

# PRO Charging Systems

Patriot Series 2420 High Frequency

## Safety, Installation, and Operating Instruction

Instructions importantes concernant la securite



### SPECIFICATIONS:

PS2420	Output: 24 VDC @ 20 ADC, 120VAC @ 8 Amps, 50/60 HZ
PS2420230	Output: 24 VDC @ 20 ADC, 230VAC @ 4 Amps, 50/60 HZ



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# Table of Contents

<u>Description</u>	<u>Section</u>	<u>Description</u>	<u>Section</u>
Important Safety Instructions	2	Troubleshoot / Technical Guide	14
Personal Safety Precautions	3	Output Connector Circuit	15
AC and Utility Requirements	7	Temperature Compensation Option	15
Safe Grounding Instructions	8	Vehicle Lockout Control Option	16
Assembly and Preparing to Charge	9	AC Convenience Port Option	16
Charging a Rechargeable Battery	11	Limited Warranty	16
Multi-Stage Charge—LED	12		
Multi-Stage Charge—LCD	12		
Error Code Description	12		

## IMPORTANT SAFETY INSTRUCTIONS

### INSTRUCTIONS IMPORTANTES CONCERNANT LA SÉCURITÉ :

SAVE THESE INSTRUCTIONS. This manual contains important safety and operating instructions for future reference.  
*CONSERVER CES INSTRUCTIONS. CE MANUEL CONTIENT DES INSTRUCTIONS IMPORTANTES CONCERNANT LA SÉCURITÉ ET LE FONCTIONNEMENT.*



This symbol means: Hazards or unsafe practices, which could result in severe personal injury or death.



This symbol means: Immediate hazards, which will result in severe personal injury or death.



This symbol means: Hazards or unsafe practices, which may result in minor personal injury, product, or property damage.



This symbol means: BE ALERT! Your safety, or the safety of others, is involved.



*Always read all instructions before using your PCS product!*

## PERSONAL SAFETY PRECAUTIONS

- *Wear complete eye protection and clothing protection.* Avoid touching eyes while working near battery. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, eyes, or other surfaces. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 10 minutes and seek medical attention promptly.
- *Dress properly.* Wear protective, electrically nonconductive clothes, and nonskid footwear. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery can produce a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn. Wear restrictive hair covering to contain long hair.
- *Avoid Working Alone.* Be sure someone is within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
- *Stay Alert.* Watch what you are doing and use common sense. Do Not operate any PCS product when you are tired.
- *Keep Children Away.* Children must never be allowed in the work area. Do not let them handle machines, tools, battery chargers, or extension cords.
- *Observe Work Area Conditions.* NEVER smoke or allow a spark or flame in the vicinity of a battery or engine. Don't expose to rain. Keep work area well lit.
- *Do Not Overreach.* Keep proper footing and balance at all times. Do not reach over or across electrical cables or frames.
- *Avoid Electrical Shock.* To reduce risk of electrical shock, unplug charger from outlet before attempting any maintenance or cleaning.
- *Do Not Operate PCS Product With Damaged Electrical Cord or Plug.* To reduce risk of damage to the electrical plug and cord, pull by plug rather than by the cord when disconnecting charger. If damaged, replace the electrical cord or plug immediately.
- *Store Idle Equipment.* When not in use, store equipment in a dry location to inhibit rust. Always lock up tools and equipment and keep out of reach of children.
- *Maintain PCS Product Care.* Inspect periodically and, if it has received a sharp blow, been dropped, or otherwise damaged in any way, have it repaired by an authorized technician. Do not disassemble charger; contact PCS technical support when service or repair is required (800.742.2740). Incorrect reassembly may result in risk of electrical shock or fire.
- *Check for Damaged Parts.* Before using any PCS product, carefully check any part that appears damaged to determine that it will operate properly and perform its intended function. Check for broken parts and any other condition that may affect proper operation. Any part that is damaged should be properly repaired or replaced by a qualified technician. Do not use the charger if any part does not operate properly.
- *Replacement Parts and Accessories.* When maintaining, only use accessories intended for use with this PCS product. Approved accessories are available from Pro Charging Systems (800.742.2740).



To reduce risk of battery explosion, follow these instructions, those published by the battery manufacturer, and by the manufacturer of any equipment that you intend to use in the vicinity of battery. Review all cautionary markings on these products and on the engine.

*Pour réduire le risque d'explosion, lire ces instructions et celles qui figurent sur la batterie.*

If it is necessary to relocate the battery for charging, first remove the grounded terminal from the battery. Then make sure all accessories are off, so as not to cause battery arcing.



