power consumption

2 Year Warranty

Awards and Accreditations

- Ignition protected ISO8846.
- CE marked
- IP45 rated

COMPLETE YOUR SYSTEM

See Page 102-103 for Grey waste accessories

YOU MAY ALSO LIKE

Grey IC and Gulley IC - Automatic Grey waste pump kits with automatic intelligent control built in - pages 88-91

Gulper 320 - High Capacity Electric Grey Waste pump - page 92-93

Product Information

Model Specifications

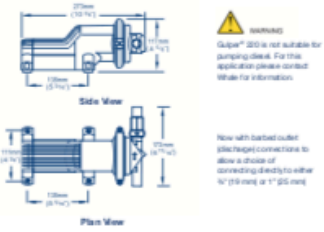
Model	Gulper® 220	
Product Code	BP1552	BP1554
Voltage	12 V d.c.	24 V d.c.
Recommended Fuse Size	5 amps Automotive	2.5 amps Automotive
Weight	1.5 kg (3.4 lbs)	
Hose Connections	19 mm (¾")	
Minimum Wire Size	1.5 mm² (16 AWG)	
Materials	Pump Body: Aluminium, Glass-filled Nylon, Clamp Ring: Acetal Diaphragm: Santoprene®, Valves: Nitrile®, Feet: EPDM Gearwheel: Delrin®, Fasteners: Stainless Steel, Brass	
Materials in Contact With Fluid	Glass-filled Nylon, Nitrile®, Santoprene®, Stainless Steel	
Accessories	Grey Waste Tanks (see page 98)	
Service Kit	AK1550 - Gulper® 220 Service Kit Contains: Diaphragm and Valves	
Maximum Suction Lift	3 m (10 ft)	
Maximum Discharge Head	3 m (10 ft)	
Maximum Discharge Head and Suction Lift (combined)	4 m (13.5 ft)	
Dry Running Current	2.4 amps	1.2 amps

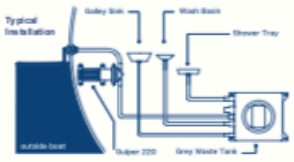
Performance Data

	BP1552 / BP1554	BP1552 / BP1554
Suction Lift	0 m (0 ft)	1 m (3 ft)
Discharge Head	1 m (3 ft)	1 m (3 ft)
Flow Rate per Minute	13.4 ltrs (3.5 US gals)	12.6 ltrs (3.4 US gals)
Current Draw	3.5 amps (12 V d.c.) 1.75 amps (24 V d.c.)	4 amps (12 V d.c.) 2 amps (24 V d.c.)

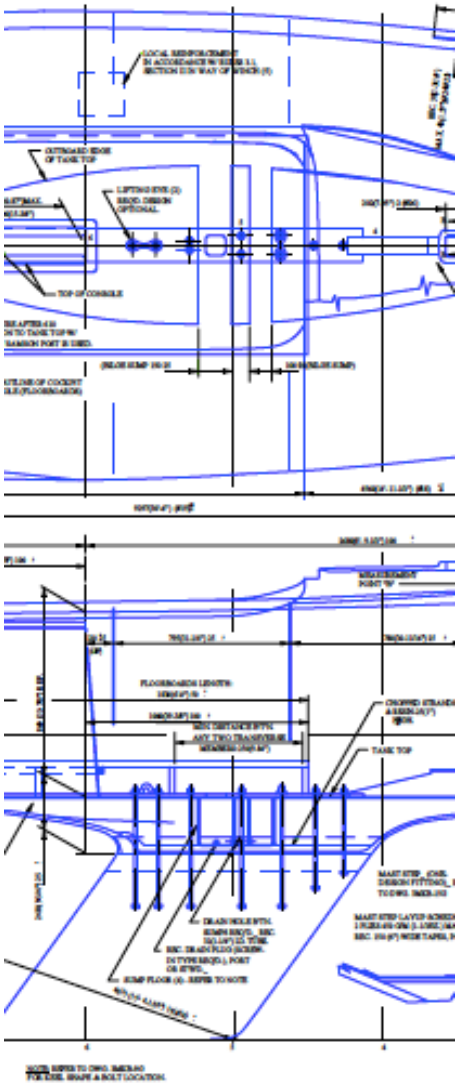
* based on Whale lab tests at zero head lift and zero head

Note: These specifications are retail items only.
For details of our bulk pack range for boat builders and wholesalers - contact Whale Support.

