Understanding the Travato Pure3/Volta System
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The goal of this document is to give people a better understanding of the Lithium Travato (GL and KL) and the Pure3 Power Management system by Volta. A certain amount of technical knowledge is necessary to fully understand something this complex plus a working knowledge of RV systems is assumed. Winnebago (WGO) has been updating components as they become available so a GL/KL manufactured in April may have different components from one manufactured in October. These changes are usually what are called "Running Line Changes" and they don't announce if or when these changes will take place. That makes documenting features somewhat challenging since it not always possible to pin down a change to a particular model year.

One excellent source of information about the Travato is the Facebook Travato Owners and Wannabees group:
https://www.facebook.com/groups/466687086845930
And the TOWB Resource page:
https://travato.group/#

Winnebago has several educational and promotional videos on the Pure3/Volta system at:
https://www.youtube.com/user/winnebagoind/search?query=pure3

There is an excellent Conceptual Power and Plumbing Systems Diagram provided by Bob Bedell on the TOWB Resource page and on the last page of this document. This diagram will help you better understand how things work together.

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RV Electric Basics

We have to start with a bit of a primer on electricity and RV electrical systems. There is a huge amount of information on the Internet if you want to do some reading but here are a few things that should help get you started. Feel free to skip over any of the next few bits if you know them already. Just be aware that the systems we are dealing with may be different from what you have been used to in the past.

In an RV, we deal with two "types" of electricity, Alternating Current and Direct Current (AC and DC). AC power is what you have at home to run things like lights and appliances. AC may be seen referenced 110V, 115V or 120V (Vac) but you may also find 240Vac at home to run things like a dryer. A 120Vac line normally has three connectors which are referred to as Hot, Neutral (Common), and Ground. The most common type of electricity in a small RV is 12Vdc and powers the lights and things that work without need for a shore line or generator. A DC line has two connectors, Positive and Negative (Ground). DC is also what is produced by that battery in your flashlight and is stored in your chassis and coach (house) batteries.

Some people see the big plug on the shore power cord on a Travato and think it is a 240Vac line, but it's only 120Vac. At campgrounds there should never be any confusion because the 50A 240Vac outlets larger RV's use have 4 prongs while the 30A 120Vac outlets we use have three prongs. But on very rare occasions you may find an outlet at someone's house that is a three prong 240Vac outlet so just know what it is you are plugging into.

To understand the terms Volts and Amps, the analogy of a water hose is often used. Voltage is the amount of pressure the water is providing and Amperage is the volume of water. The other term we use a lot is Wattage which relates to an amount of work. In math terms Volts x Amps = Watts and it is at this point where it can get a bit confusing because most RV owners are used to talking about things in terms of Amperage load and the Voltage level of the battery while with the Pure3/Volta system we generally deal with Wattage load and often ignore Voltage. If your eyes are starting to glaze over a bit, don't worry, even the more tech savvy people can get a bit confused. Think of it this way, discussing things in terms of Amp load may make sense for a 12Vdc system, but the Pure3/Volta system is involved with both AC and DC and actually "transforms" power back and forth between those two and at 3 different voltages.

On a similar note, Amps don't work well for us because 1A @ 12Vdc and 1A @ at 120Vac are very different things. If you convert this to Wattage you will see that these two things represent 12 Watts in the first case and 120 Watts in the second. Also, appliances often have their electrical usage listed in Watts which makes it easier than having to constantly convert things back and forth.

It is common to speak of the DC voltages in the Pure3/Volta system as 48Vdc and 12Vdc but the actual voltages are upwards of 58Vdc and 14.4Vdc. For the most part, we will stick with the common terms but in some cases the real numbers are important and will be used. Similarly, you sometimes see AC current referred to as 110V or 115V, but the generally accepted standard is 120Vac.

As an aside, you will also see the terms Amp Hour (AH or AHr) and Watt Hour (WH or WHr) used. For example, a standard Travato has two 100AH "deep cycle" batteries and 1 AH is a draw of 1 Amp for 1 Hr. I mention this only so you will be aware of what this refers to if you see it mentioned. Other than that, you don't really need to concern yourself with this.

What is so Special About the Pure3/Volta System?

Many Travato owners and prospective buyers still think in terms of the standard Travato with an AGM battery and think of Lithium as just another kind of battery. Also, many people think in terms of Lithium Ion batteries you buy in the store for consumer electronics or in terms of the kind of Lithium Iron Phosphate (LiFePO4) systems you see in other RV's or in DIY setups. Even Volta refers to their systems as Lithium Ion some places. Much of the "accepted knowledge" found on

the internet about Lithium batteries in RV's is based on the LiFePO4. While some of this carries over to the Pure3/Volta system, some of it does not.

The Pure3/Volta system uses automotive grade Lithium Nickel Manganese Cobalt Oxide (NMC) batteries. These batteries are a lot more durable and can handle higher voltages and more extremes of temperature than the types of Lithium battery systems found in most RVs (both DIY and commercial). Also, other RVs systems are 12Vdc systems while the Pure3/Volta system is 48Vdc (58Vcd max) and 58Vdc is about as close as you can get to a High Voltage rating while still being Low Voltage and that makes things more efficient. Think of it this way, for a 12Vdc system to produce 120Vac, you need to boost it by a factor of 10X so the currents (amps) are very high. For a 58Vdc system to get to 120Vac we are slightly over 2x boost. This means lower amperage which allows for smaller diameter (gauge) wires which will generate less heat and be more efficient as well.

The Pure3/Volta Travato is NOT better, or superior, or any other such term. It is a different way to travel. It is NOT the best solution for everyone. If you stay at campgrounds with electric the majority of time, then it's probably not going to be of any great value to you. All RV's involve the tradeoffs between cost and comfort, size and features and the addition of the Pure3/Volta system also involves a significant increase in cost.

The Pure3/Volta system is not an endless supply of electricity. The power pack has roughly 9 times (12 times for the 2020 NPE) the usable capacity as the two AGM's in a standard Travato, but it consumes more electricity during normal operation. In a standard T you cannot run the microwave or A/C without shore power or the generator, but neither of those things will drain your AGM, it will actually help top if off. However, if you have a standard Travato then you have a 1000W inverter which does drain the battery so you have to watch yourself or risk running that AGM battery down too far. In a TL, you can run almost any 120V appliance you can carry without needing shore power but you drain the battery to do it. So, just like with the inverter in the standard T, you have to pay attention to what you are doing or you may run the battery down quickly and it will take some time to get that charge back up again.