**RISK OF EXPLOSIVE GASES: WORKING IN THE VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. Batteries generate explosive gases during normal battery operation. For this reason, it is of utmost importance that prior to each use of your charger, you read this manual and follow the instructions exactly.** *Il est dangereux de travailler a proximité d'une batterie au plomb. Les batteries produisent des gaz explosifs en service normal. Il est aussi important de toujours relire les instructions avant d'utiliser le chargeur et de les suivre à la lettre.*

**Do not operate charger in a closed-in area or restrict ventilation in any way.**

***Ne pas faire fonctionner le chargeur dans un espace close et/ou ne pas gêner la ventilation.***

Clean battery terminals. Be careful to keep corrosion from coming into contact with eyes. Add distilled water to each cell until battery acid reaches level specified by battery manufacturer. This helps purge excessive gas from cells. Do not overfill. For a battery without cell caps, carefully follow manufacturer's recharging instructions. Study all battery manufacturers' specific precautions such as removing or not removing cell caps while charging and recommended rates of charge.

When using an extension cord, make sure:

- that pins on plug of extension cord are the same number, size, and shape as those of the charger's plug;
- that extension cord meets UL (Underwriters Laboratories, Inc.) acceptance;
- that wire size is large enough for AC ampere rating of charger.



Always make your extension cord connection on the charger side before connecting to a nearby **120VAC GFCI protected (Ground Fault Circuit Interrupt) outlet. Failure to use a GFCI outlet may result in electrical shock. Note: U(Universal) chargers should be connected to a 110, 115 or 230VAC GFCI protected outlet. The DC connection should always be made before connecting or disconnecting the AC side.**

Note: Extension cords should be industrial grade/heavy duty UL approved and grounded. Check extension cord before use for damage, bent prongs and cuts. Replace if damaged.

Connect the extension cord to the charger; then proceed to plug the extension cord to the GFCI protected (Ground Fault Circuit Interrupt) outlet.

Always remove the extension cord from the GFCI protected outlet first when charging is completed, followed by unplugging the charger.



Use charger for charging a LEAD-ACID (lead acid, sealed lead acid, gel cell and AGM) battery only. It is not intended to supply power to a low voltage electrical system other than in a starter-motor application. Do not use battery charger for charging dry-cell batteries that are commonly used with home

appliances. These batteries may burst, causing personal injury and damage to property.

*Utiliser le chargeur pour charger une batterie au plomb uniquement. Ce chargeur n'est pas conçu pour alimenter un réseau électrique très basse tension ni pour charger des piles sèches. Le fait d'utiliser le chargeur des piles sèches pourrait entraîner l'éclatement des piles et causer des blessures ou des dommages.*



**DO NOT** attempt to attach a charger to a battery pack if the output of the charger does not match the battery pack voltage. Example: Model i-3625 is a 36 volt output charger and is only usable on 36 volt battery systems.



**NEVER** connect to just one battery (ie. 6V) in the pack. Damage can occur.

Be extra cautious to reduce risk of dropping a metal tool onto battery. It might cause a spark or short-circuit a battery or other electrical part, possibly resulting in an explosion. If damaged, contact PCS (615.471.5300).



NEVER charge a frozen battery.

*Ne jamais charger une batterie gelée.*

Assure that the area around your charger and batteries is properly ventilated. Connect your extension cord, with no AC Power present, to the battery charger and proceed to plug your extension cord into a 120VAC GFCI protected (Ground Fault Circuit Interrupt) outlet.



**Risk of electrical shock! Do not touch uninsulated parts of the battery charger output connector, battery connector, or battery terminals.**



Once you plug in your PCS battery charging system, the charge cycle will begin automatically. State of charge will be displayed by illumination of the Light Emitting Diodes (LEDS) on the battery status indicator located on the front of the unit.

**DO NOT** connect or disconnect the DC output electrical cord to or from the battery receptacle when the charger is on. Arcing and / or burning of the plug and receptacle could result and could cause the batteries to explode. If the charger must be stopped, first



**disconnect the AC power supply cord from its outlet, then disconnect the charger DC output plug from the battery receptacle.**



We recommend that you leave your system plugged in. This will reduce sulfation on the lead plates of the batteries and allow your PCS charging system to keep your batteries fully maintained and ready to perform at their best.

**Study all battery manufacturers' specific precautions such as removing or not removing cell caps while charging and recommended rates of charge.**

*Prendre connaissance des mesures de précaution spécifiés par le fabricant de la batterie, p. ex., vérifier s'il faut enlever les bouchons des cellules lors du chargement de la batterie, et les taux de chargement recommandés.*



Never place the charger directly above or below the battery being charged; gases or fluids from the battery will corrode and damage the charger. Locate the charger as far away from the battery as DC cables permit.