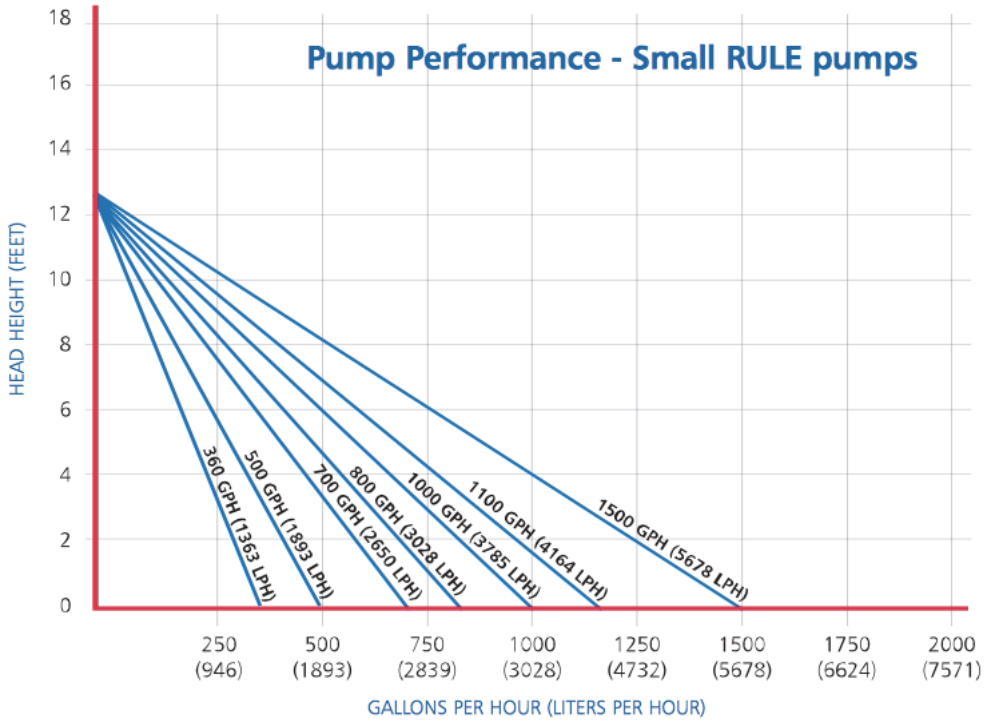




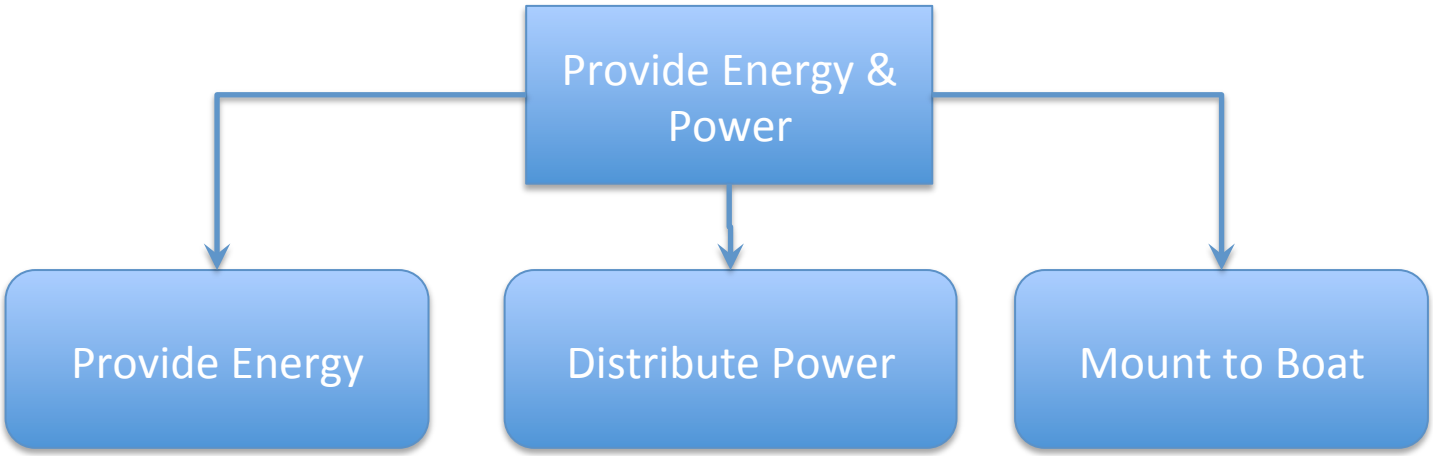
Bilge Pump Intake from Sump Under Keelson



Actual Flow Rate Will Be Less



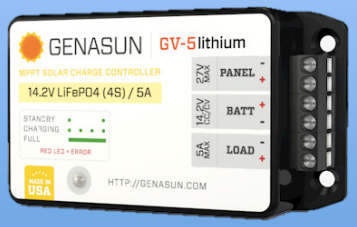
Energy & Power Functional Block Diagram



OPTIONS CONSIDERED:

- Battery & Solar Panel
- Battery Charged Offboard (Or Replaced by Offboard Stored Part)
- Solar Panel Only
- Battery Options:
  - ✧Sealed Lead Acid
    - ✧AGM Deep Cycle
    - ✧Starter Battery (Motorcycle)
  - ✧Cheap Lead Acid Battery
  - ✧Li-$FePO_4$ (Lithium Iron Phosphate)
  - ✧Primary Alkaline (e.g., Rayovac 926 Lantern Battery)