Components of the Pure3/Volta System

The Pure3/Volta System is a package with four major components; the Power Pack, the Inverter/Charger, the DC-DC Converter, and the 2nd Alternator. Some of these components have similar counterparts in the non-Lithium Travato's but some components are unique to Volta and some separate components in standard RV's are combined with others here.

The Lithium systems used in RV's are actually not a single battery; rather, they are a bunch of small batteries connected together and controlled by a Battery Management Unit (BMU). All larger Lithium batteries need some kind of BMU which can be fairly simple but it can also be quite complex (like the Volta). It's helpful to talk about the Pure3/Volta system as having "Storage Pack" or "Power Pack" rather than a battery. The BMU is a part of the Power Pack and it controls all power coming in and going out of the batteries. It determines if, when, and how the batteries charge and discharge and also takes into consideration a variety of environmental factors. This whole power pack is sealed and surrounded by padding, insulation, and a powered air duct which connects to the cabin to circulate room air.

The Inverter/Charger serves three functions: DC-AC Inverter, Charge Controller, and Automatic Transfer Switch (ATS) so it may help to discuss these three things by function rather than one big black box starting with the ATS. An automatic transfer switch does just what the name implies. In a standard Travato the ATS routes power to the 120V breaker panel (all outlets and the AC, Microwave, and Truma heating elements) from shore power or the generator, depending on which one is available. It does basically the same thing in the Pure3/Volta system. Shore power comes into the Inverter/Charger which monitors it to see if there is an acceptable 120Vac source. If there is, then that power is routed to the 120Vac panel; otherwise the Inverter is responsible for providing the 120Vac power. The Charge Controller interfaces with the BMU to supply a charge when needed. Sources include shore power, solar, and the 2nd Alternator.

The Inverter side of the system transforms the 58Vdc power to 120Vac. This isn't a particularly new technology but the devices in use today are a lot more sophisticated than they were at one time. Today's larger RV inverters are almost all Pure Sine Wave inverters which produces extremely "pure" electricity suitable for powering electronics or any other function. The Inverter in the Pure3/Volta systems is a Magnum/Dimensions (Sensata Tech) 3600W inverter which is the equivalent of a 30A shore power outlet, so you can run anything you could if you were plugged into shore power. This is very different than the Inverter in the standard Travato's which have a 1000W inverter (also Pure Sine) which only powers a few 120Vac outlets but not the microwave or A/C.

If you are not connected to shore power then the Inverter provides all the 120Vac power in the coach using the 48Vdc power supply. The Inverter can be turned on and off via the control panel. It's up to the user to control this and the Inverter does consume some electricity and produce some heat so the best policy may be to get into the habit of turning it off when you aren't using it. If you hear a fan running under the jump seat in the GL or the foot of the passenger bed in the KL, that is the Inverter/Charger. The fan runs whenever the Inverter is on and may also run while the Charger is working.

Those things in the coach that don't require AC current run on 12Vdc current. That includes things like the roof vents, USB ports, lights, refrigerator, awning, Truma fan, etc. The DC-DC Converter has the job of transforming the 48Vdc power on the bus down to 12Vdc for the coach. Unlike the Inverter which you can turn on and off, this converter is running whenever the Pure3/Volta system is on. The Inverter and DC-DC Converter both draw power from the 48V DC bus (a bus is a common connection) which connects to the Power Pack.

There is a 2nd Alternator under the hood which provides power input for the Power Pack and the 48Vdc bus. This Alternator can put out DC electricity whenever the engine is running at greater than 1600RPM. Please refer to the section titled 2nd Alternator Charging for more on this.

Power Pack "Capacity" and the SoC (State of Charge) Dial

The box that the Pure3/Volta power pack is housed in has room for four battery modules. In the 2019/2020 Travato it contains 3 but the 2020 NPE has 4 which increases the capacity by 1/3 – more on that in a later section. Winnebago (WGO) uses a slightly more conservative value for the capacity than Volta does so it's rather hard to fine tune the actual numbers. Volta rates the power pack at 10,100W (~3,366W per module) with 9,100W usable while WGO says there are 8,700W usable so I will use that number.

The other factor in all of this is that a battery does not have a % full in the same way that a pitcher does. IOW, if a 5 gal bucket is 50% full, you know that it contains 2.5 gal. A battery is generally measured by voltage (which is what you see in a standard Travato) and the Pure3/Volta system is measured by the BMU using voltage plus something called a "shunt" that basically measures the current going in and the current coming out so the percentage is more of an approximation than an exact measurement. In other words, the BMU keeps track of what's going on and gives you a "forecast" of the power remaining. This can result in some variation from day to day as to how much draw 10% represents (because it "wobbles" a bit).

The whole Pure3/Volta system is turned on and off by way of the button next to the SoC "Speedometer" dial. This dial shows the Percent State of Charge (% SoC) and has a colored backlight to indicate the general SoC (Green, Yellow, Red). There are two different dials depending on what year Travato you have.

<u>2019 Travato SoC Dial with Color Overlay</u>

The SoC dial in the 2019 goes from 0 to 100 representing the full capacity of the power pack (10,100 Watt) as Volta rates it. Owners will notice that the dial never goes all the way up to 100%, this is by design. Storing electricity in a battery produces a certain amount of heat and Lithium cells charge fairly quickly up to a point and then slow down. The closer to 100% the more heat which isn't good for the cells. If you are driving, then the system will get up to about 96% and

stay there until you stop. If you are connected to shore power, the system will charge up to about 95% and then stop charging until it drops down to about 88% and then start charging back up again. This is all controlled by the BMU and is designed to keep from over charging and to prevent the system from constantly short cycling (use a little then recharge) while connected to shore power.

There is a similar thing that happens at the lower end. When the % SoC drops to around 18%, the system shuts down. It's not totally dead as there is still power there but the only thing it will operate is the circuitry needed to deal with recharging. This built in buffer top and bottom is why WGO lists the Pure3 Travato as having 8,700 usable WattHrs as opposed to the 10,100 WattHrs that the Power Pack is rated for.

The color overlay shows the general power pack charge level with color bars that correspond to the lighted color of the dial itself. From full to about 35% is Green (good), between 35% to ~18% is Yellow (caution), and below ~18% is Red (danger).

