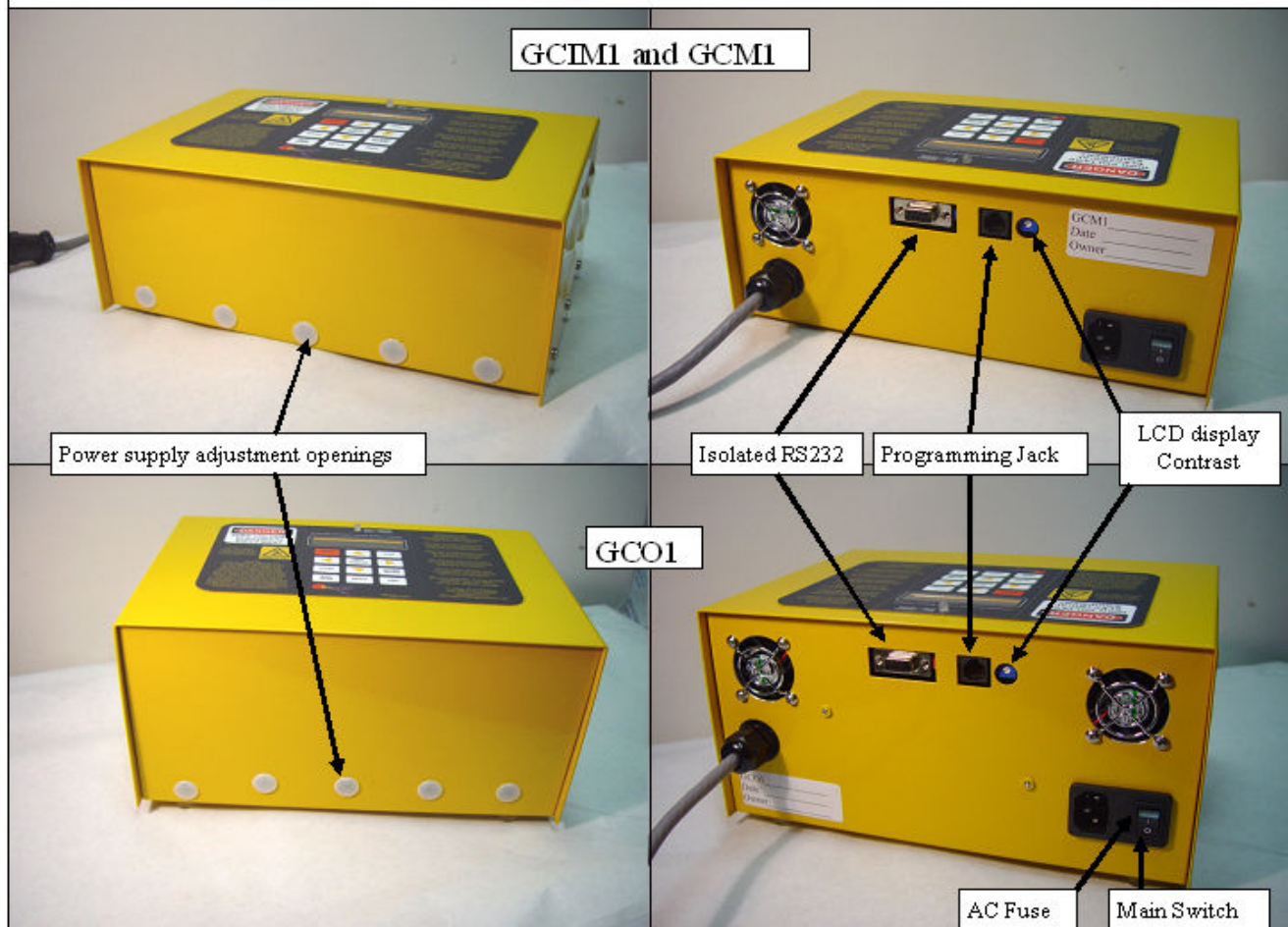


Genesis One Grid charger Operation manual V1.2



Got a hybrid car with a High Voltage battery pack that is acting up?

The Genesis One universal battery charger/balancer may be the answer. □ This charger can charge any battery from 7V to 240V at a constant current.

The Overnight Charger can charge at 1.05A and 350ma, and the Maintenance Charger can charge at 350ma.

Charger is configurable to charge with five different charge profiles, and three car profiles.

The charger has an isolated RS232 port that reports the state of the charge and other relevant data into a remote computer for data logging. Charge parameters can be reprogrammed by the user.

The hardware specific parameters and test mode are password protected.

Charger mates with custom in car harnesses, so the same charger can be used for 3 different cars, each with a unique harness. □ Charging a multi cell series battery in this way has been shown to condition the pack for better performance, and at the same time as a cell balancer to

get all of the cells to the fully charged state, and to recover from many battery related error codes. □

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User Operating Instructions: Grid Charger

Overnight 1.05 Amp "High" Current** and Maintenance 350mA Low Current models
 November 11, 2011 Program Version 1.2

Care, Handling and Use of the Grid Charger:

Read the reminder list on the right side of of the Grid Charger front panel each time before preparing to use it.

- Always turn off the AC power before connecting or disconnecting charger from the vehicle battery pack or any other battery pack being charged.
- Make certain that charging has stopped before disconnecting the charger connection to the battery. Correct sequence: STOP charger, turn off the AC power switch/disconnect the AC cord, disconnect the battery cable.
- Do not use this equipment where it could get wet or experience condensation.
- Only use a properly grounded GFCI protected 3-wire AC circuit to power this charger.
- Do not use this equipment in enclosed spaces without adequate ventilation.
- Be sure, before starting a charge, that the Car Profile matches the car when using the default settings. Pay extra attention if you have customized any settings.
- Consult Genesis One about any unexpected behaviour not covered by this user manual.