Three Energy Options



(Onboard) Rechargeable Secondary Battery with Solar Charger and Controller

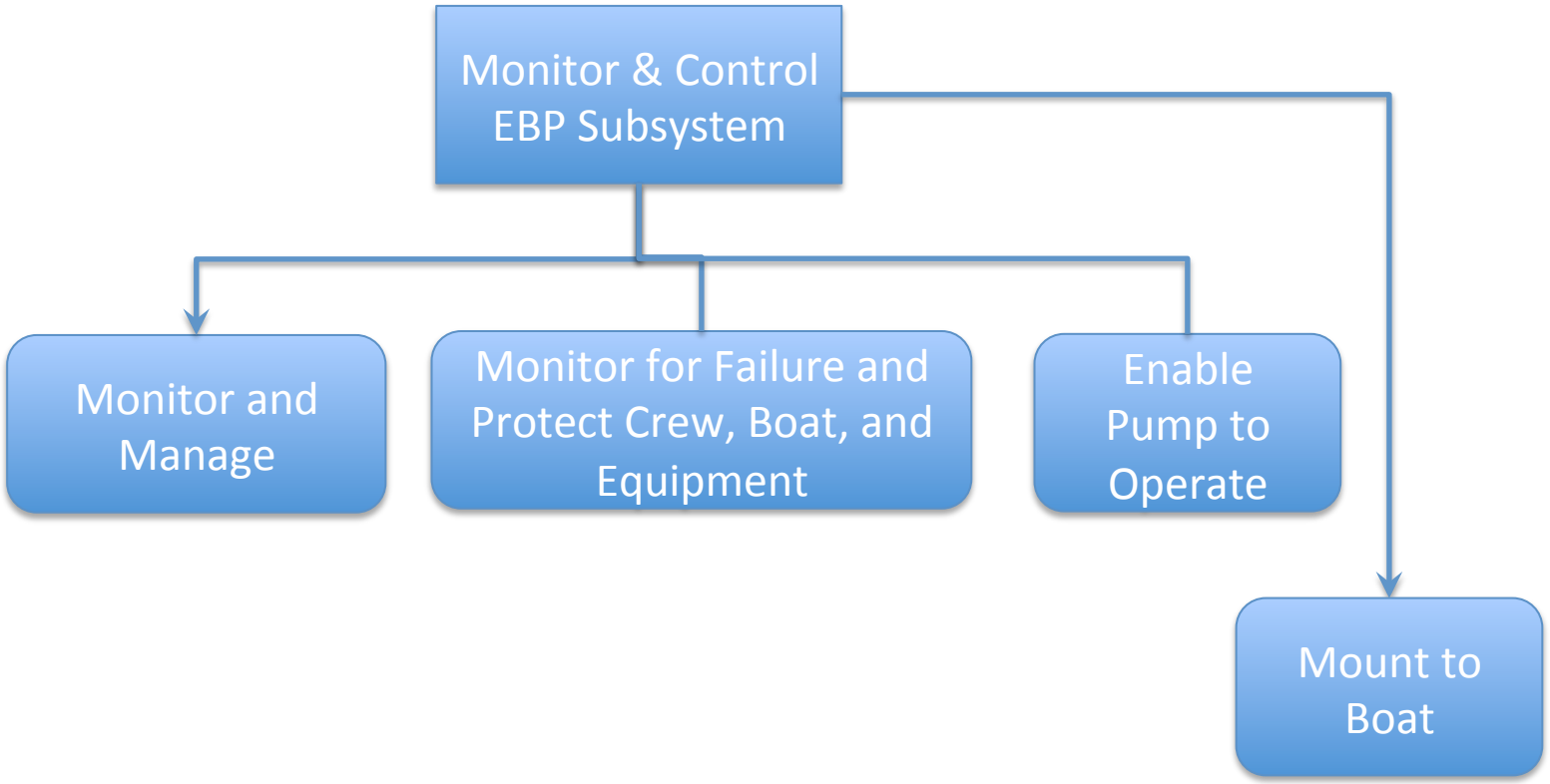
(Offboard) Rechargeable Secondary Battery

Replaceable Primary Battery

Notes

- Technically, the Genasun solar controller is not needed because the 6W solar panel is less than the Typical Threshold of 30W
- The Genasun Controller provides
  - A Regulated & Protected 5A Output Circuit that Protects the $160 Lithium Battery from being Over Discharged by the Bilge Pump
  - LED indicators to display status of charging operation
- The Lithium battery has built-in low voltage cutoff circuit
- So, this is a belt-and-suspenders design

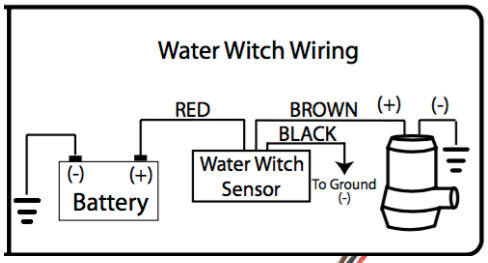
Monitor & Control Functional Block Diagram



OPTIONS CONSIDERED:

- Crew Operated/Manual and/or Automatic/Unattended

Basic Electric Bilge Pump Circuit



In-Line 10A
Fuse Holder
($10)

~5 amp-hour sealed AGM
lead acid battery (12 V) ($25)

Battery Box

18 AWG

18 AWG

5 A
MDL

3 A
AGC

Auto
Off
Manual

18 AWG

18 AWG

Blue Seas
Bilge Pump
Switch ($38)

Water Witch
Model 101 Bilge
Switch ($39)

Optional Solar
Charger

Ganz GSP-6 Solar
Panel ($75)

Recommended: Genasun
Charge Controller ($65-$75)

