Camper Power Notes

2018 Northern Lite 9’6” QSE Truck Camper

+

2015 Ford F350 SRW

Thomas Gilg aka SiletzSpey

Dec 14, 2019

Thomas' Truck Camper Use Case

Pre-conditions

- 2015 Ford F350 SRW pickup with camper package, 7-pin outlet, and 200A alternator
- 2018 NorthernLite 9'6" QSE camper with 7-pin aux power in, 100W PWM solar panel, and 30A-AC / 45A-DC shore power. No existing components are lithium ready, and many power wires are undersized ☹
- Mostly boondock on USFS, BLM, and Wildlife Refuge land
- Often take short/quick drives while boondocking in an area
- On long trips, often stay at an RV Park for a night every few days
- Always leave home with full batteries
- Do NOT want to deal with a noisy gas generator

User Requirements

- Be able to boondock for ~5 days in winter (10-40F)
- Be able to boondock for ~14 days in summer (>50F)
- Would like to top off batteries with a one-night RV Park stay
- Would like to top off batteries with one 8-hour drive day
- While boondocking, no need for microwave, air conditioner, or other heavy-draw devices
- While boondocking, would like to charge 2 laptop PCs off AC
- Would like to boondock in temperatures down to 10F outside
- Want reasonably accurate state-of-charge and time-left predictions for the sake of advanced warning, and time to react
- It is acceptable to have to prewarm the batteries prior to charging
- Want a safe, robust and unified system for charging the camper batteries off shore, solar and alternator sources

Upgrade Plan vs Use Case Goals

Upgrade Plan

- 200Ah LFP (from 100Ah FLA)
  - BattleBorn and some others over-size internally so that 100% of the marketed capacity can be safely used
  - When not over-sized internally, assume 90% usable
- 200W MPPT + LFP-profiled solar (from 100W PWM + FLA-profiled)
- 45A LFP-profiled shore (from 45A FLA-profiled)
- 30-60A LFP-profiled alternator (from ~10A FLA-profiled via 7-pin)
  - Without a DC-DC LFP charger, a 13.9V alternator will only charge an LFP to 70-90% capacity
  - Without a DC-DC LFP charger, even less LFP charging will occur when “smart alternators” reduce their output
- Upsize all wires
- Run dedicated higher-current wires to camper, bypassing 7-pin

Power Reduction Options

- When just a guy's trip, can conserve heat
- Can cut 12Ah/day by cutting Jenson media center and DVD watching

Note – despite the appearance of exact math and perfect charging/discharging rates here, it’s all rough estimates

Raw Calculations

- **Jan @ 10F** – 5 Days Winter Boondocking
  - tbd – likely marginal, even with dialing-down thermostat from comfy levels below
- **Nov @ 32F** – 5 Days Winter Boondocking
  - 57Ah daily LFP needed
    - 65Ah draw, 66% of estimated **12Ah recovery** off 200W solar
    - Furnace alone – 30Ah for 4hr@70F + 10hr@60F + 6hr@50F
  - 5-days boondocking – can’t do 285Ah off batteries/solar
  - 5-days boondocking with 3hr alt @ 30A – can do with 5Ah spare
  - 3-days boondocking – can do with 29Ah spare
- **Mar @ 32F** – 5 Days Winter Boondocking
  - 42Ah daily LFP need
    - 65Ah draw, 66% of estimated **33Ah recovery** off 200W solar
    - Furnace – 30Ah for 4hr@70F, 10hr@60F, 6hr@50F
  - 5-days boondocking – can almost do
  - 5-days boondocking with 1hr alt @ 30A – can do with 20Ah spare
  - 4-day boondocking – can do with 32Ah spare
- **Jun @ 50F** – 14 Days Summer Boondocking
  - 9Ah daily LFP need
    - 50Ah draw?, 66% 62Ah solar recovery 200W solar
    - Furnace – 15Ah ?
  - 14-days boondocking – can do with 74Ah spare

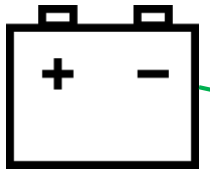
Thomas Gilg – Dec 14, 2019

NL Truck Camper OEM Power Overview

Based only on a 2018 9'6" QSE so far

Shore AC
120VAC / 30A

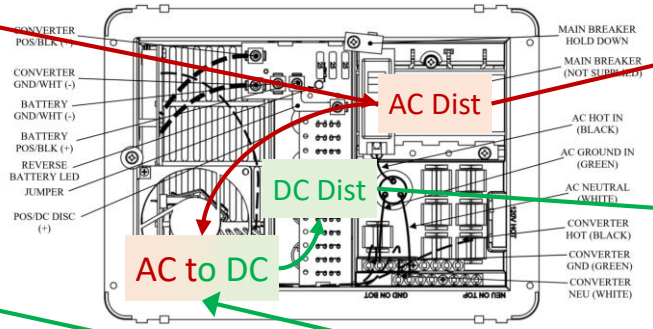
Truck Battery / Alternator
2015 F350 XLT 122VDC/200A + FLA



Camper Solar
12VDC / 95W (6A peak)

Camper Progressive Dynamics Inteli-Power

Shore AC IN, AC Breakers & Dist.,
AC Charger to DC-Battery, DC Fuses & Dist.
PD4045/60 (FLA/GEL)



Alt actually via PDI box?

- Truck isolation and ~25A thermal fuse (F350)
- Long 10ga wire to 7-pin outlet by Ford
- Med 10ga 7-pin umbilical to camper
- Med 10ga wire to camper battery by NL
- **~5A 7-pin charging with 10ga wires**
- ~15A 7-pin charging if 4ga upgrade

- **~15A charging with long 10ga NL wires ?**
- ~40A charging if 4ga upgrade

Camper Enerwatt Solar Regulator

DC-Solar to DC-Battery Charger
EWC-30 (PWM FLA/GEL not LiFePO4)

- **0-6 amps charging**

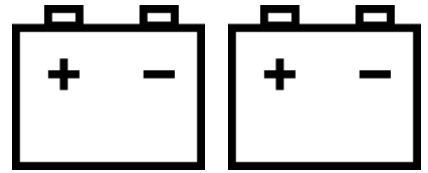
AC Devices

- Fridge on AC
- Water Heater on AC
- Microwave
- Air Conditioner
- AC Outlets

DC Devices

- Fridge Control on Propane
- Water Heater Control on Propane
- Furnace Fan/Control on Propane
- Exhaust Vents and Fans
- Water Pump
- USB Outlets
- TV
- Lights

Camper Battery
(FLA from Dealer)



