Understanding the 3rd Generation Travato Pure3/Volta System
Version 5.2 – 12/26/2020
by Graham Smith

The goal of this document is to give people a better understanding of the 3rd Generation Lithium Travato (GL and KL) and the Pure3 Power Management system by Volta. The 3rd Generation are the 2021 and late 2020 models that come with the Volta Bluetooth module pre-installed (i.e. not user added). These models have a new, higher density, power pack with about a 10% greater capacity. This includes some of the 2020 NPE models with the 4 module pack.

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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 some components as they become available in what are called "Running Line Changes" which makes documenting features somewhat challenging since it not always possible to pin down a change to a particular point in time. Also, WGO/Volta have been retrofitting some changes and Volta has available two aftermarket products for prior generations. Keep an eye out for changes to these documents.

Contributions from Winnebago (Russ Garfin, Chris Bienert, Duane Cyrus, Bob Bloomingdale, Brad Strickler), Volta Power Systems (Jack Johnson, Kirk Chapman, Jason Meser), and Others (James Adinaro, Ron Merrit, Daniel Senie, Truma)

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

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. These are also known as "nominal voltage" which simply mean "named".

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; and discussions of Watts generally mean Watts/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; aka LFP) 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 (see Note). 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 3rd Generation power pack has roughly 10 times (13 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. In a TL the reverse is true - you can run almost any 120V appliance you can carry without needing shore power but you drain the battery fairly rapidly to do it.

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.

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 System (BMS). All larger Lithium batteries need some kind of BMS 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 BMS 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 BMS 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.

One downside to a 48Vdc system is all 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. That requires the addition of a DC-DC Converter which has the job of stepping down 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 3rd Gen power pack contains 3 modules while the NPE has 4 and both are housed in an insulated outer metal container under the coach near the rear axle. Winnebago (WGO) rates the usable capacity at 9,600W in the 3-module and 12,800W in the 4-module power packs.

When discussing the State of Charge it is important to understand 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 BMS 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 BMS 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.

3rd Gen Travato SoC Dial

The SoC dial goes from 0 to 100% representing the available capacity of the power pack. Owners will notice that the dial rarely stays all the way up to 100% unless you are driving or connected to shore power. Most often, even if connected to shore power, it will hover about 98% and may drop to 90% for a while before going back up. This is all controlled by the BMS and is designed to keep from over charging and to prevent the system from constantly short cycling (use a little then recharge).

There is a similar thing that happens at the lower end. When the % SoC drops to around 10%, 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.

The dial colors represent the state 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

Bluetooth Monitor App

The App will show the current Power Level and Temperature of the pack. Power level represents the *Net* value which is the Power In minus the Power Out. If you have more charge coming in than going out, this will be a Positive number. If the reverse is true it will be a Negative. Both the Temp and Power have a graph that shows the past 15 min and 24 hr.

"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, BMS, 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 12Vdc 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-1600W in the winter if the Power Pack is cold and the power pack heater 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 often **not constant**):

Volta + Travato systems	35-40W/hr	(continuous)
Inverter	200-250W/hr	(continuous when on)
LP Valve	20W/hr	(continuous when on)
K refrigerator	48-60W/hr	(thermostatic control)
G refrigerator	60-72W/hr	(thermostatic control)
Waste/Water tank heaters	222W/hr	(thermostatic control when switched on)
Power Pack Heater Pad (dual)	200W/hr	(120Vac thermostatic controlled by BMS)

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 and Microwave at the same time.

Connecting to shore power would seem to be pretty straight forward, but the Pure3/Volta system has a few eccentricities – primarily the state of the Inverter when you connect. In brief:

--If the Pure3/Volta system is 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 is turned on (power button in) and the Inverter is ON, then when you plug in the shore power will take over providing the AC power. It may take a minute or two before the AC power comes on because the system will test your connection first. 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).

--If the Pure3/Volta system is turned on (power button in) but the Inverter is OFF, then when you plug in the AC power (outlets, microwave) should come on. It should only take 30 sec or so for this to happen but if after a minute or two you don't have AC power then go to the Winnebago/Volta control panel and press the On/Off button which should connect the AC power. If you disconnect shore power at this point then 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.