18 AWG

18 AWG

18 AWG

18 AWG

18 AWG

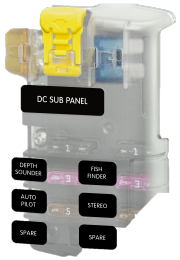
2.5 amp

Rule 24
360 GPH ($20)

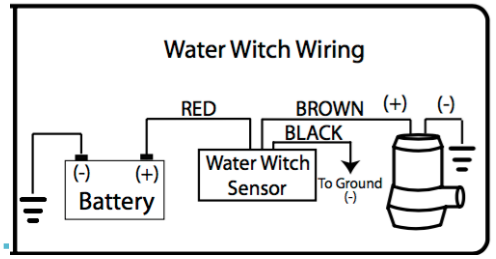
Rule Pumps Non-Automatic Submersible Pump Data

Model	GPH	Amps @12v	Amps @13.6v	Fuse Size	Height	Width	Weight (lbs)	Hose Diameter	Float Switches
24	360	2.1	2.5	2.5	3-1/2"	2-3/8"	0.5	3/4"	35-40
25D	500	1.9	2.5	2.5	3-1/2"	2-3/8"	0.5	3/4"	35-40

“Gucci” Bilge Pump Circuit Integrated with Fixed-Mount VHF



VHF Radio)
Spare (Panel Lights)



Battery Box

10 AWG

20A ANL

LiFePO$_4$ Battery

10 AWG

Voltmeter

Bilge Pump Switch 3-Position)

