

Magnetically Activated Charger Contacts for Mobile Robots



The RoboPad charging contact system offers a precision, high current charging solution for mobile robots and Automated Guided Vehicles (AGV). It is composed of a charge contacts base that is typically affixed on the floor, and a collector unit with extendable contacts, mounted on the robot. Unlike conventional spring-loaded contact products commercially available, RoboPad utilizes high energy magnets to control the connection and disconnection action automatically, while using no additional power from the mobile systems batteries. The magnet's strong attractive action result in a high pressure, high quality electrical contact. The magnet's repelling function actively forces the pads retractions as the robot moves away. The base's ultra-low profile, and the collector's extension range, allows for far more compact charging configurations over any other charge system, in permanent factory and business environments.

Applications

- Automatic Guided Vehicles
- Mobile robots
- Warehouse shuttles
- Cleaning Robots
- Personal mobility system
- Amusement rides
- Electric forklifts
- Autonomous Lawn and Garden Maintenance Robots

Features List

- Two-part system made of retractable collector and fixed base
- Fully passive – No power required
- High contact pressure
- Excellent low resistance electrical contacts
- Ultra-low-profile charge base
- Floor, or wall mounting
- Very low footprint
- Ultra-fast connect/disconnect. Minimizes or eliminates accidental arcing
- Built-in solid-state Hall switch to indicate retracted/extended state
- Durable and weather resistant.
- Guaranteed over 100K cycles
- High Current Capacity – 100A Typical
- Low cost

Ordering References

Part Number	Description
RPB90100	RoboPad Charging Base, 90mm wide, 100A
RPC90100	RoboPad Exendable Collector, 90mm wide, 100A
RPKIT90100	RoboPad Kit including Base and Collector, 90mm wide, 100A

Description

There are few commercially available options available today for performing the charging function of a mobile robot or AGV. The majority of them use weak spring loaded copper or brass contacts which use the shape of the contact to ride over the charging pad, creating considerable wear and tear on the system. What is needed is a rapidly connecting, low wear contactor that can supply high current for extended periods and disconnect without creating damaging electrical arcs. The RoboPad meets this challenge head on, and uniquely solves problem using a high technology and precision system. In addition, the low-profile design allows for mounting the charging pads almost anywhere – including walls, poles, under platforms and even overhead.

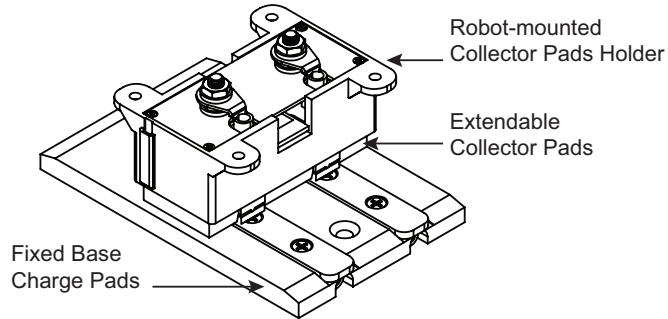


FIGURE 1. RoboPads Charge System composition

The RoboPad charging contact system operates on the principles of magnetic attraction and repulsion. Most commonly, the floor mounted charging pads are placed in a location either along the route, or at specific waypoints in the path of the robot. The robot will then stop at this specific location and connect to the charger for the required time. Another encountered arrangement is to place the charging pads in a protected parking location that is off the main path to allow other robots to travel unimpeded.