What is Displayed on Power-up:

First the unit checks that the EEPROM version matches what is expected by the program, and displays it:

```
EEPROM V 1.000
Parameters Read.
```

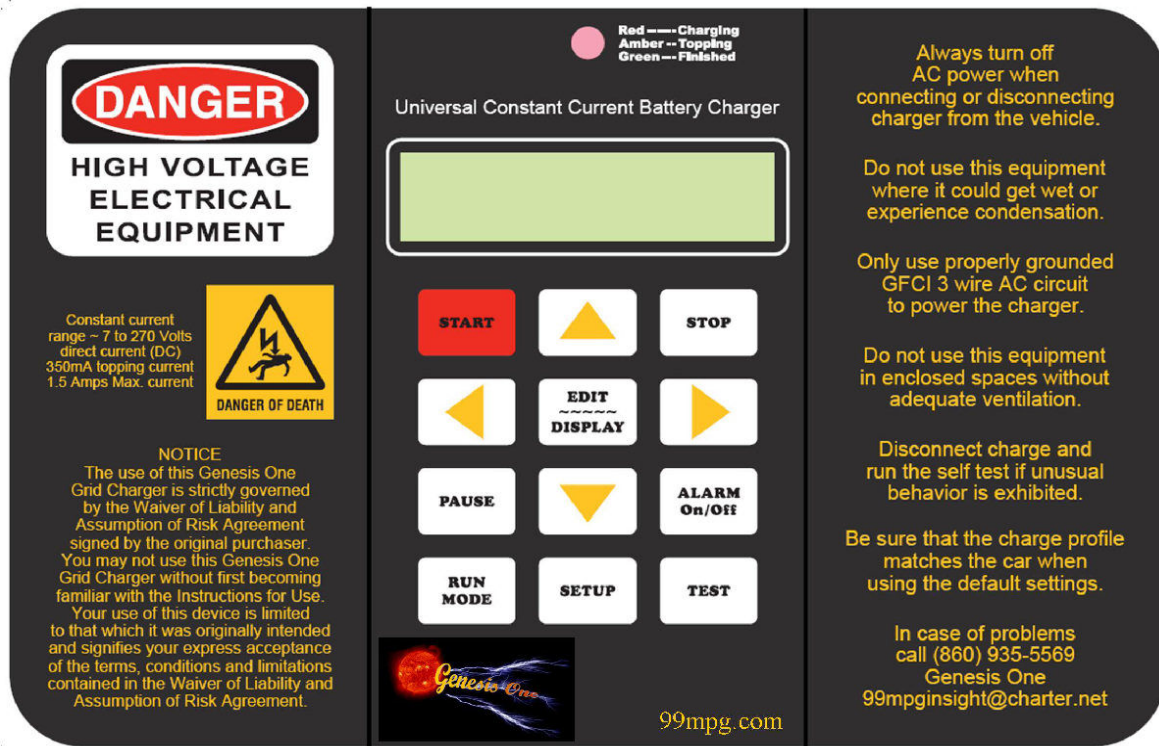
"Parameters Read." means that they match and the parameters stored in non-volatile memory, including those changed by the user, have been read into RAM memory to use in operation. "Defaults Written" on the second line instead would mean the unit sees a mismatch of versions and will instead take the default values contained in the program code and load them into EEPROM memory. This happens with

a new unit at the factory, when the user activates "Restore Defaults", or when a newly updated program version requires new or re-arranged parameter locations in the EEPROM.

After the ViewTime, the program Version Number and Date is displayed:

Prod Gridcharger
V 1.1 Code 11/10

Then the previously selected Car Profile information is displayed and finally, the Off- mode display, initially set to show Battery Volts and Charging Current on the top and bottom LCD lines, respectively.



User Operating Instructions: Grid Charger

Overnight 1.05 Amp "High" Current** and Maintenance 350mA Low Current models
November 10, 2011 Program Version 1.2

Front Panel Key Functions and LED Indicator:

Keypad Keys:



Press this key to Start Charger operation. (Charger behavior at this time depends on the Run Mode selected & the charge characteristics of the CarProfile choice & its programming. See "Run Modes:" and "Car Profiles..." below for details.)

Note: [START] will also end/over-ride other modes such as Test (Tech) mode.



When the STOP key is pressed:

If charging: Stops/ends/cancels charging for all Run Modes.

If Editing a parameter: Aborts/exits without saving changes (If pressed before [EDIT] was pressed for the second time to store the changed value.)

If in Setup: Ends/Exits Setup and resets pointer to the first item (CarProfile), for the next time.

If in Test (Tech) mode: Stops/resets the Test mode and returns unit to normal standby/Off mode



If charging: Suspends charging (power supplies turned off) but retains the time charging and MilliAmp-Hours accumulated up to this point and the Voltage at the start of charging. Press START to resume charging with this data continuing to advance.

If in Test (Tech) mode: Turns off the power supply(s) being tested and retains the place in the Test sequence, ready to resume at the same place when START is pressed to resume.



Turns select Over & Undercurrent, and AutoStop reminder beeps audible alarms on or off. Alarm function Powers up "On". For Over and Under current alarms, it controls the LCD display of the alarm as well as the audible (beeper). When AutoStop reminder is sounding, pressing this key (during the pauses between the beeps) will silence it.



First press: Switches display from DATA display to DATA edit.

Second Press: Saves the change and returns to DATA display.

See "Using the EDIT Function" below.



in EDIT: Increment data (increase the value by one, at the cursor position)
in DISPLAY: Switch to top line of display for selecting data to display



in Charging: Toggles between the 2 available LCD charging display pages
in EDIT: Decrement data (decrease the value by one, at the cursor position)
in DISPLAY: Switch to bottom line of display being active for selecting data to display
in SetUp: Toggles 2-choice items - F/C degrees, Y/N Soak, User/Tech level access
in Test (Tech): Turns off PCCHI power supply**



in EDIT: move edit field one digit right
in DISPLAY: scroll right for the next data item to display



in EDIT: move edit field one digit left
in DISPLAY: scroll right for next data to display



Press to select Setup Function and point to the next Setup item in the rotation. See "Using the SETUP Function:" below.



Press to select RUN MODE choice (editing). The current Run Mode will be displayed on the bottom line of the LCD and can then be edited like the other parameters. See "Using the EDIT Function" below.



Press to select Test Function and point to the next Test pattern in the sequence. The first one switches all the power supplies on. Each subsequent press of TEST will move to the next Test step.

If PAUSE is pressed during Test, the power supply(s) will be turned off and the position in the sequence remembered. Press START to resume testing at the same step as before when PAUSE was pressed

If a key is not interpreted or active in the charger's current mode of operation or in the User Access Level, a beep and a message like the following will warn about this and no action occurs:



LED Indicator:



On - Red, during charging until the last stage (Topping).

