

E-Ray 12 Volt Lithium Ion Battery (revised February 2026)

- ***When is a Charger Required? (My GUESS, Should be OK for ~4+ weeks)***
- ***Type of Charger Needed? (This Revised Doc Shows Why, IMO: Best use the GM C8 Charger sold from 2020 that are for Li-Ion & Lead Acid Batteries. Verify in Instructions. NOT Shown on Charger Body.)***
- ***What if Li-Ion Battery Shows no Voltage? The Low Voltage Protection Contactors Probably Opened. A solution, Jump Start, covered in text!***
- ***February 2026: Added E-Ray Charging Algorithm (pg. 4) & Condensed***


When Does E-Ray Lithium-Ion Battery Need Charging?

The first 2024 MY (Model Year) Owner's Manual was released in July 2023 had two very confusing statements. One said if the EV battery was low, it needed to be plugged into a charger! Crazy, there is no plug/charger, The other stated if the car was "stored" for over a week plug In the GM 12 volt battery charger ???

In the Jay Leno E-Ray video with Tadge Juechter (*Executive Chief Corvette Engineer at the time*) he agreed with Jay that Lithium Ion 12-volt batteries can go longer than Lead Acid without a charger. When my E-Ray was delivered February 2024, the paper Owner's Manual had the "after 1 week storage use charger statement." Could not get a formal answer as why, so contacted Tadge Juechter. (The following Pic shows his email response.)

Owner's Manual, Page 268: 12-volt Lithium-ion Battery(E-Ray)
When the vehicle is going to be stored for longer than one week a battery maintainer package can be used to keep the battery charged when the vehicle is not in use.

Not what Tadge Juechter said in the Jay Leno E-Ray video so when my E-Ray arrived February 28 contacted him! He wrote:



Hi Jerry,
Our Owner's Manuals are very conservatively written. E-Ray can stand for several weeks easily without a tender. Longer than that, I would put the tender on it. Li batteries are actually better than lead-acid for sit-time. I never bother disconnecting the terminal. Congrats on getting such an early VIN!

Tadge Juechter

GM corrected what were misstatements in all MY 2024 Owner's Manuals in the MY 2025 Owner's Manual (see Pic Below.) ***No foolish mention of charging the EV battery with an external device. AND for Li-Ion 12-volt battery it now states "need a charger if stored for a long time!" No mention of "how long."***

2024 Owner's Manual

268 Vehicle Care

12-volt Lithium-ion Battery (E-Ray)

When the vehicle is going to be stored for longer than one week, the 12-volt lithium-ion battery negative and Controller Area Network (CAN) signal connectors should be disconnected to preserve the life of the 12-volt lithium-ion battery. Ensure the signal connector is facing downwards and shielded from direct water exposure to prevent corrosion while disconnected. A battery maintainer package can be used to keep the battery charged when the vehicle is not in use.

The 2025 Owner's Manual eliminated the reference to "stored over a week." Also searched and no mention of "Controller Area Network (CAN) or removing the cables (wherever they were!) LOL

2025 Owner's Manual

280 Vehicle Care

12-Volt Lithium-Ion Battery (E-Ray)

Use the Battery Voltage info tile to determine if your battery is low and needs to be charged. See *Instrument Cluster* ⇨ 81 under the "Info Tiles" section for more information.

GM recommends charging your 12-volt lithium-ion battery when storing your vehicle for long periods of time. See "Vehicle Storage" later on in this section.

From Page 282 Storage

When storing the vehicle on a long-term basis:

- Attach a compatible battery tender or trickle charger to the 12-volt lithium-ion battery.
- Keep the remote key more than 3 m (10 ft) away from the vehicle.

Considering: Tadge's Statement; My Best GUESS based on my observation: Install a Charger before sitting ~4 Weeks.

Next Issue: *Type of Charger Needed:*

GM Specifies and Sells the Same CTEK Sourced Maintenance Charger for All C8s. MY 2025 GM Charger Instructions State, for Li-Ion and Lead Acid Batteries.

I bought the GM MY 2025 Charger, part # 85530676 from GM Parts Source ShopChevyParts.com for \$127 + shipping (MSRP = \$175.) **Details of my tests follow in a Pic/Caption Format. You can scan and read what is important to you.**



BTW, I bought the GM Spec'd Li-Ion/Lead Acid charger when I decided to use my 10-year-old CTEK (seldom used) charger when the 2nd Schumacher charger in 23 years being used on my Street Rod 24/7, failed. Initially thought it might work for the E-Ray IF the Li-Ion battery got below 13 volts. Recent GM Doc clearly says NOT!

Fastened, my old CTEK charger to the wall and routed the wires thru a split

hollow tube that is ~5 feet high so I can duck under when needed!

More Info on Which Charger to Use:

Can A Conventional Lead Acid Battery Be Used?

My first thoughts were perhaps, as some Li-Ion battery manufacturers indicate, they can work but will not charge to as high a voltage. BUT "New" GM Info, says NOPE! See GM Tech Link in Appendix, TIP page 15, is repeated below:

TIP: Older unapproved battery maintainers may not provide current as the 12V LiB is normally sitting at 13.3V, and older chargers will not output any current when the voltage appears to be at a fully charged level. As a result, the 12V LiB will drain and the contactors will open during programming when an older legacy battery maintainer is connected.

Note all GM Maintenance Chargers sold from 2020 for C8s are for Li-ion & Lead Acid batteries, as they are labeled in the Instructions BUT NOT on the Charger.

I drive my E-Ray at least several times a week and usually a ~60-mile round trip to town. The alternator has more than enough time to charge to the level GM defines as Maximum. I typically measure 13.3 volts about 80% to 85% capacity. If the car sits for ~4 days the dash gauge reads fully charged 13.3 Volts in ~5 miles.

Next: What if I Left My E-Ray Sit Too Long and There is No/Very Low Voltage Reading? The Low Voltage Protective Control May Have Opened the Li-Ion Battery Contactors.

All Li-Ion 12-volt car batteries have protective circuits in case the battery voltage gets too low. In the Appendix the several page GM Tech Link re E-Ray 12-volt battery states:

Under Voltage – In an under-voltage condition, the relay will open if any cell drops below 2.5 volts, which may occur when the battery is discharged below 11 volts. The relay can be closed under normal conditions by charging the battery using the EL-52800 E-XTEQ Diagnostic Charge Battery Station (DCBS) or an approved charger in power supply mode.

However, two forum members (*both having the CTEK charger sold for Li-Ion batteries NOT the GM sold charger*) showed a very low or no voltage. As suggested, they Pressed the RESET button on their chargers and the Contactors DID NOT RESET. One borrowed a friend's combo Li-Ion/Lead Acid charger and Rest did not close the Contactors. It is suggested if that happens to Press RESET longer than the 10 Seconds recommended and reconnecting the charger. IF THAT DOES NOT HELP, JUMP START THE CAR. Can use another car battery with jumper cables OR what they both did: Use a Jump Box. One reported his dealer brought over a Jump Box, started the E-Ray and the dealership service folks said right after it was in the shop it started fine.

The other member used his own Li-Ion Jumper Box (*they are sold on Amazon, some for under \$100*) and started the car. He had a place to go and after a 1 hour drive the battery read the normal 13.3 volts, where the Alternator charges.

Turns out per Google, jump starting with either another car's 12-volt battery or Jump Box **BYPASSES** the Open Protective Contactors. When the E-Ray's Alternator starts charging IT closes the Open Controller Contacts.

Note: Jump Starting procedures are outlined in the Owner's Manual and are similar for Lead Acid and Li-Ion E-Ray battery. Appendix has some info.

My Observation of E-Ray Charging System Algorithm

Unlike the C8 with Lead Acid Battery (*see Pic that follows*) GM does NOT supply the same info for the E-Ray! So with 2 years of observations this is my SWAG. Like the C8 in normal daytime driving, the E-Ray 12-volt battery does the same as the Lead Acid as far as % charge. It charges to ~80%. Is that like the Lead Acid normal charging to 80% a "Fuel Economy Mode?" Perhaps one reason but from all the info on Li-Ion batteries it's certainly to help increase battery life. Plus no need to charge further to start the car.