DC Devices Direct Off Batteries

- Breaker 1 – "E.J." Jacks Controller$_{\text{green thick}}$
- Breaker 2 – "Fridge"$_{\text{black}}$ + Radio$_{\text{blue}}$ + DTV Ant?$_{\text{black}}$
- Breaker 3 – "Battery"$_{\text{black thin}}$
- Breaker 4 – "Solar"$_{\text{black thin}}$
- Breaker 5 – Battery Parallel$_{\text{black thin}}$
- Somehow somewhere - Power Awning**?**

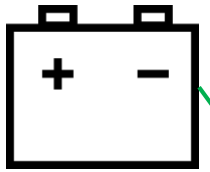
Thomas Gilg – Dec 14, 2019

NL Truck Camper Lithium Upgrade – Option #1 most likely to do

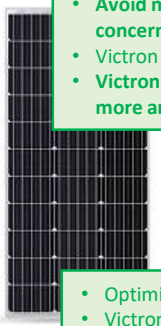
Based only on a 2018 9'6" QSE so far, required switches and fusing not shown

Shore AC
120VAC / 30A

Truck Battery / Alternator
2015 F350 XLT 122VDC/200A + FLA



Camper Solar +New Panel
12VDC / ~200W (12A peak)

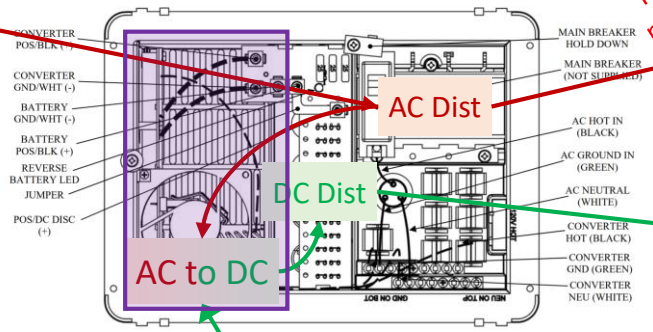


- Optimized LI charging
- Slower 30A charge rate
- **Avoid many high-amp concerns**
- Victron – can BT monitor
- **Victron – can stack for more amps, 30A+30A**

- Optimized LI charging
- Victron – BT monitor
- Handles 3 100W panels

(Upgrade) Camper Progressive Dynamics Inteli-Power

Shore AC IN, AC Breakers & Dist.,
AC Charger to DC-Battery, DC Fuses & Dist.
PD4045LI/60LI (LiFePO4) $212/$272



Rumor to chase – PDI LI module may not come off bulk like Victron

- Call PDI to see if my cage can handle 60A LI upgrade

(New) 2/0 alt-to-NL $x
(New) 4ga within NL $x

(Upgrade) 4ga within NL $x

(New) Victron Orion-Tr Smart

DC-DC 30A$_{6ga\ terminals}$ $263

(New) Victron SmartSolar

MPPT 100V-PV 20A$_{10ga\ terminals}$ $157

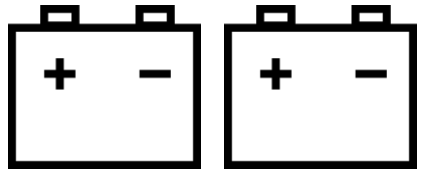
(New) Victron Monitor Premium Features

All Amps In/Out, Est. Run-time, Alarms,
Batt Volts, Batt SOC, Batt Temp, Ext Relay Ctrls
BMV-712 + Temp Probe $227

(New) Victron Battery Protect

BP 12/24V 100A $59

Camper Battery
(New) BB, RELiON-LT or LB-LT
$1500 - $2600



AC Devices

- Fridge on AC
- Water Heater on AC
- Microwave
- Air Conditioner
- AC Outlets

DC Devices

- Fridge Control on Propane
- Water Heater Control on Propane
- Furnace Fan/Control on Propane
- Exhaust Vents and Fans
- Water Pump
- USB Outlets
- TV
- Lights
- **(Moved Off Batt)** Fridge if fully on DC
- **(Moved Off Batt & Switch)** Radio + DTV Ant.

DC Devices Off Batteries

- Jack Controller, Power Awning?

High-amp alt. concerns – high amps taking 10ga return ground loops, low rpm alternator overheating, overloading battery #1 if battery #2 BMS goes offline, combined shore+alt+solar exceeding 0.3C – 0.5C recommended charge rates, undervoltage VSR/combiner approaches only charging LI to 70-80%, …

Thomas Gilg – Dec 14, 2019

BattleBorn 200Ah
Portrait GC2|GC2 $2100

10.32d" x 14.72w" footprint, 11h"