<u>2020 Travato SoC Dial without Color Overlay</u>

The 2019 dial caused some confusion because it didn't reflect the usable capacity so it has been changed in 2020 models. Some of the above still applies including the fact that shore power won't necessarily keep you at 100% charge, you will float somewhere above 90% (and this can vary). Here are some differences in the dial… The SoC dial in the 2020 goes from 0 to 100 representing the *usable* capacity of the power pack (8,700 Watt). The most significant thing is that 100% in a 2019 is different than 100% in a 2020 and the same is true of 10% (10% on the 2019 dial was about 1,010 Watts and on the 2020 dial 10% is about 870 Watts), So talking in terms of percentage can be confusing.

The dial colors also change in 2020 as follows:

Steady Green - charge 100% - 21%
Steady Yellow - 20% - 10%
Steady Red - below 10%
5 Slow Blue Flash then a Pause – power pack is too cold to charge
5 Slow Yellow Flash then a Pause – power pack is too hot to charge
6 Red Blink then a Pause – system has shut down due to low charge
Rapid Flashing Blue – communications error between the SoC and the system

<u>Bluetooth Monitor App</u>

In the fall of 2020, Volta will begin selling an add-on Bluetooth module that will allow you to monitor your system from a phone or tablet. At this time, Winnebago has not said if they plan on making this standard equipment at some future time. As soon as a unit is available for testing, I will be posting a separate document covering the application.

Changes from Standard G and K

Despite the floor plans and most of the outfitting being the same, the new Pure3/Volta system is not an add-on to a standard T. It is an entirely new T, redesigned from the ground up, that is as different from the non-L T's as the T's are from other B's. If you tour a K and a KL or a G and GL you won't notice any differences other than a couple different panels and some changes in under-bed storage. But if look underneath the van you will see a number of changes and those are worth discussing.

The most obvious change is that a standard Travato has a generator behind the rear axle while the L's have a power pack. The power pack is larger than the generator but actually weighs about the same so there's no noticeable change in the vehicle weight. The other thing you will spot is that in addition to a Gray and Black waste tank, there is a Fresh Water tank. In a standard G and K the Fresh Water tank is inside the coach but that area in a Pure3 coach is taken up

with the Inverter/Charger, DC-DC step down converter, and miscellaneous electronics. There has been some concern about the water tank possibly freezing but the tank is inside a double wall container that has a heat duct from the Truma and a heating pad so this should carry you through the shoulder seasons (a Travato isn't a 4 season RV).

Another difference is that the waste and water tanks have been resized. Some people have objected to this since the volume of two of these tanks have gone down but it's not a huge drop. The Gray tank capacity has not changed in either model but the Black tank went from 13 gal to 12 gal in the KL. The Fresh Water tank has the biggest change going from 21 gal to 18 gal in the GL and 23 gal to 18 gal in the KL. That does mean you may have to fill your fresh water tank more often but a number of people, myself included, already carry drinking water separately which helps.

"Background" Power Usage

Every RV has a certain amount of background power usage. This is sometimes referred to as "parasitic draw" because its electricity being lost for no apparent gain. An example is the Jensen entertainment system. The Jensen is never truly off – rather it's in standby so it is always drawing a small amount of electricity. There are also components like the LP detector, PCS, Truma panel, Volta panel, SoC, BMU, 48-12Vdc converter fan, Solar controller, etc, etc. IOW, there are a lot of little things that add up.

There are also things like the LP switch (which is a solenoid) which uses electricity whenever it is on but most people wouldn't be aware of that. The refrigerator cannot be called parasitic but it is still a background usage since it is probably running whenever the coach is in use. James Adinaro at FitRV.com did a lot of work documenting how much electricity (both DC and AC) various components in a standard Travato use. He also did a major conversion of their Travato to a Lithium system that has nearly as much capacity as a 2019 Pure3/Volta Travato.

There is enough background power used in a Pure3/Volta system that even with the refrigerator and Inverter turned off, you can expect about a 900W drop over a 24hr period. This can go up to 1300W-1500W in the winter if the Power Pack is cold and the power pack fan is on. If you are going to be traveling every day then that's not an issue but keep that number in mind when we talk about storage.

There is no simple way to measure these draws so the following is based on data from WGO and Volta, the notes from James, and my testing here are some **estimates** (these values will vary and are not constant):

Volta + Travato systems	35-40W	(continuous)
Inverter	200-250W	(continuous when on)
LP Valve	20W	(continuous when on)
Battery compartment fan	17W	(continuous when battery cold)
K refrigerator	48-60W	(thermostatic control)
G refrigerator	60-72W	(thermostatic control)
Waste/Water tank heaters	222W	(thermostatic control when switched on)
Power Pack Heater Pad	100W	(120Vac thermostatic controlled by BMU)

Shore Power

The term shore power comes from the boating world and refers to connecting to an external electrical supply. This can be any 120Vac outlet from 15A to 30A. It is possible to make use of a 50A outlet at a campground by means of an adapter plug which uses one 120Vac "leg" of the 240Vac 50A outlet. When you connect to shore power that is less than 30A then it is important that you adjust the setting of the Power Control System (PCS) to the appropriate Amperage. This device monitors the AC load so that you don't exceed the amperage you have available. For example, if you set this to 15A then it might keep you from running the A/C, Microwave, and TV all at the same time.

There is one thing about shore power in a Pure3/Volta system that can be rather confusing because it has changed over time*. This pertains to what happens after you plug in is conditional on what the state of the system was when you connected. Some of this has to do with the position (In{On} or Out{Off}) of the power button, next to the SoC dial. In brief:

--If the Pure3/Volta system was turned off (power button out), then when you plug in the system will power up and you will have both DC and AC power available. As mentioned above, the AC power will be provided by the shore power connection. If you unplug the shore power connection at this point, the Pure3/Volta system will shut back down again – because the power button is still in the Off position.

--If the Pure3/Volta system was turned on (power button in) and the Inverter was ON, then when you plug in the system will power up and you will have both DC and AC power available. The only difference will be that shore power will take over providing the AC power. If you unplug the shore power connection at this point then the Inverter will resume providing AC power (which was the state before you plugged in).