Below: How GM Charges C8 Lead Acid Batteries

C8 Charging System (key points only)

Charge Mode

The Body Control Module will enter Charge Mode when ever one of the following conditions are met.

- The wipers are ON for more than 3 seconds.
- The estimated battery temperature is less than 0° C (32°F).
- Battery State of ***Charge is less than 80 percent.***
- Vehicle speed is greater than 145 km/h (90 mph)
- ***System voltage was determined to be below 12.56 V***

When any one of these conditions is met, targeted generator output voltage will be between 13.9 and 15.5 V,

Fuel Economy Mode

The BCM will enter Fuel Economy Mode when the estimated battery temperature is at least 0°C (32°F) but less than or equal to 80°C (176°F), the calculated battery current is less than 15 amperes and greater than -8 amperes, and the ***battery state-of-charge is greater than or equal to 80 percent.*** Its targeted generator output and can be between 12.5 and 13.1 V.

The BCM will exit this mode and enter Charge Mode when any of the conditions described above are present.

C8 E-Ray Charging System

(from my 2-year observation.)

- If E-Ray sits for 5 days after starting, it will show ~13.5 volts on the dash meter. Gauge is showing the Alternator voltage NOT Battery voltage.
- In about 5 miles it will stabilize at 13.3 volts about 80% charge (see table page 13 in Appendix.)
- An interesting observation with the E-Ray NOT possible with a none Hybrid Vette! If using Stop/Start, which I always do, when you Stop the gauge reading alternator voltage, ONLY reads the battery voltage! Takes bout 10 to 15 seconds for the charge to depilate but typically I read 13.2 volts. That is with the battery powering the radio, AC fans etc.
- Once the engine restarts it usually will go to 13.4 volts for a mile or so then back to 13.3 volts where GM wants it. As noted, the GM Lead Acid li-Ion combo charger also charges to that 13.3 volt level.

I Observed About 6 Times, Battery Volts Going to 14.4 Volts!

First time I was concerned but the 2nd time (*about 2 months later*) I realized it's "Probably" the BMS (Battery Management System) calibrating the % Charge level, balancing the internal cels. Or both. Best do that by charging to 100%.

Other Observations:

I have observed the "Battery Voltage Dash Guage" go to 14.4 volts, about 6 times while driving! One occurrence it went to 14.5 volts. Typically when I start to drive it read 13.4 to 13.5 volts. That was as expected. Thought it would, as usual, within ~10 miles drop to the usual 13.3 volts. BUT it went to 13.6, 13.7, 13.8 after about 5 seconds at each voltage. It continued to increase in the same 0.1 volt increments each ~5 seconds until it reached 14.5 volts.

I had observed similar several other times. Note, in the 24 months I have had the E-Ray it could have done that more often but I only had voltage showing on the dash in MY Mode. It appears to be calibrating the Li-Ion battery state of charge as discussed in the Jason Fenske video. And/or balancing Cels. Jason notes can ONLY be sure the Li-Ion battery is at 100% charge if you get past about 14.2 volts. Ford recommends for EVs to do that once a month versus for battery life charging below 80% for maximum battery life and to reduce energy use. Great video. Also balancing internal cels is best done charging to 100%.

Another time it was 14.1 volts when I started! It went to 14.4 volts within a mile the stepped down in 4 to 5 seconds per 0.1 volt. In 5 miles it was back to 13.3/13.4 volts. (*Forum Member Lefty32 posted his went to 14.4 volts!*)

SIDEBAR

Detailed Info from my Research and Tests Made on my E-Ray Li-Ion Battery Since I got it in February 2024

My E-Ray Li-Ion Battery Charging History:

- My E-Ray was built February 7th, 2024
- Sat on QC Hold with ~100 others (*GM's QA Method To Check For Possible Manufacturing issues that might require modified tooling or additional operator training at some assembly stations etc.*)
- Left BG on February 27
- At My Dealer Late February 28

So, the battery was sitting for a minimum 20 days after install in BG and sometime before it was installed in the E-Ray. Thought I should use a charger when I got it home. It wasn't clear if my old equivalent to GM CTEK built charger would work. I bought that ~10-year-old, Model 3300 CTEK charger in 2013 for my C7. Plugged into my E-Ray after measuring the battery voltage at 13.28 volts. It indicated Fully Charged in seconds. Tried one other time with the same result. I and some others who have posted on Forums **INCORRECTLY** thought the old Vette chargers might work. Since the E-Ray alternator charges the Li-Ion 12-volt battery to 13.3 volts when I plugged my 2014 CTEK Charger, similar to what GM sold that year, it instantly showed fully charge. Yep since 100% charger on a Lead Acid battery is ~12.9 volts, logical. **MISTAKENLY** thought IF the Li-Ion battery dropped to ~12.9 volts it would start charging. BUT as the TechLink Tip says, **"Nope, battery internal contactors will OPEN when the old charger is connected."**

Apparently from having driven my E-Ray home ~50 miles from the dealer the E-Ray alternator had fully charged the Li-Ion battery to the voltage/capacity GM desired! The LT2 alternator charges the battery to ~13.3 Volts. That is above the voltage that would cause my Model 3300 lead acid battery charger, seeing 13.3 volts when it was connected and lit the fully charged LED.

Some Info re: Should A CTEK (or Other Brand) Dedicated Lithium-Ion Battery Charger Be Used?

This was posted on a forum as received from CTEK to the question:

Lithium-ion is a general term used for many types of lithium batteries including Li-FePO4, Li-Fe, Li-iron and LFP type batteries our Lithium Charger, will work fine on your ERay 12V lithium battery. It has 8 Step Cycles

1 STEP- ACCEPT Tests if the battery can accept charge. This step prevents charging from proceeding on a defective battery.

2 STEP -BULK Charging with maximum current until about 90% battery capacity.

3 STEP -ABSORPTION Charging with declining current up to 95% battery capacity.

4 STEP -ANALYZE Tests if the battery can hold charge. Batteries that cannot hold charge may need to be replaced.

5 STEP -COMPLETION Final charge with reduced current up to approximately 98% battery capacity.

6 STEP -MAXIMIZATION Final charge with maximum voltage up to 100% battery capacity. (My Note: Does GM want the battery charged to this higher voltage? Also, will the Li-Ion Battery Management Control, BMC, allow the battery to be charged to the higher level?)

7 STEP -FLOAT Maintaining the battery voltage at maximum level by providing a constant voltage charge.

8 STEP -PULSE Maintaining the battery at 95–100% capacity. The charger monitors the battery voltage and gives a pulse when necessary to keep the battery fully charged.

CTEK Added: Another option is our client-branded **Corvette charger that is both 12V lead-acid and lithium compatible (Lithium-ion; Li-FePO₄, Li-Fe, Li-iron, LFP type)**. For more information on the GM Corvette charger please contact your local dealership

There is some additional Technical Information that Cautions charging to 100% other than perhaps once a month! It is discussed in detail in a video by Jason Fenske (Engineering Explained.) An expert in mechanical car issues and ICEs, Jason is gaining an understanding of EV's and the technical questions centered around their batteries. He notes he has read many tech papers on the subject.

This is one of his several Video's, this one related to LiFePO₄ batteries:

<https://www.youtube.com/watch?v=w1zKfIQUQ-s&t=1s>

This is a Pic from The Video to Which I Added Info: (See Appendix Page 14)

How To Ruin Your Electric Car's Battery - LFP Edition!

Jason Fenske Quotes Jeff Dahn, PHD Physicist and Li-Ion Battery Expert

“cycling near the top of charge (75 - 100% SOC) is detrimental to LFP/graphite cells.”

LFP = LiFePO₄

“time spent cycling at high states of charge is critical to minimize.”

Known as Tesla's “Secret Weapon!”