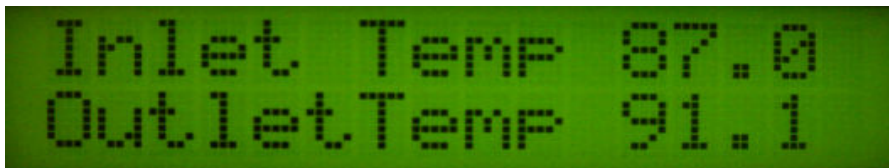


On - Amber, during the last topping/balancing stage of charging



On - Green, when the charge has been completed and/or unit is ready to charge.

Viewing Values and Parameters on the Liquid Crystal Display:



The Liquid Crystal Display (LCD) is the Transflective type that is viewable in bright light as well as low light with its back light. It has 2 lines of 16 characters each. There is a Contrast Adjustment potentiometer accessible through a hole on the back of the unit (See Photo, page .1), should the factory setting ever need changing. The display screens have a **user adjustable presentation time** (the time an information or alert page stays on display, before moving on to the next one or back to the usual screen for the mode the charger is in.) The presentation time (S_ViewTime*) is set slow enough for most new users, who can speed it up later as they get used to seeing what is displayed. The keypad is not read during the ViewTime delay (until a "beep" is sounded - wait for the beep), so a shorter ViewTime makes for quicker operation for this reason also.

The following information applies to the Standby (Not Charging) state.

Initially, the top line of the LCD is active for scrolling the possible items for display. This means that pressing the Left or Right Arrow key will change the item displayed on the top line, and the bottom line is unaffected. Pressing the Down Arrow key will make the bottom line of the LCD active for scrolling and editing, instead. There will be a brief indication of "Line 2 Active", to confirm that the charger has reacted to the key press.

The top line can display from a smaller list of the "favorite" items that are not editable, for faster access to the one you want to see.. In other words, these items are values and times that the charger has measured, rather than parameters that set limits, which can be changed to modify charger behavior.

The bottom line is for editing parameters as well as viewing measured values and times. It can be scrolled to display all the items available to the User or Factory/Technician, editable and not, according to the current User or Tech level. Press the Up Arrow key to again make the top line of the LCD the one which is active for scrolling.

"Line 1 Active" will be displayed for the ViewTime on the top line.

Suggestion: Select items for display that are the most useful to see before charging. For example: "Battery Volts" for the top line and the PTC value or a temperature for the bottom line. Scroll to check that the battery temperature readings are suitable for charging.

Inlet Temp 87.0
OutletTemp 91.1

Inlet Temp 87.0
TempDiff 4.1

For one second in six, the top line of the LCD will flash "Not Charging. R0" or R 1 or R 2 ...R14, to indicate the reason it is not charging now. The Reason codes are listed in the Stopping Charging section below. This provides an indication to the user of what last happened to the charger to stop the charging (useful to know at a glance if you check the charger and it has stopped). If the unit has not stopped a charging session since it was powered-up, the reason will show as "R 0".

Typical Operation, Starting Charging:

- Plug the car/battery harness to the charger.
- Plug the power cord to a 120V or 240VAC 50/60 Hz. outlet or extension cord in good condition. A GFI 3 wire circuit is recommended for powering the charger.
- Turn on the power switch on the back of the unit
- Check that the battery Voltage and temperatures displayed are in the range expected for this battery pack.
- If the charger operation or battery pack is to be different from the last use, edit the Run Mode and Car Profile settings as required. (See instructions on how to do this below.)
- Press the START key and observe the displayed indications of Charger mode, Battery Voltage, Charge Current, Charge Time so far in minutes and seconds, and milliAmp-Hours charge accumulated.

M6 159.2V 1056mA
CH 0:13 0mAH

Press the Down Arrow key to see another page of information: PTC value, Inlet Temperature (Ti), Outlet Temperature (To), and the Difference between outlet and inlet Temperatures (Td).

PTC 82 Ti 64.1

Press the Down Arrow key again to go back to the first display page and to toggle between pages.

How the Grid Charger Works:

It contains a 350mA Constant Current power supply (and a 700 mA CC power supply to make 1050 mA total in "High Current" operation**) and 4 nominal 48V adjustable Constant Voltage power supplies identified as P48A, P48B, P48C, and P48D. P48A is adjusted near its minimum at 41V. The other 3 are adjusted to near their maximum Voltage, around 54V. These power supplies are switched in and out of operation so as to be able to provide any charging Voltage from 7V up to about 245V. One or both of the Constant Voltage power supplies are always used so that the charging is done in a Constant Current manner. For batteries/conditions requiring a Voltage between 7 and about 42V, only the Constant Current power supply(s) are required as they can output their full current over this range. For a Voltage range of about 42 to 69V, P48A will be switched on as well by the microcontroller detecting the SwitchV1 threshold of 42V (or as Tech-edited) and operating a solid state relay to add P48A's Voltage in series. The Constant Current power supply(s) will initially reduce their output Voltage as required to maintain their set Constant Current output of 350 or 1050 mA. The CC power supplies will gradually raise their output Voltage as the battery charges to maintain their target current. When a little higher Voltage is required (over 69V, given by SwitchV2) the microcontroller will switch off P48A and switch on P48B which can provide 54V instead of 41V. For the next Voltage range of 69V to 96V, P48A will be switched back on and add its 41V to the equation. This continues if higher Voltage is required (depending on CarProfile settings) up to the point that all of the 48V nominal Power Supplies, P48A to P48D are on.

Stopping Charging:

There are many ways or Reasons for the charger to stop charging, in order to automate and optimize the process of charging, and protect the battery. The reason the charger stops charging is displayed briefly as it happens on the LCD, sent out on the serial port with the regular status reports, and kept and displayed as the "R" indication on the "Not Charging" flash message. This message is shown one second out of 6 seconds. (Reason indicated as R 1, or R 2, etc.) There are fourteen of these reason codes at present, which advise the reason why the Grid Charger last stopped charging:

R1: Manual Stop, STOP key was pressed.

R2: The maximum allowed Voltage has been reached. (ChgStopVP1*, ChgStopVP2*, ChgStopVP3*, depending on the CarProfile selected)

R3: The maximum allowed total charging time has occurred. (Max CGTime*)

R4: The timed end of topping mode occurred. (TopTimeMN*)

R5: Battery now too hot to continue. (MaxPTCVal*)

R6: The TEST button was pressed.

R7: The maximum allowed milliAmp-Hours charge was supplied to the battery (Max_chg_AH*)

R8: End of Topping charge due to Voltage plateau detected.