*Ne jamais placer le chargeur directement sous la batterie à charger ou au-dessus de cette dernière. Les gaz ou les fluides qui s'échappent de la batterie peuvent entraîner la corrosion du chargeur ou l'endommager. Placer le chargeur aussi loin de la batterie que les câbles c.c. le permettent.*



If it is necessary to remove battery from vehicle to charge it, always remove grounded terminal from battery first. Make sure all accessories in the vehicle are off in order to prevent an arc.



*S'il est nécessaire de retirer la batterie du véhicule pour la charger, toujours d'ébrancher la borne de mise à la masse en premier. S'assurer que le courant aux accessoires du véhicule est coupé afin d'éviter la formation d'un arc.*



Never smoke or allow an open spark or flame in the vicinity of the BATTERY the battery or engine.

*Ne jamais fumer près de la batterie ou du moteur et éviter toute étincelle ou flamme nue à proximité de ces dernières.*



Working in the vicinity of a lead-acid battery is dangerous. Batteries generate explosive gases during normal operation. For this reason it is of the utmost importance that prior to each use of your charger, you read and follow the instructions provided exactly.

*Il est dangereux de travailler à proximité d'une batterie au plomb. Les batteries produisent des gaz explosifs en service normal. Il est aussi important de toujours relire les instructions avant d'utiliser le chargeur et de les suivre à la lettre.*

- To reduce risk of battery explosion, follow all safety instructions below and those published by battery manufacturer. Review cautionary markings on vehicle or equipment containing battery.
- Use of an attachment not recommended or sold by the battery charger manufacturer may result in a risk of fire, electric shock or injury to persons.
- Do not operate this charger if it has received a sharp blow, was dropped or otherwise damaged in any manner. Refer to a qualified service agent.
- Charger contains no serviceable parts. If it fails during its warranty period, contact your dealer, OEM supplier, or visit the PCS website at [www.Pcsdv.com](http://www.Pcsdv.com) for information concerning how to obtain a warranty replacement.
- To reduce risk of electric shock, unplug charger from AC outlet before attempting any maintenance or cleaning.
- For external cleaning, use a clean damp towel.
- Have your distributor, dealer or other qualified service agent repair or replace worn or damaged parts immediately. **Repairs should not be attempted by people who are not qualified.**

- Whenever removing AC plug from the receptacle, pull from the plug body, not from the cord.
- Do not operate the charger if it malfunctions. Personal injury or property damage could result.
- Do not charge non-rechargeable batteries.
- During charging, battery and charger must be placed in a well ventilated area.
- When charging a battery mounted in an automobile, take the following precautions:
  - The battery terminal not connected to the chassis must be connected first. The other connection must be made to the chassis as far away from the battery and fuel line as possible. The battery charger is then to be connected to the supply mains.
  - After charging, first disconnect the battery charger from the supply mains. Then remove the chassis connection and, finally, the battery connection.

### **PERSONAL PRECAUTIONS WHILE WORKING WITH BATTERIES**

- Have someone within range of your voice ready to come to your aid if needed.
- Have plenty of fresh water and soap nearby in case battery acid contacts your skin, clothing, or eyes. Wear eye and clothing protection and avoid touching eyes.
- If battery acid contacts skin or clothing, wash immediately with soap and water.
- If acid enters eye, immediately flush eye with running cold water for at least 10 minutes. Get medical attention immediately.
- NEVER smoke or allow a spark or flame in vicinity of battery.
- Be extra cautious not to drop a metal tool onto battery. It might spark or short circuit a battery or other electrical part that may cause an explosion.
- Remove personal metal items such as rings, necklaces, watches, etc. Batteries can produce a short-circuit strong enough to weld such items causing a severe burn.
- NEVER charge a frozen battery. Thaw it out for safer and more efficient charging.

