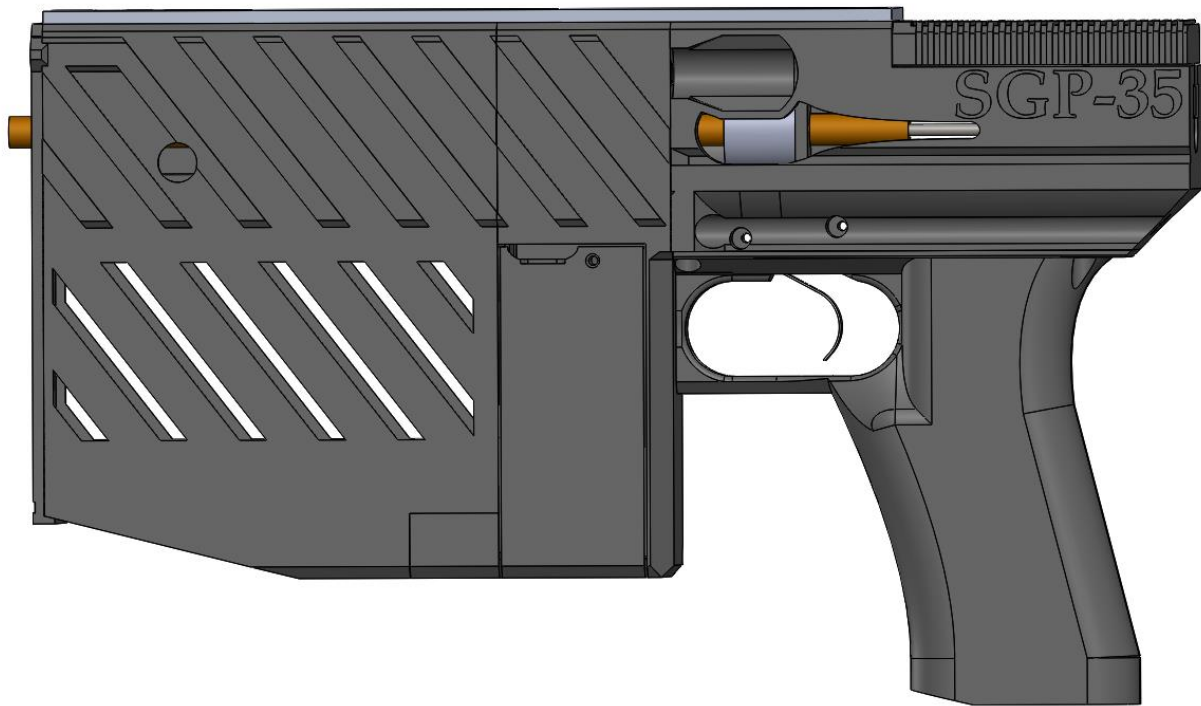


SGP-35

Single Stage SCR Coilgun

User Manual



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1. Introduction

The Arcflash Labs SGP-35 (Solenoid Gauss Pistol – Model 35) is a single stage, SCR switched, high voltage capacitor driven, slide-action coilgun.

It is a single stage design which relies on an Atmel 85 microcontroller for SCR triggering, signal processing, battery voltage lockout and charging. The microcontroller does NOT monitor main drive coil or heatsink temperature.

The charging of the capacitor is activated by powering on the unit and discharging is initiated through the SCR and coil upon a trigger pull, or through a high wattage bleeder resistor when the power is shut down. The capacitor will remain energized for approximately 10 seconds after the power is removed. The charger will activate for approximately 8 seconds, and will operate sporadically to maintain a full charge on the capacitor while the unit is powered on. Charging system power is indicated by a red LED on the barrel. Fully charged capacitor is indicated by a green LED on the barrel. Other conditions are described in detail in this manual.

The SGP-35 is configured to ONLY fire 0.25x0.75" steel projectiles (dowel pins). Arcflash Labs recommends the use of 2575 Magnetic Armatures (sold separately) but any 0.25x0.75" steel dowel pin should work.

The SGP-35 is shipped standard with a CFS (constant force spring) magazine which can hold up to 18 rounds single stacked.