R9: Temperature Differential (Outlet - Inlet Temperature) target reached, meaning the charging energy received by the battery is now going into heat rather than raising the state of charge.

R10: Higher current than expected through power supplies

R11: Too HOT Outlet Temperature

R12: Too COLD Inlet Temperature
R13: Too HOT Inlet Temperature
R14: Too Cold Outlet Temperature

Pausing Charging:

Press [PAUSE] to suspend charging. (This works while actively charging, not while in a Delay Wait (Run Modes 3 or 4) or Delay Interval (Run Mode 5) period.) The LCD indicates:

PAUSE Charging.
Keeps Chg. data.

This Pause Mode will allow a parameter to be changed without losing track of information on the charging process up to that time, such as the charge time and milliAmp-hours delivered to the battery. The LCD will flash the status message on the top line:

Pause Charge R 0

every 6 seconds so long as the charger remains paused. Press [START] to resume charging. The charger may back down by a charger mode (for example from M6 to M5) if the battery Voltage has decayed below a boundary switch-point while charging was paused.

Car Profiles (Matching Battery Pack Charging Requirements):

Three programmable Car Profiles are available for selection in Setup. These allow the charger to be quickly switched between 3 different car models or battery pack types. They can also be used set to the same battery/car type for people with 2 or 3 Insights or Civics (but with a different year edited/programmed for each description), for the best match between each car harness and the charger. (In other words, associate each car and its harness and temperature sensors, with a different CarProfile, even though the cars are the same model.) Which CarProfile the charger is now using is selected in Setup. How each CarProfile will control the charging and the description displayed for it, are determined by editing 3 parameters for each CarProfile, explained below.

Following are examples of typical CarProfile descriptions, seen when the charger is turned on and in Setup:

InsightGen1 2000
144V Profile = 1

Civic HCH2 2006
158V Profile = 2

ToyotaPrius 2006
202V Profile = 3

CarProfiles have their descriptions automatically generated, from the "Model_Yrn*" parameters (where *n* is 1, 2, or 3 to match the CarProfile number) and from the corresponding programmed Cut-back Voltages. This gives the user an approximate indication of the nominal battery pack Voltage each CarProfile can be used to charge. CarProfile 2 is usually factory set for for a 158V pack, for Honda Civic 2nd generation and Accord cars.

The following parameters are programmable for each CarProfile, using EDIT:

Cut-Back Voltage:

This is the Voltage level at which the charger switches to low-current topping charging - User Editable
Cut-backVP1*, Cut-backVP2*, Cut-backVP3*

Cut-backVP1* 167

Note: In addition to creating the nominal pack Voltage value for display (calculated as = 0.862 X Cut-backVPn) as mentioned above, the Cut-backVPn is also used to determine the Low Voltage Start Point in Long-Term Maintenance charging. (calculated as = 0.88 X Cut-backVPn)

Maximum Voltage:

This is the highest Battery Voltage allowed and when reached, charging will be stopped - User Editable
ChgStopVP1*, ChgStopVP2*, ChgStopVP3*

ChgStopVP1* 180

Car model and year:

This parameter is interpreted to display the Car model and year, as explained below- User Editable
Model_Yr1, Model_Yr2, Model_Yr3

Model_Yr1* 100

Model_Yr2* 306

This will display as "InsightGen1 2001"

and this as Civic HCH2 2006

and ToyotaPrius 2006 for CarProfile3

Model_Yr3* 506

Here are the choices and what number to enter (by editing) for each Model_Yrn parameter:

Car Model Coding: (where the 2-digit year is entered in place of "xx")

0xx = " Custom Car " This allows for a car or Battery Pack not on the list of models.

1xx = "InsightGen1 "

2xx = " Civic HCH1 "

3xx = " Civic HCH2 "

4xx = " Accord "

5xx = "ToyotaPrius "

6xx = "InsightGen2 "

In addition, two temperature offsets are associated with CarProfiles 2 and 3, so the the Grid Charger can be calibrated at the factory to best match the temperature sensors of each different car harness:

Calibration offset for the Inlet temperature sensor on each car/harness - Factory/Tech Editable

InTemp1Cal*, InTemp2Cal*, InTemp3Cal*

Calibration offset for the Outlet temperature sensor on each car/harness - Factory/Tech Editable
OutTemp1Cal*, OutTemp2Cal*, OutTemp3Cal*

Run Modes:

The Run Mode is selectable by the User to match the need for charging immediately, only after a delay, or for continuously scheduled charging with long intervals between topping up. These choices provide flexible operation to suit varying circumstances, like returning home with a hot pack and charging later when it has had some time to cool down. The Run Modes available are:

Run Modes 1 and 2:**

Manual Charge with No Delay, High** and Low current, respectively. Works One Time once START has been pressed. Only use Run Mode 2 for the Low Current Maintenance Charger. (If you edit the Run Mode to 1 by mistake with a Current Maintenance Charger, it will be corrected to 2 right after by the charger.) Starts charging immediately and stops automatically or by pressing the [STOP].

Run Modes 3 and 4:**

Delayed Start of Charge, High** and Low current, respectively. Works One Time once START has been pressed. Only use Run Mode 4 for the Low Current Maintenance charger. (If you edit the Run Mode to 3 by mistake with a Current Maintenance Charger, it will be corrected to 4 right after by the charger.) Starts charging after the programmable Start Delay (minutes to hours) has expired and stops automatically or by pressing [STOP]. The Start Delay is programmable in Minutes, from 1 to 9999 (166+ hours) , by editing the "StartDelay*" parameter.

Not Charging R 0
StartDelay* 2

Once started and waiting for the delay to count down, the display will indicate on the top line, the time remaining, in minutes, before charging will be started.

Start 2 min.

Run Mode 5:

Long Term (Storage) Maintenance Charging, Low current. In this mode, the charger **cycles continuously** between a waiting, off, interval and a charging time, to keep the battery pack charged. It works this way once START has been pressed, until STOP is pressed. It starts up in the Wait Interval, not charging, and indicates the time remaining before starting to charge, on the LCD.

Charging begins after the Wait Interval (IntervalHrs*) counts down to zero, or if low battery Voltage is detected. ("Low Voltage" is calculated based on 88% of the edited Cut-backVPn, about 147V for a First Gen Insight or Civic and 161V for a Second Gen Civic or an Accord.) The Grid Charger then charges for a programmable Maintenance Charging Time (MaintRunTme*) or until charging is suspended automatically due to a full or hot battery. The charger then returns to the Wait Interval to start over. It will continue cycling off and on indefinitely until [STOP] is pressed.