### **AC AND UTILITY REQUIREMENTS**

The use of an improper extension cord could result in a risk of a fire or electric shock. If an extension cord must be used, it must be UL and CSA approved. Locate all cords so that they will not be stepped on, tripped over, or otherwise subjected to damage or stress. Extension cord must be properly wired, must be in good electrical condition, and must be properly rated (at least 1.25 times the AC rating of the charger as specified in the following table:

## RECOMMENDED MINIMUM GAUGE (AWG) FOR EXTENSION CORDS FOR PATRIOT SERIES 2420 HIGH FREQUENCY BATTERY CHARGER

Length of cord (feet)	25	50	100	150
AWG	16	16	14	12

- Refer to the Product ID Label affixed to the product and identify the input requirements such as '120VAC, 60Hz, 10Amps'. Make sure the product will be connected to a matching utility power rating. For example, if product is rated at 60Hz, do not connect to a 50Hz utility.
- The rating of the input AC cord, if replaced by a certified technician, must not be less than 16AWG, 300V for 100VAC or 120VAC utilities and not less than 18AWG, 300V for 230VAC or 240VAC utility power. Cord must be hard usage SJT type or better and must be UL/CSA approved. The cable end connecting to charger must be an approved IEC 60320 power connector.
- Do not connect product to AC receptacles that share power with any other moderate to heavy loads such as air conditioners, motors and other common appliances. Most appliances turn on/off at random and cause power surges and power droops that can severely affect the product connected to that same power circuit.
- Inspect AC Receptacles for general wear, including loose or hanging receptacles and be very aware of potentially worn contacts. If any heat is felt in and around the receptacle while the charger is operating, this is an immediate indication of danger caused by a worn receptacle.

### **SAFE GROUNDING INSTRUCTIONS**


- Do not remove Ground Pin from charger's A.C. Plug, or connect to utility power via an adaptor that bypasses the product's ground pin connection. The product must be grounded at all times when connected to utility power.
- This battery charger must be grounded to reduce the risk of electric shock. This charger is equipped with an AC cord set having an equipment-grounding conductor. This AC cord set must be connected to an appropriate receptacle that is properly installed and grounded in accordance with the National Electrical Code (NEC) and all local codes and ordinances.

** WARNING: IMPROPER CONNECTION OF THE EQUIPMENT-GROUNDING CONDUCTOR MAY RESULT IN THE RISK OF AN ELECTRIC SHOCK.**

- The equipment grounding connector has green insulation with or without yellow stripe(s). If repair or replacement of the charger's AC cord set is necessary, refer to a qualified service agent. Do not connect the equipment grounding connector to a live terminal.



## **ASSEMBLY AND PREPARING TO CHARGE**

 **WARNING:** The instructions printed on the charger are for daily reference.. For your own protection, when using ANY type of charger, always ensure that the batteries in your Battery Pack ARE ALL at the same state of charge, same condition, same size, and same rating. **DO NOT MIX DIFFERING BATTERY SIZES, BATTERY TYPES OR OLD BATTERIES WITH NEW.** Never use charger for any purpose contrary to its intended purpose of charging rechargeable batteries in accordance with ALL instructions printed in this manual.

- **IMPORTANT:** Attach Output DC Cable to Charger BEFORE Connecting to equipment or vehicle. Insert Cable Connector into Charger Output Connector and Rotate Lock until the Lock CLICKS into position and the wings on the Rotate Lock line up with the Lock Mark position on the front product
- Be sure area around batteries is well ventilated while batteries are being charged. Gas can be forcefully blown away using a non-metallic material like cardboard.
- Inspect the receptacle found on the equipment or vehicle into which the charger output cable connector is expected to mate into:
  - The receptacle must not be worn in any way. Also, carefully inspect receptacle contacts for wearing, burn or pitting marks.
  - The receptacle contacts must be clean and free of any dirt, grime, grease, liquids, or other contamination.
  - High power currents flow across the contacts between Charger Plug and Vehicle Receptacle and can be a source of high heat when mating contact surfaces are worn or dirty. Replace receptacle or charger plug, or both when worn. It is also highly suggested to periodically replace the plug and receptacle every three years, but subjective to use, as is the case with all plugs and receptacles on all appliances.
- Inspect the equipment or vehicle cabling once every 30 days for loose or worn wires, connectors, terminals and ensure fuse safety devices (over current protection) have been installed by the equipment or vehicle manufacturer. Start at the receptacle and inspect each wire and joint connecting the battery along with any series or parallel wires.
- Follow the wire connection from the equipment or vehicle's receptacle down to the first battery on both the positive and negative conductors. On one of those conductors, an in-line fuse or a fuse-box fitted with an over-current device (fuse) must be installed within 6 inches of the battery post on the first battery. **If fusing is not found, install fuse protection prior to using charger with equipment or vehicle.**
- The charger is factory preset to charge in MODE-1, unless supplied with an OEM's equipment nor vehicle—in which case, the MODE will be set to that mode defined by the OEM Equipment Specification. If changing battery type, verify and re-establish the charger MODE settings.
- If charger was purchase 'used' or with used equipment—**IDENTIFY THE TYPE OF BATTERIES INSTALLED IN THE EQUIPMENT AND VERIFY THAT THE MODE IN WHICH THE CHARGER IS SET IS APPROPRIATELY SELECT FOR THE BATTERIES.** This will ensure that an 'inventory-stocked charger' at the dealer's location was not mismatched with the batteries installed on the equipment or vehicle.