--In early 2019 units, if the Pure3/Volta system was turned on (power button in) and the Inverter was OFF, then when you plug in the system will power up but you will only have DC power available*. To turn on the 120Vac power you needed to go to the Winnebago/Volta control panel and press the On/Off button which will turn on the AC power. Regardless of this difference, if you disconnect shore power after being plugged in, the Pure3/Volta system will NOT revert to its prior state with the AC powered off, rather the Inverter will take over providing AC. If you don't want AC on at this time, then you need to go to the Winnebago/Volta control panel and press the On/Off button which will turn the AC power Off.

*This last one has changed but it's not clear when it changed. It relates to the state of the Inverter and a jumper switch on the control panel. If you have an early 2019 unit then it applies to you but if you have a later 2019 or 2020 unit it does not. With the later units, the 120Vac outlets will switch to shore power shortly after plugging in and will do this regardless of whether the Inverter was On or Off prior to hooking up.

You may find that there is a Dimensions Owner's Manual in the Winnebago Supplement with details about the Winnebago/Volta control panel. It is important to know that this manual is generic in nature and not specifically about the Winnebago control panel which is configured differently. Many of the settings in this manual are either not available in the Pure3/Volta system or function differently.

It is important to be aware that if you are using the A/C or the Truma on EL/Mix at night and shore power is lost for any reason then the Inverter will take over and your power pack will start to drain. If this happens then you may find yourself VERY low on power come morning. You can protect yourself from this by pressing the SoC On/Off button to the Off position after connecting to shore power. The system will reman on as long as you have shore power, but if power is lost then the whole system will shut down. Not a perfect solution but it won't drain your battery either.

Max Branch Amps

This is a place where the exact usage of a feature has no clear cut "correct" answer. The Travato manual refers to this as both the Adjustable Charge Rate and the Battery Charger Current Limit while Pure3/Volta refers to this as the even more cryptic Max Branch Amps. Basically, what this is for is to tell the Charge Controller the MAX Amps it can draw from your shore line <u>to use for charging</u>. When you first get your new Pure3/Volta Travato, check to see how this is set as the setting WGO uses has changed.

When you are connected to shore power the charge controller will draw some current to recharge the power pack if and when needed. If you are at a campground the shore connection will probably be 30A so it would *seem* to make sense that you set this to match, but it's really not necessary. If you set it at 15A it will still charge the power pack but not as

fast – and that's probably OK because it would be rare to need to do a large fast recharge using a shore line. The upside to leaving it at 15A is that you would never risk tripping the breaker on any shore power connection even if you are just connected to a 15A house outlet at Uncle Bob's house. The down side is if for any reason your power pack is low when you connect to shore power then it will take longer to recharge. The instructions to change this are in the Operators Manual.

Please don't confuse this with the Power Control System (PCS). In both the Pure3/Volta and standard Travato, there is a PCS which you really should set to match your shore line amperage (see the manual). It may seem at first as if these are the same thing, but these are actually two separate systems. In the case of the Pure3/Volta controls you are setting a limit for the Charge Controller, while the PCS serves to keep you from running too many AC devices for your shore power connection to handle.

Using the Inverter

If there is no shore power connection, then the Inverter can provide 120Vac to all outlets in the coach. The Inverter, even if there is no load on it, consumes a certain amount of electricity (parasitic load). The total parasitic load of the combined Inverter/Charger, DC-DC converter, and other components is ~300W and the Inverter is a good percent of that so it makes sense to turn it off when you aren't using it.

You will probably have to check to see if the Inverter is on or off at certain points.

--If the system is totally off and you turn it on with the SoC switch, the Inverter will automatically come on and unless you want to use it, you need to turn it off.

--If you connect to shore power then the inverter will automatically turn off (if it was on) and shore power will take over providing your 120Vac power.

--When you disconnect from shore power, your inverter will automatically come on regardless of whether it was off or on when you connected to shore power. This is the one I always forget about. See the section on Shore Power for details.

If shore power is available then the Inverter display panel will say, "DEVICE STANDBY: OVERRIDE BY CHGR" if you press the Inverter On/Off button. You may also see the message "CHG#1—OFF DISABLED BY JMPR" if no charging is needed. You can find more information on messages in the Travato manual.

Solar Charging

With a standard Travato, having 200W (actually 215W-230W) of solar when boondocking can help keep the battery topped off but that's not quite so true when it comes to the Pure3/Volta system because it has a higher background load. The Solar Charge Controller in the Pure3/Volta system is a MPPT (Maximum Power Point Tracking) controller which interacts with the BMU to determine when to charge and what "charging profile" (Constant Current, Constant Voltage, and Float) to use. When the Pure3 systems were introduced, the controller was not optimally set and people found that it didn't always do a very good job of charging. After tweaking and testing, Volta changed to a different set of parameters in the summer of the 2020 model year. The newer parameters do a better job of optimizing the charging but 215W is not quite enough to keep up with the drain from the background systems plus the refrigerator except during peak sunlight hours. See the last section about a pending update for all owners.

This MPPT controller only has two blinking lights and this has proven to be one of the more confusing things in the Pure3/Volta system because it is difficult to figure out what the blinking lights mean. The lights change according to which charging profile the controller is using and this information is on the controller if you are interested. Basically, as long as the lower light isn't solid Red, you are getting some kind of charge. Note, that if you are at a full charge, the lights will be Red as the controller is shut off at that point and will stay that way until the charge drops to the low 90% range.

2nd Alternator Charging

There is a second alternator under the hood that is part of the Pure3/Volta system. This alternator will output up to 6000W* when it is at maximum revolutions. This has created some confusion as owners and prospective owners may have been under the impression that the alternator puts out 6000W all the time. According to Volta, it's all about pulley ratios. Every alternator has an RPM that it 'turns on' at and there is an upper limit on RPM's as well. It's a balancing act to produce energy at a relatively low RPM (without being a drag on the engine) but not over spin the alternator at extremely high RPM. At high-idle (1600 RPM), it's guesstimated to be about 2000W of the 6000W max, but there is no chart I have seen that indicates how much wattage you get at any specific RPM. It's another one of the "black box" issues with the Pure3/Volta system that makes it tough to predict the gains you get in daily operation.

WGO has said that a driver should be able to fully recharge the Power Pack in about 90 min of driving, but there is a big difference between driving 90 min on an Interstate vs a US highway vs wandering the countryside. The Promaster engine can be rather efficient so you may find yourself doing 45 MPH down a flat country road and notice that the Tachometer is only at 1400 RPM. The alternator *may* still be putting out some current but it's not going to match what you get at highway speeds. On the other hand, hilly terrain even at slower speeds may match highway output.