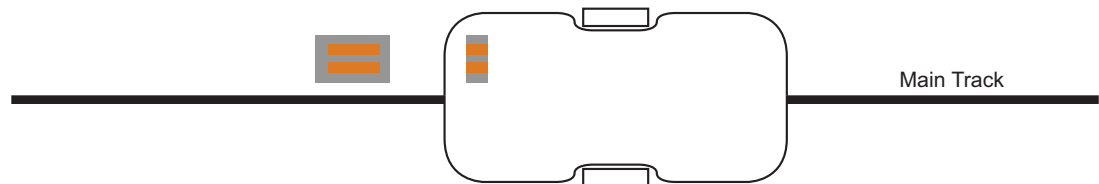


FIGURE 2. Charge pads at stop points along the robot's main track

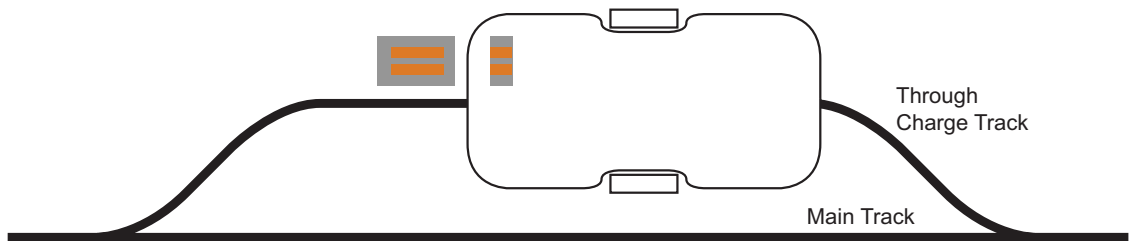


FIGURE 3. Charge pads located at diverted track

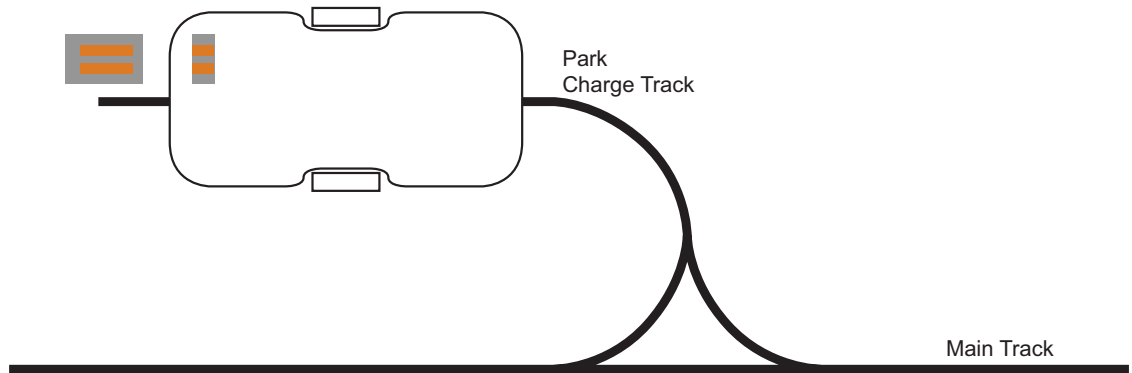
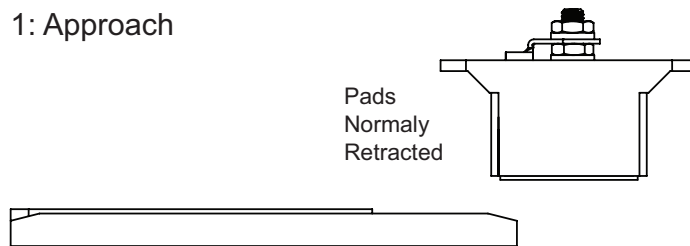


FIGURE 4. Charge pads located at charge parking

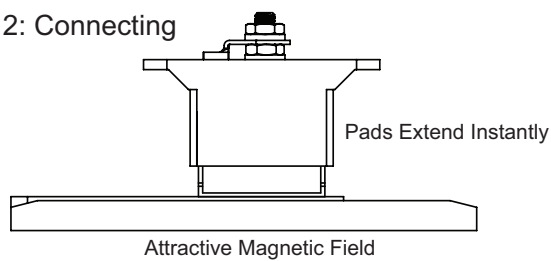
To charge, the robot or AGV simply drives over the charging pads on the floor. When the robot's collector pads are aligned with the base, they instantly extend. By detecting the charge voltage directly, or monitoring the built-in sensor in the charging contacts, the robot can determine when to stop. Current can then flow to the battery to charge it.