As a beta tester of the SGP-35, you are privileged to join an exclusive community of electromagnetic gun developers and enthusiasts around the globe. Until now, only a handful of individuals have ever seen an electromagnetic gun, let alone fired one. Congratulations on your purchase of a piece of history.

1.1 Terminology and Safety

The list below and throughout this manual is a summary of the major hazards associated with the device, but is NOT ALL INCLUSIVE. There are many other hazards associated with the device which are not laid out in this manual. We recommend wearing high voltage, flame retardant gloves at all times when using the device as well as goggles and thick clothing. Never use the device indoors or around flammable materials and always have a fire extinguisher on standby.

The SGP-35 is NOT WATER RESISTANT AND NOT IMPACT SAFE. Exposure to water or dropping from distances greater than 1 foot may cause irreversible damage to the gun, fire, explosion, electrical shock or venting of toxic gas from the battery or capacitors. If the SGP-35 is dropped or exposed to water: discontinue use immediately and return the gun to its manufacturer for repairs. Water or impact damage is easily detectable and a surcharge will be assessed for repairs in such instances.

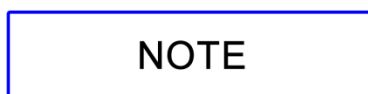
The following terminology is used throughout this manual for the purpose of denoting important and safety critical information:



An operation, procedure, or practice which if not correctly followed could result in personal injury or loss of life.

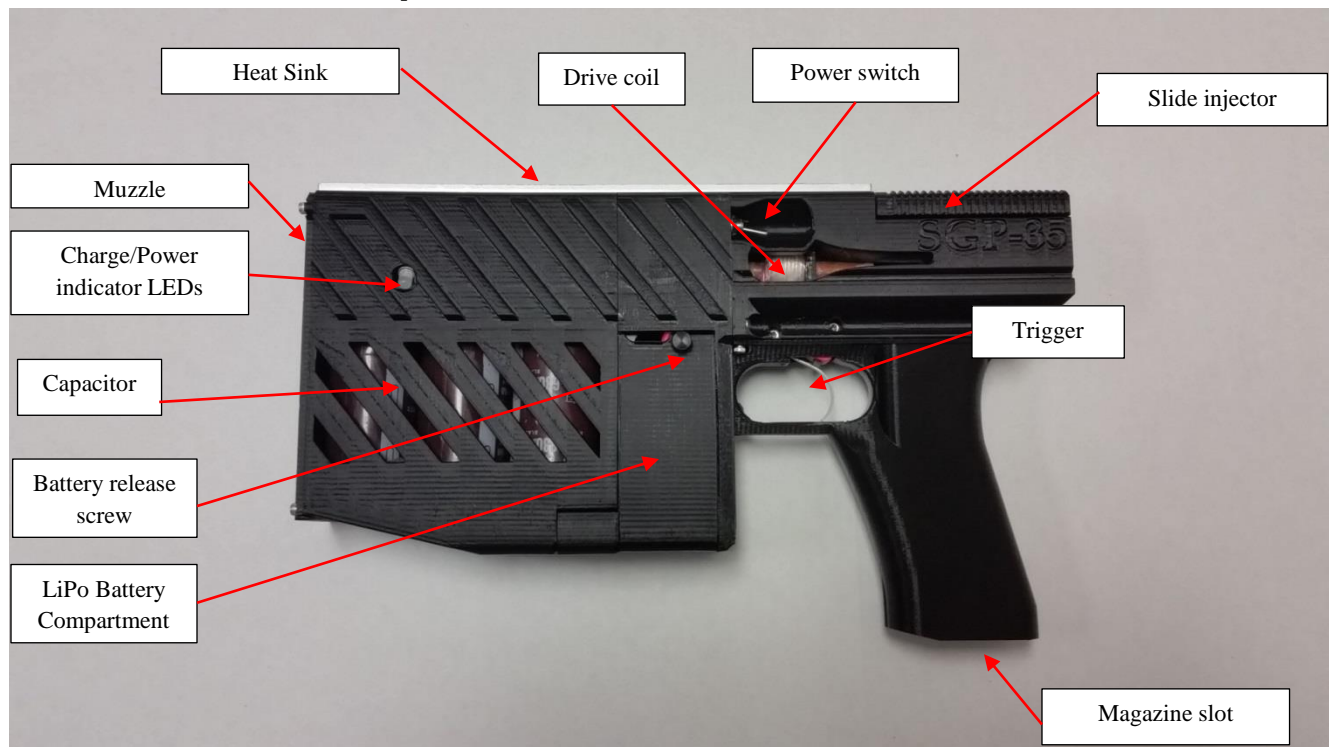


An operation, procedure, or practice which if not strictly observed, could result in damage to the device and/or voiding of the device's warranty.