Jason Fenske Video: [How To Ruin Your Electric Car's Battery - LFP Edition!](https://www.youtube.com/watch?v=w1zKfIQUQ-s&t=1s)

Play (k)

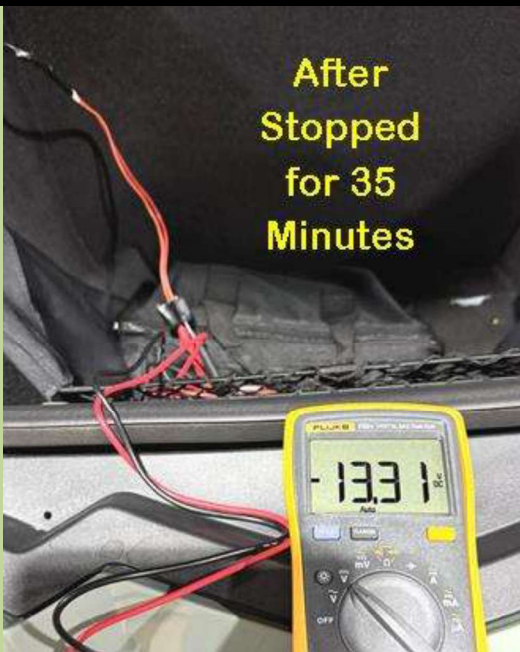
PIC w/Captions of My Test Info

Before I installed the GM Spec'd and Sold E-Ray (and all C8) Charger, I made a battery voltage measurement. (Read same voltage as when I brought my E-Ray home ~50 miles from the Dealer.) I had just finished a ~50-mile roundtrip drive to town. The LT2 alternator charges the battery when engine is running.

For fun, checked after I stopped before ~2 minutes as there is a higher parasitic current draw until the "battery saver circuits" fully activate. The Frunk light goes off in less than 10 minutes but some other circuits may still be active up to ~20/30 minutes. Note the Frunk light is lite in this Pic.



After
Stopped
for ~2
Minutes
After E-Ray
Drove ~50
Miles



After
Stopped
for 35
Minutes

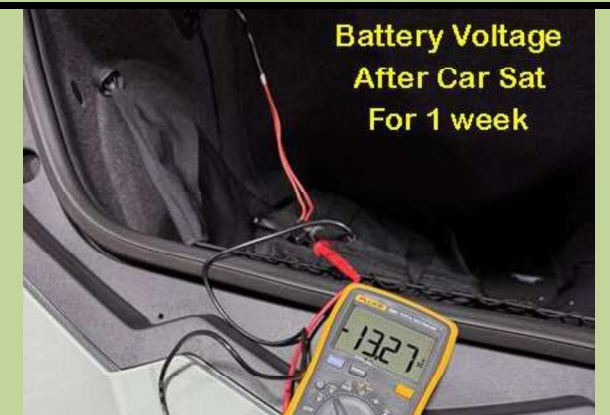
Waited 35 minutes for Battery Saver Circuits to lower parasitic current draw to its lowest level. Not sure what that level is for the E-Ray but Andybump measured ~10 milliamps after ~15 minutes for his C8. That is very low, equivalent to a 0.12-Watt Bulb!

So, with whatever parasitic current was flowing at 2 minutes, it caused the battery voltage to be 0.03 volts lower that with the lowest parasitic current draw at 35 minutes. Therefore, the base starting voltage would be ~13.3 **IF the charger was installed at that time.**

But after 1 hr 15 minutes Charger had not lit the 100% charge LED and I did not have the time to wait.

Was out of town for a week and prior to leaving, as mentioned above, had no time to wait for the max charge LED light. So, when I returned home I 1st measured the battery voltage. It was 13.27 Volts. So, in that week, battery voltage reduced from ~13.31 to 13.27. Therefore, the battery voltage dropped 0.04 volts.

I then plugged in the Charger.



Battery Voltage
After Car Sat
For 1 week

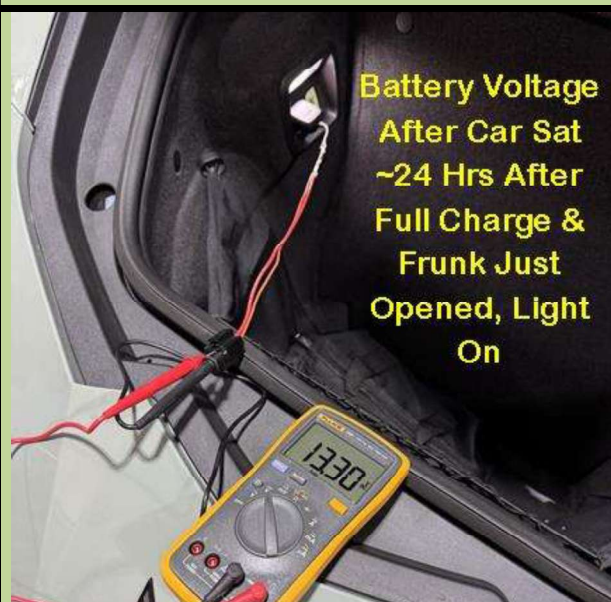
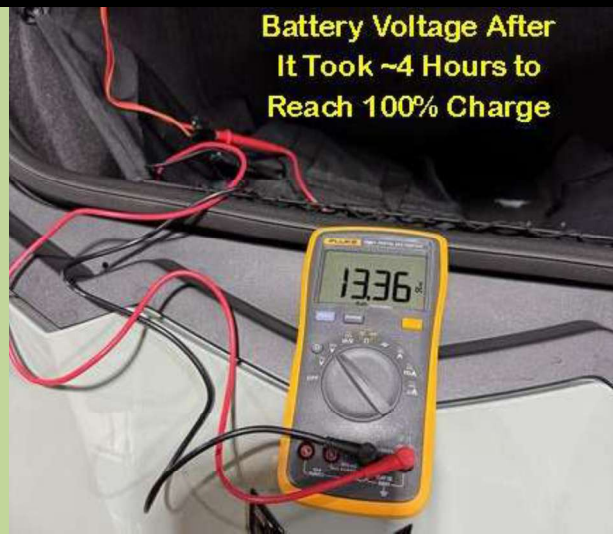


Note: Instructions state Li-Ion & Lead Acid batteries on Cover and in Tech Specs. BUT NOT on Charger! Too many languages with other "stuff!"

After installing the GM MY 2025 charger, within seconds it showed what the instructions say is 80% charged LED. Looking at the capacity versus voltage table for LiFePO4 battery in the appendix. The measured 13.27 volts is about 80% capacity.

But as some Internet info suggests, charge significantly slows when past 80%. It took ~4 hrs to reach what the instructions label 100% charge LED.

About 30 minutes after the charger reached 100% and was removed the parasitic current draw at a low level. The Battery Voltage was 13.36. That is significantly below the ~14.4 volts some Li-Ion batteries can be charged. The Capacity versus Voltage table in the appendix shows it could be called ~99% but that is before the voltage/capacity curve takes a sharp turn upward. It shows max voltage at 100% capacity can be 14.4 volts.



An internet discussion re measuring Li-Ion battery voltages states, quoting:

"Voltage: The higher the battery voltage, the fuller the battery is. In order to get accurate results, you must keep the battery at rest for at least four hours before measuring. Some manufacturers even recommend around 24 hours of rest."

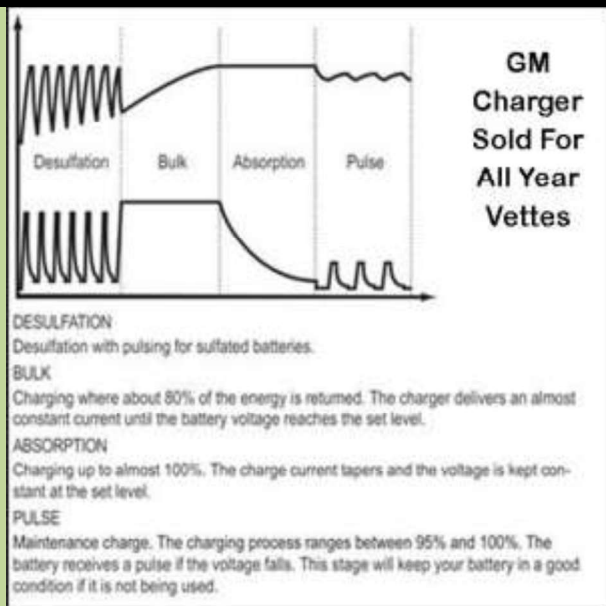
So, after 24 hours from being charged to 100% with the GM Spec'd Charger it shows 13.3 volts. That is the same voltage where the LT2 alternator charges the battery! Using the table in the Appendix that is ~80% capacity.