Charging Algorithms are selectable by referencing the table below. Each mode is set to charge a particular battery pack **AND MUST BE SET CORRECTLY IN ACCORDANCE WITH THE FOLLOWING TABLE:**

**MODE—Switch Setting:      0 = Switch Up      1 = Switch Down**      Switch Setting (Left to Right)

Mode	Battery Name	Type	AH Range (20hr)	Absorb VPC*	1	2	3	4	5
01	Crown CR-225	Flooded	200-250	2.380	0	0	0	0	0
02	Exide GC-135	Flooded	200-250	2.400	0	0	0	0	1
03	JCI 6V-GC2 Energizer	Flooded	210-260	2.450	0	0	0	1	0
04	Trojan T105	Flooded	200-250	2.400	0	0	0	1	1
05	Trojan T1275	Flooded	130-170	2.400	0	0	1	0	0
06	Trojan L16G-AC	Flooded	355-425	2.400	0	0	1	0	1
07	USBattery US1800	Flooded	190-235	2.450	0	0	1	1	0
08	USBattery US2200	Flooded	205-260	2.450	0	0	1	1	1
09	Full River DC220-6	AGM	195-245	2.450	0	1	0	0	0
10	Full River DC335-6	AGM	305-365	2.450	0	1	0	0	1
11	GNB / Crown	AGM	200-250	2.330	0	1	0	1	0
12	Trojan T105 Reliant	AGM	210-230	2.450	0	1	0	1	1
13	DEKA / USBattery	AGM	200-250	2.400	0	1	1	0	0
14	Trojan 6V-GEL	GEL	165-215	2.333	0	1	1	0	1
15	PsZ-Cell – Lead Acid	Flooded	075-125	2.400	0	1	1	1	0
16	PsZ-Cell – Lead Acid	Flooded	125-175	2.400	0	1	1	1	1
17	PsZ-Cell – Lead Acid	Flooded	200-250	2.400	1	0	0	0	0
18	PsZ-Cell – Lead Acid	Flooded	300-350	2.400	1	0	0	0	1
19	PsZ-Cell – Lead Acid	AGM	075-125	2.450	1	0	0	1	0
20	PsZ-Cell – Lead Acid	AGM	125-175	2.450	1	0	0	1	1
21	PsZ-Cell – Lead Acid	AGM	200-250	2.450	1	0	1	0	0
22	DEKA / GNB-Cell	AGM	300-375	2.450	1	0	1	0	1
23	General – GEL	GEL	075-125	2.333	1	0	1	1	0
24	Energysys 12XFC82	Pure Lead	075-125	2.450	1	0	1	1	1
25	Energysys – AGM	Pure Lead	200-250	2.433	1	1	0	0	0
26	Energysys – AGM	Pure Lead	300-375	2.433	1	1	0	0	1
27	Optima OPT-D31M	Spiral	050-100	2.450	1	1	0	1	0
28	General – Spiral Lead	Spiral	130-170	2.450	1	1	0	1	1
29	Sony LiFePO4 Cell	Li+	055-065	4.172	1	1	1	0	0
30	Sony LiFePO4 Cell	Li+	190-210	4.172	1	1	1	0	1
31	BMZ LiFePO4 Cell	Li+	160-175	4.175	1	1	1	1	0
32	Empty	User	-----	-----	1	1	1	1	1

Absorb VPC = Absorption Volts Per Cell, the standard in the lead-acid battery industry for specifying voltage parameters for charging. 12 volt lead-acid battery pack has 6 cells, a 24 volt lead-acid battery pack has 12 cells, etc.

**For Lithium applications or battery types not listed, please contact Pro Charging Systems at 615.471.5300 .**

## **CHARGING A RECHARGEABLE BATTERY**

- An LED Display is assumed to be used. For products using an LCD (Liquid Crystal Display) Display, the information below is displayed in readable format—refer to the section titled ‘LCD Display Menu Formats’ for a complete description of how the LED information is translated and displayed on the LCD.
- For 4 consecutive seconds, upon connection to AC Power, the Front Panel LEDs will flash a pattern to annunciate the mode setting as Described in the following table where ‘0’ = Off, and ‘1’ indicates LED Flashing:

**LED CHARGE MODE INDICATOR TABLE**

LED’s Left to Right						LED’s Left to Right					
MODE	1	2	3	4	5	MODE	1	2	3	4	5
1	0	0	0	0	1	10	0	1	0	1	0
2	0	0	0	1	0	11	0	1	0	1	1
3	0	0	0	1	1	12	0	1	1	0	0
4	0	0	1	0	0	13	0	1	1	0	1
5	0	0	1	0	1	14	0	1	1	1	0
6	0	0	1	1	0	15	0	1	1	1	1
7	0	0	1	1	1	16	1	0	0	0	0
8	0	1	0	0	0	17	1	0	0	0	1
9	0	1	0	0	1	18	1	0	0	1	0

**Note: Once the charging algorithm (MODE) has been changed, there will be a longer than normal startup time (up to 10 minutes) for the first use after the algorithm change. LEDs will not flash and the charger will appear to be frozen. DO NOT UNPLUG THE CHARGER DURING THIS PERIOD, THE INTERNAL DATABASE IS BEING REBUILT.**

**For additional charging algorithm information including a detailed description of the numerous charging stages, please scan the following QR code:**



## MULTI-STAGE CHARGE (TYPICAL) WITH LED DISPLAY

Power On	(Red)	Illuminates continuously when AC POWER IS PRESENT.
Shutdown	(Red)	Illuminates typically when used only during Error Decode Mode. Refer to 'TROUBLESHOOTING IF FLASHING.
Detection	(Red)	Illuminates when battery not connected while powered by AC. Refer to 'TROUBLESHOOTING IF FLASHING.
Charging	(Yellow)	Charge Status Indicator—May illuminate steady or flash during the Multi-Stage Charge Process.
Charged	(Green)	Illuminates during the Finishing and Float/Maintenance Stages. When flashing in conjunction with a continuously illuminated Power On Red LED, it is signifying an alert. Refer to Error Code Description for alert definition.

**For additional information including a detailed description of LED indications and functionality, please scan the following QR code:**



## MULTI-STAGE CHARGE (TYPICAL) WITH LCD DISPLAY

- Use of an LCD display converts messages from what is otherwise a blinking LED into readable characters. Therefore, refer to the previous section for a description of a typical charge stage.

**For additional information including a detailed description of LCD messages and functionality, please scan the following QR code:**



## ERROR CODE DESCRIPTION

There are numerous Error Codes available to alert the user to possible battery issues or charger related issues. For chargers utilizing an LED display, the error codes will be displayed by flashing LED's. For chargers equipped with LCD displays, the Error Code Number will be displayed.

During an Error Code Annunciation, the charge cycle has terminated its normal operation, prematurely. An abnormal charging condition was detected and charging stopped due to a Charge Error Condition. Refer to the following **Charge Error Table** for an extended description of the failure or condition and its possible remedy. Error Code Values 1-31, which use the first flash pattern, are not highlighted. Error Code Values 32-64, which use the second flash pattern are highlighted in yellow.

'ALERTS' are highlighted in magenta.

## CHARGE ERROR TABLE

**FLASHING LEDES: 0 = OFF, 1 = FLASHING, S = SOLID**

Condition	LED 1	LED 2	LED 3	LED 4	LED 5	Error Number
Battery Over Voltage	0	0	0	0	1	1
Battery Temperature Low	0	0	0	1	1	3
Battery Temperature High	0	0	1	0	0	4
Battery Pack Unbalanced –V	0	0	1	1	1	7
Battery Pack Unbalanced –A	0	1	0	0	0	8
Batt Is 100% Discharged	0	1	0	0	1	9
Batt Beyond Over Discharged!	0	1	0	1	0	10
Batt Emergency Under-Voltage	0	1	0	1	1	11
Batt Temperature Sensor Open	0	1	1	1	1	15
Batt Temperature Sensor Shorted	1	0	0	0	0	16
Batt Over-Temperature	1	0	0	0	1	17
Battery Storage Error	1	0	0	1	1	19
Battery Testing Error – Sulphated	1	0	1	0	0	20
Battery Testing Error – Discharged	1	0	1	0	1	21
Bulk Charge Safety Time Error	1	1	0	0	1	25
Absorption Safety Time Error	1	1	0	1	0	26
Excessive Safety Time Error	0	0	0	0	1	32
Mode Selected Not Valid – Empty	0	0	0	1	0	33
Product Not Operational!	0	0	0	1	1	34
Lockout (Inhibit) Enable Defective	0	0	1	0	0	35
Lockout (Inhibit) Disable Defective	0	0	1	0	0	36
Internal Over Temperature	1	0	0	0	1	48
Finish Stage Exit via High Voltage	S	0	0	0	1	---
Equalization Stage Exit via High Voltage	S	0	0	0	1	---

**For detailed information regarding each of these charge errors, please scan the following QR code:**





## **TROUBLESHOOTING AND TECHNICAL GUIDE**

To be able to troubleshoot safely and effectively, it is important to read this guide completely before beginning any tests.