VHF 5.5/0.3 amp

1.0 amp

7.5 amp

18(?) AWG

18(?) AWG

1.0 amp

1.0 amp

10.0 amp

Auto 12 AWG

Off 12 AWG

5.0 A

Manual

12 AWG

Water Witch Bilge Pump Counter

18 AWG

18 AWG

12 AWG

Water Witch Model 101 Bilge Switch

4 amp

Whale Gulper 220 Pump

12 AWG

Genasun GV-5 Solar Controller

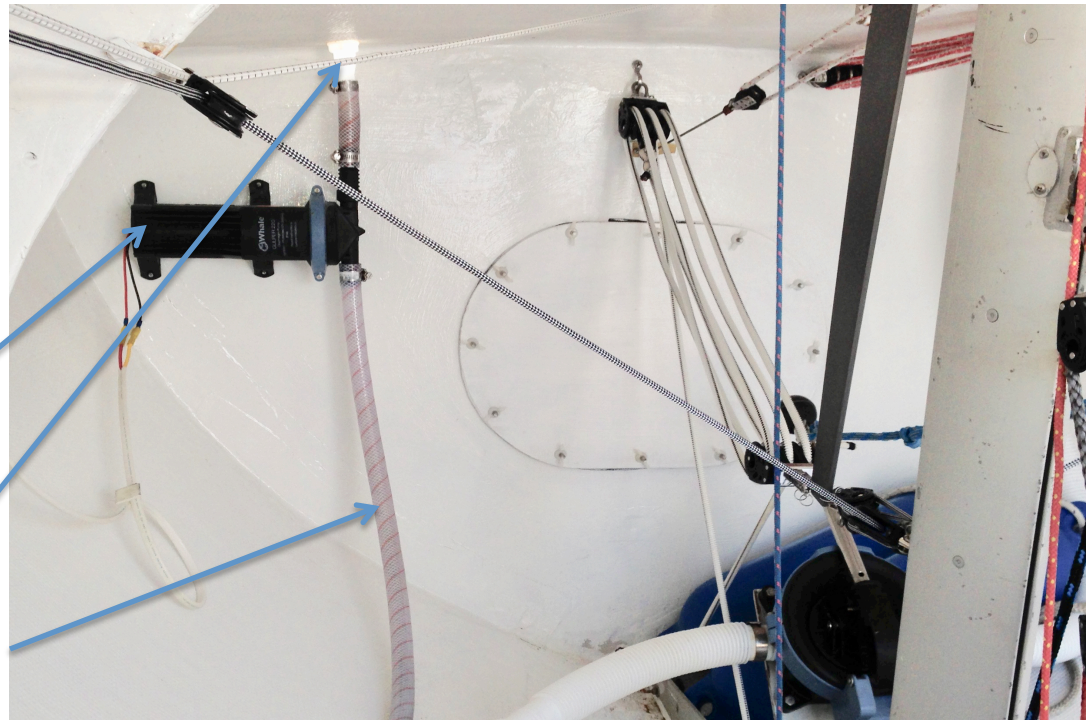
20/2 Cable

Ganz GSP-6 6W Solar Panel

Electronics Box

Mounting the Pump

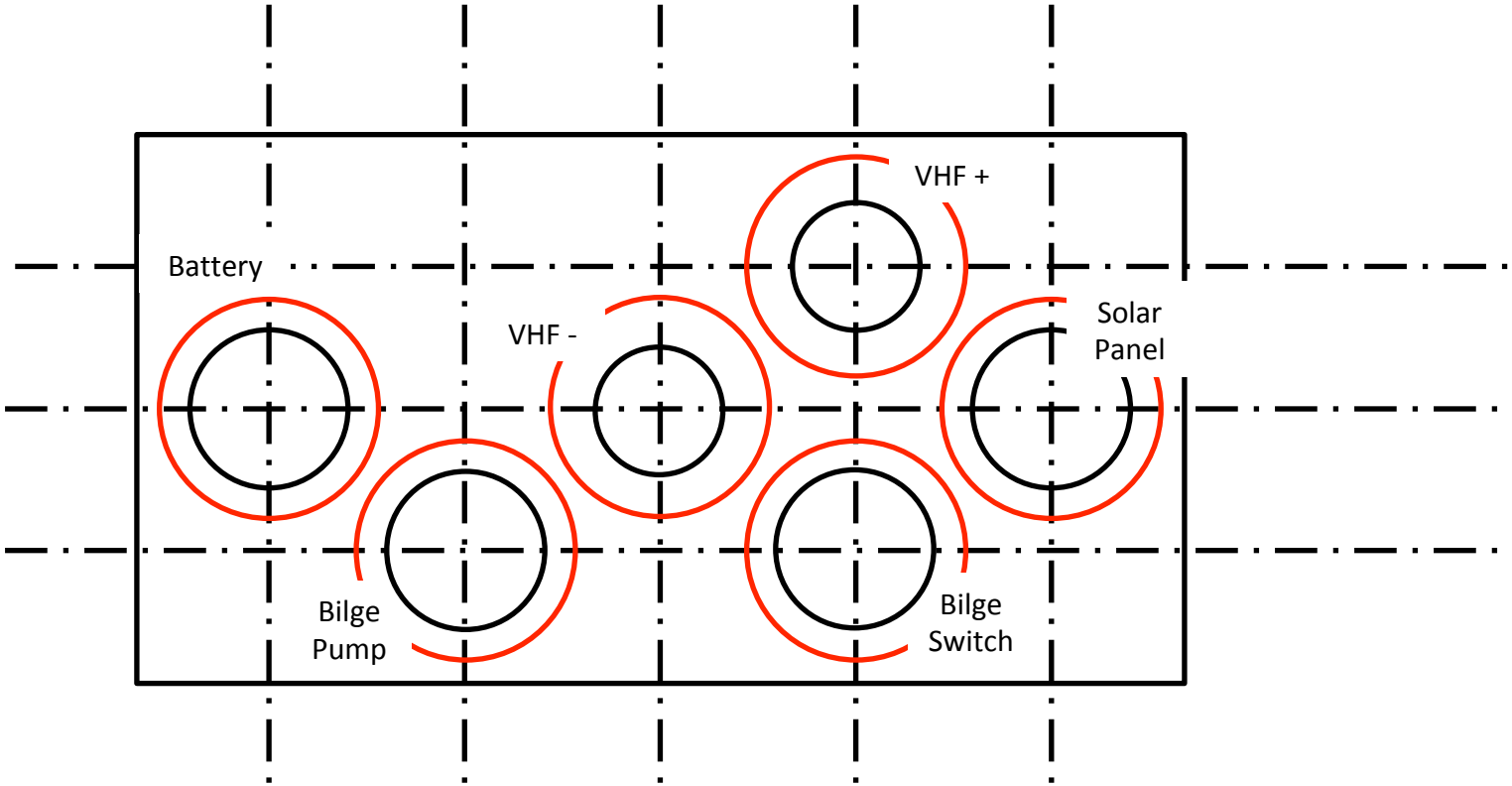
- Whale Gulper 220 Pump
  - Positive Displacement Pump
  - Not Waterproof; Needs to be Keep Dry
  - Alternate Whale Submersible Pumps are Waterproof
- Mounted to Forward Bulkhead
- Discharge Through Deck
- Inlet Hose Led to Aft Sump Well



Electronics Housing

Batt +	Batt -	Bilge P +	Bilge P -	P SW Gnd	P SW Out	P Sw Rtn	VHF +	VHF -	Spare +	Spare -	Solar P In
12	10/2		12/2			12/3	18/1	18/1		16/2	6.1mm 20/2

Electronics Housing Cable Penetrator Layout



$LiFePO_4$ Battery Characteristics

*Feature	• 12.8V 10Ah LiFePO4 rechargeable battery with PCB inside • Low self-discharge • Steady discharge and charge performance • Outstanding thermal stability.
Voltage	12.8 V (working) 14.6 V (peak) 10.0V (cut-off)
Capacity	10Ah (120 Wh)
Terminals	T1 terminal

Protection	• 1x PCB installed with the battery pack and protects the battery from
	  ◦ Over charge and over discharge
	  ◦ Over current protection
	  ◦ Short circuit protection

Cycle Life	>1000 cycles (80% of initial capacity @ 0.2C rate, IEC Standard)
Operation Temperature Range	- 4F (-20°C) ~ 140F (60°C)
Charging rate	• Standard: 0.2C (2.0A) • Maximum: 1.0C (10A)
Discharging Rate	• Standard: 0.5C (5.0A) • Maximum Continuous: 2.0C (20A) • Maximum Impulse rate < 30 sec : 5.0C (40A)
Dimensions(LxWxH)	151mm (5.94") x 65mm (2.6") x 118mm (4.65")
Weight	3.25 lbs (1.47 kg) --- 55% lighter than 12V 10Ah lead acid battery
Warning:	• Do not use in series or in parallel • Must use LiFePO4 charging circuit. Do not use Lead Acid charger to charge this battery.