How it works

1: Approach



2: Connecting



3: Departing

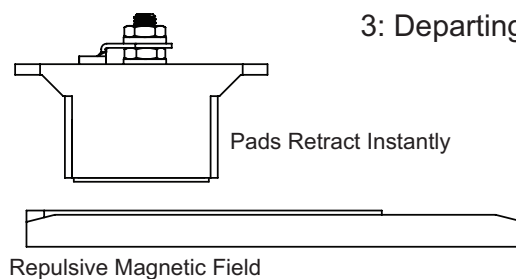


FIGURE 5. Collector pads extension and retraction depending on position over base

High force magnets are staggered with opposing polarities in the charging base and charging contacts such that a strong force of repulsion occurs during entry and exiting the floor mounted charging pad. Only during the centermost electrically active area of the base pad does the strong attractive action appear, allowing for a solid electrical connection between charger pad and base pads to be achieved. This locks in the high current charging so the AGV batteries acquire full charge at the maximum rate possible. When the charge cycle is completed, the robot simply pulls forward or reverse off the pad and the contacts automatically retract into the underside of the AGV.

Benefits over brush/springs

Conventional charging contacts use spring loaded collector contacts which drag or hang underneath the mobile robot in use. These units have a low floor clearance and tight height tolerance as they must physically slide up a ramp on the base: if they are mounted too low, they will touch the floor or hit the side of the base. If they are mounted too high, they will have weak spring pressure or not make contact at all.

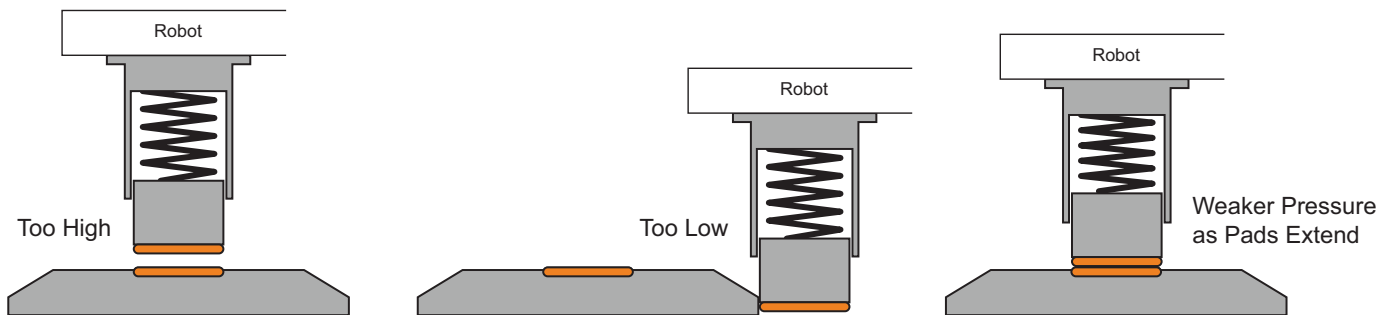


FIGURE 6. Spring loaded pads have lower ground clearance and must be adjusted tight height tolerance

Spring contacts have a high wear rate over time because the constant sliding action of the contacts over the charging pads, and the weakening of the springs behind the contacts which push the contact against the pad when compressed. Ideally, the charging contacts on the Robot should connect rapidly – almost instantaneously to the pads without sliding and pull away rapidly to avoid being dragged over the charging pad as the robot exits the charger.

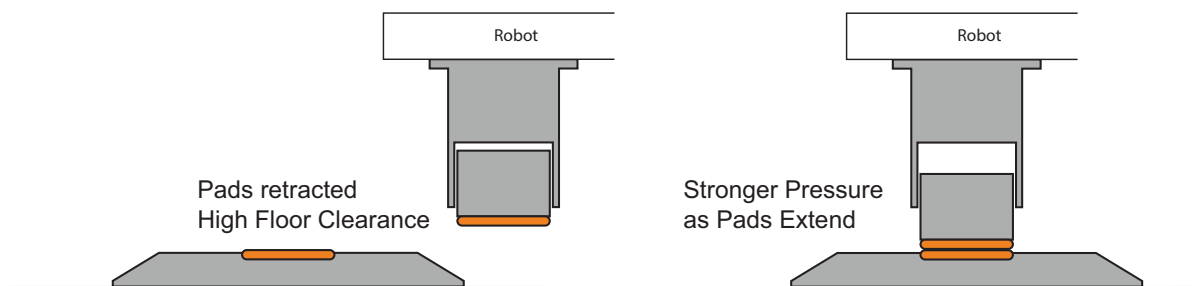


FIGURE 7. RoboPads have higher floor clearance and much stronger contact pressure

