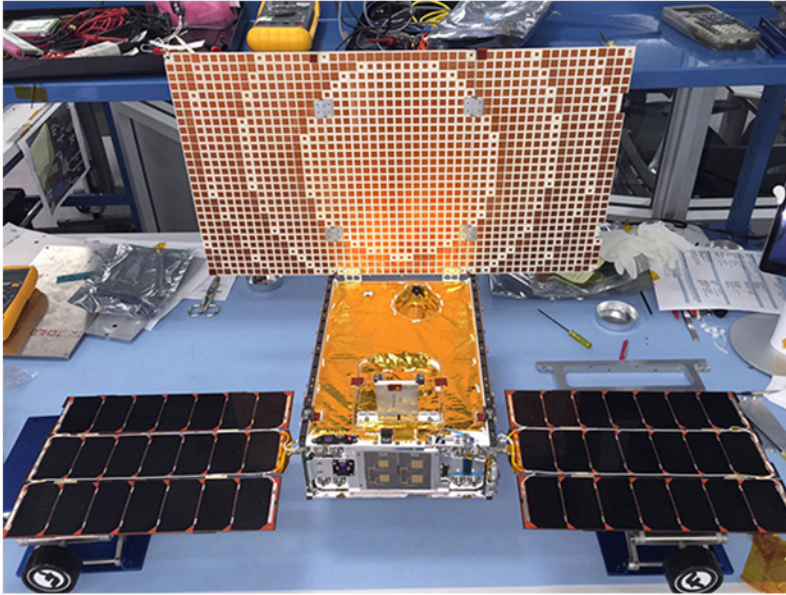


MARCO (Mars Cube One)



A technology demonstration accompanying InSight will be the first interplanetary use of a "CubeSat" spacecraft. A pair of briefcase-size spacecraft named Mars Cube One (MarCO) will launch on the same rocket as InSight and carry out a number of risky communication and navigation flight experiments. If successful, the twins, MarCO-A and MarCO-B, will fly separately to Mars and pass the planet at about 2,175 miles (3,500 kilometers) away just as InSight is landing. One could potentially receive transmissions from InSight and relay status information to Earth about the lander's descent and touchdown.

All previous CubeSats have orbited the Earth. MarCO is the first attempt to go to another planet (First interplanetary Cubesat). By verifying that the technologies for interplanetary missions are feasible and can be developed on a short timeline, this test mission could lead to many other SmallSat applications for exploring our solar system. Some could provide similar support functions as "carry your own" relay providers. Others could have primary scientific research functions of their own, such as radio transmissions through planetary atmospheres, imaging with small cameras, observations with other miniaturized instruments, or in-place measurements of space environments.

MarCO is also the first cubesat with its own propulsion system.

The primary mission of MarCO is to provide real-time communication relay while the InSight lander is in the entry, descent, landing phase. Over the years, there have been several CubeSats that have been flown around Earth's orbit, but Mars Cube One will go beyond the orbit of the Earth. This will allow for unique data outside of the Earth's atmosphere and orbit. Instead of several hours for the information to relay back to Earth, the MarCO will retrieve EDL-critical data at a more rapid rate. Without the MarCO CubeSats, InSight would relay the flight information to Mars Reconnaissance Orbiter (MRO) which does not transmit information as quickly.

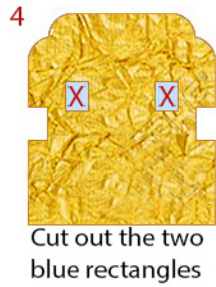
Current tactics rely on sending data to nearby orbiters, which would then send data through space and back to Earth, or even attempting to send data directly to Earth. Because future missions will no longer be able to rely on these methods, CubeSats will hopefully improve data relays in real time, as well as reduce the overall mission cost.

The two MarCo subesats will follow the InSight Mars lander towards Mars. MarCO's propulsion system uses compressed R236FA gas, a common propellant in fire extinguishers. Each MarCO has eight thrusters that can release this cold-gas propellant in different directions from a single, shared tank. The thrusters will operate for trajectory adjustments and for desaturating the reaction wheels. MarCO is a pioneering CubeSat use of propellant for desaturating attitude-control reaction wheels; Earth-orbiting CubeSats typically control attitude with electromagnet devices that "push" against Earth's magnetic field, an option not available to MarCO in deep space.

The reason for flying two identical MarCO spacecraft is redundancy in case either one does not operate as planned.

The two identical Mars Cube One spacecraft were nicknamed by JPL engineers as WALL-E and Eva, in reference to the main characters in a 2008 Pixar film about space robots, called "Wall-E".