Battery Sizing

Marine Solar Panel Size Calculator

Number of Amp/Hours used Per day*	0.92
Number of Hours of Direct Sunlight per day	10.0
Minimum Watts Required	1.1
Recommended Panel Size (add 20%)	1.3

*** Add up the average amount of time (in hours) that your onboard 12VDC electrical appliances are used per day using the worksheet on the right.**

Input Data into Yellow fields only!

Appliance	Avg Current Draw (amps) at 12VDC	Average Daily Use (hours/day)	Average Consumption (AmpHours/day)
Bilge Pump	4.0	1.0	4.0
GPS	0.5	0.0	0.0
TV & DVR	6.0	0.0	0.0
VHF (receive)	0.3	6.0	1.8
VHF (transmit)	6.3	0.1	0.6
Instruments	0.5	0.0	0.0
AutoPilot	2.0	0.0	0.0
Medium Fridge	5.0	0.0	0.0
Stereo	2.0	0.0	0.0
Anchor Light	2.0	0.0	0.0
Laptop Computer	4.8	0.0	0.0
Other	0.0	0.0	0.0
		TOTAL	**6.4**

DOD	90%
Average Voltage	13.2
EOL SOC	80%

84.9

7.1 Amp-Hr 94.3W-hr

Battery capacity should be: 117.9W-hr

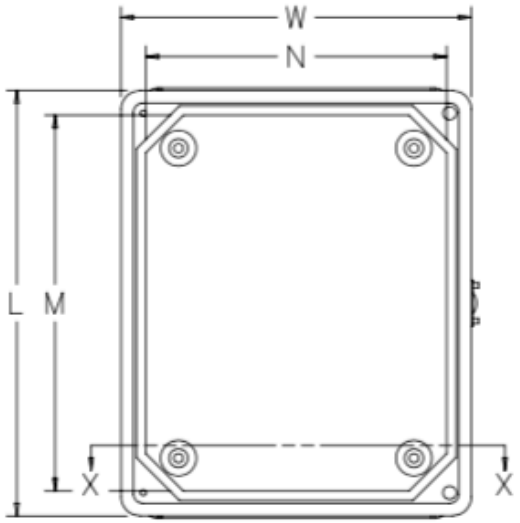
8.9A-Hr

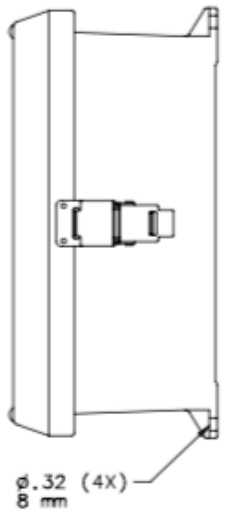
****Electricity capacity is expressed in Amp Hours. If you use a 5 amp appliance for 2 hours that's 10 Amp Hours.
Batteries have a Amp Hour Rating and your battery bank is the key of any electrical system. It is important to list every item that uses battery power in your boat This includes not only DC lights, radio, etc, but also AC items that run off the inverter such as a Micorwave or TV. Basically we are powering AC applicances from 12V DC Batteries through the inverter so converting AC amps to DC amps is required.
ex - an AC appliance, if you know the Amps mulitply by 10. So 8 Amps AC = 80 Amps
For DC or AC Appliance, if you know the Watts divide by 12 and now you have the AMPS.