The magnetic action of the RoboPad is almost instantaneous as it takes around 20ms for the pads to fully extend or retract. Another major advantage of the RoboPad is the constant strong pressure the contacts push against the charging pads due to magnetic attraction. Unlike spring loaded contacts, the RoboPad systems pressure increases as the pad extend. Extension force remains constant over the life of the pads and will always provide the maximum charging current and less residual heating effects than conventional spring-loaded systems.

Construction

Highly durable ABS plastic with flame retardant is used in the construction of the RoboPad charging system. Integral ceramic rare-earth magnets are securely mounted internally providing a smooth and accurate extension and retraction. All components are precision injection molded and have a high-quality finish.

Hall switch

Located on the side of the charging contact housing is a Hall Magnetic Sensor. This solid-state device is located near one of the retractable collector magnets and changes state when the pads extend or retract, providing the robot's Battery Management System and/or supervisory computer with this important information.

Mounting and Wiring

Mounting the charging system underneath the AGV/Mobile Robot is the most commonly used option. For this application, the charging pad is secured to the floor itself. Mounting the collector contacts on the robot can be done in several locations.

Mounting the charging plates directly under the robot can now be a real possibility with the RoboPad. The low profile allows sufficient clearance in most applications to centrally mount the pads. This may be more convenient for parking the robot over charging pads that are along its route.

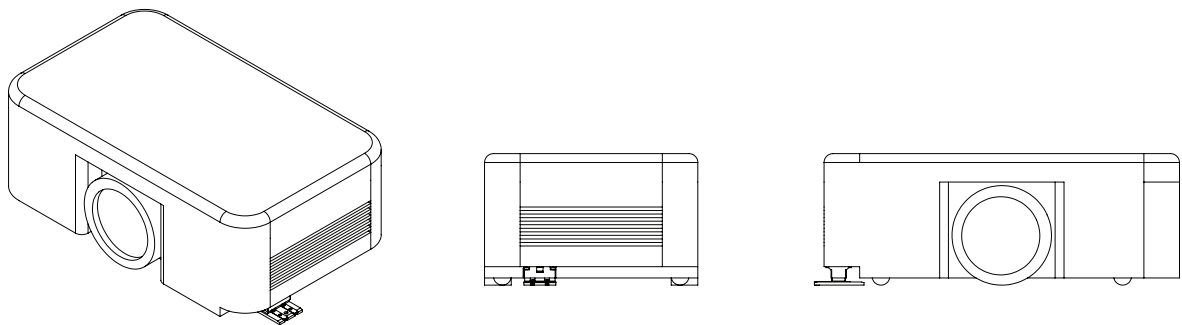


FIGURE 8. Base charge pads on floor and collector pads under robot

An alternative location of the charging system is on the sides of the robot. If mounted on the right or left side, the robot would drive up against the charging pads mounted vertically on a post or wall to connect. The retracted pads can be flush with the chassis surface and will extend only when aligned with the base charge pads.