What About Using an Older Model CTEK Charger? New GM Info, See page 17 states Nope:

GM Doc TIP: Older unapproved battery maintainers would not provide current as the fully charged 12V LiB is normally sitting at 13.3V, and older chargers will not output any current when the voltage appears to be at a fully charged level. As a result, the 12V LiB will drain and the contactors will open during programming when an older legacy battery maintainer is connected.



Note: I thought (as did others) when the Li-Ion battery got to ~13 volts the old charge would work! GM Says NOT-- **The Internal Contactors Will Open if battery volts are low!**



Another Concern: Li-Ion chargers should NOT HAVE a Desulphation cycle. Found, CTEK method of operation prevents Desulphation cycle being used (full details in appendix.)

- **CTEK Desulphation is accomplished if needed by sensing if the lead acid battery is sulfated by measuring the internal resistance.**
- **A sulphated lead acid battery has a high internal resistance;**
- **A Li-ion battery has low resistance**
- **The Desulphation Cycle is bypassed if not need.**

No Diagram of C8 Charger Cycles. Too Many Languages, no room! So Asked Google about Desulfation Cycle

Google AI Said: "Yes, the C8 battery charger, designed for both lithium-ion and lead-acid batteries, typically includes a Desulfating cycle for lead-acid batteries. This feature helps to remove sulfation, a process where sulfate crystals can build up on the battery plates, hindering the battery's ability to store and release energy."

No assurance that Google AI is right! BUT combined with what CTEK says how their Chargers evaluate (above) if a battery is "Sulfated" and when to use the Desulfation Cycle, it probably does. But doesn't activate when connected to a low resistance Li-Ion battery.

Forum Member Andybump's 2021 Corvette Charger ALSO States For:
All Lead Acid & Lithium Batteries.

TECHNICAL SPECIFICATIONS

Model number	1090
Input	110-120VAC 50-60Hz 11A
Output	Max 4.3A 12V
Back current drain*	less than 1.5mA/week
Ambient temperature	-4°F to +122°F
Battery types	All types of 12V lead-Acid batteries (VRLA, GEL, Calcium, AGM and Gel); 12V (metal) lithium batteries (LiFePO4, LiFe, Li-ion, LFP)
Battery capacity	14-160Ah
CEC400 Battery capacity	24-100Ah
Warranty	5 Year

The highlighted area states All Types of Lead Acid and Lithium Batteries. As AndyBump notes even though there was no E-Ray in 2021. GM knew it was coming and specified that requirement to CTEK!

In addition, Member Andybump's 2021 Corvette Logo Charger states it is for Li-Ion and Lead Acid batteries.

My 2013 CTEK Model 3300 equivalent to the Corvette Logo charger states it's for Lead Acid batteries. Because my E-Ray battery was at the alternator set 13.3 volts it showed Green Charged enough in seconds. GM states IF the Li-Ion battery voltage is TOO LOW (*no value given*) when an older CTEK Lead Acid only battery charger is connected the internal Li-Ion connectors would open and could not be charged!

Bottom Line: Is an Older GM CTEK Charger Acceptable? NO!

In latest Li-Ion Doc r.e. E-Ray Battery says NO. Thought my older 2013 Model 3300 CTEK charger could be satisfactory. *NOT*, See page 17.

It appears if battery gets to around 13 volts where I thought an old charger might work, it will open the internal contactors and it will not be able to charge! All Li-Ion batteries have such contactors and Battery Management Control to "protect" the battery.



**CTEK 56-926
Lithium with 12 volt
Plug for Frunk
Receptacle**

QUESTIONABLE IMO

Is the CTEK (Or Other) Dedicated Li-Ion Charger Acceptable to Use?

No guidance from GM who may just say we don't test all chargers.

It may OK even if it charges to 14.0 volts, although long use at that higher voltage may reduce battery life. That is an issue for Hybrid and EV batteries but the 12-volt battery is relatively low cost to replace in the E-Ray compared to an EV battery even if the life is reduced.

BUT WHY TAKE A CHANCE? GM CHARGER DESIGNED WITH BATTERY MANUFACTURER, WORKS JUST FINE!

Bottom Line: On Charger to Use for E-Ray

IMO safest to use what GM has defined, no doubt with the Li-Ion battery manufacturer input, that is compatible with the Battery Management Control (BMC.) Like all Li-Ion batteries it has a BMC that controls things like charging rates, Min and Max voltages, balancing cells etc. Some may be part of the car software. There are no visible BMC controls on the battery as some that are sold where you can adjust charging parameters. With the E-Ray Li-Ion battery and GM sold charger those parameters are fixed.

APPENDIX

Lithium-Ion Battery info:

Percentage (SOC)	1 Cell	12V
100% Charging	3.65	14.6
100% Rest	3.40	13.6
90%	3.35	13.4
80%	3.32	13.3
70%	3.30	13.2
60%	3.27	13.1
50%	3.26	13.0
40%	3.25	13.0
30%	3.22	12.9
20%	3.20	12.8
10%	3.00	12.0
0%	2.50	10.0

This is a Chart Showing lithium car battery capacity versus voltage. It is a very flat curve except at the high and low extremes. So, the typical voltage reading I have made showing from 13.3 volts means the battery was ~80% charged.

Since it is such a flat voltage/capacity curve, judging capacity by voltage measurement is not the best method but gives an indication. It also has significant implications if charging with a CTEK designed for lead acid batteries like my ~10-year-old Model 3300 and probably older GM chargers designed for lead acid batteries. They typically charge to

about 12.9 volts. Although that would be sufficient to start the car and the alternator could charge to the battery, GM Doc page 17 says NOPE, Contactors would open!

Other Internet Info RE Li-Ion Batteries

These are the questions I asked and Google answered:

My Question: When does a CTEK Charger start the Desulphation Cycle?

Google Answer: Desulfation is accomplished at the very first stage of charging if it is needed with a CTEK charger. If it is not needed it bypasses this stage of charging. It senses if the battery is sulfated by measuring the internal resistance of the battery.”

My Question: Does a sulfated battery have a high internal resistance?

Google Answer: Yes, a sulfated lead acid battery has a high internal resistance; when a lead acid battery becomes sulfated, the sulfate crystals that form on the plates create a non-conductive barrier, significantly increasing the battery's internal resistance and hindering its ability to deliver current effectively.

My Question: Does a Li-Ion Have the same internal resistance as a lead acid battery

Google Answer: No, a lithium-ion battery typically has a significantly lower internal resistance compared to a lead-acid battery; meaning a Li-ion battery offers less resistance to current flow, allowing for faster charging and discharge rates with less energy loss as heat.

Bottom Line: We don't know why GM may NOT WANT a higher Li-Ion battery charger voltage than 13.3 volts. Perhaps it is a reason I searched and found it provides for better battery life. In addition, Li-Ion battery manufacturers who are NOT PUSHING their own chargers state similar to this Quote:

NOTE: This generic Li-Ion charger statement shows they can charge from 14.4 to 14.8 volts. BUT a GM Tech Link re the E-Ray battery states: TIP: The 12 V LiB may be damaged if charged to more than 14.5 volts. This is some additional info from that GM TechLink:

The 12V lithium-ion battery is charged by the K1 14V Power Module while the vehicle is operating in the EV modes (Stealth and Shuttle modes). Once the vehicle exits an EV mode and the engine is powering the vehicle, the generator (LT2 alternator) takes over 12V LiB charging.