*Several changes have appeared during the 2020 model year. The auto-start module and the alternator control module have both been updated to eliminate some issues that resulted in some underperformance in charging. Volta is going to be doing a recall to replace the alternator control. Also, the 2020 NPE has a different alternator that has a max output of 8000W and this new alternator started appearing in all the GL/KL line sometime in Aug/Sep 2020. If you have one of the new alternators, you can expect to get more charge in less time than the older model.

It cannot be said often enough to keep an eye on your SoC! If you are driving and the SoC is not going up then something is wrong. If you find this happening then you MUST act to limit your usage and find a place (or places) to recharge with shore power. As long as you are frugal, you can get 3 days use from a full charge and then you need to recharge. If the SoC ever gets so low that it's in the Red and shuts off - be sure to press the On/Off button so that it is Out. This puts the system "to sleep", otherwise it will just keep using power for system functions until it is so low it crashes completely at which point it can be really hard to charge back up.

High-Idle Recharge (Auto-Start)

The Pure3/Volta system is also equipped with a High-Idle recharge capability. This can be activated either manually or automatically - both methods do the same thing, initiate a 1 hour cycle, and charge exactly the same way. To use this, you must first "arm" the system by putting it into Monitor Mode. This can be done using the ignition key or via the key fob. The Silver Auto-Start button is on the dash below and to the left of the steering wheel.

There are step-by-step instructions in a separate document entitled "Travato Pure3/Volta Auto-Start Instructions".

The amount of charge that will be added by running a recharge cycle can vary with conditions such as load. If you are running the A/C at the time then that will consume a portion of the output. While the recharge cycle is running, the engine will alternate between high and low idle to keep the engine from over-heating (when you are driving there is air blowing across the radiator but while stationary it's up to the fan to keep the engine cool). This reduces the total time the Alternator is charging but it does this in a somewhat unpredictable way. Auto-Start and High-Idle use components from FCA (Fiat-Chrysler Automotive) and an automotive control supplier to control the engine idle. This control module was updated at least once in 2019 to smooth out the constant shift between high and low idle. The end result is that you can expect about a 1000W-1550W gain with the original alternator, depending on equipment and circumstances. If you have a 2nd Gen 2020 with the new alternator, you may see a 3000W or more charge.

As an aside, when the engine comes on, so will the lights and the radio so turn these off when you engage Monitor Mode. You can take advantage of this in the summer by pre-setting the cab A/C to come on with cab air recirculation set and all ducts except the two middle ones turned off. This will blast cold air back into the coach when the engine starts – it's remarkably efficient at cooling the coach.

One question that arises is how "noisy" is the High-Idle charging. Ron Merrit (aka Wincrasher) did some tests on his GL and he found that at its loudest it's 70dB at the front bumper, 60dB at the rear, and 56dB @ 50'. A regular T generator is around 85dB up close. Technically, the TL high-idle is roughly half as loud as a regular generator however people may find it more annoying because it alternates between high and low idle whereas a generator (particularly with a resonator) is a constant sound. I find it isn't bothersome inside and only when close to the engine outside.

There is also the rather tricky question of idling the engine to recharge the battery. As a general rule, you should be able to do this any place and time you can run the generator. However, you could not or would not want to do that if you are someplace where it's not allowed (like 4 am in a campground). Also, be aware that some towns or locations may have rules against idling a vehicle. As an example, I have seen a sign at a campground that stated "No Engine Idling". I can only guess at the reason, but like most things it pays to know the rules in advance. One place where you will likely see such a sign is at a highway rest stop. I have seen this both with and without a caveat regarding the size of the vehicle or whether or not it is a diesel.

How Long Can I Run {fill in the blank} …

The single most frequently asked questions are, "What can I run" and "How long can I run it" using the Pure3/Volta system. Well, basically, if it's 120Vac and draws less than 30A (3600W) then you can run it. As to how long, well that depends. People hate those answers because they aren't exact and definitive enough but most of the time there is no definite answer. Let's look at the most asked example, the Air Conditioner…

To figure out how long you can run the A/C (see note), you have to know how much current it draws. That will vary with the fan speed (High or Low) and the "thermostat" setting. The original Coleman Mach 10* doesn't have a true thermostat but it does have a dial with a color indicator for temperature. I'm not sure if anyone has done a real study but the Mach 10 spec sheet indicates that it will draw somewhere between 1350W to 1625W. With the dial set at half, the compressor would come on and go off to regulate the temperature; but the percent of the time it will stay on is going to depend on how hot it is inside the coach.

If you assume the worst-case then the math would tell you that 8,700W / 1,625W would give you 5.4 hr of run time. But in one rather unscientific test I did with my 2019, I ran the A/C at the mid-way setting on Low speed for roughly 5 hrs and the SoC went from 90% down to 40% or about 1010 Watt per hr. So clearly there are a lot of variables at work.

> *In the summer of 2020, Airexcel started shipping a new "quiet" version of the Mach 10 known as the NDQ. This unit has better controls and a more efficient design and uses less electric. Also, there is a Bluetooth controller with a proper thermostat and a fan motor that only comes on with the compressor. The result is a much more energy efficient unit. The average energy consumption is going to be under 1000W/hr or less once the coach has been cooled. This could mean an additional hour or two of runtime.

Your best bet is to use common sense and keep and eye on the SOC. Several people have talked about replacing the gas cook top with an Induction cooker, using a slow cooker, or using the Truma on EL or MIX. You can do that if you wish but you have to watch your electrical usage if you don't want to run out of power at 3am. You can do the math yourself on the cooking appliances but you should read Daniel Senie's excellent Truma primer (which can be found here: https://travato.group) before trying to run it on EL or Mix. Electric heating can use more electricity than the A/C and is less efficient than LP so unless you are really low on LP, you should use it rather than the Pure3/Volta power supply.

General Cold Weather Considerations

Caution: All Lithium batteries have some limitations when it comes to weather and the Pure3/Volta system is no exception. The information that has been gathered here has come from a number of sources and is as accurate as I can make it. HOWEVER, as with all things, the owner MUST assume the responsibility for using this system wisely. The Pure3/Volta system will do everything it can to keep the user from damaging the power pack, but that is not to say that the system cannot be damaged. Remember Murphy's Third Law – "You cannot make anything foolproof because fools are too ingenious."