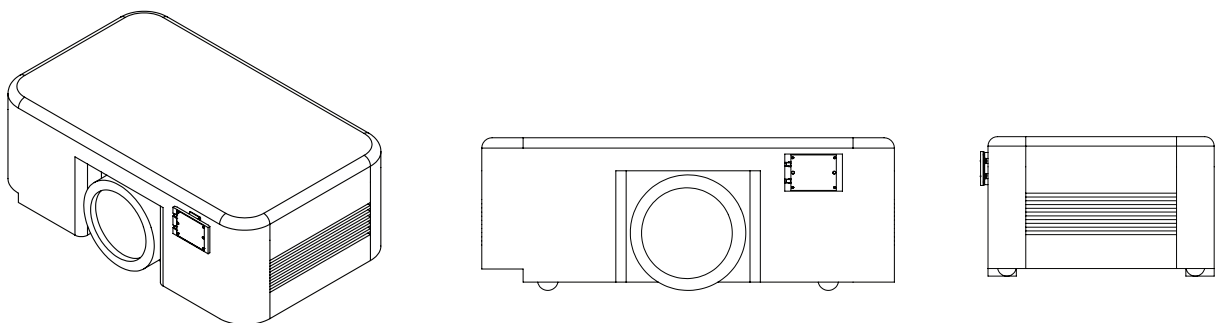


FIGURE 9. Base charge pads on wall and collector pads on robot's side

The base assembly can be mounted on any non conductive surface such as wood, concrete, tile, or plastic. The base assembly is fastened to the floor or mounting surface by use of either two 6mm or 1/4 inch screws. To avoid damage to the surface, double side adhesive tape can be used in some conditions to affix the charge base on the floor.

Wires connected to internal ring lugs exit on one end of the housing and allow connection with red and black (recommended colors) 8-10 AWG wire to the charging power supply.

On the robot side, the collector contacts unit attaches to the AGV or Mobile Robot with four 4mm screws. Connection to the collector contacts is made with ring lugs and 8-10 AWG wires to the robot's battery system. For best results, the user's ring lug must be placed directly over the ring lug that connect to the copper braid on the charging contacts.

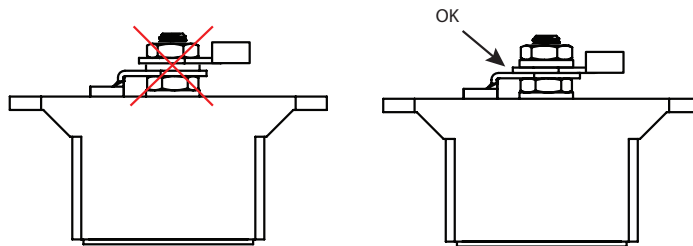


FIGURE 10. Attach user lug directly over the braid lug

Copper ring lugs are recommended to connect to the charging base and the collector pads. Additionally, adding solder to the lug and wire will strengthen the connection and make it highly wear resistant.

Connecting to the hall sensor.

Three wires connect to the collector pad's hall sensor: a Ground wire (Black), a +5V to +24V power wire (Red), and an output wire (White). The sensor has an open collector output and will pull the output to ground when the pads are extended. The sensor output is off (floated) when the pads are retracted. When connecting to a PLC or computer, a 1K to 10K pull up resistor must be inserted between the output and a 5-24V source.

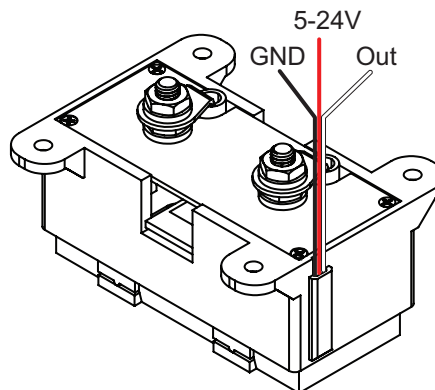


FIGURE 11. Connection to the Hall Sensor

Part of Roboteq's Integrated Solution for Mobile Robots

The RoboPad charging connection is part of a complete system of AGV or Mobile Robot components available from Roboteq. From a line of single and dual channel motor controllers, to complete power management solutions, Roboteq can provide additional solutions for your project.