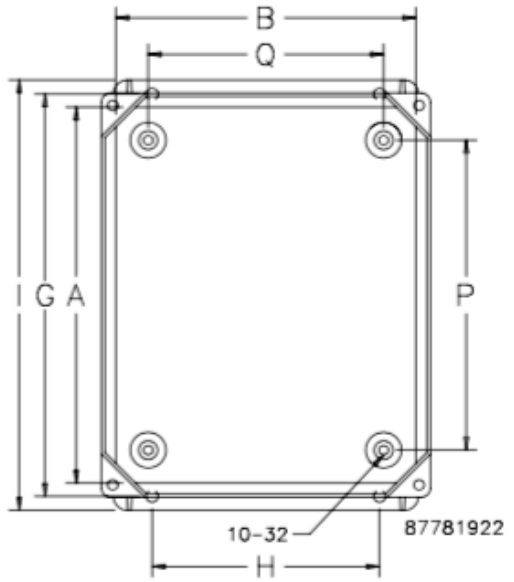
Flat Clear Cover with Latches, Type 4X

Catalog Number: CHJ1008HWPL1LG

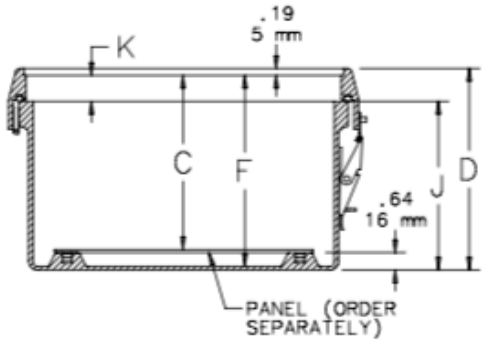
Flat Clear Cover Window Enclosures







Top View with Door/Cover Removed



SECTION X-X

Standard Product

Catalog Number	AxBxC in./mm	No. of Latches	Window Size N x M in./mm	D in./mm	F in./mm	G in./mm	H in./mm	I in./mm	J in./mm	K in./mm	L in./mm	P in./mm	Q in./mm	W in./mm	Steel Panel	Aluminum Panel	Panel Size in./mm
CHJ606HWPL1LG	5.71 x 5.72 x 4.05 145 x 145 x 103	1	6.00 x 6.00 152 x 152	4.90 125	4.62 118	6.75 171	4.00 102	7.51 191	4.28 109	1.38 35	6.00 152	4.25 108	4.25 108	5.97 152	A6P6	A6P6AL	4.88 x 4.88 124 x 124
CHJ806HWPL1LG	7.71 x 5.72 x 4.05 196 x 145 x 103	1	8.00 x 6.00 203 x 152	4.90 125	4.62 118	8.75 222	4.00 102	9.51 242	4.28 109	1.38 35	9.31 236	6.25 159	4.25 108	7.31 186	A8P6	A8P6AL	6.75 x 4.88 171 x 124

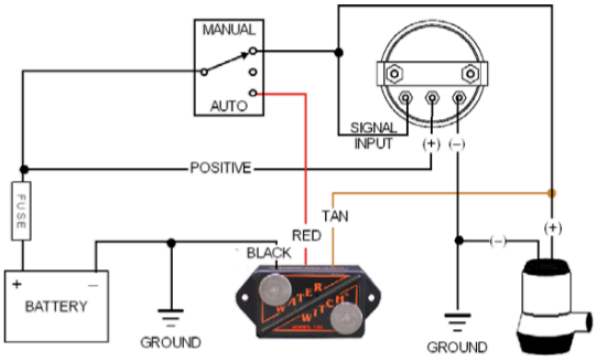
ANCOR

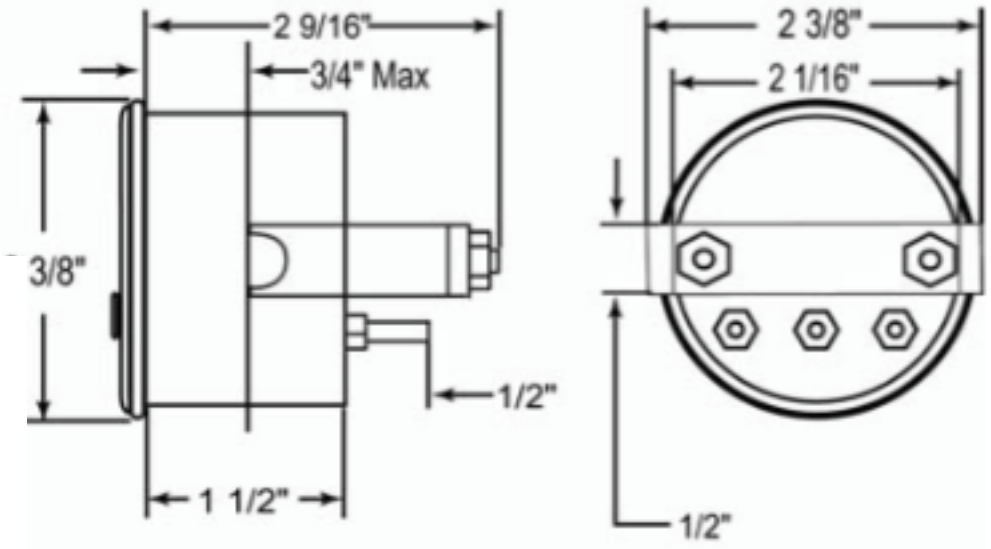
Wire Seals

- Made of Nylon 6/6 flame resistant, self extinguishing Buna-N form seal
- All seals exceed NEMA 4 x or 6 specs
- Overlapping clamping spines allow for superior pull-out protection and resistance
- Strain relief fittings are resistant to salt water, acids, alkalis, alcohol, oils and are non-corrosive for use in the marine environment
- Good underwater to 300 feet /91.4 m (150 PSIG) provided there is a liquid tight seal between body and housing
- Provide low cost cable entries into panels and junction boxes
- UL 94 v-0

Description	For Use with	Thread Size	Cable Range		Clearance Hole	Body Length	Thread Length	Qty/ Pkg	Part #
Round Cable	18–10 AWG	3/8" NPT	.08"–.24"	2–6 mm	.68"	.87"	.59"	1	**764998**
Round Cable	20–1 AWG	1/2" NPT	.00"-.47"	0–12 mm	.83"	1.06"	.51"	1	**765000**
Round or Flat Cable	4–1, 14/2–10/2, 16/3–12/3 AWG	1/2" NPT	.24"-.55"	6–14 mm	.83"	1.10"	.51"	1	**765002**
Round Cable	1–3/0 AWG	3/4" NPT	.51"-.71"	13–18 mm	1.05"	1.22"	.51"	1	**765004**
Round Cable	4/0 AWG	1" NPT	.71"-.98"	18–25 mm	1.35"	1.53"	.75"	1	**765006**
Flat Cable	14/3-12/3 & 12/2–10/2	1/2" NPT	.31"-.56"	8–14 mm	—	1.10"	.51"	1	**765010**
Flat Cable	14/3-12/3 & 12/2–10/2	3/4" NPT	.31"-.56"	8–14 mm	—	1.22"	.51"	1	**765012**