This section is somewhat complicated by the fact that it does not involve simple yes/no or right/wrong propositions. Please read it carefully and consider how it impacts you where you live. And always bear in mind that all marketing hype aside, the Travato was designed to be a 3-season coach. You should expect complications in deep winter conditions.

Before getting into the technical issues involved with using the Pure3/Volta system in the winter, it's worth taking a few minutes to talk about the Travato as a whole. In particular it's worth remembering the design changes involved in making room for various components of the Pure3/Volta system and the fact that the fresh water tank is now underneath the coach rather than inside. This potentially makes winter travel more of a challenge and at this point we have limited practical experience to determine how well this will work.

The price list on the GL and KL have a manually controlled heated drainage system as an option. Anyone who lives in a colder climate and expects to travel in the winter should consider this mandatory. In a K this option covers heating pads on the black and grey waste tanks and the G adds a heating strip on the grey tank macerator pump as well. Regardless of whether or not a Travato has the optional waste tank heating pads, there is a heating pad on the fresh water tank in both the GL and KL that is standard equipment.

The tank heaters all operate on 12Vdc so you do not have to use the Inverter to power them. On page 7-14, the manual has a caution about not running the tank heaters "…for an extended time unless you are providing a supplemental 12-Volt power source to recharge the Pure3/Volta battery." The combined draw for all heating pads is about 225Watts but that is not continuous as the pads are regulated with thermostats. This caution was carried over from the standard Travato (AGM battery) and while this would not seem to be a burden on the Pure3/Volta system, WGO chose to leave it in since this is a "quiet" load[1] that is easy to forget about.

In addition to the water tank heating pad, the fresh water tank is double walled and there is a Truma heat duct that circulates air into the empty space. This will help keep that tank warm even when the tank heater is off. It is unfortunate that there isn't a temperature probe in the fresh water tank to help the user know when the tank heater might be needed.

Cold Weather Power Pack Considerations

All lithium batteries have a temperature range that they operate best in. In the case of the Pure3/Volta Power Pack there is a set of parameters that the Battery Management Unit (BMU) enforces that are designed to protect that battery by keeping it from charging or discharging outside certain temperature limits. The stated temperatures refer to a measurement taken *inside the power pack* which may be different than the outside temperature.

Most notably, below 37° F /3° C the Power Pack <u>will not charge</u>. This is controlled by the BMU and is done to protect the battery cells from damage. If the Power Pack goes below 37° F /3° C then it must climb up to 42.6° F /6° C before it will start charging again. These temperatures are not that cold for a lot of the country and it doesn't take many days to "cold soak" the batteries which can result in them taking longer to warm up again.

There is no visual indicator on the 2019 when the power pack temperature is below the level to accept a charge but that's been added to the 2020 models. In any case, the Power Pack will discharge down to about -4° F /-20° C so even when it is really cold you can probably start the system.

Cold Weather Storage

Unless you live someplace that is warm all the time you will have to winterize your Travato. This is done the same way as with a non-L Travato and that information is well covered elsewhere already so we can skip that.

It is rather difficult to discuss winter storage because we all live in different climates and have different ideas as to when and how we want to store our Travato. On Page 6-13 of the Travato GL/KL manual WGO recommends shutting the entire Pure3/Volta system down for storage. However, on the following page there are some Notices that state that Volta recommends that the system be plugged into shore power for storage and that warn against allowing the battery voltage to drop too low for an extended period of time. These warnings are slightly out of context and are confusing.

Here is the best information I have been able to assemble from Winnebago and Volta on this:

1. As a general rule, if your Travato is going to be sitting unused for more than a day or two then make sure it is charged up to at least 50% (80% is better), disconnect from any external power source, and shut the whole Pure3/Volta system down.[2] Think of it like your parent nagging you to "Turn off the lights when you leave the room."

2. If you are storing your Travato with the Pure3/Volta system shut down, then you should periodically (at least by 90 days) turn it on and make sure that the SoC shows you are still in the Green. If the reading is less than 50% then you should consider plugging it in for a while or going for a drive to get it back up above 50% before shutting it down again.

3. If you are only going to be storing your Travato for a week or so, then you can leave it plugged into shore power. If temperatures are getting cold and you expect to use it soon then it might be prudent to put the Truma on EL2. At this time, I do not have a consensus on what temperature to set the Truma, but 50° F /10° C seems like it should be enough to keep the power pack warm.

4. One major caution if you are going to be leaving your Travato plugged in with the Truma on EL – consider what will happen if your shore power connection is lost! If you refer back to the section on Shore Power you will see that if your Pure3/Volta system was on at the time you plugged in then it will switch to the Inverter if power is lost. This could drain your power pack fairly quickly. The solution is to turn the Pure3/Volta system Off before plugging in. In that case, if shore power is lost, the Pure3/Volta system will shut down. You will end up with a cold coach in the morning but won't have drained the power pack.

5. As a general rule, it's not a good idea to leave your Pure3/Volta Travato plugged into shore power as a means of long term storage. What happens is that the systems stay on and draw power and the power pack constantly goes through a discharge/recharge cycle between 80% to 95% which isn't good for the batteries.

6. The one thing you should never do is to leave the whole system on without shore power for an extended period of time so that it runs down completely. The Pure3/Volta system can use 900W or more per day, depending on environmental factors. This can slowly run the power pack down after a few days. If you let the power pack go into the Red it will "shut down" but it will not be able to go into sleep mode and will continue to use some electricity till it gets down to a point where damage is possible (page 6-14 in the Operators Manual).

7. In a worst-case scenario, the power pack can withstand overnight temperatures as low as -40° F /-40° C during storage as long as the *average* temperature for any 3-month time period does not go below the baseline of -4° F /-20° C. This *should* mean that in most areas of the US you can safely store a Travato L in the winter if you follow the rules.

Cold Weather Operation

It is worth pointing out here that there is a big difference between getting a Travato L that has been sitting in freezing temperatures for 2 months ready for a trip and actually going camping in that kind of weather. Everyone is different in what they expect to be able to do so there are almost no blanket assumptions that can be made other than to say that at some point people will want to warm up the cabin enough to make it livable. And if you can do that you can probably use the Pure3/Volta system.