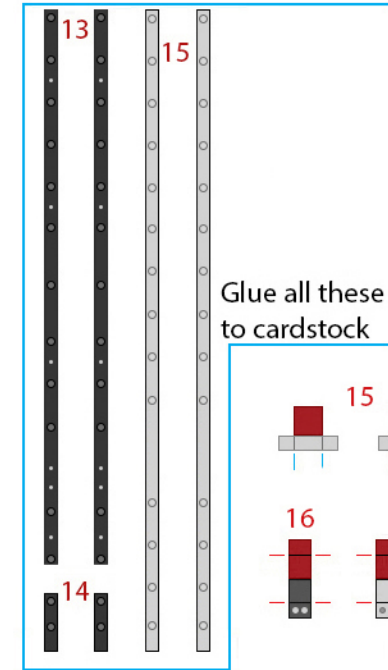
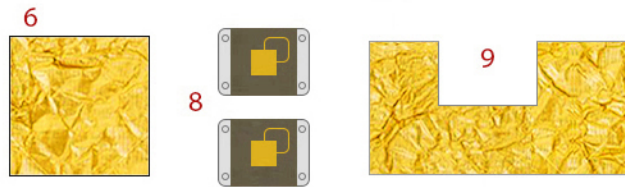
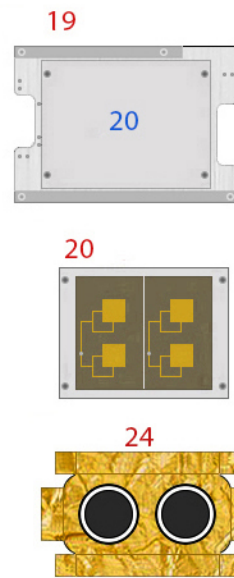
InSight spacecraft along with the two MARCO Cubesats were launched onboard a United Launch Alliance Atlas-V rocket, Saturday, May 5, 2018, from Vandenberg Air Force Base in California.



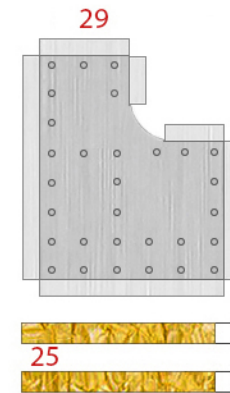
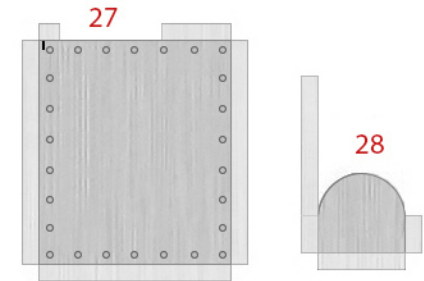
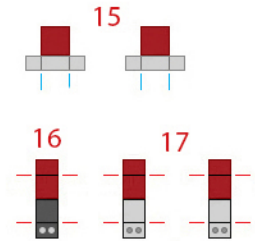
Cut out the two
blue rectangles