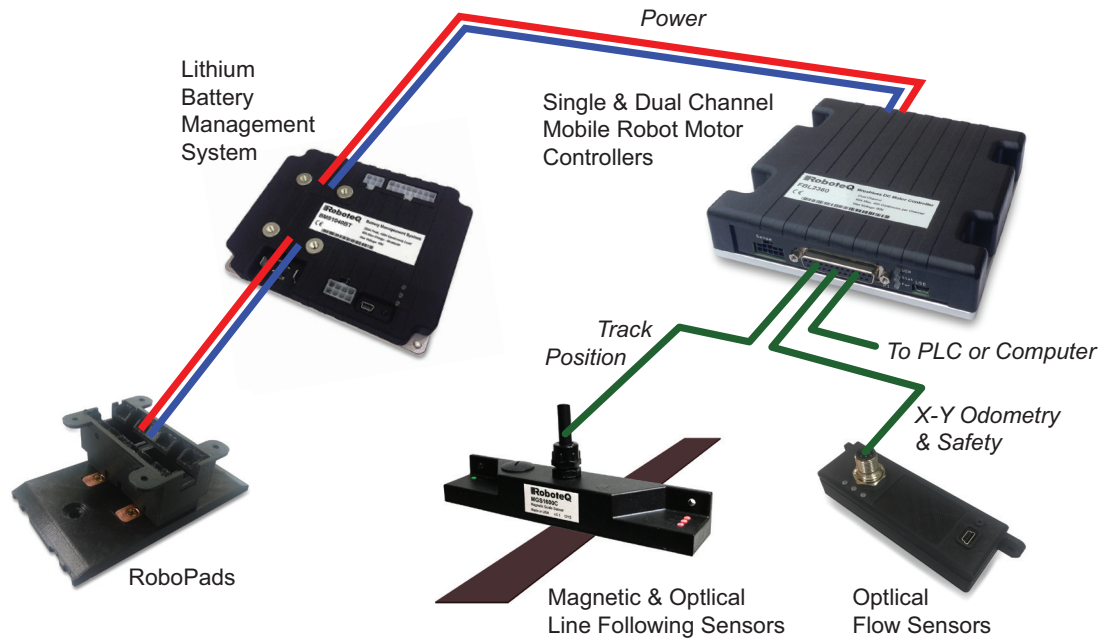


FIGURE 12. Roboteq's integrated product solution for Mobile Robots

Specifications

Dimensions Base	140 x 90 x 10mm
Dimensions Collector Extended	90 x 56 x 42mm
Dimensions Collector Retracted	90 x 56 x 32mm
Extension range	10mm
Current	100A max, 75A continuous
Voltage	200V max
Extension/Retraction speed	20ms typical
Contact Pressure	1.5kg typical
Left/Right alignment tolerance	+/-5mm
Hall sensor voltage	4.5 to 24V, open collector output
Max up/down cycles	>100,000
Collector Sensor Activation Distance	4mm min / 5mm max