The Wait interval is programmable in hours, from 1 to 9999 (416 days) , by editing the "IntervalHrs*" parameter. This is the interval between the end of the previous charge and the start of the next.) The maximum Maintenance mode charging time is programmable in minutes, from 1 to 9999 (166+ hours), by editing the "MaintRunTme*" parameter. It is usually set to a shorter time than the other single operation Run Modes.

Not Charging R 1
IntervalHrs* 168

Not Charging R 1
MaintRunTme* 360

StopAlarm reminder beeps are not activated for Long-term Maintenance RunMode 5, as the user is likely not nearby to hear them, while the continuing beeping could annoy other people.

Using the EDIT Function:

First, make the Bottom display line on the LCD active by pressing the Down Arrow key.

Scroll to select the item to edit, using the Left and Right Arrow keys.

Note: More items are available to edit in Tech Access than in User Access. These additional parameters are mostly calibrations and switch-points that should not be changed by the user. Altering these, except as directed by Genesis One, can cause the charger to overcharge, undercharge or otherwise malfunction and risk damage to the battery pack.

Press EDIT to make the value field editable.

Using the Left and Right Arrow keys, move the cursor to the digit position to be changed.

Press the Up and Down Arrow keys to Increment (increase) and decrement (decrease) the value of the digit to arrive at the desired number. For most parameters, there is a safeguard limit of 9999 as the maximum value that will be retained. (Exceptions are the Clock adj and calibration Tech edit parameters) This is done so that the user will not inadvertently enter a higher number by incrementing the thousands digit past nine to raise the not-displayed 10-thousands digit above zero. When another press of the UP arrow would have raised the parameter past 9999, it will be held at this maximum.

When another press of the DOWN arrow would have wrapped around the parameter value past 0000 to 64536 (the maximum value of a 16-bit number) it will be constrained to 0000.

Move the cursor to another digit to be changed, if required, (using the Left and Right Arrow keys) and then change its value (again, using the Up and Down Arrow keys).

When the correct value for the parameter is displayed, press the EDIT key a second time to save the new value and exit Edit, returning to Display mode. If you want instead to abandon the changes made and not save them, then press STOP instead of pressing EDIT the second time.

Be careful about changing parameters if you are not sure about what you intend to accomplish, the effect of changing a each parameter and the correct value to use for your battery pack and environment. For example, reducing the SampleTime* from its default 30 minutes below about 10 minutes for an Overnight charger, could result in a false detection of the Voltage Plateau (Voltage no longer increasing) and a premature end of charging.

Changing the Run Mode:

Press the RUN MODE key. The RunMode* variable will automatically be selected for display and editing on the second line of the LCD:

```
RunMode* 1
```

Press the EDIT key to place a cursor in the RunMode value field for editing.

```
RunMode* 0001
```

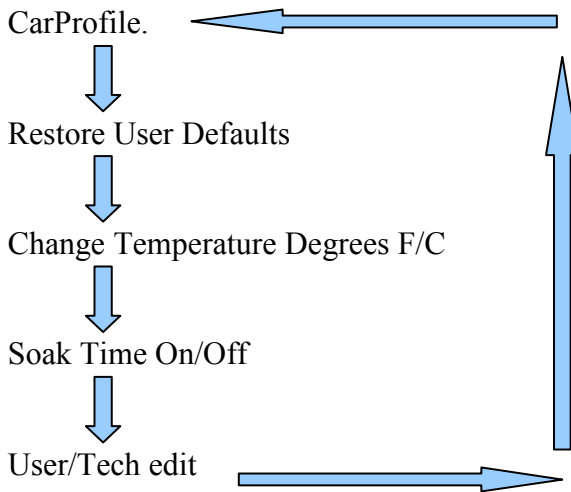
Follow the EDIT instructions above to change the value/choice of RunMode, and save it.

```
RunMode* 0003
```

If an invalid RunMode is entered, the warning "Invalid RunMode" will be displayed. This warning will also be displayed if START is pressed with an invalid RunMode, and the unit will remain off, not charging.

Using the SETUP Function:

Pressing the SETUP key places the charger in Setup Mode, starting with the first item: CarProfile. Each press of [SETUP] will move to display the next Set Up item and at the bottom of the list will return to the first item.



CarProfile:

```
CarProfile* 1
```

CarProfile is a 3-choice item, with the current choice shown on the bottom line of the LCD.

Use the EDIT mode to select 1, 2, or 3. Always press STOP when finished with Setup. If you want to change a SetUp item other than CarProfile, press SETUP again to point next to "Reload Defaults".

Reload Defaults:

Reload Defaults
press [<] now,

To restore the User parameters to the factory defaults, press the left arrow key. These are the items with an "*" at the end of the name that are editable on the bottom line of the display in User Mode. (This function will not over-write the Tech parameters section of memory, to avoid losing the factory calibrations.) A brief message will indicate that the restore has been prepared:

Restore Defaults
has been setup.

Then the next LCD page will be displayed, giving the instruction to switch the AC power off & on:

Switch power off
& on to activate

If a key other than [<] is pressed, the charger will not proceed with restoring the factory defaults and will indicate on the LCD that this action has been cancelled due to the wrong key pressed.

Restore-Defaults
cancelled Wr Key

Press SETUP to rotate through the other 2-choice (toggle) setups. Press the Down Arrow key to toggle the choice for the item indicated. This works for Temperature Degrees F/C, Extra Soak Time and Tech Access choices. The LCD will then show the new choice to confirm the change.

Change Temperature Degrees (F or C):

For changing the degrees C or F used for display, the LCD prompts:

Chng Temperature
F/C, press Down.

Pressing the Down Arrow key at the above screen will change the degrees C or F used for display and show the current setting on the bottom line, either:

Temp > degrees C

or:

Temp > degrees F

Soak Period After "Voltage Plateau Detected" End of Charge:

For the choice of extra charging time in the Topping Phase, the LCD prompts:

Extra Soak Time?
Y/N, press Down.

See the explanation of "Soak" in the section: "Further Explanation of Charger Operation..."

Pressing the Down Arrow key at the above screen will toggle the "Soak" function operation on/off and show the current setting on the bottom line, for example:

Xtra Tme Soak On

Parameters Viewing & Changing Access Level:

For the choice of Access Level, User or Technician, the LCD prompts:

Tech Access?
Y/N: press Down.