The 12V LiB has an internal set of contactors that will open if voltage, current or temperature reach a critical state. Contactor self-tests run every time the vehicle is powered down and, once the self-tests begin, are completed within 5 seconds. It may be possible to hear the contactors opening and closing. The battery communicates via CAN to the K9 Body Control Module (BCM) to provide status and DTCs.

The TechLink also notes it has circuits to protect the battery:

Voltage – In an over-voltage condition, the relay will open in any cell that exceeds 4.0

volts, which can be expected when the battery is charged above 15 volts. The relay will close once voltage is below 15 volts.

Under Voltage – In an under-voltage condition, the relay will open if any cell drops below 2.5 volts, which may occur when the battery is discharged below 11 volts. The relay can be closed under normal conditions by charging the battery using the EL-52800 E-XTEQ Diagnostic Charge Battery Station (DCBS) or an approved charger in power supply mode.

Severe Discharge – If the battery is severely discharged — any cell drops to 1.5 volts — it will set a critical low voltage and end of life fault and the relay will not close again

Over Current – If there is an over-current condition, such as an external short circuit, the relay will open if current exceeds 2,000 amps. The relay can be closed under normal conditions by charging the battery using an approved charger in power supply mode.

Over Temperature – The relay will open if there is an over-temperature condition where the internal temperature exceeds 185°F (85°C). The relay will close once the temperature drops below 176°F (80°C).

Here are some Internet comments about charging a Li Ion car battery to 80 to 85% versus 100%

> Charging a lithium-ion (Li-ion) car battery to 80–85% instead of 100% can help - improve the battery's long-term health and efficiency:

> Battery degradation: Charging a Li-ion battery to 100% regularly can cause it to degrade faster. This is because the high voltage needed to maintain a full charge can stress the battery's chemistry.

> Charging rates: Charging rates slow down significantly after 80%.

> Battery efficiency: Li-ion batteries are most efficient when operating between 20–80%.

> While it's safe to charge to 100% when needed, like for a long journey, it's best to avoid doing so regularly.

The Above General Statements are Supported by Extensive Testing Summarized by Jason Fenske in This Video:

<https://www.youtube.com/watch?v=w1zKfIQUQ-s&t=1s>

For EVs it suggested charging to 100% about once/month. That recalibrates the method used to define and display capacity or battery miles left to drive.

Important for HEV's and very important for EVs. As noted, the flat volts versus battery capacity curve makes defining an accurate battery capacity with voltage measurement difficult. Jason says to get accurate values; they count electrons coming in from charging and out.

However, over time that measurement becomes inaccurate. Assume they are measuring and counting amps in and out. So, it needs to be recalibrated and the high voltage at the curve end clearly defines 100%. But for the same amount of battery energy storage, it takes more energy and is harder on the battery to say charge from 75 to 100% than from say 0 to 25%. Same amount of energy storage but it requires more effort. Jason equates that to filling an empty parking lot from 0 to 25% where there are many open spaces compared to 75 to 100% where it takes effort to find empty spaces.

This is a GM Tech Link with Li-Ion Checking Details and Info About the Corvette E-Ray 12-Volt Lithium-Ion Battery

April 30, 2024 Updated October 3, 2024 – By: Lane Rezek and Brett Holsworth

The 2024 Corvette E-Ray uses two lithium-ion batteries — one for high-voltage functions with the front electric axle and one for low-voltage operations that replaces the traditional lead-acid 12V battery. (Fig. 8)

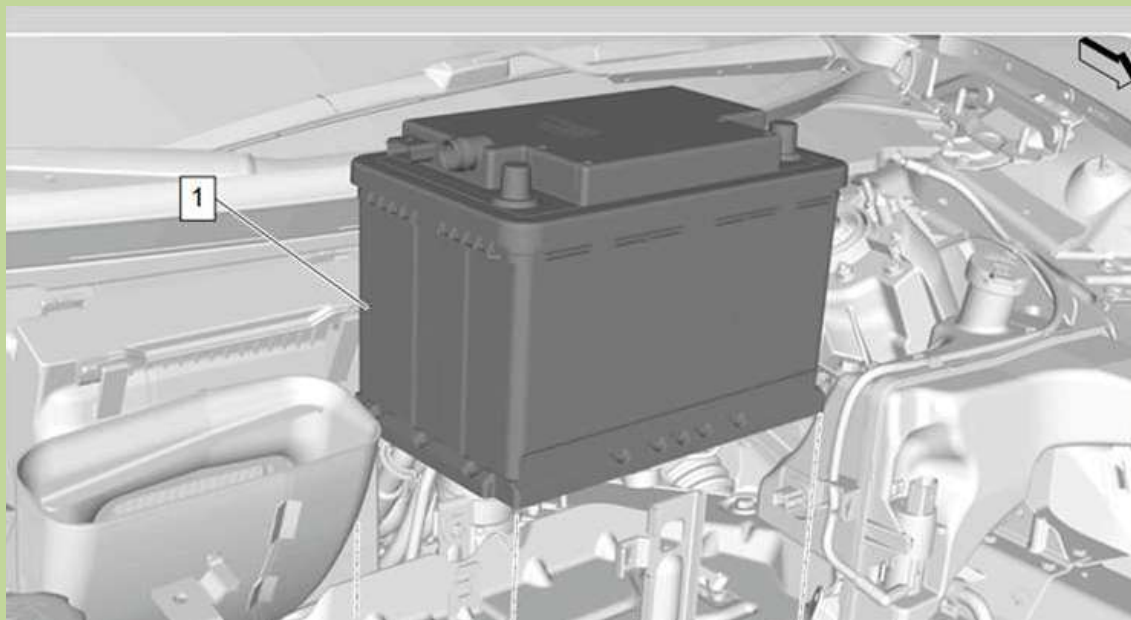


Fig. 8

While other Corvette models have 12V flooded lead-acid batteries, the 12V lithium-ion battery in the E-Ray, also known as the 12V LiB, enables the 6.2L V8 (RPO LT2) to perform a flying start when exiting Stealth mode while driving.

The 12V lithium-ion battery is charged by the K1 14V Power Module while the vehicle is operating in the EV modes (Stealth and Shuttle modes). Once the vehicle exits an EV mode and the engine is powering the vehicle, the generator takes over 12V LiB charging. (Note: I inserted Pic of 300 V DC to 12 V DC converter.)



Battery Contactors

The 12V LiB has an internal set of contactors that will open if voltage, current or temperature reach a critical state. (*My note: They may open based on a low or high temp.*) The voltage curve is not the same as a lead-acid (PbA) 12V battery.

Contactors self-tests run every time the vehicle is powered down and, once the self-tests begin, are completed within 5 seconds. It may be possible to hear the contactors opening and closing. The battery communicates via CAN to the K9 Body Control Module (BCM) to provide status and DTCs. 12V battery voltage is displayed on the instrument cluster. (Fig. 9) GDS2 can be used to read scan tool information directly from the 12V LiB under the K244 Battery Management Control Module.



Fig. 9

Over Voltage – In an over-voltage condition, the relay will open in any cell that exceeds 4.0 volts, which can be expected when the battery is charged above 15 volts. The relay will close once voltage is below 15 volts.

Under Voltage – In an under-voltage condition, the relay will open if any cell drops below 2.5 volts, which may occur when the battery is discharged below 11 volts. The relay can be closed under normal conditions by charging the battery using the EL-52800 E-XTEQ Diagnostic Charge Battery Station (DCBS) or an

approved charger in power supply mode.

Severe Discharge – If the battery is severely discharged — any cell drops to 1.5 volts — it will set a critical low voltage and end of life fault and the relay will not close again.

Over Current – If there is an over-current condition, such as an external short circuit, the relay will open if current exceeds 2,000 amps. The relay can be closed under normal conditions by charging the battery using an approved charger in power supply mode.

Over Temperature – The relay will open if there is an over-temperature condition where the internal temperature exceeds 185°F (85°C). The relay will close once the temperature drops below 176°F (80°C).