As previously mentioned, if the outside temperature has been low for several days then the power pack may be "cold soaked" in which case you would need to get the power pack up to about 43° F / 6° C. As long as the Pure3/Volta system will turn on, you can use the Truma to provide heat inside. Using LP will produce the most heat but if you have shore power then you could conserve LP by using either EL2 or MIX2 (see notes).

There is a fan that circulates coach air through the Pure3/Volta Power pack when it's cold so the goal here is to get the inside of the coach warmed up so that the fan can circulate warm air down into the power pack from the coach which will heat the battery. Once you reach the 43° F / 6° C point inside the power pack then the battery will begin to charge and you will be ready to go. Starting in Aug/Sep 2020 there will also be a 100W/120Vac heating pad inside the power pack. The primary purpose of this is to heat the battery while plugged into shore power. If can you plug in the night before a trip, your battery should be warmed up by morning. If your battery is low then you probably should NOT try and heat the battery using battery power with the unit stationary – you could end up using too much power that way.

As an alternative, if the system will turn on but you don't have shore power then you could just start driving. If you have a battery heater pad then turn on the inverter to power it. Turn up the cab heater to add to the overall coach heat and set the Truma to LP[3] and turn up the heat. This would be a really handy way to boot strap because once the temperature is up high enough, the 2nd Alternator will start charging the power pack.

As a purely practical matter, not too many people would consider camping if the cabin temperature were below 43° F so it would seem as if charging would not be a problem. But it's not the cabin temperature that is at issue, rather it is the temperature of the power pack which is under the chassis where it is a lot colder. But most people are going to look to get the cabin temperature up to at least 60° F and at that point the Pure3/Volta system *should* be able to take care of itself. I have found that camping in below freezing temperatures works as long as I kept a reasonable cabin temperature. If you have a mid-2020 Travato, then you also have improved insulation.

The take-away is this… While it may be possible to just get in and start driving and "bootstrap" the system into operation, L owners who plan on traveling in winter may want to consider trying to warm things up before they leave. There is no one right or wrong answer here. The Pure3/Volta system is smart enough to protect the power pack from damage from too cold a temperature, but that leaves the owner with a bit of a problem. If you start on a trip with a cold system and *hope* it warms up enough to start charging, then you need to keep an eye on the SoC gauge.

2020 National Park Edition

The National Park Edition (NPE) Travato was a chance for Winnebago to show of what they could do with the Travato. It was also a chance to prototype and put into production a lot of features that would be rolled into the mid-year 2020 product line. One major feature is a 4-module power pack which increases storage capacity by about 1/3 for a total usable capacity of 11,600W. One point of confusion this creates is that it becomes even more difficult to speaking in percent usage because 10% in a standard Travato is 870W while in the NPE it's 1160W. As far as the Pure3 system goes, this is the only difference between the NPE and the mid-year 2020 KL/GL.

Notes, Changes and Corrections

Cold Weather Notes:

1. Winter time will see an increase in electrical usage for "quiet" loads – that is loads that are there but you don't think about much. Shorter days means more lights; LP solenoid and Truma fans; Volta air fans; tank heaters; etc. This stuff all adds up so just because you aren't running the A/C doesn't mean you don't have to watch the SoC and make sure it doesn't drop too far.
2. When shutting down the Pure3/Volta system for storage, be sure to turn everything off first. That includes the lights, LP, Truma, fan, refrigerator, everything that draws power. The reason is that you want all this stuff off when you power back up again. When you turn the Pure3/Volta system on, the Inverter will automatically come on. If you are on battery power, be sure to turn that off as you don't need that drawing power.
3. Never use EL or Mix to provide heat unless you have shore power or are absolutely certain you can charge the battery or you will rapidly use up your available charge.
4. Several mid-year changes have been made including improved insulation and a power pack heating pad. These bring the Travato closer to an all season mobile home.