If the correct password has been entered, Technician Level Extended Editing Capability can be selected. **Only select Tech Access when the charger is disconnected from the car battery (or any battery) .** Without the valid password, the Access Level can only be User Level. The current selection is shown on the bottom line of the LCD:

Tech Extend Edit

User edit limits

The "Tech Extend Edit" message indicates that Technician level access has been set, after the Down arrow key was pressed. Press it again to return to the previous choice.

Password Not Entered or Incorrect:

Note: The password is reset to "0" each time the charger is powered off and will need to be re-entered, if access to the Tech parameters is required. For all other charger operation and use, except TEST, the password is not needed. If the correct password has not been Edited in to the Password parameter, this will be indicated on the LCD bottom line after the Down Arrow is pressed in Setup, Tech Edit:

Invalid Password

The charger then brings up the Password variable on the bottom line, ready to be corrected in Edit.

Password 0

As usual for editing, press EDIT to be able to enter the correct Password using the arrow keys, and then press EDIT again to save it. Then press SETUP to resume the change to Tech Extended Edit level. (The charger will have remembered that you were doing the User/Tech change and will put you back at this point, instead of at the next/first item, CarProfile.) Press the Down Arrow key to change to Tech Extended Edit level.

Press STOP to end Setup:

At this point, either press STOP to end Setup or press SETUP again to continue from the top (to rotate around to Car Profile). **Always press STOP when finished with Setup**, so the charger will end Setup function and not make an unexpected change the next time that the Down Arrow key is pressed.

TEST:

This function is normally only used at the factory, to test and adjust the power supplies. It can also be used to check that each power supply is working and is still close to its original factory Voltage adjustment. Test Function works only in Tech Access level (Tech Extended Editing), not in User Access level. **Only select TEST when the charger is disconnected from the car battery (or any battery) . Note: The Test Mode will not start if the charger sees battery Voltage.** In that case, the charger will warn on the LCD:

Can't do TEST Md (Can't do TEST Mode)
Battery detected

Insulate any battery wire connection leads or plug so no short circuit occurs.

Press TEST to select Test Function and point to the first/next Test step in the sequence. The first step switches all the power supplies on. Briefly, after TEST has been pressed, the LCD shows "Test Mode Now 1" on the top line and a message like "Saved PS V 198.8" on the bottom. The display then looks like:

Batt Volts 198.5
1 198.8VS 0mA

The Batt Volts 198.5 shows what is being measured now in this step . The bottom line indicates "1" for step 1, 198.8VS for the Voltage measured and saved to non-volatile memory during a previous test or the factory calibration, and 0mA as the current now (When done as a factory test with a resistor load drawing current, the actual current will be shown instead of 0.) Press EDIT (once only) to replace the previously stored test value with the present value. Be sure that you want to over-write the original

stored values and also to wait for the Voltage reading to stabilize before pressing [EDIT] to take the Voltage sample. Unless a power supply output has been re-adjusted, or a power supply replaced, stay with the initial sample to keep as a reference for comparison.

Press the Down Arrow key in this step 1, to turn off the PCCHI power supply**, to test at 350 mA, if a test load is being used. Press the Up Arrow key in this step 1, to turn the PCCHI power supply** back on.

Each subsequent press of TEST will move to the next Test step, selecting only one of the power supplies to be on for testing and adjustment. There are 7 steps in total. If PAUSE is pressed during Test, the power supply(s) will be turned off and the position in the sequence remembered. Press START to resume testing at the same step as before, when PAUSE was pressed. Press STOP to end Testing and reset the step counter to step 1, for the next time this function is used. Or, if TEST is pressed enough times to cycle through all the steps, the following screen will be displayed:

End of TEST Mode
TEST to restart.

Serial Output:

Setup Parameters and hardware:

The configuration required for the receiving computer or data-logger is:

9600 Baud, 8 bits, No Parity, 1 Stop bit (9600 8-N-1) The RS-232 interface is isolated from the high-Voltage connections and the vehicle Voltages by opto-couplers.

What is sent out from the serial port:

The Grid charger outputs data providing the status and values of key variables every minute during charging and at significant changes in operation, like an automatic stop. The RS-232 interface is provided on a DB9 Female connector that can be hooked to a computer serial port or USB to Serial adapter, using a standard DB9 Male to DB9 Female, straight through, serial cable. A terminal program in the computer, such as Hyper-Term, can be used to receive and display the data. Alternately, the serial port can be coupled to a data logging device for later viewing and analysis.

At program start-up, the Grid Charger outputs messages like:

"Prod Gridcharger, V1.1 Code 11/09" This is the test/ID message.

Then the headings line is sent: "BattV,ChgCur,SysSt,StopR,ChgMode,ChgT,mAHrs,InT,OutT, TScntr"

These are abbreviations for: "Battery Volts, Charge Current, SysStatus, Stop Reason, ChargerMode, Charge Time Minutes, milliAmpHrs, Inlet Temp, Outlet Temp and Topping Sample Counter".

The headers line is also sent out when START is pressed, at the end of the delay-start of charging in Delayed Charge (RunModes 3 & 4) and Long Term Maintenance Charging (RunMode 5), and at low Voltage start in Long Term Maintenance Charging (RunMode 5).

Then comma separated (CSV) data, in the same order as the headings, is output every minute while charging and for some changes in status such as switching to Topping Mode 9.

Explanation and listing of the SysStatus Variable flag bits:

This 1-Byte (8-bits) variable is the third item transmitted. It provides 8 status or On/Off conditions of the charger's operation.

Bit#	Description/Function	Value if True (On)
0	HighCurrent**, True for RunModes 1 and 3	1
1	Pause, indicates charging or Test has been paused	2
2	Test, indicates if in Test mode	4
3	DelayedCharge, True if Delayed Charging is active	8
4	MaintCharging, in charging period of Maintenance cycle (RunMode 5)	16
5	MaintWaiting, indicates waiting to start the next Maintenance charging	32
6	Toppingflag, in Topping, the last phase of charging at low current	64
7	ChargeFlag, charging in progress	128
	Total of all values:	255

From an interpretation of the SysStatus value reported, from 0 to 255, the state of the charger can be almost completely determined.