Glue to two
layers of
cardstock

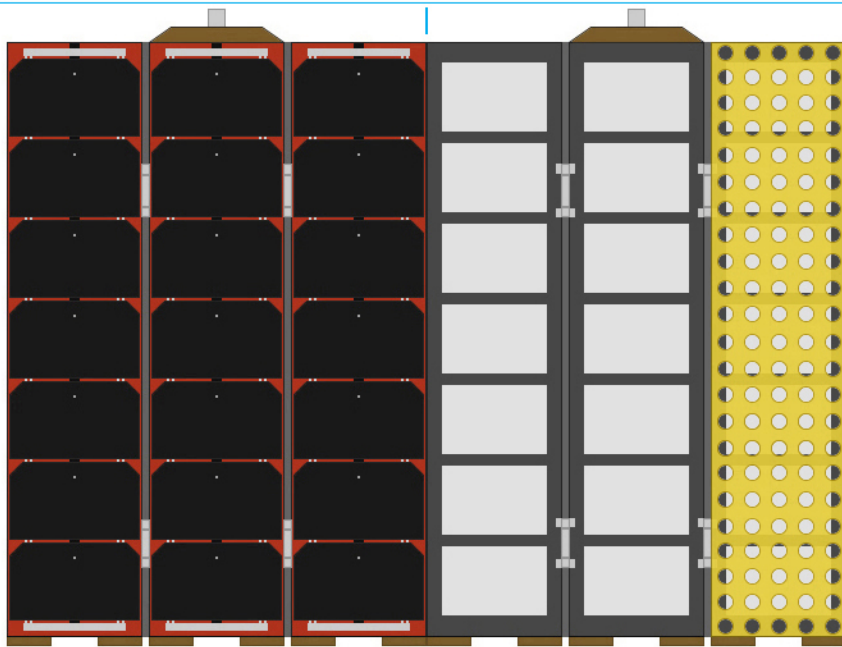


Glue all these
to cardstock

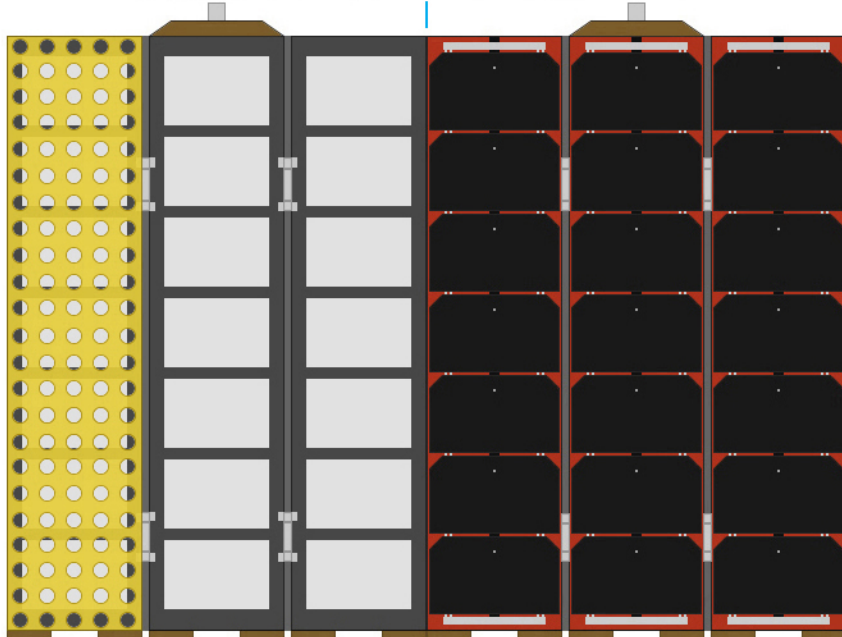


MARCO (Mars Cube One) [MarCo-A](#)

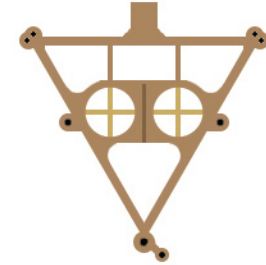
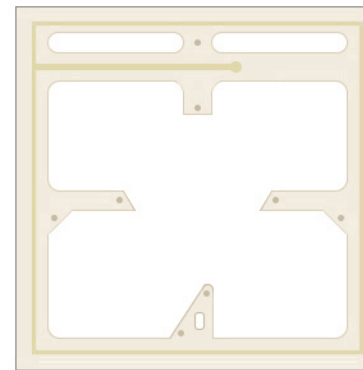
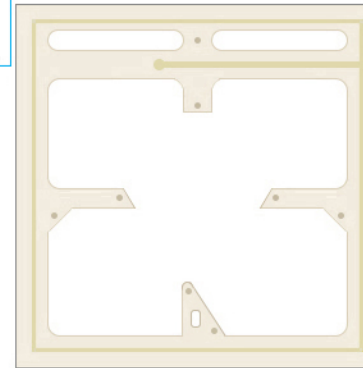
Need a thin stiff wire or thin music wire cut at the same length as the line below (5.5 inches) to use as a support rod for the solar panels below.



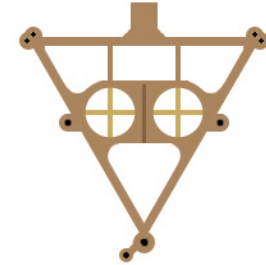
Fold-Glue each back-to-back at the blue lines



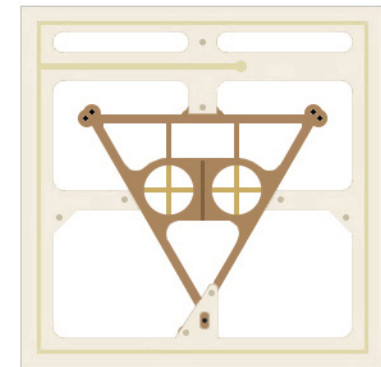
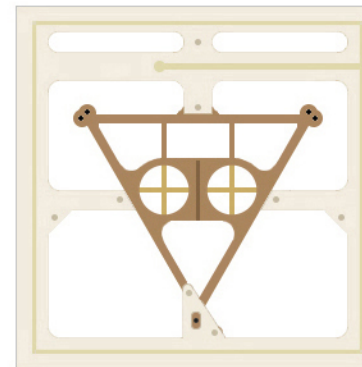
Detailed Version



Cut out the white areas from all 4 parts, glue each matching parts back-to-back.