--While charging the display panel may show the message "CHG#1-AC IN LMT" followed by the DC battery voltage and DC amps used for charging. To convert to AC the formula is V*A(DC) / 120 = A(AC)

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 (and back ON in the morning). 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.

If you want to use a surge suppressor on the line, stick with one of the basic models without any kind of voltage protection circuit that will cut off power if out of range. The Pure3/Volta system takes care of that and the two devices won't get along well. Look for a separate article about Surge Suppressors for more information.

Max Branch Amps

This is a place where the exact usage of a feature has no one "correct" answer and the explanation is a bit esoteric. The Travato manual refers to this as both the Adjustable Charge Rate and the Charger Current Limit (which is a more descriptive term) while the Pure3/Volta control panel refers to this as the even more cryptic Max Branch Amps. This setting is a cut-off point for the Charge Controller to keep it from overdrawing from your shore power connection and is similar to the function of the Precision Circuits Power Control System (PCS) you have in your Travato.

> *The PCS is not a part of the Pure3/Volta system and can be found in all Travato's. You can refer to your Operator's Manual Supplement for more information on this, but in brief you should set this to match your available 120Vac power supply (15A, 20A, or 30A). When connected to shore power, the PCS should be set to match that (usually 30A) and when not connected to shore power and using your Pure3/Volta Inverter the PCS should be set to 30A.*

When you are connected to shore power the Charge Controller will draw some current to recharge the power pack if and when needed, but since this load occurs before the PCS, the charger controller has its own protection in the form of a bypass switch regulated by the Max Branch Amps setting. The MBA setting tells the charge controller that if the <u>total load</u> (including the charge current) exceeds the setpoint, the charger should stop charging and give the coach all available current.

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 you don't have to. If you leave it set at 15A it will still charge the power pack because you would rarely be drawing more than 15A at any given time but it will charge slowly. On the other hand, if you have it set at 30A and connect to a 15A outlet, you will likely trip the breaker. If you will be connecting to different power supplies then the prudent thing might be to leave it set to 15A and only increase it to 30A in a case where the battery is quite low and you need to charge quickly. The instructions to change this are in the Operators Manual.

Using the Inverter

If there is no shore power connection, then the Inverter can provide 120Vac to all outlets in the coach. The Inverter consumes a certain amount of electricity (parasitic load) even if there is no load on it. 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 the case 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 BMS 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 during 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.

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 the power pack charge level and the available sunlight. Basically, as long as the lower light isn’t solid Red, you are getting some kind of charge. 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. If there is little to no sun, the lights will be off. One note, the solar controller is located in an overhead bin and is labeled as a DC-DC converter. This has confused numerous people into thinking that this is the 48-12 Vdc converter which is located under a bed or the jumpseat.

2nd Alternator Charging

There is a second alternator under the hood that is part of the Pure3/Volta system. This alternator is larger than the original version and has an output up to 8000W when it is at maximum revolutions (which you will seldom reach). There has been some confusion as owners and prospective owners may have been under the impression that the alternator puts out full wattage all the time. The 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 2600W, 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 with the old alternator, but with the newer alternator that could be reduced. And 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.

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 (longer in a NPE) 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 until you can recharge. 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.

Auto-Start (High-Idle Recharge)

The Pure3/Volta system is also equipped with a High-Idle recharge capability referred to as "Auto-Start". The Auto-Start title has created some confusion since there actually two different mechanisms involved. The primary mechanism is the Auto-Start module which is similar to an automobile remote start and actually uses the same Promaster circuitry. This can be activated either manually or automatically - both methods do the same thing which is to initiate a 1 hour high-idle cycle (see notes) which will allow the 2nd Alternator to charge the power pack. To use this, you must first "arm" the system by putting it into what I call "Monitor Mode" (standby)*. 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.

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 inconsistent 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 has been updated at least once to smooth out the constant shift between high and low idle. Without a load like the A/C you can expect to see a 3000W or more gain with the 3rd Gen alternator.

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 (New Jersey has a blanket prohibition). 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.

* There is one other side issue with the auto-start that turned up unexpected when I was testing. One condition that can initiate an auto-start is a low chassis (Promaster) battery. If the van has been in storage then the chassis battery may be a bit low. If you then put the Pure3/Volta system into monitor mode, it will start up about 10 seconds later. One Facebook user reported this was happening and it appeared that they had a weak battery due to some drain and as soon as the key is turned the voltage drops enough to trigger a start. In the event it does, you can let the engine run a few min and shut it off and you should be able to re-engage monitor mode. Also, try turning the key and waiting 60-90 seconds before engaging monitor mode.