V Battery Protect
BP|100A $59

V SmartSolar
MPPT 100|20A$_{10ga}$ $158

V Orion-Tr Smart
12|12-30A$_{6ga}$ $263

Shore AC EMS (Prior ToDo)
Progressive Industries 30A InHand

Determine Truck-Camper Spacing & Placements

Phillips Dual Connector
15-326/336 100A$_{4ga}$ $114+

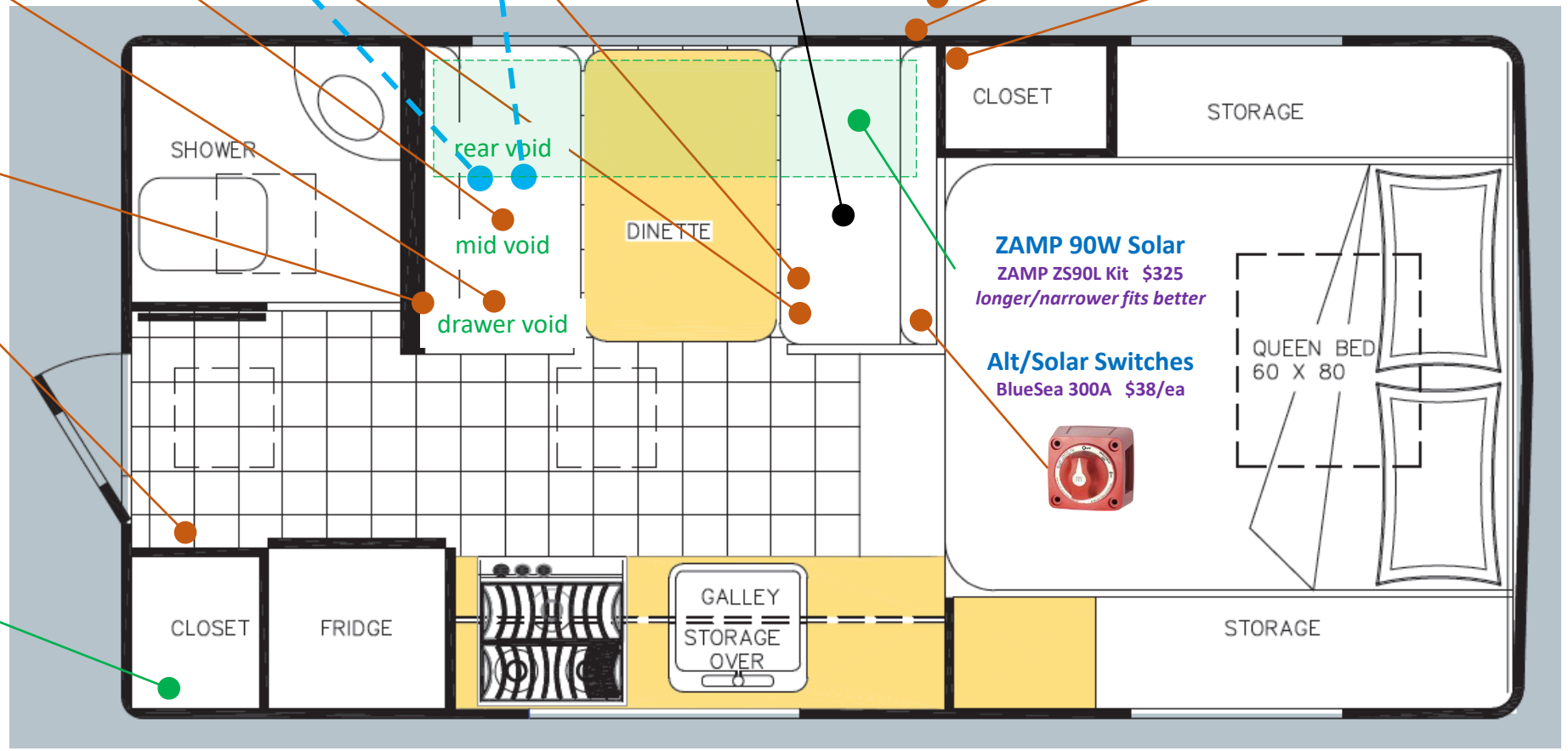
Solar Entry Gland
model tbd

V Power Monitor
BMV-712 + Temp $227

Determine How to Re-use or Move

NL-Factory Master Battery Switch

Detail to chase – voltage diff between existing and ZAMP panels. For parallel, cannot exceed ~2V



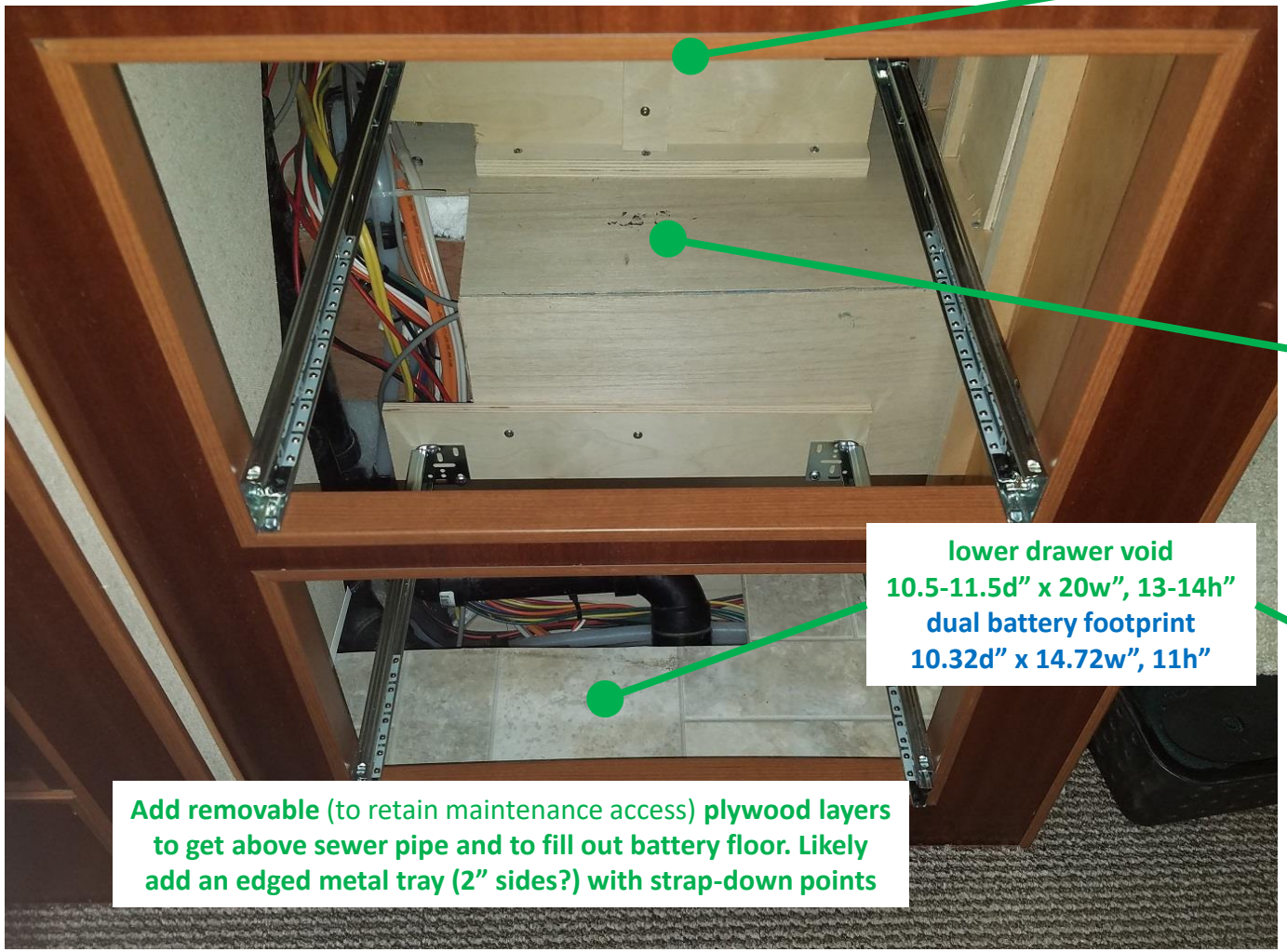
Battery Compartment with Breakers 1..5

- Repurpose for non-battery needs/storage
- (tbd) Move/refuse B1 "Jacks" to PDI
- (tbd) Move/refuse B2 "Fridge/Radio/Ant" to PDI
- Pull B3 "Battery", or upgrade wire if keeping B1/B2
- Pull B4 "Solar", see new solar wiring
- Pull B5 "Battery Parallel", not needed