**WARNING: DO NOT DESASSEMBLE THE CHARGER. TAKE IT TO A QUALIFIED SERVICE AGENT WHEN SERVICE OR REPAIR IS REQUIRED. INCORRECT REASSEMBLY MAY RESULT IN A RISK OF ELECTRIC SHOCK OR FIRE. THE FOLLOWING PROCEDURES ARE INTENDED ONLY TO DETERMINE IF A MALFUNCTION MAY EXIST IN THE CHARGER.**



**DANGER: TO REDUCE THE RISK OF ELECTRIC SHOCK, ALWAYS DISCONNECT THE CHARGER'S AC CORD SET FROM AC POWER AND ITS DC CORD SET FROM BATTERIES BEFORE ATTEMPTING ANY MAINTENANCE OR CLEANING.**

- LEDs Frozen (no activity) or Charger seems inoperable:
  - Battery may have been subjected to an Over-Discharge condition. Using a DC voltmeter, check if battery voltage is well under its 100% depth of discharge level defined as 1.75 volts per cell (VPC) for lead acid batteries (21.0 volts for a 24V battery system). Disconnect AC, then disconnect the DC charge cables and re-connect. Connect AC to resume charging.,
- Batteries Hot To the Touch—Charger continues to charge:
  - A hot battery or batteries may signify cells that are:
    - Shorted due to material collected at the bottom of the cell and not able to break down and recombine back into the battery plates, and/or
    - Stratification of the acid into layers where a denser acid layer is carrying most of the amperage
    - An overcharged cell due to other cells being unbalanced and at a much lower state of charge

Possible corrections include:

- Cease charging, operate vehicle to slightly discharge battery pack, then resume charging
- Breaking apart the battery pack and load test each battery—replace defective batteries
- Check Charger MODE setting and confirm charger is configured for the proper charge algorithm

### **TECHNICAL NOTES**

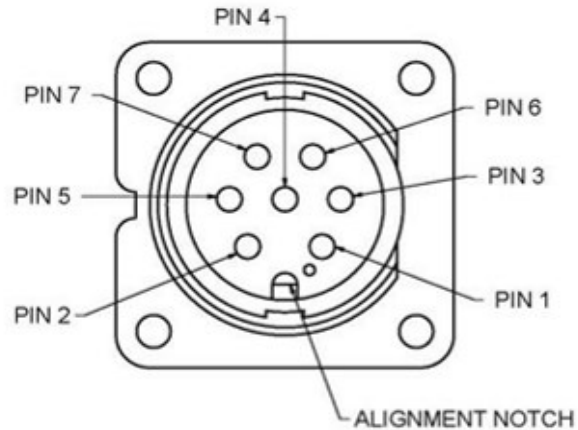
- Do not connect charger to a receptacle that shares its circuit with other loads such as motors and most all common appliances. These shared circuits cause severe line voltage droops that, upon appliance abruptly turning on or off, will cause instantaneous line voltage changes that may be beyond the ability of the charger to compensate fast enough, causing permanent non-warranty damage to charger.
- Do not charge more than one battery pack at a time. Battery pack characteristics differ and may cause the micro-processor to misinterpret algorithmic values and possibly function improperly.
- Do not charge more than one battery pack at a time. Battery pack characteristics differ and may cause the micro-processor to misinterpret algorithmic values and possibly function improperly.
- **If charging a series connected string of two or more batteries or cells, ensure that all batteries and cells in the series connected string, are all at the same state of charge, age, type, and condition.**
- The charger uses RF energy only for its internal functions. Therefore its RF emissions are very low and are unlikely to cause any interference in nearby electronic equipment.

- The charger has an operating temperature range of -35C to +55C, and a shipping/storage temperature range of -40C to +125C. It needs to be stored in clean, dry conditions.
- Medical Electrical Equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in this manual.
- Portable and mobile RF communications equipment can affect Medical Electrical Equipment.
- The use of Accessories, transducers, and cables other than those specified by the manufacturer, may result in increased Emissions or decreased Immunity of the Battery Charger.
- The Battery Charger should not be used adjacent to or stacked with other equipment and that, if adjacent or stacked use is necessary, the Battery Charger should be observed to verify normal operation in the configuration in which it will be used.
- Important: If batteries are left in storage for a lengthy period (months), Charger should be connected to AC Power continually or periodically (once per month) to replenish batteries self- discharged condition to prevent possible permanent damage to battery.