General

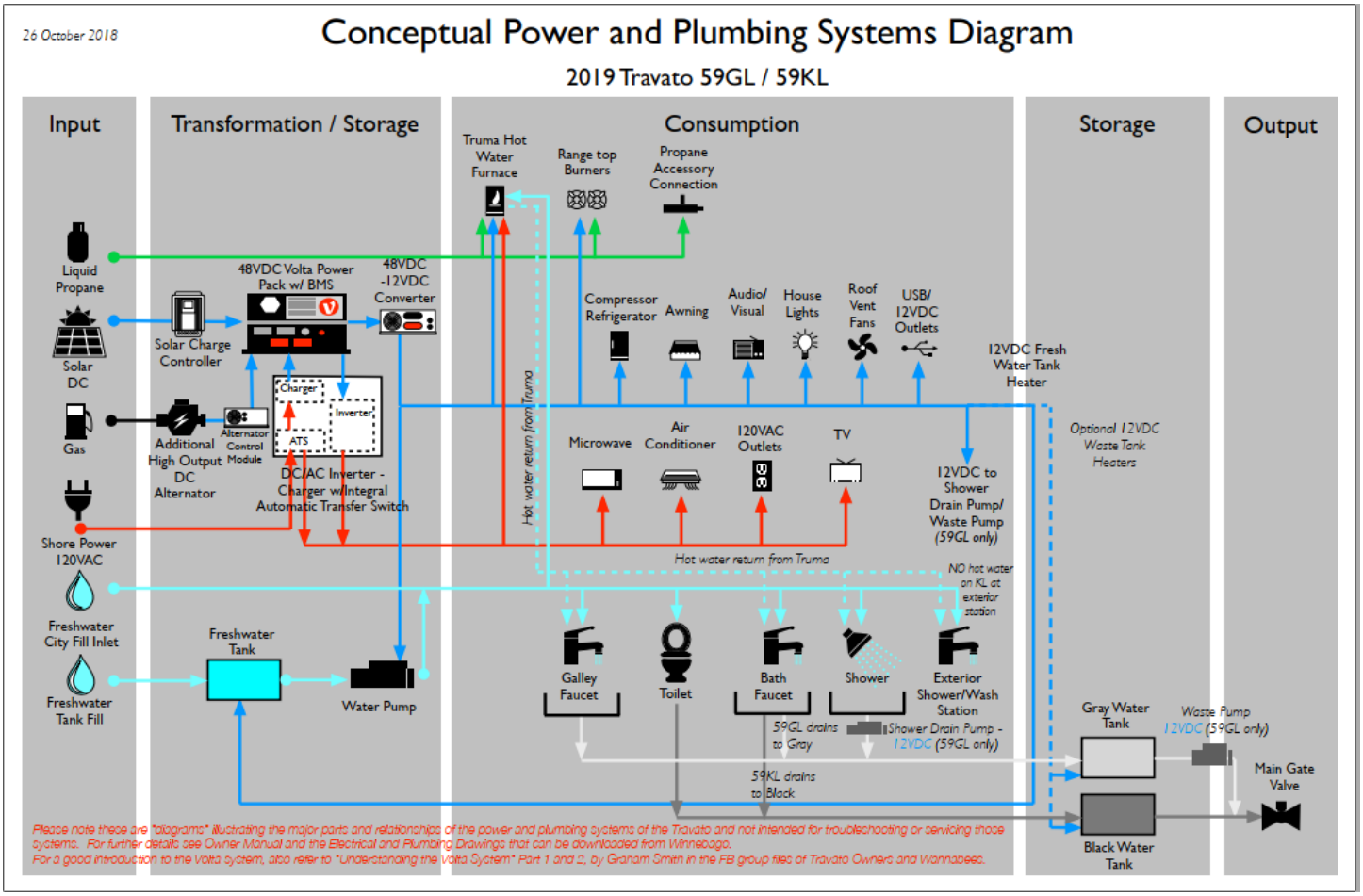
--It was previously stated that the SoC would flash Red if it was too cold to charge. This is incorrect and is due to a mistaken understanding on my part regarding "error conditions".
--Corrected tank heating pad wattage to include fresh water tank which had been left out of the calculation.
--Auto-start Monitor Mode will not disengage if you start the engine. The result is the engine will shut down when you step on the brake to put it in gear. If this happens, remove the key and press unlock 3 times which turns Monitor Mode off.
--It has only recently (as of Jan 2019) become clear that the 2nd Alternator doesn't reach full power (6000W) until you reach highway speeds. Driving at low speed or running high-idle may only output around 2000W. This means you get less charge going to the batteries than previously thought.
--Added information on charging while driving to the 2nd Alternator section
--Changed the section on High-Idle recharge regarding the expected charge
--Added a section on Using Auto-Start to Recharge a "Dead" System
--Added a section on Power Pack "Capacity" and the SoC
--I had previously said that the battery level drops faster and charges slower between 95%-85%. This was based on a misunderstanding. There are some cases where this might occur but it's not the norm.
--It was previously stated that you could heat the power pack from below using a space heater but this isn't correct. That suggestion was based on incorrect information received. The power pack has an insulated outer container that makes that an ineffective solution.
--The main change between the 2019 and 2020 is the SoC. This change makes it important to know which year is being discussed when it comes to percent usage.
--As mentioned, the 2020 NPE has a larger power pack than the standard GL and KL. It is not a simple task to retrofit standard GL or KL with the 4th module and Volta has declined to offer this as an upgrade. It is a complex process requiring changes to the controlling firmware in the BMU that only they can do and they aren't setup to do this on top of manufacturing new components.
~~--At the time of this writing, the new "quiet" Coleman A/C with the Bluetooth control panel is not standard equipment and there is no indication as to when it will be available in sufficient quantities to meet demand.~~
--The Auto-Start instructions have been moved to a separate document.
--After many questions, I still am not clear on why WGO rates the useable capacity lower than that listed in Volta documentation but I have been told that 8,700W is the correct number to be used.
--The section on solar charging was re-written for ver 3.1
--The section on the Truma Combi was removed from ver 3.1 since all the information was covered already in a document by Daniel Senie.

Upcoming Changes

In the Fall of 2019, Volta will start selling a Bluetooth module for the SoC which will allow you to monitor, but not control, several functions of the system. This will include an easier to read % Power along with an estimated Time Remaining. There will also be a net Power In/Out number which will tell you what the Net Draw is on the power pack. You can pre-order this from VoltaPowerSystems.com

Also available for purchase from the same web site is a self-installable heater pad for the power pack. This may be more than an owner will care to take on but you can purchase the device and have someone else install it for you. Unless you live in a location with sustained temps below freezing and want to be able to leave without a long warm up period, you probably don't need this. Be aware that the GL install is much more complicated due to the location of the components. Time estimates for installation are less than one hour for a KL but more than 6 hours for a GL.

Finally, Volta is in the process of sending out replacement Alternator Control Units and MPPT (solar) controllers. The first is to correct a problem with interference that may only affect some people. The second is to give users a more effective controller that should increase the charging capability of the solar panels. You will be contacted about this in time so don't call or email Volta or WGO about this.


26 October 2018
Conceptual Power and Plumbing Systems Diagram
2019 Travato 59GL / 59KL
Input
Transformation / Storage
Consumption
Storage
Output
Liquid Propane
Solar DC
Gas
Shore Power 120VAC
Freshwater City Fill Inlet
Freshwater Tank Fill
48VDC Volta Power Pack w/ BMS
48VDC -12VDC Converter
Solar Charge Controller
Additional High Output DC Alternator
Alternator Control Module
Charger
Inverter
ATS
DC/AC Inverter - Charger w/Integral Automatic Transfer Switch
Freshwater Tank
Water Pump
Truma Hot Water Furnace
Range top Burners
Propane Accessory Connection
Compressor Refrigerator
Awning
Audio/ Visual
House Lights
Roof Vent Fans
USB/ 12VDC Outlets
12VDC Fresh Water Tank Heater
Microwave
Air Conditioner
120VAC Outlets
TV
12VDC to Shower Drain Pump/ Waste Pump (59GL only)
Optional 12VDC Waste Tank Heaters
Hot water return from Truma
Hot water return from Truma
NO hot water on KL at exterior station
Galley Faucet
Toilet
Bath Faucet
Shower
Exterior Shower/Wash Station
59GL drains to Gray
Shower Drain Pump - 12VDC (59GL only)
59KL drains to Black
Gray Water Tank
Waste Pump 12VDC (59GL only)
Main Gate Valve
Black Water Tank
Please note these are "diagrams" illustrating the major parts and relationships of the power and plumbing systems of the Travato and not intended for troubleshooting or servicing those systems. For further details see Owner Manual and the Electrical and Plumbing Drawings that can be downloaded from Winnebago.
For a good introduction to the Volta system, also refer to "Understanding the Volta System" Part 1 and 2, by Graham Smith in the FB group files of Travato Owners and Wannabees.