A recommended procedure, suggested practice, or point of additional information which may facilitate the ease of use for the operator, or point out a feature of particular importance which is useful to know, but not safety-critical.

2. Overview of components



2.1 Barrel



- **Lethal shock hazard: The SGP-35 operates at 450 Volts and up to 2000 Amps.** Never touch the coil, the heatsink or any components inside the ventilation holes while a battery is connected to the gun, or within 10s of switching the power off. Never disassemble the unit.
- Muzzle energy is sufficient to break bones, cause serious injury or even death. It goes without saying: never point the gun at anyone or anything you do not intend to destroy.
- Never fire projectiles longer than 0.75" – firing projectiles other than Arcflash 2575 Magnetic Armatures or 0.25x0.75" steel dowel pins could result in fire or explosion.

The SGP-35 is a single shot handheld gauss pistol – its core component is a high voltage switch called a silicon controlled rectifier (SCR) which quickly discharges all the stored energy in the capacitor into the drive coil, creating a large magnetic field. The field is designed to expand as the projectile moves towards the center of the drive coil and contract a precise amount of time after. The expansion and contraction of this magnetic field is precisely timed to accelerate the 2575 armature. Projectiles longer, shorter, or smaller in diameter than the standard may not fire at all or may fire less effectively. The nominal exit velocity is between 25-38 m/s for the 2575 armature.

While its muzzle energy is comparable to most bb-guns (around 2 joules or 1.5 ft/lbs), it should be treated the same way as a firearm: with the utmost respect. Hazards from accidental discharge

include broken bones and severe injuries – in short, never point the device at anything you don't want to destroy. Treat it as loaded at all times.

The device is powered by a low voltage (16V) battery. This low voltage is internally stepped up to 450 volts and stored in large capacitor. The drive coil is held at a reference voltage of 450V with respect to the battery. To avoid risk of shock, do not touch it while the unit is powered on. The heatsink is electrically insulated from the electrical system, but in the event of water ingress or contamination, it may become charged to 450V. Never touch any metal parts of the gun (except the trigger and the power switch) while it is powered or shortly after it is shut down as it takes approximately 10 seconds for the gun to fully power down, even after the green power light has extinguished.

The drive coil of the SGP-35 may appear larger or smaller than the picture. Despite its small size, it is mathematically optimized to deliver the most energy from the capacitor into the projectile. Do not be concerned if the coil you receive appears smaller than the pictured version, as the physical size of the coil is in no way correlated with the muzzle energy.

2.2 Injector



- **Do not slam the slide or let go of the slide at full extension like a conventional firearm. This will damage the retention mechanism and may also fail to seat the round.**
- To properly seat a round, rack the injector slowly, keeping your hand on the injector slide mechanism at all times. **DO NOT RELEASE THE SLIDE UNTIL THE ROUND IS FULLY SEATED**

Projectiles are pushed out of the magazine by a hand-operated slide injector. This mechanism is similar to that of a conventional firearm in appearance and function, but more delicate since it relies on a small magnet for retention and proper positioning rather than a flange. While the retention system has been improved with respect to the SGP-34, it is still a fragile component.

This injector dispenses single rounds from the magazine into the chamber, where the action of the trigger activates the SCR, creating an expanding magnetic field in the drive coil and sucking the projectile out of the injector mechanism and into the barrel where it is then accelerated out of the gun.

To operate the injector, insert a magazine, and pull the injector slowly back to the rear position until you hear a light click and the slide encounters resistance, then slowly move the slide forward again until it is fully reset to the original forward position. This will chamber an armature. After each shot, you must manually rack the slide to chamber the next round, similar to a bolt-action.



The injector held in the rear position.