- Somehow somewhere - Power Awning**?**

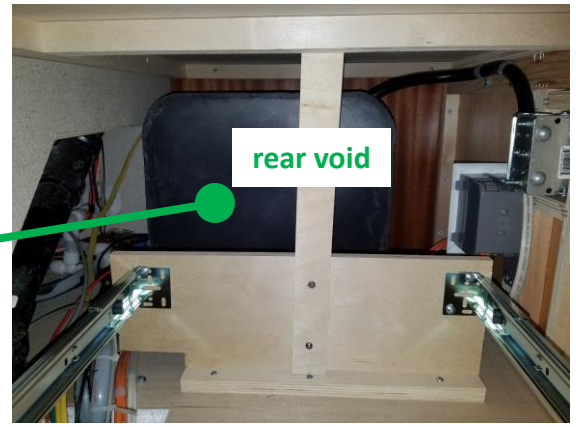
Thomas Gilg – Dec 14, 2019

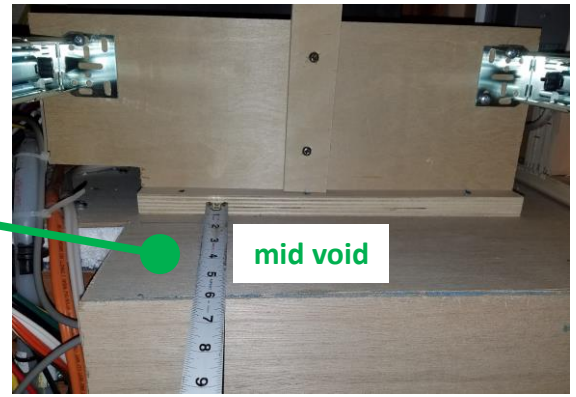
Lower Drawer Sacrifice

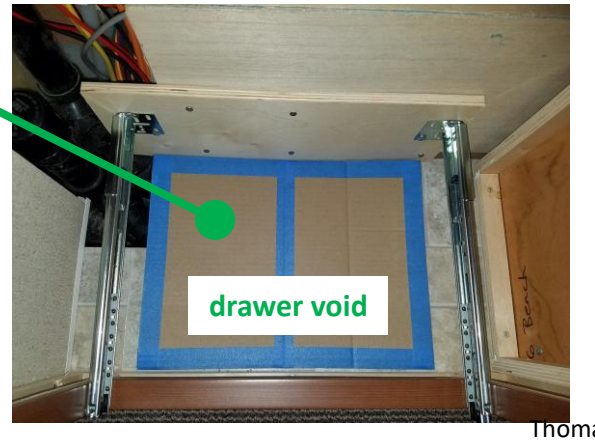


Add removable (to retain maintenance access) **plywood layers to get above sewer pipe and to fill out battery floor. Likely add an edged metal tray (2” sides?) with strap-down points**

lower drawer void
10.5-11.5d” x 20w”, 13-14h”
dual battery footprint
10.32d” x 14.72w”, 11h”







Gregory Parker
Zamp install

Battery Placement Options

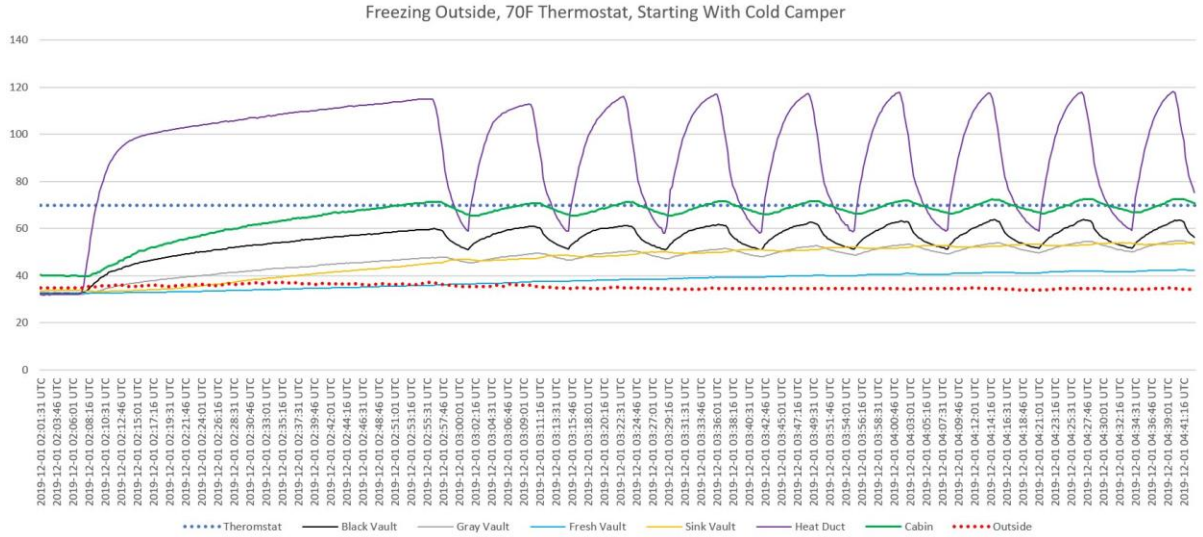
- Under dinette benches (preferred)
  - Batteries under rear bench tbd. Need to pull plywood and check space
  - Semi-warm due to nearby 2” duct
  - Controllers under front bench, all existing/new DC power points within 6 feet
- Under dinette table (most likely)
  - Batteries in new wood boxes below table. Install boxes while re-doing carpet
  - Good-warm due to being in-cabin. Will take some leg space
  - Controllers under front bench, all existing/new DC power points within 4 feet
- In existing battery compartment
  - Unheated, hence low battery temp concern in winter
  - Really no nearby places for new controllers
  - On opposite corner from truck power in and DC distribution panel
  - Likely some ~10+ foot wire runs back-and-forth (i.e. 20+ foot)

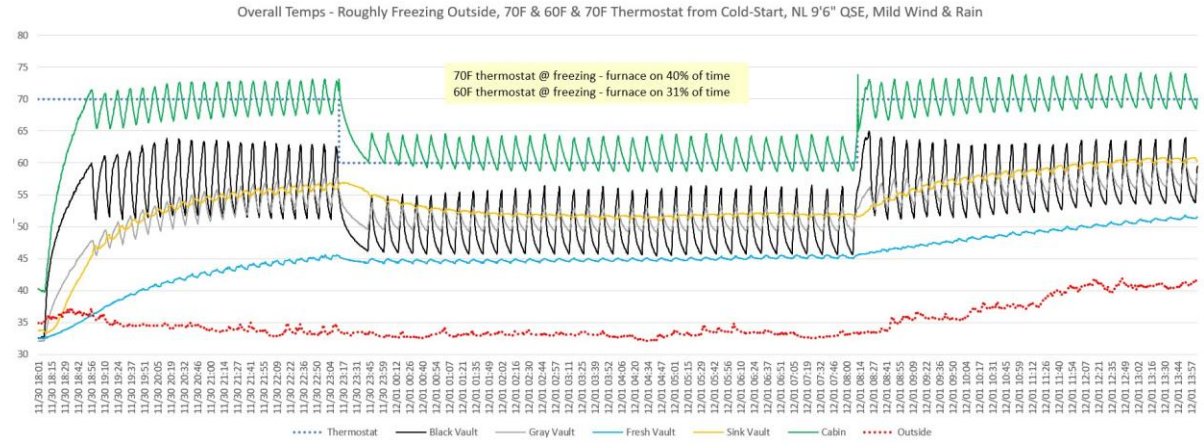
Philips Dual Socket Plug/Connector
- 4ga connectors
- 100A continuous rating
- 200A surge rating
- p/n 15-326 and 15-336