Mechanical Drawing

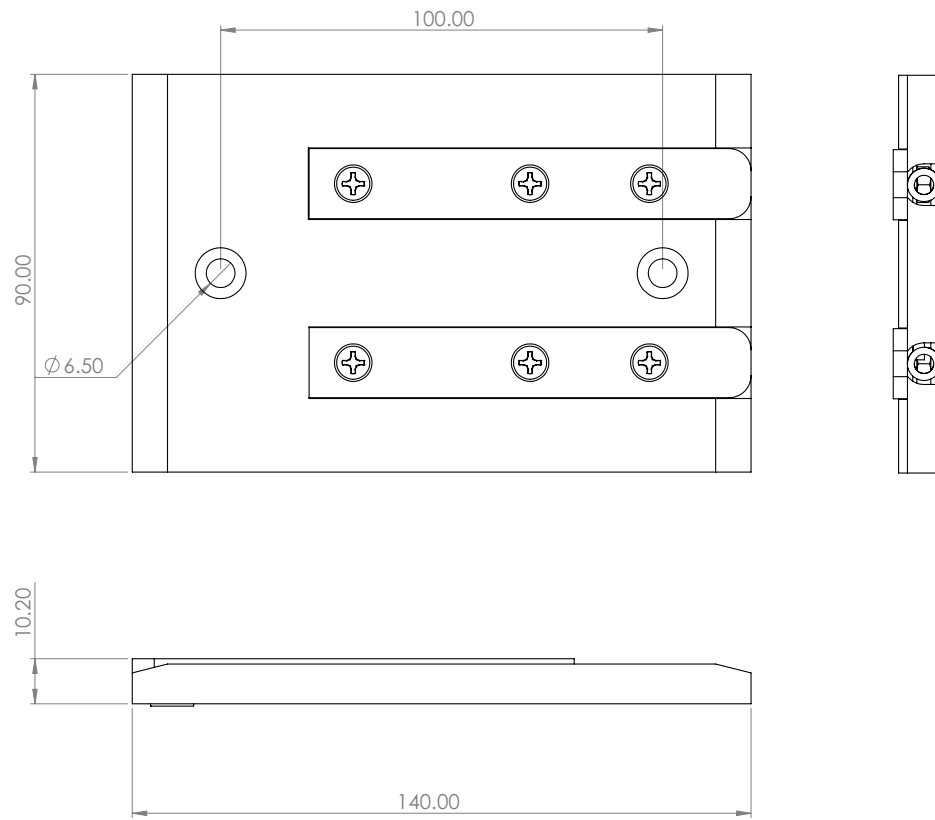


FIGURE 13. Base charge pads mechanical dimensions

Close position 33.5mm height
Open position 44.0mm height

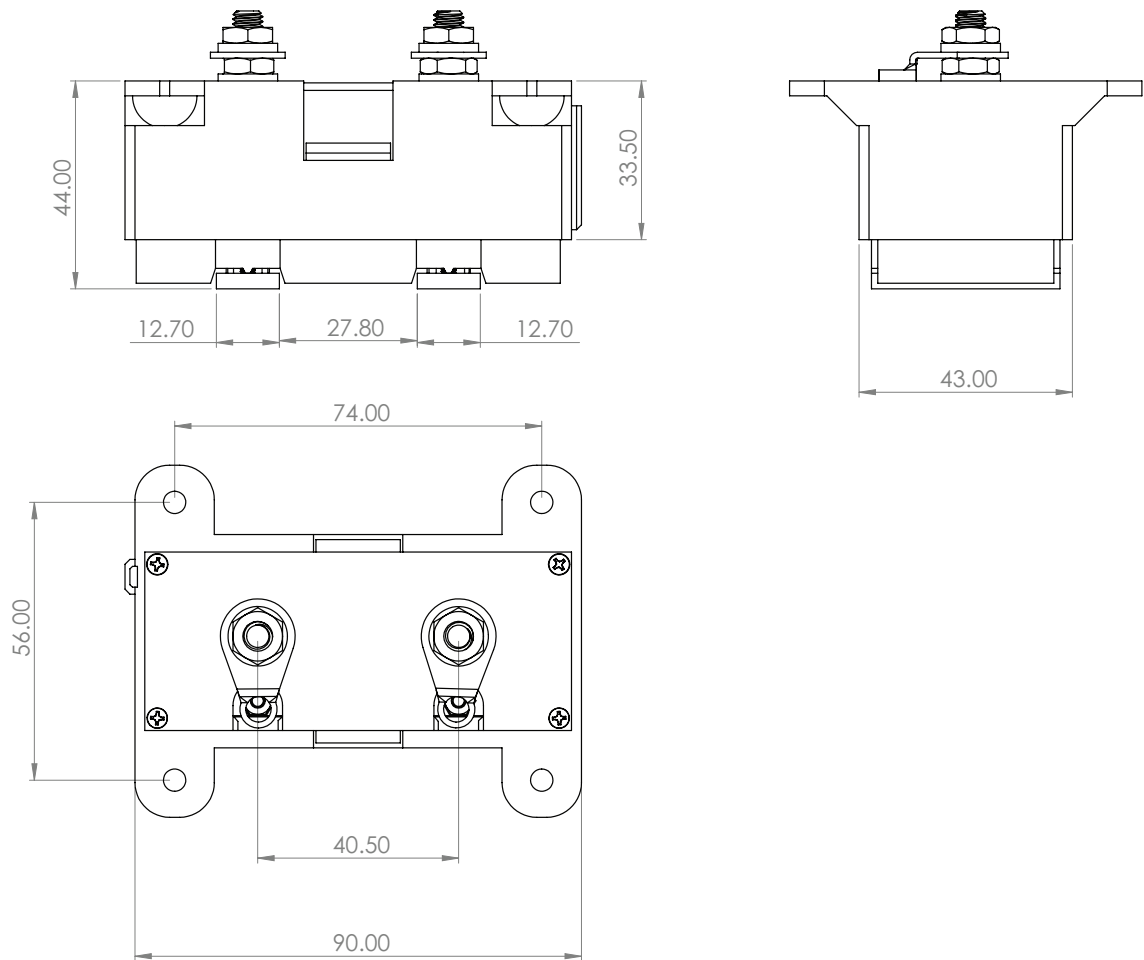


FIGURE 14. Collector charge pads mechanical dimensions