The lithium-ion battery will not decay like a lead-acid battery. The battery health will fall off sharply; it will never provide a slow crank. The contactors inside the battery provide protection to the battery and, if the battery fails, it may be due to the contactors not allowing power to the posts, resulting in the battery to appear to be completely dead.

The 12V LiB also has an internal control module (K244 Battery Management Control Module), which can be programmed with SPS and has data available to view in GDS2. The K244 Battery Management Control Module should not be confused with the K16 Battery Energy Control Module, which is strictly for the high-voltage battery.

SPS Programming

Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install an approved battery maintainer or power supply that provides a steady and stable voltage to support the 12V system during SPS programming events.

TIP: Older unapproved battery maintainers may not provide current as the 12V LiB is normally sitting at 13.3V, and older chargers will not output any current when the voltage appears to be at a fully charged level. As a result, the 12V LiB will drain and the contactors will open during programming when an older legacy battery maintainer is connected.

The following tools are approved to provide a steady power supply while performing programming on the E-Ray. Older tools or unapproved tools, which may not keep current flow at a proper level during programming, should NOT be used.

MTRMSP0702GM – Midtronics MSP-070 Power Supply Charger with 2-Meter Charge Cable

MTRMSP0703GM – Midtronics MSP-070 Power Supply Charger with 3-Meter Charge Cable

MTRMSP0705GM – Midtronics MSP-070 Power Supply Charger with 5-Meter Charge Cable

XTQEZ0179B – E-XTEQ 512EVO Battery Charger/Maintainer

XTQEZ0179BX2 – E-XTEQ 512EVO Battery Charger/Maintainer (Quantity: 2)

XTQEZ0179BX3 – E-XTEQ 512EVO Battery Charger/Maintainer (Quantity: 3)

XTQEXBC1012-001-G – E-XTEQ BC1012 12V/100A Diagnostic Charger/Maintainer

XTQEXBC1012-001-GX2 – E-XTEQ BC1012 12V/100A Diagnostic Charger/Maintainer (Quantity: 2)

ESS6100 – Associated Equipment 100A Reflash Power Supply Charger

IBC6008MSK – Associated Equipment 70A Intellamatic Smart Charger/Analyzer

IBC6008 – Associated Equipment 70A Intellamatic Smart Battery Charger with Power Supply

ESS6008MSK – Associated Equipment 70A Intellamatic Smart Wheel Charger

ESS6008 – Associated Equipment 70A Charger with Power Supply

Battery Testing and Charging

Currently, GM does not offer an external testing method for the 12V lithium-ion battery. Do not use the EL-52800 E-XTEQ Diagnostic Charge Battery Station (DCBS) or EL-50313 Midtronics GR8 Battery Tester/Charger to perform a load test. However, these tools may be used to charge the 12V LiB. Be sure to use the proper settings on both tools to charge the 12V LiB.

Use the scan tool — Battery Management Control Module – Battery State of Charge to determine the battery’s state of charge.

TIP: The 12 V LiB may be damaged if charged to more than 14.5 volts.

When using the DCBS, select “Charging,” “manual battery selection”, and then “Lithium” when setting up the charger. If the contactors are open, the tool will automatically detect no power and ask for confirmation. Once confirmed, the DCBS will energize the battery to close the contactors.

Refer to Bulletin #23-NA-055 for additional information and FAQs regarding using the DCBS.

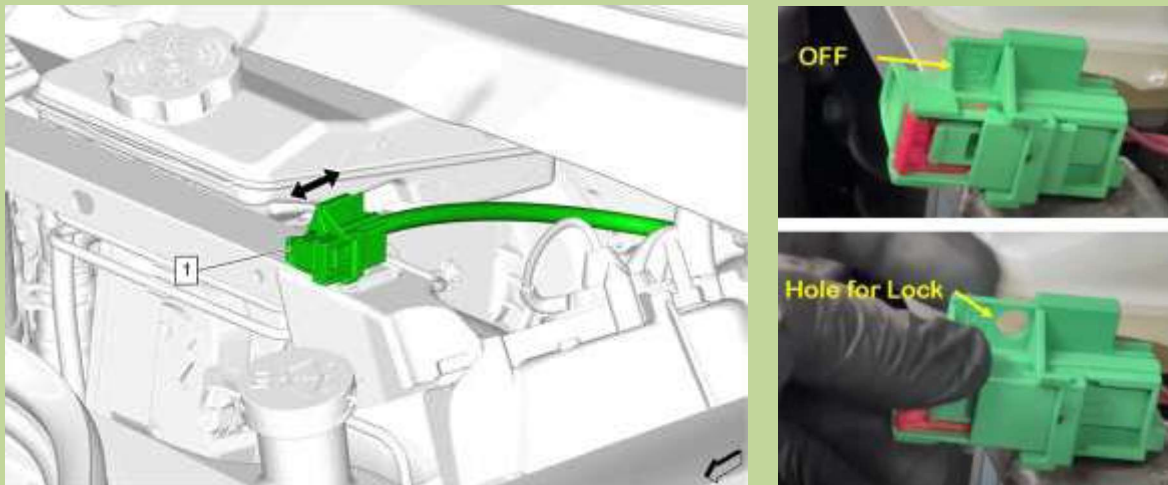
When using the GR8, select “Charging,” “PDI”, and “In Vehicle” when setting up the charger. If the contactors are open, select “power supply mode,” set the max voltage to 14.5V and allow the battery to charge for several minutes before going to a normal charge mode.

Battery Replacement

If the 12V lithium-ion battery requires replacement, the vehicle will set DTCs in accordance with emissions regulations. The DTCs should be recorded on the warranty claim.

TIP: Since the 12V LiB is connected to the high-voltage system, the High-Voltage Service Lockout (HVSL) must be engaged before disconnecting the battery negative cable when replacing the battery. (Fig. 10) Engage the HVSL by lifting the red Connector Position Assurance tab and then, while depressing the connector tab, pull apart the connector halves until the indicator tab wording changes from ON to OFF. Place a tie strap or a high-voltage disable padlock through the exposed HVSL hole to prevent improper re-engagement.

Fig 10



The 12V LiB should be ordered as a regular service part through EPIC, but there will be a unique return process to be announced soon. Do not send a faulty 12V LiB to your local 12-volt battery recycler, as it is considered hazardous material and must not be mixed with other 12V batteries.

The 12V lithium-ion battery will have two new unique labor codes for warranty. If the traditional labor code for 12V batteries is submitted, the claim will be rejected. The new codes, as of April 1, 2024, are 4041430 – Battery Module Replacement and 404143E – Battery Module Replacement – Emissions. These codes do not require a printed test slip since an external test is not possible.

The appropriate Service Information diagnostics should be followed if an emissions-related fault is the cause of a battery failure. When the 12V LiB reaches its end of life, it will be indicated by the end-of-life parameter in GDS2 as set by the K244 Battery Management Control Module. The Driver Information Center message “Service Charging System Vehicle May Stall” will be displayed in the vehicle without any DTCs set.

Do not replace a 12V LiB with a lead-acid battery in a customer-pay scenario, as a number of vehicle conditions may occur with the missing control module.

END TECH LINK

More Li-Ion Car 12 Volt Battery Info Found!

The following is more info than even I can explain fully but reinforces IMO why it’s SMART to use the battery charger GM sells for the E-Ray. Yep, been selling the same one that charges both Li-Ion and Lead Acid batteries since 2020 when the C8 came out! Yep, that was before the E-Ray was OUT!

As seen above that charger only charges to ~13.3 volts the same voltage as the Alternator. WHY not higher like 14+ volts some Li-Ion batteries can be charged? That would be 100% capacity where 13.3 volts is about 85 to 90% capacity. Is the reason like the C8 Lead Acid Battery being charged to only 80%, which GM clearly states is to save gasoline energy? Or is it to extend the Li-Ion battery Life? GM does not say.