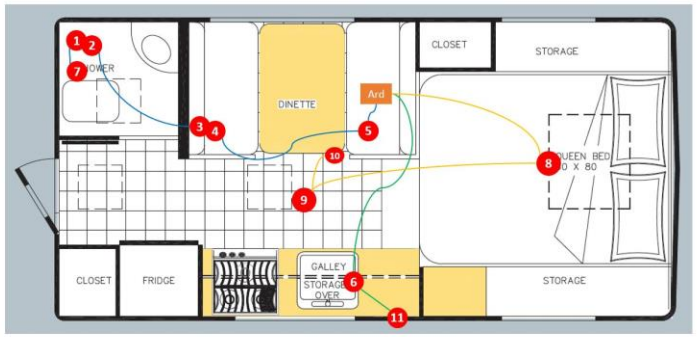
Phillips QCS2 Plug/Connector
- New w/o amps specs
- 4ga and 2ga versions

Furnace & NL Monitoring

shared with Northern Lite Truck Camper Enthusiasts group on Facebook



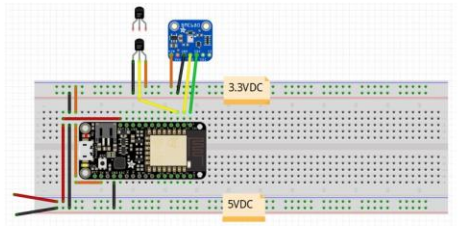




1) Black vault down-low air
2) Black tank surface at 1/4 full position *
3) Gray vault down-low air
4) Fiberglass inner surface near gray vault **
5) Fresh vault down-low air
6) Sink vault air
7) Heater vent output (using 1 of 2 two-inch basement vents) ***
8) Bedroom head-high air TO BE WIRED
9) Cabin head-high air
10) Cabin ankle-high air TO BE WIRED
11) Outside air circa propane vent ****

** See water thermal-mass aspects*
*** See surface v free air diffs, consequences for water line mounts*
**** Mostly to see propane furnace on/off*
***** Minor concern about propane tank cooling effects*

Sensors equalized to +/- 0.1F of each other, about 0.1F steps, about +/- 1.0F accuracy over well below freezing to near boiling temp



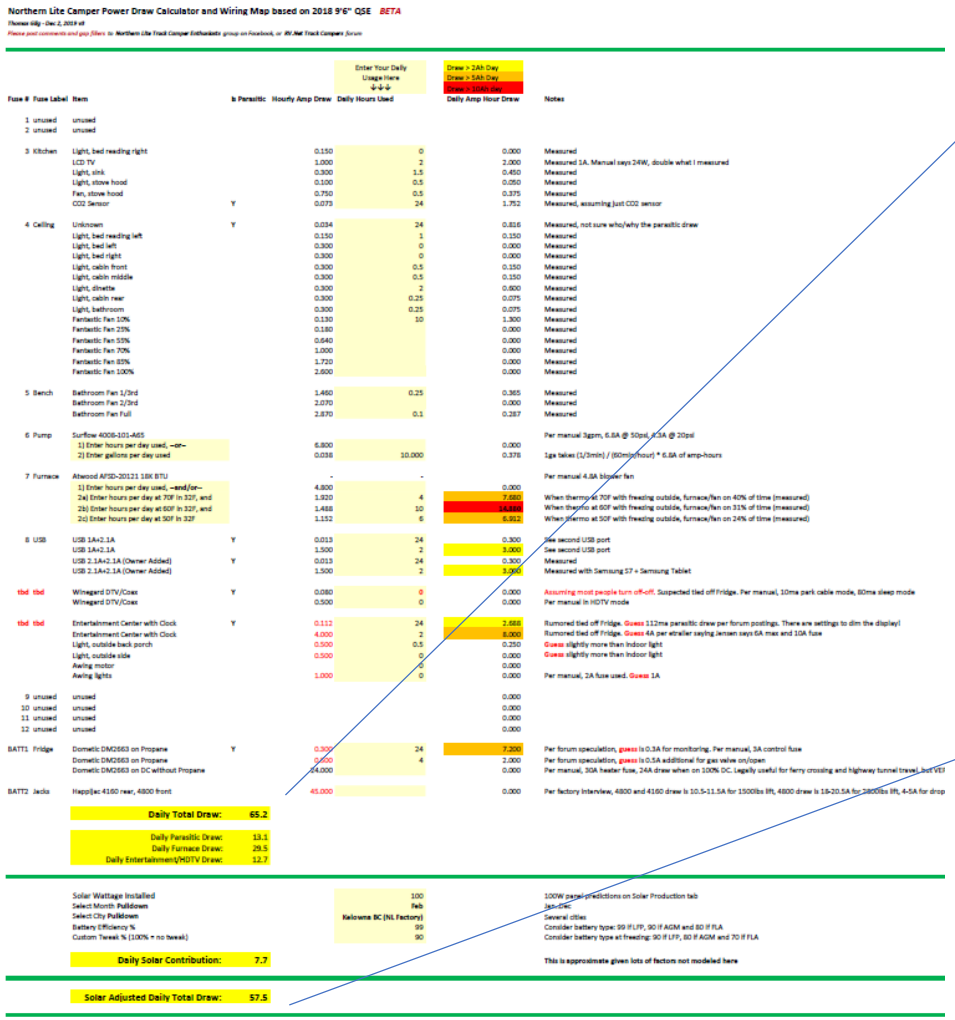
Sensors
- DS18B20 temp sensors x11
- BME680 for humidity, barometric, altitude and VOC-gas sensing x1
- Simple low-voltage 24ga wires around camper

ESP8266 Arduino
- WiFi to home LAN
- Sensor data streamed to Adafruit MQTT Service every 15 seconds
- Live MQTT dashboards
- Data download to MS-Excel for better analysis and graphing

When Freezing Outside
- 70F thermostat : furnace/fan on 40% of time @ 4.8A
- 60F thermostat : furnace/fan on 31% of time @ 4.8A
- 50F thermostat : furnace/fan on 24% of time @ 4.8A

NL Power Calculator

shared with Northern Lite Truck Camper Enthusiasts group on Facebook



Northern Lite Camper Power Draw Calculator and Wiring Map based on 2018 9'6" QSE *BETA*