## **OUTPUT CONNECTOR CIRCUIT**

### **OUTPUT CONNECTOR FIGURE**

- PIN 1: Temperature Compensation Positive (+)
- PIN 2: Temperature Compensation Negative (-)
- PIN 3: Battery Charge Output Positive (+)
- PIN 4: Vehicle Lockout (Inhibit) Positive (+)
- PIN 5: Battery Charge Output Negative (-)
- PIN 6: No Connection
- PIN 7: Vehicle Lockout (Inhibit) Negative (-)



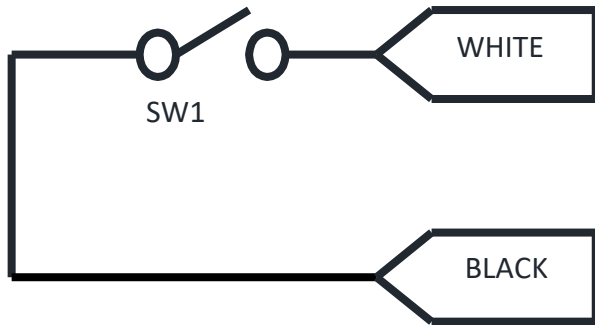
## **OPTIONAL TEMPERATURE COMPENSATION**

The charger contains a temperature compensation circuit to accommodate an optional Temperature Compensation Cable.

- If your charger is equipped with a Temperature Compensation Cable, charging set points will automatically be adjusted based on battery temperature.
- If your charger does not have the Temperature Compensation Cable, the charger will function based on battery performance at 25 Degrees C. (77 degrees F).
- For additional information, please call Pro Charging Systems tech support at 615.471.5300.

## VEHICLE LOCKOUT CONTROL OPTION

### INHIBIT (LOCKOUT) WIRING



When charging, SW1 is open.  
When not charging SW1 is closed.

SW1 maximum current = 3Adc

- The circuit depicted above, when applied as an application with the equipment or vehicle, will prevent the operating of that equipment or vehicle while the charger is connected to A.C. Utility Power.
- The White connection on the vehicle side is connected to battery positive (+). Max voltage 100VDC.
- The Black connection on the vehicle side is connected to the lockout contactor.
- For products with 'Pigtail' Lockout Inhibit Cable already installed, a tethered output pigtail is included on some models and exits the front of the charger. **For component information, please scan the following QR code:**



## AC CONVENIENCE PORT ACCESSORY OPTION

- This option is mounted on equipment or vehicle body and allows an A.C. extension Cord to connect to it, where the charger is mounted deep inside the vehicle. It provides a 5-LED Status display. This option is not available for 'R-Series' charger products. **For component information, please scan the following QR code:**



### LIMITED WARRANTY

Pro Charging Systems, LLC (PCS) makes this Limited Warranty only to the original retail purchaser.

PCS warrants this battery charger for three years (unless the charger is used outside of the USA or the charger has a part number with the RM designation) from the date of retail purchase against defective materials and/or workmanship. \*-RM suffix refers to "Restricted Markets" such as Rental applications and Heavy Industrial applications. These chargers, along with any chargers used outside of the USA, will have a warranty period of 18 months from the date of retail purchase against defective materials and/or workmanship. CR refers to "Certified Reconditioned" and designates a 1 year warranty.

If such defects should occur, this unit will either be repaired or replaced at the discretion of the manufacturer. It is the responsibility of the original purchaser to return the charger along with proof of purchase, transportation, and/or any mailing or handling charges prepaid to the manufacturer or its authorized representative. Chargers that are purchased more than two years beyond the date of production will automatically have a warranty start date that will be the two year anniversary of the production date.

This limited warranty is void if the product is misused, improperly maintained, handled carelessly or incorrectly operated.

Additionally, this warranty is void if the charger is disassembled, the charger's charge cables are cut, the power cord is cut off, the charger is altered without authorization from PCS, the serial number is removed, or repair is attempted by anyone other than an authorized representative.

PCS makes no other warranty other than this limited warranty and expressly excludes any implied warranty, including warranty for any incidental or consequential damages. This is the only expressed limited three year warranty authorized by PCS and does not authorize anyone to assume or make any other obligation towards the product other than this three year Limited Warranty. Some states do not allow limitation of incidental or consequential damages. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

Please call Pro Charging Systems, LLC for full warranty information at **(615.471.5300)**.