It may be useful to inspect the chamber after removing the magazine to verify whether the gun is loaded. To do this, rack the slide back all the way with the magazine removed, hold the top of the gun up to a bright light or light-colored surface (like a wall or ceiling) and look down the magazine well. If you can see light, there is potentially no armature in the chamber. If you do not see light, or see only a small light, there is likely an armature chambered.



Armature in chamber



Potentially safe

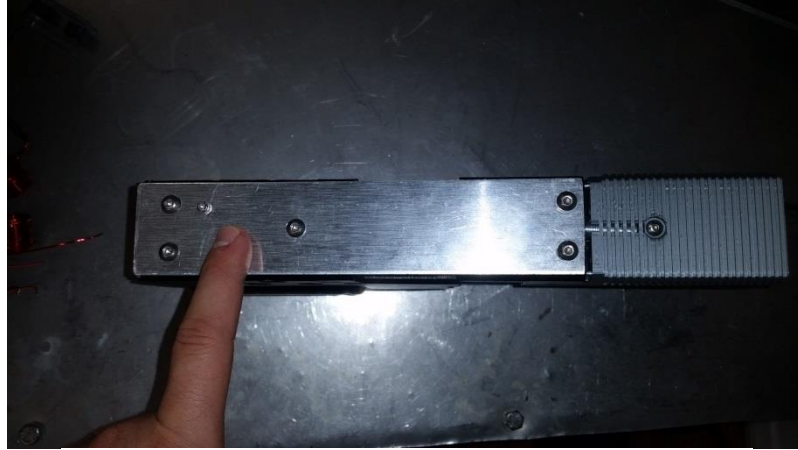
While this method demonstrates one potential way to check whether the gun is safe, just because there is no armature in the chamber does NOT mean that the gun is safe or unloaded. There still may be a round jammed in the barrel. The only way to fully verify that the gun is unloaded is to remove the battery, wait 10 seconds, and insert a wire or rod down the barrel and observe the end of the rod through the magazine well.

2.3 Heat sink



- Serious burn hazard: The heat sink may get hot enough to burn after extended operation (>150°F). Don't touch it.

- While the heat sink is electrically shielded from sources of high voltage, there still exists the possibility, however slight, that a component may become dislodged or water may form a conductive path and the heat sink may become electrically charged during operation, therefore we advise against touching it while the unit is powered on.



The heat sink may become very hot during operation

The SGP-35 relies on an ultra-compact high voltage boost converter to step up the battery voltage and charge its capacitor rapidly. Due to the small size of the SGP-35, it relies on a less advanced technology than Arcflash Labs' patented CQR chargers. The boost converter generates a great deal of heat and its core components are mounted to the bottom of the aluminum plate that runs the length of the top of the gun. This aluminum plate serves as structural reinforcement and as a heatsink to cool the charger – it is not recommended to tape over it or cover it as doing so may result in overheating of the charger, fire or explosion of the electrical components.

2.5 Battery



- The SGP-35 contains a large 4S Lithium Polymer battery. Never leave a charged battery unattended and always store in a cool, dry environment.

- It is strongly recommended to remove the battery from the gun for storage for additional safety.



- Take care not to pinch the wires when closing the battery compartment.

The SGP-35 contains a Lithium Polymer battery. As with any device containing a large lithium battery, it presents a number of hazards including shock, fire, explosion or venting of toxic gas. Always store the gun and battery in a cool, dry environment indoors, away from any flammable materials.



Proper positioning of the battery after connection

To insert or remove the battery, simply turn the thumbscrew on the battery compartment to release the latch, then connect the battery with the main switch off. Position it appropriately as shown below, and tuck the charging cables neatly into the remaining space before closing the compartment. Ensure that no wires are pinching when closing the compartment as this could result in a short or battery fire.

2.6 Trigger

The trigger of the SGP-35 is a microswitch electrically connected to the microcontroller. The trigger is NOT physically or electrically connected to the firing mechanism. The firing mechanism of the gun is fully controlled by the microcontroller to prevent damage to the battery. The trigger will not function in the case of battery undervoltage.

2.7 Magazine

The SGP-35 uses a proprietary 18 round magazine (SG18). While it is similar in appearance to the MG20. The SG18 is NOT compatible with the MG series of magazines. To order a replacement or extra magazine, please contact Arcflash Labs directly at admin@arcflashlabs.com. SG18 magazines are also offered for sale at www.arcflashlabs.com.