Fuse #	Fuse Label	Item	Is Parasitic	Hourly Amp Draw	Daily Hours Used	Daily Amp Hour Draw	Notes
1	unused	unused					
2	unused	unused					
3	Kitchen	Light, bed reading right		0.150	0	0.000	Measured
		LCD TV		1.000	2	2.000	Measured 1A. Manual says 24W, double what I measured
		Light, sink		0.300	1.5	0.450	Measured
		Light, stove hood		0.100	0.5	0.050	Measured
		Fan, stove hood		0.750	0.5	0.375	Measured
		CO2 Sensor	Y	0.073	24	1.752	Measured, assuming just CO2 sensor
4	Ceiling	Unknown	Y	0.034	24	0.816	Measured, not sure who/why the parasitic drew
		Light, bed reading left		0.150	1	0.150	Measured
		Light, bed left		0.300	0	0.000	Measured
		Light, bed right		0.300	0	0.000	Measured
		Light, cabin front		0.300	0.5	0.150	Measured
		Light, cabin middle		0.300	0.5	0.150	Measured
		Light, dinette		0.300	2	0.600	Measured
		Light, cabin rear		0.300	0.25	0.075	Measured
		Light, bathroom		0.300	0.25	0.075	Measured
		Fantastic Fan 10%		0.130	10	1.300	Measured
		Fantastic Fan 25%		0.180		0.000	Measured
		Fantastic Fan 55%		0.640		0.000	Measured
		Fantastic Fan 70%		1.000		0.000	Measured
		Fantastic Fan 85%		1.720		0.000	Measured
		Fantastic Fan 100%		2.600		0.000	Measured
5	Bench	Bathroom Fan 1/3rd		1.460	0.25	0.365	Measured
		Bathroom Fan 2/3rd		2.070		0.000	Measured
		Bathroom Fan Full		2.870	0.1	0.287	Measured
6	Pump	Surflow 4008-101-A65					Per manual 3gpm, 6.8A @ 50psi, 4.3A @ 20psi
		1) Enter hours per day used, –or–		6.800		0.000	
		2) Enter gallons per day used		0.038	10.000	0.378	1ga takes (1/3min) / (60min/hour) * 6.8A of amp-hours
7	Furnace	Atwood AFSD-20121 18K BTU		-	-		Per manual 4.8A blower fan
		1) Enter hours per day used, –and/or–		4.800		0.000	
		2a) Enter hours per day at 70F in 32F, and		1.320	4	7.680	When thermo at 70F with freezing outside, furnace/fan on 40% of time (measured)
		2b) Enter hours per day at 60F in 32F, and		1.488	10	14.880	When thermo at 60F with freezing outside, furnace/fan on 31% of time (measured)
		2c) Enter hours per day at 50F in 32F		1.152	6	6.912	When thermo at 50F with freezing outside, furnace/fan on 24% of time (measured)
8	USB	USB 1A+2.1A	Y	0.013	24	0.300	See second USB port
		USB 1A+2.1A		1.500	2	3.000	See second USB port
		USB 2.1A+2.1A (Owner Added)	Y	0.013	24	0.300	Measured
		USB 2.1A+2.1A (Owner Added)		1.500	2	3.000	Measured with Samsung S7 + Samsung Tablet
tbd	tbd	Winegard DTV/Coax	Y	0.080	0	0.000	Assuming most people turn off-off. Suspected tied off fridge. Per manual, 10ma park cable mode, 80ma sleep mode
		Winegard DTV/Coax		0.500	0	0.000	Per manual in HDTV mode
tbd	tbd	Entertainment Center with Clock	Y	0.112	24	2.688	Rumored tied off Fridge. Guess 112ma parasitic draw per forum postings. There are settings to dim the display!
		Entertainment Center with Clock		4.000	2	8.000	Rumored tied off Fridge. Guess 4A per etrailer saying Jensen says 6A max and 10A fuse
		Light, outside back porch		0.500	0.5	0.250	Guess slightly more than indoor light
		Light, outside side		0.500	0	0.000	Guess slightly more than indoor light
		Awing motor			0	0.000	
		Awing lights		1.000	0	0.000	Per manual, 2A fuse used. Guess 1A
9	unused	unused				0.000	
10	unused	unused				0.000	
11	unused	unused				0.000	
12	unused	unused				0.000	
BATT1	Fridge	Dometic DM2663 on Propane	Y	0.300	24	7.200	Per forum speculation, guess is 0.3A for monitoring. Per manual, 3A control fuse
		Dometic DM2663 on Propane		0.500	4	2.000	Per forum speculation, guess is 0.5A additional for gas valve on/open
		Dometic DM2663 on DC without Propane		14.000		0.000	Per manual, 30A heater fuse, 24A draw when on 100% DC. Legally useful for ferry crossing and highway tunnel travel, but VEI
BATT2	Jacks	Happijac 4160 rear, 4800 front		45.000		0.000	Per factory interview, 4800 and 4160 draw is 10.5-11.5A for 15000lbs lift, 4800 draw is 18-20.5A for 24000lbs lift, 4-5A for drop

Daily Total Draw:	65.2
Daily Parasitic Draw:	13.1
Daily Furnace Draw:	29.5
Daily Entertainment/HDTV Draw:	12.7

Solar Wattage Installed	100	100W panel predictions on Solar Production tab
Select Month **Pulldown**	Feb	Jan-Dec
Select City **Pulldown**	Kelowna BC (NL Factory)	Several cities
Battery Efficiency %	99	Consider battery type: 99 if LFP, 90 if AGM and 80 if FLA
Custom Tweak % (100% = no tweak)	90	Consider battery type at freezing: 90 if LFP, 80 if AGM and 70 if FLA
Daily Solar Contribution:	7.7	This is approximate given lots of factors not modeled here

Solar Adjusted Daily Total Draw:	57.5

Daily Total Draw:	**65.2**
Daily Parasitic Draw:	13.1
Daily Furnace Draw:	29.5
Daily Entertainment/HDTV Draw:	12.7

Solar Wattage Installed	200
Select Month **Pulldown**	**Feb**
Select City **Pulldown**	**Seattle WA (Foggy)**
Battery Efficiency %	99
Custom Tweak % (100% = no tweak)	90
Daily Solar Contribution:	**16.7**
Solar Adjusted Daily Total Draw:	**48.5**

Upshot With 200W Solar

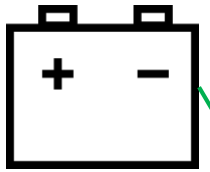
- Winter cold + poor solar = heavy dependency on batteries
- Summer warmth + great solar = almost break even