What happens if you use a charger that can go to 14 volts? GM does not say and we don’t know. But the following may help understand why I think it’s SMART to use the GM sold Maintenance Charger:

Li-Ion car batteries are not new. I have a friend who has an RV with several Li-Ion batteries he uses when parked. He charges them with the vehicles Alternator as well as solar cells on the roof. He has done a lot of investigating on Li-Ion Battery design and charging. He uses high end Valance Li-Ion batteries and can set many charging and operating parameters with his phone.

This is a Pic my friend sent from his phone AP with typical values placed just to give perspective:

Renogy BT

Read

Set

Battery

Load

General Parameter

System Voltage(V)

12

Battery Type

USER

Advanced Setting

High Volt Disconnect(V)	16.0
Charge Limit Voltage(V)	15.2
Equalize Charge Volt(V)	14.8
Boost Charge Volt(V)	14.4
Float Charge Volt(V)	13.8
Boost Char Return Volt(V)	13.2
Over Disc Return Volt(V)	12.5
Low Voltage Alarm(V)	12.0
Over Discharge Volt(V)	11.0
Discharge Limit Volt(V)	10.5
Over Disc Delay Time(S)	6

Monitoring

Record

Settings

Device Info

Note my friend can set the:

- High Voltage Disconnect Voltage
- Discharge Limit Voltage
- Charge Limit Voltage
- Low Voltage Alarm etc.
- And many other charging/discharging parameters

As he explained it is all dependent on the specific Li-Ion battery design as to what value range is acceptable. In the E-Ray all these parameters are defined by the E-Ray software or whatever BMS is in the Battery. It's NOT accessible for us to set. It reinforces why IMO best to use what GM sells for the maintenance charger and with the battery manufacturer (*whoever it is not visible on the battery.*)

Another Tech Item I Only Have Internet Sourced Knowledge:

A few internet sources state you require 100% Charge of a Li-Ion Battery to Balance the individual Li-Ion Cells.

I believe the Ford conflicting statements in that regard, summarized in the Jason Fenske in his video state it best! Summary page 15. This is Video:

<https://www.youtube.com/watch?v=w1zKfIQUQ-s&t=1s>

For EV's there may be some logic because of the very flat battery voltage/capacity curve until about 13.5 volts when the curve is steep to 14+ volts where the battery is at a known 100% capacity. For the expected mileage they display, their algorithm is based on monitoring current in and out, which can be off over time. So an occasional charge to a known 100% allows resetting parameters to a known capacity. BUT Ford clearly states best for battery life and energy use to charge in the 20 to 80% range,

YOUR CAR YOUR CHOICE, BUT APPEARS TO ME BEST TO USE WHAT GM AND THE LI-ION BATTERY MANUFACTURER DEFINED AND PROGRAM REQUIRED DATA IN THE BCM.

What if the Battery Voltage Gets TOO LOW or Perhaps TOO COLD Opening the Internal Contactors?

The Charger Instructions state this prevents the Charger from detecting there is a battery connected. The Charger needs to RESET the UVP (Under Voltage Protection.) Pressing the large RED Rest Button for 10 seconds should open the UVP. Once open, the charger automatically starts the charging cycle.

A Forum Member recorded these values on his Stored E-Ray in Cold NH, no charger:

December 2 = 13.30 volts

January 2 = 13.12 volts

February 6 = 12.99 Volts

March 11 = 12.74 volts: It went into Under Voltage Battery Protection. My thought: It's possibly a combo low voltage and lower temperature that caused the BMS to open contacts. All 12-volt Li-Ion batteries will open contacts and disconnect the battery to protect it at some temperature. * See Note Below

CAUTION: *A member with a CTEK dedicated Li-Ion charger with the same RESET wording had what appeared to be a dead battery. He tried pressing the Reset as suggested. Even tried Rest with a GM C8 charger. It did not allow charging. His Chevy dealer brought a Battery Jump Box that allowed the car to start. He stated the Dealer tech said once started the battery was fine.*

***Note Cold Temperatures:** *A 12-volt Li-Ion battery's BMS usually opens the Contacts to STOP Charging or Discharging when the temps are 25 F to 32 F (is battery manufacturer dependent.) Perhaps won't occur with just the low parasitic current draw but when you open the door and currents increase may at that time. Might explain why there was a report the battery had enough power to open the door but then opened contacts and no voltage reading!*

From 2024 Owner's Manual, E-Ray Jump Start Box Procedure

GM States use approved Jump Box BUT no has list of what they are!

Appears they are saying use the Jump Box so battery accepts a C8 charger!

1. Set the jump start box to OFF.
2. Connect the red (+) cable to the lithium-ion battery positive (+) tab.
3. Connect the black (-) cable to the lithium-ion battery negative (-) post.
4. Once the jump start box has been connected, set the jump start box to ON. After the jump start box is powered on, ensure the instrument cluster lights up before starting the vehicle.
5. After the instrument cluster lights up, **use a GM approved battery charger to fully charge the battery.**

WA Technology

**“60” E-Ray, C8 Z51, 2017 Grand Sport & 2014 Z51 Stingray
Mods or Info Available As PDFs:**



60 PDFs discuss improvements or info about a E-Ray, C8, 2017 Grand Sport, 2014 Z51 Stingray function and/or esthetics. Some are minor and others, like installing “Low Dust Brake Pads” on C8 & C7s, have detailed information.

Below are the PDF's available. Click Blue PDF link or copy and paste the PDF link (Blue type) into your browser. Or email me at TechSupport@NetWelding.com and state the title desired, shown in Yellow:

E-Ray PDI & Info <i>Details of My E-Ray PDI</i> http://netwelding.com/E-Ray_PDI.pdf	
E-Ray 1st Mod <i>Details of My E-Ray Cross Brace</i> http://netwelding.com/E-Ray_Mod_1.pdf	
E-Ray Need Lift? <i>Yep, How I Scraped My Front Aero Panel</i> http://netwelding.com/E-Ray_Lift.pdf	
E-Ray PPF Bottom Of Rocker Panels <i>Small Amount of PPF Added To Rocker Panels</i> http://netwelding.com/E-Ray_PPF.pdf	
E-Ray Tire Slide & Rear Mesh <i>Safe way to remove and install wheels</i> http://netwelding.com/E-Ray_Tire_Slide.pdf	
E-Ray 12 Volt Battery http://netwelding.com/E-Ray_12_Volt.pdf	
'23 and Later Emergency Trunk Access http://netwelding.com/Emergency_Trunk_Access.pdf	

<p>C8 & E-Ray Brakes <i>C8 Brakes Are Anemic Compared to Other MEs</i> http://netwelding.com/C8_Big_Brakes.pdf</p>	
<p>C8 & E-Ray PDR SD Card Selection <i>Things to Consider When Buying SD Card</i> http://netwelding.com/PDR_SD_Card.pdf</p>	
<p>E-Ray, C8, C7 eLSD vs Positraction <i>eLSD is a Modern Dif; Positraction is from 1960s</i> http://netwelding.com/eLSD_VS_Posit.pdf</p>	
<p>E-Ray, C8 FWD Hybrid <i>WFWD Hybrid Provides More Power & MPG</i> http://netwelding.com/C8_FWD_Hybrid.pdf</p>	
<p>C8 Edge Red Engine Cover <i>Engine Cover Matches Valve Cover</i> http://netwelding.com/Engine_Cover.pdf</p>	
<p>C8 Engine Compartment Lights <i>Multicolor Lights Remote operated</i> http://netwelding.com/Engine_Lights.pdf</p>	
<p>C8 Side Skirts & Splitter <i>Install C7 Carbon side skirts & splitter on C8</i> http://netwelding.com/Side_Skirts.pdf</p>	
<p>C8 Z51, GS/C7 Z51 Ceramic Brake Pads <i>Performance Vettes have dusty brakes. These help!</i> http://netwelding.com/Ceramic_Pads.pdf</p>	
<p>C8 Low Restriction Air Intake <i>Low Restriction Air Filter Why & How To</i> http://netwelding.com/C8_Air_Intake.pdf</p>	
<p>C8 & C7 Splitter & C8 Condenser Mesh <i>Mesh Protects AC Condenser & Splitter Install</i> http://netwelding.com/CF_Splitter.pdf</p>	
<p>C8 NAV SD Card Removed Error <i>Error When SD Card and Reader Are Fine</i> http://netwelding.com/NAV_SD_Card.pdf</p>	
<p>C8/GS/C7 Splash Guards <i>GM splash guards. ACS Best Front Guards for GS.</i> http://netwelding.com/Splash_Guard.pdf</p>	
<p>Jacking a E-Ray/C8/GS/C7 Vette <i>Safely jacking either front only or back & front</i> http://netwelding.com/Jacking_A_C7.pdf</p>	
<p>E-Ray, C8 & C7 Plates & Frame; <i>Must Meet South Carolina Law</i> http://netwelding.com/License_Plate_Frame.pdf</p>	