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, you have to know how much current it draws. That will vary with the fan speed (High or Low) and the temperature setting. The 3rd Gen Travato has a new "quiet" version of the Mach 10 known as the NDQ which has better controls and a more efficient design. The NDQ Mach 10 spec sheet indicates that it will draw somewhere between 1,260W to 1,525W. If you assume the worst-case then the math would tell you that the 2020.5 would give you 5.7 hr of run time and 7.6 hr in the NPE. But there are a lot of variables at work and real-world tests indicate it's more like 1000W/hr or 8 hr in the 2020.5 and 11 hr in the NPE. Even that might be high. The NDQ has a fan that comes on and goes off with the compressor. In moderate temperatures you may average as little as 800W/hr overnight which would give you 10 hr in the 2020.5 and over 13 hr in the NPE.

Here is a list of the major 120Vac peak draws:

Air Conditioner	1525W	12.7A
Truma EL1	850W	7.0A
Truma EL2	1700W	14.0A
Microwave	1200W	10.0A

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 complicated because 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 and improved insulation aside, the Travato is basically 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 which makes winter travel more of a challenge.

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. It's unclear why WGO would consider this an excessive load on the Pure3/Volta system, except that this is a "quiet" load 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 System (BMS) 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 will not charge. This is controlled by the BMS 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. 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. 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 much more than a week, 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. 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 might 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, 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 adequate.

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 in the 90% range 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 6-15 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 need to get up to ~43° F before it will charge. 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).

In the 1st Gen Travato, there was a 12Vdc fan that circulated coach air through the battery compartment to warm it. In the 3rd Gen version, there is a 120Vac (200W) heater pad on the power pack that comes on when the battery is cold. The pad will only be on if you have shore power or turn on the Inverter. If you have a shore power connection then the draw from the heating pad won't be an issue. However, if your battery is low then take care when using the Inverter as that additional 200W load can lower your charge faster than you might be used to.

As an alternative, if the system will turn on but you don't have shore power then you could just start driving. Then turn on the inverter to power the heating pad. This would be a really handy way to boot-strap because once the battery 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.

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.

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 heating pad; 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. The improved insulation and a power pack heating pad bring the Travato closer to an all-season mobile home, but it's still not a true 4 season coach.

Bluetooth Monitor App Note:
One issue with this app is that each battery module has 3 sensors so a regular 3 module power pack has 9 total and the 4 module pack has 12. The pack temperature is an average of all of these. However, the determination of the Too Cold/Too Hot state is based on any one of the sensors being out of range. The practical result of this is that the temperature displayed in the app, while accurate, may not actually tell you when the pack charging status will change.

Auto-Start Notes:
The main purpose of the Auto-Start is to ensure that when the system runs low, it will Auto-Start and allow the power pack to recharge enough to keep operating. The ability to manually start this same process at a point well above the auto-start level is a secondary function. The process of charging involves several different electronic components and firmware and there can be some inconsistencies in how much charge you get when a cycle starts, either automatically or manually. With the 3rd Generation alternator you will likely see the upper limit of charging around 80% and the reasons why it stops here are well beyond the scope of this document (and my sanity).

General
--The Lithium Nickel Manganese Cobalt Oxide (NMC) batteries used in the Volta/Pure3 system are warranted for normal use for 8 years. Testing has shown that the battery life is equal to roughly constant use for 10 years assuming a full cycle (full discharged and then recharged). In other words, short of outright abuse, the batteries should outlast the warranty.
--Background power usage can vary significantly with the temperature and conditions. All numbers are rough averages.
--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.
--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 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.
--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 BMS that only they can do and they aren't setup to do this on top of manufacturing new components.
--The Auto-Start instructions have been moved to a separate document.
--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.
--Added auto-start notes.
--Rewrote Max Branch Amps section in Ver 5.0 to clear up some confusion (including my own) about exactly what this setting does.

Here is an excellent Conceptual Power and Plumbing Systems Diagram provided by Bob Bedell from the Travato Facebook group. This diagram should help you better understand how things work together.