NL Truck Camper Lithium Upgrade – Option #2 nice mount + simple

Based only on a 2018 9'6" QSE so far

Shore AC
120VAC / 30A

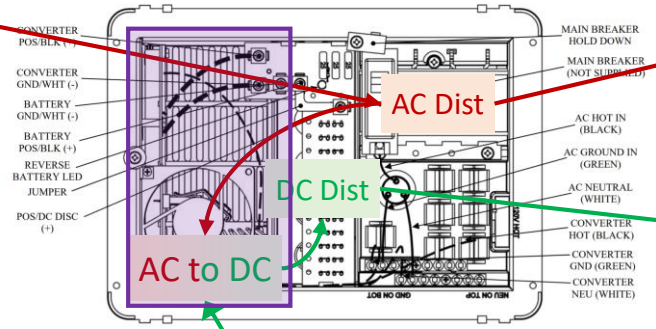
Truck Battery / Alternator
2015 F350 XLT 122VDC/200A + FLA



Camper Solar +New Panel
12VDC / ~200W (12A peak)

(Upgrade) Camper Progressive Dynamics Inteli-Power

Shore AC IN, AC Breakers & Dist.,
AC Charger to DC-Battery, DC Fuses & Dist.
PD4045LI/60LI (LiFePO4) $212/$272



(New) 2/0 alt-to-NL $x
(New) 4ga within NL $x

(Upgrade) 4ga within NL $x

(New) Redarc DC-DC + Solar

Truck DC-DC + MPPT Solar, Isolation,
50A Current Limiter Out
DCC50S BCDC1250D 50A$_{4\text{-}6ga\ rec}$ $486

- Optimized LI charging
- OK-ish 50A charge rate
- No configurability, no monitoring
- Redarc – always 50A out via available solar + supplemental alt
- **Redarc - water/dust proof, fan-less**

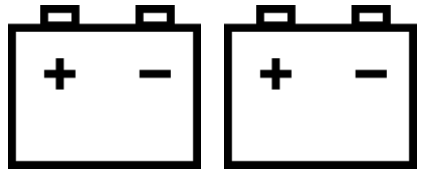
(New) Victron Monitor Premium Features

All Amps In/Out, Est. Run-time, Alarms,
Batt Volts, Batt SOC, Batt Temp, Ext Relay Ctrls
BMV-712 + Temp Probe $227

(New) Victron Battery Protect

BP 12/24V 220A $97

Camper Battery
(New) BB, RELiON-LT or LB-LT
$1500 - $2600



AC Devices

- Fridge on AC
- Water Heater on AC
- Microwave
- Air Conditioner
- AC Outlets

DC Devices

- Fridge Control on Propane
- Water Heater Control on Propane
- Furnace Fan/Control on Propane
- Exhaust Vents and Fans
- Water Pump
- USB Outlets
- TV
- Lights
- **(Moved Off Batt)** Fridge if fully on DC
- **(Moved Off Batt & Switch)** Radio + DTV Ant.

DC Devices Off Batteries

- Jack Controller, Power Awning?

High-amp alt. concerns – high amps taking 10ga return ground loops, low rpm alternator overheating, overloading battery #1 if battery #2 BMS goes offline, combined shore+alt+solar exceeding 0.3C – 0.5C recommended charge rates, undervoltage VSR/combiner approaches only charging LI to 70-80%, …

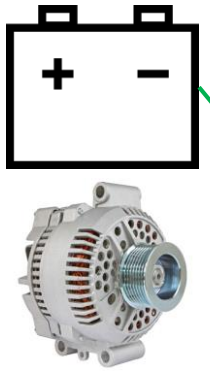
Thomas Gilg – Nov 27, 2019

NL Truck Camper Lithium Upgrade – Option #3 max alt. amps strategy

Based only on a 2018 9'6" QSE so far

Shore AC
120VAC / 30A

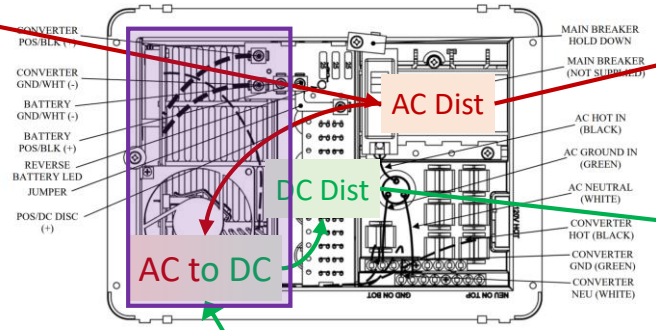
Truck Battery / Alternator
2015 F350 XLT 122VDC/200A + FLA



Camper Solar +New Panel
12VDC / ~200W (12A peak)

(Upgrade) Camper Progressive Dynamics Inteli-Power

Shore AC IN, AC Breakers & Dist.,
AC Charger to DC-Battery, DC Fuses & Dist.
PD4045LI/60LI (LiFePO4) $212/$272



(New) 2/0 alt-to-NL $x
(New) 4ga within NL $x

(Upgrade) 4ga within NL $x

(New) Sterling 1260

DC-DC 60A$_{4\text{-}6ga\ rec}$ $408

- Optimized LI charging
- **OK-ish 60A charge rate**
- Drip proof

(New) Victron SmartSolar

MPPT 100V-PV 20A$_{10ga\ terminals}$ $157

- Optimized LI charging
- Victron – BT monitor
- Handle 3 100W panels

(New) Victron Monitor Premium Features

All Amps In/Out, Est. Run-time, Alarms,
Batt Volts, Batt SOC, Batt Temp, Ext Relay Ctrls
BMV-712 + Temp Probe $227

(New) Victron Battery Protect

BP 12/24V 220A $97

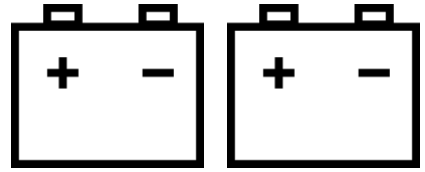
AC Devices

- Fridge on AC
- Water Heater on AC
- Microwave
- Air Conditioner
- AC Outlets

DC Devices

- Fridge Control on Propane
- Water Heater Control on Propane
- Furnace Fan/Control on Propane
- Exhaust Vents and Fans
- Water Pump
- USB Outlets
- TV
- Lights
- **(Moved Off Batt)** Fridge if fully on DC
- **(Moved Off Batt & Switch)** Radio + DTV Ant.

Camper Battery
(New) BB, RELiON-LT or LB-LT
$1500 - $2600



DC Devices Off Batteries

- Jack Controller, Power Awning?