2.8 Capacitors



- The SGP-35 contains three large capacitors capable of storing over 200J of energy.

The SGP-35 contains three large electrolytic capacitor (2,000+ uF total capacitance).

The capacitors remain charged for approximately **TEN SECONDS** after disconnecting all power from the gun. During this time, the capacitors may still be capable of delivering lethal shock to the user. During this time, the gun may also still fire, although this scenario is unlikely. To power down the gun we recommend the following procedure: 1) point the gun in a safe direction, 2) set the main switch to

the off position, ensuring the green power light is not active, 3) remove the magazine from the gun, 4) wait approximately 10 seconds, 5) remove the battery, and 6) verify that there is no round still remaining in the barrel.

3. Operation

3.1 Startup



- It is unsafe to power up the gun with a magazine inserted.
- Always check that there is nothing inside the barrel before powering up. Any rounds or magnetic debris inside the barrel during startup could result in a misfire.



- **Do not slam the slide or let go of the slide at full extension like a conventional firearm. This will damage the retention mechanism and may also fail to seat the round.**
- To properly seat a round, rack the injector slowly, keeping your hand on the injector slide mechanism at all times. **DO NOT RELEASE THE SLIDE UNTIL THE ROUND IS FULLY SEATED**



For more information on LED indicator colors and patterns please see Section 4 - Software

1. Ensure battery is charged to its nominal voltage of 16.8V.
2. Open battery compartment and connect the battery as shown in section 2.5.
3. Carefully stuff the connector and wires into the battery compartment, ensuring wires clear pinch points and close the compartment using the thumbscrew.
4. Activate the main power switch. You should observe the LED turn solid red, followed by solid green after ~7 seconds.
5. Insert a magazine into the bottom of the handle, and ensure it is fully seated. It may be necessary to slap or firmly press the magazine to ensure it is fully seated against the injector rod. The magazine will click into place when it has passed the ball detent retaining mechanism.



Insert magazine



Rack slide to chamber a round.

DO NOT RELEASE THE SLIDE UNTIL ROUND IS FULLY SEATED

6. Rack the slide slowly back until you hear a light click, and **gently guide the slide forward** to chamber the first round. **DO NOT let go of the slide from the rear position.**
7. The gun is now charged and loaded. Press the trigger to fire. The LED may turn red occasionally, this is caused by the microcontroller periodically turning on the charger to keep the capacitors “topped off”, allowing for a more consistent shot.

3.2 Shutdown










- The heat sink is hot enough to burn you after extended operation. Even without firing a round, the heat sink may still be hot.

1. Point the gun in a safe direction
2. Remove the magazine.
3. Discharge any round still left in the chamber.
4. Shut off the main switch, ensure the LED fully turns off.
5. Wait 10 seconds, then remove the battery.
6. Perform a chamber inspection as described in section 2.2, being careful to point the gun in a safe direction.
7. Wait for the heat sink to cool before storing. Use the back of your hand to feel the air above the heat sink without touching it. **The heat sink may still be hot enough to burn, even after the gun has been shut down.**

4. Software

The SGP-35 is equipped with firmware revision 3.

The LED on the barrel indicates the following:

Color	Pattern	Description
	Solid	Ready
	Blinking	Low battery, firing disabled
	Solid	Capacitor charging (Gun may be fired while charging)
	Blinking	Not used
	Solid	Malfunction code 1
	Blinking	Malfunction code 2
	Alternating	Malfunction code 3

5. Hardware Specifications

Accelerator Specifications

Primary power source	1x 4S LiPo – 16.8V, 850mAh
Power supply	100W (IGBT boost driver)
Capacitors	3x 680uF/450V electrolytic
Switches	1x High Voltage SCR
Projectile	0.25x0.75" carbon steel, 71gr
Capacity	18 rounds
Rate of fire	8.6 rounds/min
Muzzle velocity	90-110 fps (100 fps nominal)
Muzzle energy	~1.5 ft-lbs
Efficiency	1.5%

Physical Dimensions

Active barrel length	0.6"
Bore	0.25"
Physical Dimensions	11.5" x 7" x 1.9"
Overall Weight (unloaded, no battery)	1.85 lbs