Example:

If SysStatus = 129, this must be from bits 0 and 7 being On, and all others off, (1 +128). This means High Current until Topping (Bit 0) and it is charging now (Bit 7), but not Delayed Charge or MaintCharging or in charger mode 9, Topping, as those bits are zero. Conclusion: the charger is in RunMode 1 (Immediate) charging, charging at high current before the Topping phase.

Converting decimal to binary:

To convert decimal to binary is very easy, you simply divide the decimal value by 2 and then write down the remainder, repeat this process until you cannot divide by 2 anymore. For example, let's take the decimal value 157:

157 ÷ 2 = 78 with a remainder of **1**
78 ÷ 2 = 39 with a remainder of **0**
39 ÷ 2 = 19 with a remainder of **1**
19 ÷ 2 = 9 with a remainder of **1**
9 ÷ 2 = 4 with a remainder of **1**
4 ÷ 2 = 2 with a remainder of **0**
2 ÷ 2 = 1 with a remainder of **0**
1 ÷ 2 = 0 with a remainder of **1**

<--- to convert write this remainder first.

Next write down the value of the remainders from bottom to top (in other words write down the bottom remainder first and work your way up the list) which gives:

10011101 = 157

Power Failure:

AC mains (grid) Power Failure or AC power disconnect or switch-off while in operation: What happens when power fails during operation?

In RunModes 1 to 4, Immediate and Delayed Start charging: Once power is re-applied, the charger powers up OFF, waiting for manual intervention. (Push START to restart.)

In RunMode 5, Long-Term Maintenance Charging:

If the charger was in-between charging periods, in the waiting interval, it will power up at the beginning of the waiting time, while watching, as usual, for a low battery Voltage to prompt an earlier start of active charging.

If the charger was charging at the time of the power failure, it will start up with 1 minute of waiting interval to allow it to get a good reading of the battery Voltage and appropriate charger mode to use, then start charging. As it charges, it watches the battery Voltage and looks for the usual conditions to determine when to end the charging period and go to the waiting interval.

Abnormal Conditions:

Over-Current:

If more current is measured than expected for the present charger operation (Run Mode, Charger Mode, etc.) this could indicate a mis-adjustment or failure of a power supply. If this condition is detected, the charger will stop charging and display this message, plus alarm beeps to alert the user:

```
Stop-Overcurrent
Charge mA 395
```

Under-Current:

If less current is measured than expected for the present charger operation, this will cause an audible and visual warning, as shown below, but not a stop of charging:

```
Warn-Lowcurrent.
Charge mA 325
```

Detection of this condition only works if Alarm is ON. (The power-up default is On, but it can be switched Off and back On, using the ALARM On/Off key.)

In either case, contact Genesis One, describing the circumstances, for advise on how to correct it.

Fan and Temperature Control and Shut-down:

At the start of charging, the fan is turned on and the Grid Charger's microprocessor waits for a set time (2 minutes) before using the information from the Inlet and Outlet Temperature sensors. After the

delay, the air flow through the battery pack and over the sensors will now enable the sensors to post useable values for the Inlet (ambient Temperature) and the Outlet (battery warmed air) Temperature. The Grid Charger's microprocessor uses the raw corrected data, before conversion to deg. F or deg C, so that it will work the same regardless of the User's preference for degrees F or C. The raw data is about 5 points per degree F, giving a resolution for temperature testing, of about 0.2 degree F. These temperature readings can be used, after the 2-minutes delay, to test for both over and under-temperature conditions, which are reasons to cause a shut down of charging. If this happens, a message will show on the LCD that lasts for the ViewTime, and a Reason Code is generated.

Here is a listing of the 4 "temperature out of safe range" conditions that will cause a shut-down, along with the Reason Code and LCD message indicated for each one:

R11: Too HOT Outlet Temperature: This is an indication that the battery may be too hot for safe charging. It is tested against a Tech editable parameter "MaxOutTpRaw*" with a default of 850 = about 107 degrees F. The LCD message is:

HOT OutTemp Stop
Try Delayed Chg.

R12: Too COLD Inlet Temperature: This triggers below about 40 deg. F, where there is concern that very cold air entering the battery pack could over-chill the cells nearest the inlet. The LCD message is:

COLD InTemp Stop
Heat car inside.

R13: Too HOT Inlet Temperature: This triggers above about 97 deg. F, where there is concern that very warm air entering the battery pack would prevent adequate cooling of the battery pack. It is tested against a Tech editable parameter "MaxInTmpRaw*" with a default of 800 = about 97 degrees F. The LCD message is:

HOT InTemp Stop.
Cool car inside.