High-amp alt. concerns – high amps taking 10ga return ground loops, low rpm alternator overheating, overloading battery #1 if battery #2 BMS goes offline, combined shore+alt+solar exceeding 0.3C – 0.5C recommended charge rates, undervoltage VSR/combiner approaches only charging LI to 70-80%, …

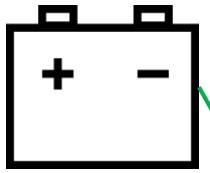
Thomas Gilg – Nov 27, 2019

NL Truck Camper Lithium Upgrade – Option #4

Based only on a 2018 9'6" QSE so far

Shore AC
120VAC / 30A

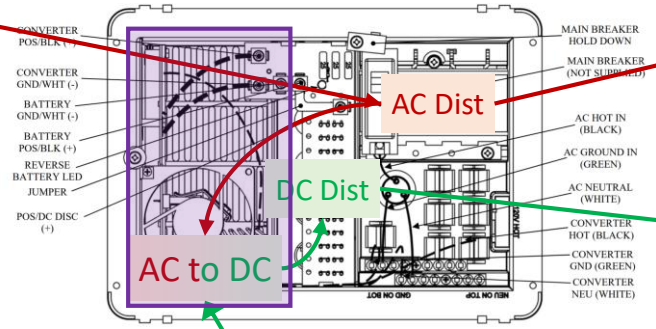
Truck Battery / Alternator
2015 F350 XLT 122VDC/200A + FLA



Camper Solar +New Panel
12VDC / ~200W (12A peak)

(Upgrade) Camper Progressive Dynamics Inteli-Power

Shore AC IN, AC Breakers & Dist.,
AC Charger to DC-Battery, DC Fuses & Dist.
PD4045LI/60LI (LiFePO4) $212/$272



(New) 2/0 alt-to-NL $x
(New) 4ga within NL $x

(Upgrade) 4ga within NL $x

(New) Renogy DC-DC + Solar

Truck DC-DC + MPPT Solar, Isolation,
50A Current Limiter Out
DCC50S 50A$_{4\text{-}6ga\ rec}$ $299

- Optimized LI charging
- OK-ish 50A charge rate
- Renogy – 25VIN max, might prohibit serial solar
- Renogy – only 25A alt + 25A solar if both active
- Renogy – not highly regarded by some (?)
- Renogy – supports solar to truck battery charging

(New) Victron Monitor Premium Features

All Amps In/Out, Est. Run-time, Alarms,
Batt Volts, Batt SOC, Batt Temp, Ext Relay Ctrls
BMV-712 + Temp Probe $227

(New) Victron Battery Protect

BP 12/24V 220A $97

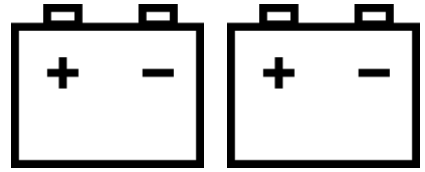
AC Devices

- Fridge on AC
- Water Heater on AC
- Microwave
- Air Conditioner
- AC Outlets

DC Devices

- Fridge Control on Propane
- Water Heater Control on Propane
- Furnace Fan/Control on Propane
- Exhaust Vents and Fans
- Water Pump
- USB Outlets
- TV
- Lights
- **(Moved Off Batt)** Fridge if fully on DC
- **(Moved Off Batt & Switch)** Radio + DTV Ant.

Camper Battery
(New) BB, RELiON-LT or LB-LT
$1500 - $2600



DC Devices Off Batteries

- Jack Controller, Power Awning?

High-amp alt. concerns – high amps taking 10ga return ground loops, low rpm alternator overheating, overloading battery #1 if battery #2 BMS goes offline, combined shore+alt+solar exceeding 0.3C – 0.5C recommended charge rates, undervoltage VSR/combiner approaches only charging LI to 70-80%, …

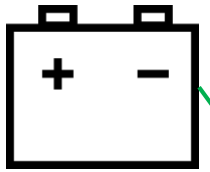
Thomas Gilg – Nov 27, 2019

NL Truck Camper Lithium Upgrade – Option #5 least likely to do

Based only on a 2018 9'6" QSE so far

Shore AC
120VAC / 30A

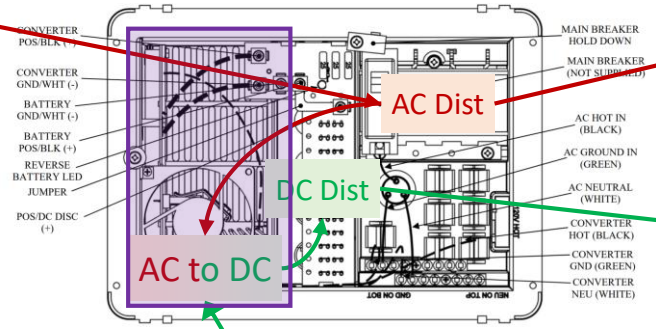
Truck Battery / Alternator
2015 F350 XLT 122VDC/200A + FLA



Camper Solar +New Panel
12VDC / ~200W (12A peak)

(Upgrade) Camper Progressive Dynamics Inteli-Power

Shore AC IN, AC Breakers & Dist.,
AC Charger to DC-Battery, DC Fuses & Dist.
PD4045LI/60LI (LiFePO4) $212/$272



(New) 2/0 alt-to-NL $x
(New) 4ga within NL $x

(Upgrade) 4ga within NL $x

AC Devices

- Fridge on AC
- Water Heater on AC
- Microwave
- Air Conditioner
- AC Outlets

DC Devices

- Fridge Control on Propane
- Water Heater Control on Propane
- Furnace Fan/Control on Propane
- Exhaust Vents and Fans
- Water Pump
- USB Outlets
- TV
- Lights
- **(Moved Off Batt)** Fridge if fully on DC
- **(Moved Off Batt & Switch)** Radio + DTV Ant.

(New) Victron Batt. Combiner

Cyrix-Li-ct 12/24-120$_{AM\ Solar\ 2ga\ rec}$ $76

- **Crude** and partial LI charging *rely on solar to top off, etc*
- Poor choice if smart alt. or dealing with voltage drops
- **FAST 100A+ charge rate**

(New) Victron Monitor Premium Features

All Amps In/Out, Est. Run-time, Alarms,
Batt Volts, Batt SOC, Batt Temp, Ext Relay Ctrls
BMV-712 + Temp Probe $227

(New) Victron Battery Protect

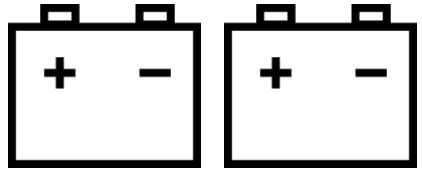
BP 12/24V 220A $97

(New) Victron SmartSolar

MPPT 100V-PV 20A$_{10ga\ terminals}$ $157

- Optimized LI charging
- Victron – BT monitor
- Handle 3 100W panels

Camper Battery
(New) BB, RELiON-LT or LB-LT
$1500 - $2600



DC Devices Off Batteries

- Jack Controller, Power Awning?

High-amp alt. concerns – high amps taking 10ga return ground loops, low rpm alternator overheating, overloading battery #1 if battery #2 BMS goes offline, combined shore+alt+solar exceeding 0.3C – 0.5C recommended charge rates, undervoltage VSR/combiner approaches only charging LI to 70-80%, …

Thomas Gilg – Nov 27, 2019