<p>Change C8/GS/C7 Oil <i>WHY change your own oil and C7 Lifting Methods</i> http://netwelding.com/Changing_Oil.pdf</p>	
<p>E-Ray/C8/GS/C7 Mirror Proximity Alarm <i>Limit switch alarm warns when close to door frame</i> http://netwelding.com/Mirror_Proximity_Alarm.pdf</p>	
<p>Jacking Pads for E-Ray/C8/GS/C7 <i>Manual says Jacking Pads 2 1/2-inch max OD..</i> http://netwelding.com/Jacking_pads.pdf</p>	
<p>E-Ray/C8/GS/C7 Radar Power <i>For C7 tapped rear fuse panel. For GS tapped mirror</i> http://netwelding.com/Radar_Detector_Power.pdf</p>	
<p>E-Ray, C8 & C7 Wheel Chatter/Hop <i>Why sharp, low speed turns with cold tires causes the front tires to chatter/hop.</i> http://netwelding.com/Wheel_Chatter.pdf</p>	
<p>E-Ray/C8/GS/C7 Wheel Locks <i>Wheel locks, help protect your expensive wheels.</i> http://netwelding.com/Wheel_Locks.pdf</p>	
<p>Deer Whistle Installed on E-Ray/C8/GS/C7 <i>Do they work? Plus Install Info</i> http://netwelding.com/Deer_Whistle.pdf</p>	
<p>C8 & C7 Splitter Protector <i>Scrape Armor Protection for Splitter</i> http://netwelding.com/Splitter_Protectors.pdf</p>	
<p>E-Ray, C8 & C7 Cargo Area <i>Rear cargo area storage device and rear protector</i> http://netwelding.com/Rear_Cargo_Area.pdf</p>	
<p>C8 Front Coilover Tower Covers <i>Prevent water from filling Cast aluminum cavities</i> http://netwelding.com/Tower_Covers.pdf</p>	
<p>C8.R Info & GS Rear Diffuser (Fits Any C7) <i>Rear Carbon Flash Composite Diffuser</i> http://netwelding.com/Rear_Diffuser.pdf</p>	
<p>GS/C7 Belt Rattle <i>Passenger seat belt rattles against the seat back.</i> http://netwelding.com/Eliminate_Rattle.pdf</p>	
<p>Aluminum C8 & C7 Chassis and Repair <i>The C7 aluminum chassis. Includes weld repair info.</i> http://netwelding.com/Aluminum_Chassis.pdf</p>	
<p>GS/C7 License Plate Light <i>LED license plate light & cargo area bulbs</i> http://netwelding.com/License_Plate_Light.pdf</p>	

<p>E-Ray/GS/C7 Door Panel Protector <i>Black plastic protector prevents scuffing of door</i> http://netwelding.com/Door_Panel_Protector.pdf</p>	
<p>GS/C7 Improved Cup Holder <i>A solution to the cup holder spilling</i> http://netwelding.com/Improved_cup_Holder.pdf</p>	
<p>C7 Carbon Fiber Grille Bar <i>Install genuine carbon fiber grille bar overlay</i> http://netwelding.com/CF_Grille_Bar.pdf</p>	
<p>GS/C7 Blind Spot Mirror <i>Smaller rear and side windows cause C7 blind spots.</i> http://netwelding.com/Blind_Spot.pdf</p>	
<p>GS/C7 Skid Pad Protector <i>After the air dam, the aluminum "skid pad" hits</i> http://netwelding.com/Skid_Pad_Protector.pdf</p>	
<p>GS/C7 OnStar Lights <i>Rear view mirror OnStar LED's, at a quick glance, look like a police car flashing light! This is a fix.</i> http://netwelding.com/OnStar_Lights.pdf</p>	
<p>GS/C7 Skip Shift Eliminator <i>Skip Shift Eliminator install</i> http://netwelding.com/Skip_shift_Eliminator.pdf</p>	
<p>GS/C7 Catch Can & Clean Oil Separator <i>What is Coking and how to reduce the potential</i> http://netwelding.com/Catch_Can.pdf</p>	
<p>GS MGW Flat Stick Shifter <i>The MGW shifter shortens throw and is more precise</i> http://netwelding.com/MGW_Shifter.pdf</p>	
<p>GS/C7 Round Shift Knob <i>A round shift knob shortens throw on OEM shifter</i> http://netwelding.com/Shift_Knob.pdf</p>	
<p>GS/C7 Stingray Sill Plate <i>Stingray sill plate replaces original.</i> http://netwelding.com/Sill_Plate.pdf</p>	
<p>GS/C7 Nylon Bra <i>Nylon Bra Stops Bugs. Fits with Stage 3 Winglets</i> http://netwelding.com/Nylon_Bra.pdf</p>	
<p>GS/C7 Clutch Fluid Change <i>Clutch fluid after 3000 miles gets dirty</i> http://netwelding.com/Clutch_Fluid.pdf</p>	
<p>GS/C7 Cold Air Intake <i>Low Restriction Air Filter & Duct</i> http://netwelding.com/Cold_Air_Intake.pdf</p>	

<p>GS/C7 Soler Modified Throttle Body <i>For Improved Throttle Response</i> http://netwelding.com/Soler_Mod_TB.pdf</p>	
<p>GS Splitter Stage 3 Winglet <i>Stage 3 Winglets Integrate with Spats</i> http://netwelding.com/Stage_3_Winglets.pdf</p>	
<p>C7 Removing GM Plastic Film <i>How To Remove The Rocker Panel Film</i> http://netwelding.com/Rocker_Panel_Film.pdf</p>	
<p>GS 2LT to 2.5 LT <i>Red Upper Dash Pad Like 3LT</i> http://netwelding.com/Red_Dash_Pad.pdf</p>	
<p>Jake Emblem/Decals for GS <i>Jake Symbols Support GS Racing Image</i> http://netwelding.com/Jake_Embles.pdf</p>	
<p>Rusty GS/C7 Muffler <i>Why the C7 muffler rusts way to turn matte black.</i> http://netwelding.com/Muffler_Rust.pdf</p>	
<p>Boomy Bass Solution <i>Use Presets to Adjust Bass etc. Tone/Balance</i> http://netwelding.com/Boomy_Bass</p>	
<p>GS/C7 Air Dam, Functions <i>Why Missing from Z51, Some GS & Z06</i> http://netwelding.com/Air_Dam.pdf</p>	
<p>Rusty GS/C7 Muffler <i>Why the C7 muffler rusts way to turn matte black.</i> http://netwelding.com/Muffler_Rust.pdf</p>	
<p>Engineering a ProStreet Rod <i>How Our '34 ProStreet Rod Was Designed and Built</i> http://netwelding.com/Engineering%20Street%20Rod%2003-08.pdf</p>	
<p>Motorsports Welding Article <i>Wrote Article on NHRA and NASCAR Chassis Design</i> http://netwelding.com/Motorsports_Welding_2018.pdf</p>	
<p>Write Flyer Build: Fun Winter Project http://netwelding.com/Wright_Brothers_First_Airplane.pdf</p>	
<p>Chris Craft Build: Fun Winter Project http://netwelding.com/Building_Dumas_Chris_Craft_Boat_Model.pdf</p>	