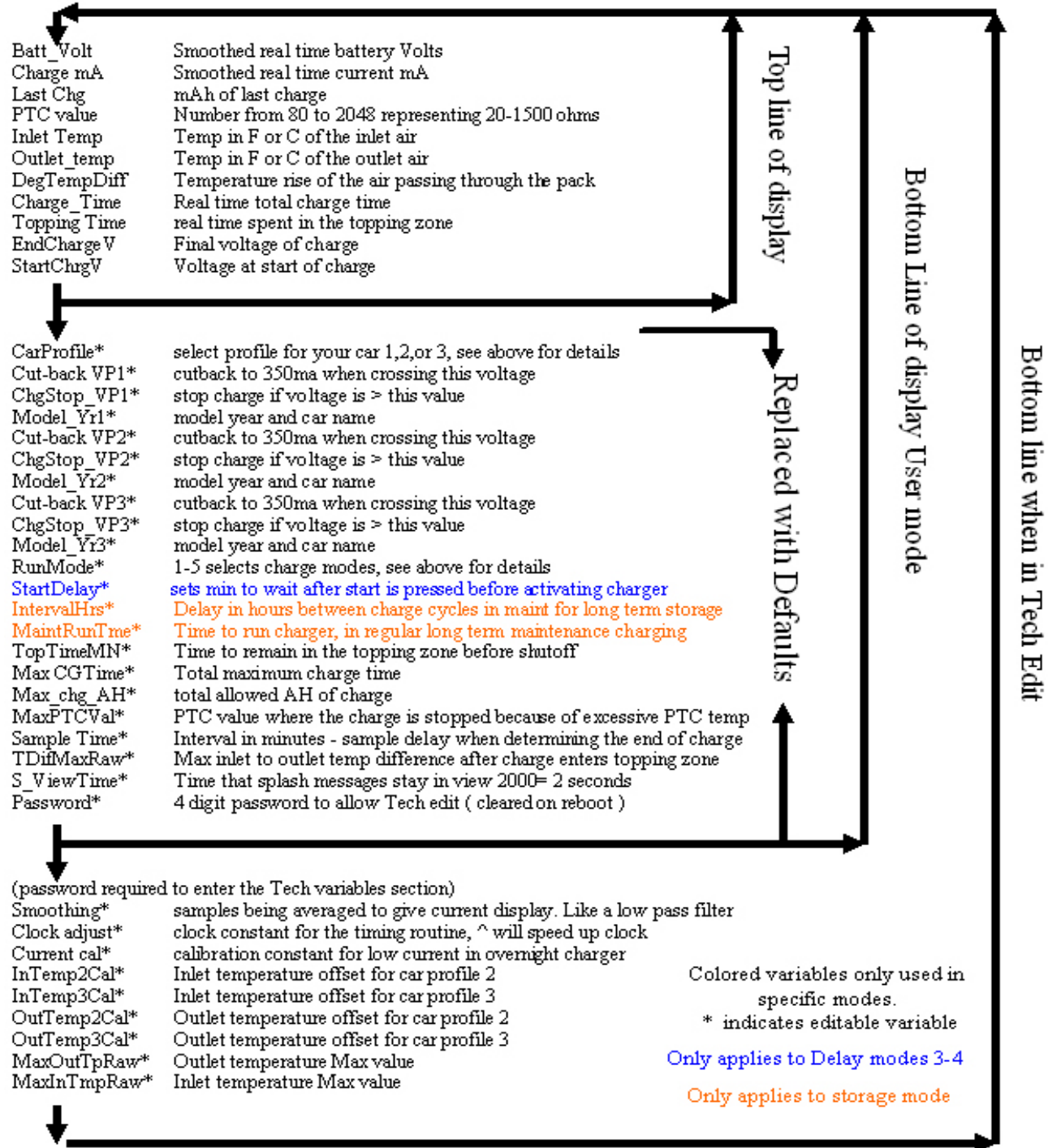
R14: Too Cold Outlet Temperature: This triggers below about 48 deg. F, indicating that the battery is probably a little colder than that, too cold for safe & efficient charging. The LCD message is:

Cold OutTmp Stop
Try Delayed Chg.

When the unit is not charging, the Grid charger temperature sensors and the battery pack PTC sensor, if applicable, are still monitored and may cause the fan to run for a while or cycle on and off.

Variables and Parameters List:

List of variables and their position in the sequence



Further Explanation of Operation and "chargermodes" (M1, M2..... M9):

Parameters:

On the page above is the listing of the charger variables and the parameters that can be edited in User and in Tech Level Access. They are shown in the order they will be presented when scrolling using the Left and Right Arrow Keys.

Note: The Tech level items include calibrations done when the charger was first built and tested. These are not likely to require field adjustment. (If one of these parameters requires changing, access the Tech Level using Setup and have the Password already edited to the correct number as directed by Mike at Genesis One.)

General:

Knowing the meaning and function of the parameters that control charger operation will be helpful to your understanding of how it works and what it can do. Consequently, some time spent to read through this listing will be time well spent. As indicated in the introduction section "**How the Grid Charger Works:**" this charger consists of several power supplies that can be switched on and off individually under microprocessor control to build a rising Voltage at one of two available** constant current values. As a result, it is able to charge almost any battery from below 12V up to a little over 200V nominal (Prius, 2004 to present).

Topping Mode:

After doing the bulk of the charging, as determined by the Voltage of the battery, some of the cells will have reached full charge before the others. It will now be necessary to cut back the charge current (if it is an Overnight charger) to a value these full or nearly full cells can tolerate without damage, while the lower charge cells continue to charge at the lower current rate (350 mA). Also, from this time onward, additional methods are started to determine a good time to end charging. The Cut-back point, that starts Topping Mode 9, is determined by the Cut-back Voltage for Profile 1, 2, or 3 (whichever is in use): Cut-back VP1, Cut-back VP2, and Cut-back VP3. Even if the charger is a Maintenance model, or an Overnight model set for Run Mode 2 or 4, with the current always at only 350mA, this Cut-back change point signals the time for a switching to the final Topping mode M 9. This charger mode has different behavior from the previous bulk charging modes in that it is looking for other conditions (besides Maximum allowed Voltage reached, Maximum Amp-Hours delivered to the battery, Maximum Total Time spent charging, or temperature), to end charging. In Charger Mode 9, Topping Mode, it can determine if the battery Voltage has "plateaued" and either stop charging or allow it to continue for a "soak" period. To detect this leveling off of Battery Voltage at full charge the charger first looks for a minimum Voltage to have occurred and the Voltage to be rising or at least stable for ten minutes. Then it takes a snap shot of the Battery Voltage, waits for the SampleTime* to elapse and compares the battery Voltage now with the snap shot. (Sometimes decimal digit "dithering" at the instant of sampling, could cause this sample to be rejected, even if they both appear to be identical on the serial output.) If they are seen as identical, the Topping Plateau has been detected and charging will be stopped. (if Extra Soak Time has not been set up). If not, the charger repeats this test after it waits again for another SampleTime* period. Note that some battery packs in poor health, with some high internal resistance cells for example, may not exhibit the normal plateau. In that case, the charge will get

stopped by one of the other methods such as exceeding the maximum set Topping Time (TopTimeMN*) or Temperature Differential.

It is in this Topping Mode 9 that the cell balancing and the most improvement to battery pack health is likely to occur.

Soak:

The Soak period will last for the remainder of the maximum allowed Topping Time and (used sparingly), provides overcharging to bring up out-of-balance cells that are well below the average State-of-charge. (If selected by the Soak" choice in Set Up)

Planned Accessories and enhancements:

Automatic Discharge/Recharge Cycling:

An auxiliary output is available to operate a Discharge Load for discharge/recharge cycling, which can help "condition" an ailing battery pack. This auxiliary output is accessed on a socket behind the hole-plug on the charger's left side. More details will be provided with the instructions of the Discharge Load.

OBD-II State of Charge (SOC) Reset Device:

A small module that plugs-in to the OBD-II diagnostic port could be used to set the battery SOC to a high level after a grid charge has been completed. Then the car will know to expect the battery to be at its high SOC instead of where it last thought it was.

Comments and Feedback Welcomed:

We encourage and look forward to your comments and feedback concerning this Instruction Manual and your experience using your Grid Charger. We would like to learn from shared experience and data and make this information available to the user community and incorporate it in any future enhancements if applicable.