Water Witch Bilge Pump Counter



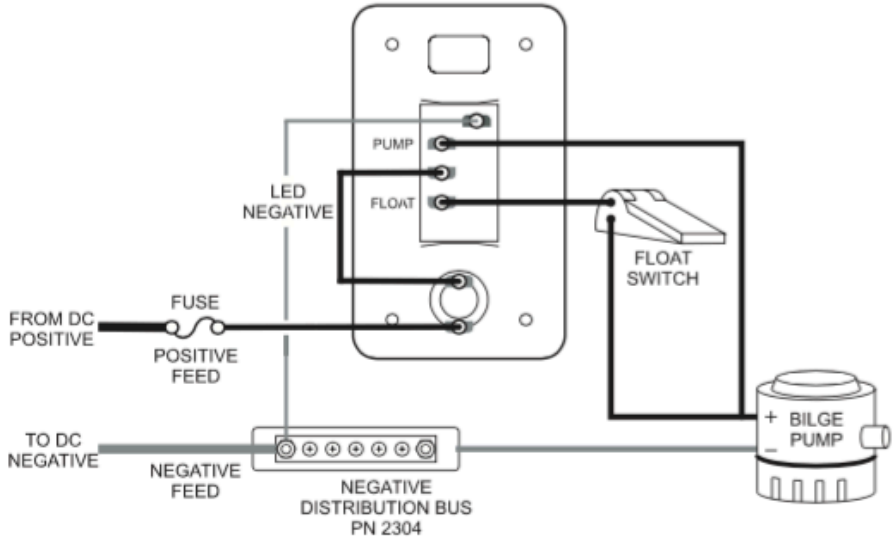


Round Bezel

Blue Sea Systems Pump Switch

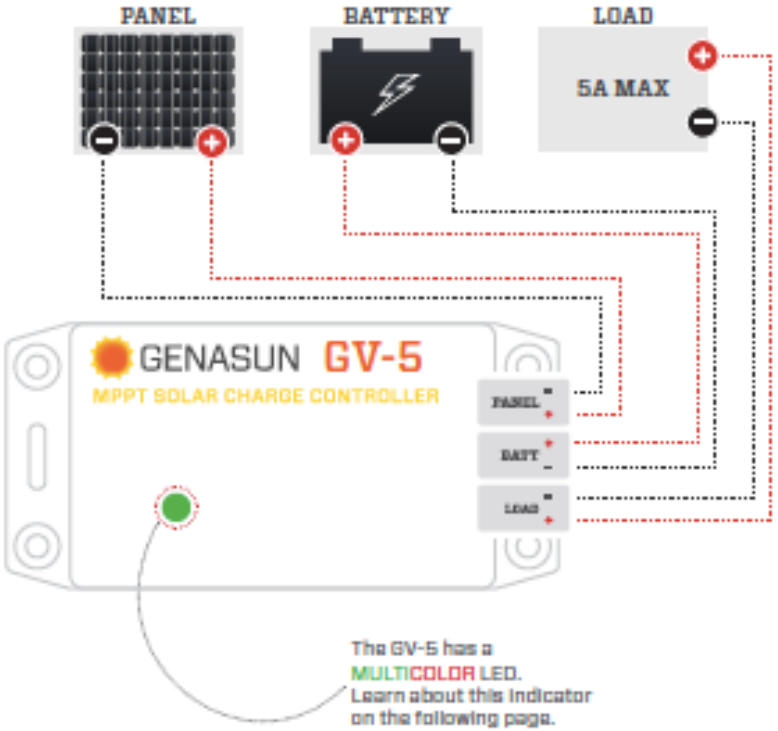
Panel Specifications

Material:	0.100" 5052-H32 Aluminum Alloy	
Primary Finish:	Chemical Treatment per Mil Spec C-5541C	
Final Panel Finish:	Graphite color 2 part textured Polyurethane	
Fuse Holder:	Accepts commonly available AGC (fast acting) and MDL (slow blow) 1-1/4" x 1/4" glass fuses.	
Fuse:	15 Ampere AGC (fast acting) fuse installed.	
Amperage Rating:	Switch and Fuse Holder, 20 amperes maximum for 12 volt system 15 amperes maximum for 24 volt system	
Voltage Rating:	Panels are rated for 12 or 24 volts DC.	
Circuit Indicator:	LED embedded in switch, rated 100,000 hour 1/2 life	
Panel Depth:	2.75" 69.90mm	
	Inches	**Millimeters**
Overall Dimensions:	2-1/4 x 3-3/4	57.20 x 95.30
Mounting Centers:	1-13/32 x 2-29/32	36.10 x 74.20
Water Resistant:	Will withstand the water exposures normally encountered in above deck applications: Salt spray, rain, hose washdowns, momentary immersions.	



Wiring Diagram
DC Water Resistant Power Distribution Panel
PN 8263

Genasun Solar Charge Panel Controller



4.3 x 2.2 x 0.9"

ST Blade Fuse Block

6 Circuits with Negative Bus and Cover

5025