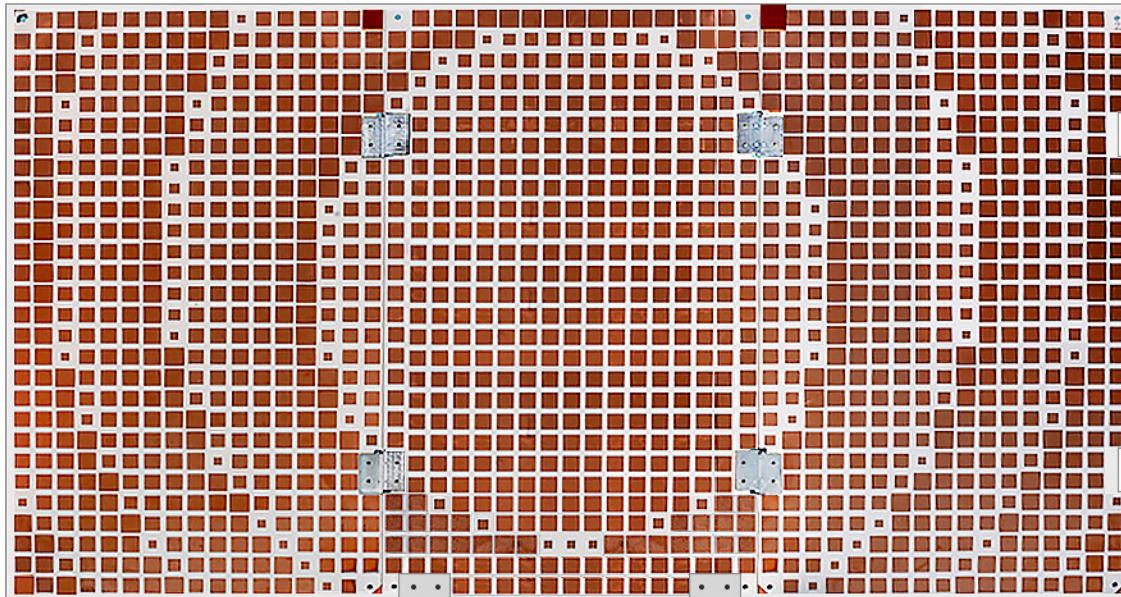


Simple version

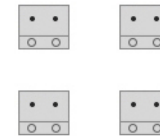
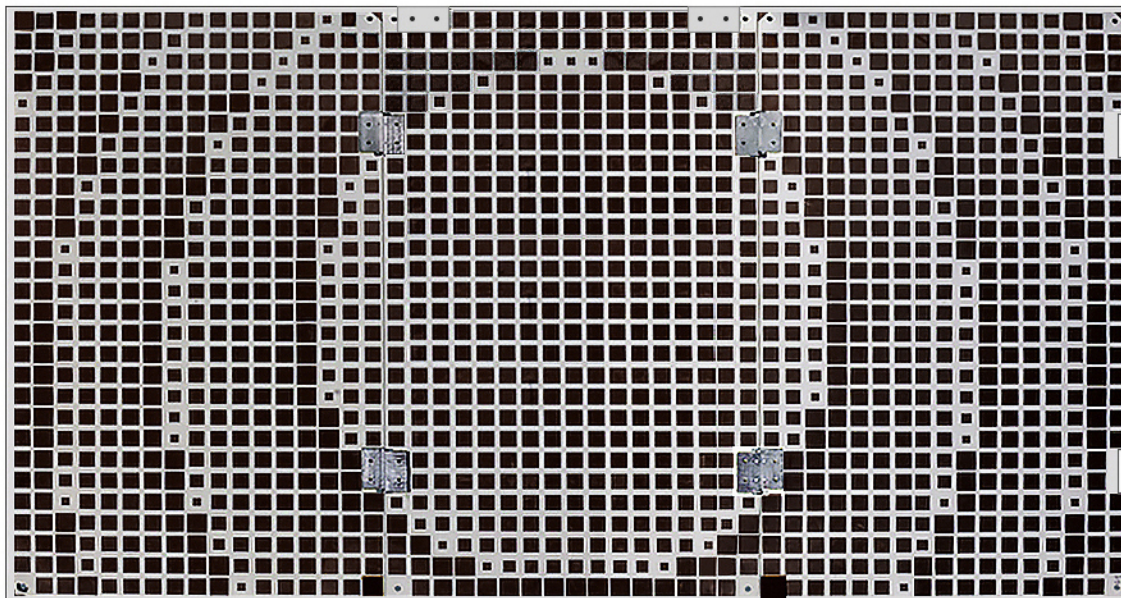


Cut out the white areas, glue the two back-to-back.

Need thin stiff wire, plastic broom straw or music wire cut at the same length as the line below, colored light grey or silver. Make 6 of these.



Glue these back-to-back, match the two notches on the sides



Valley fold these at the line

Optional detail parts, includes 1 spare

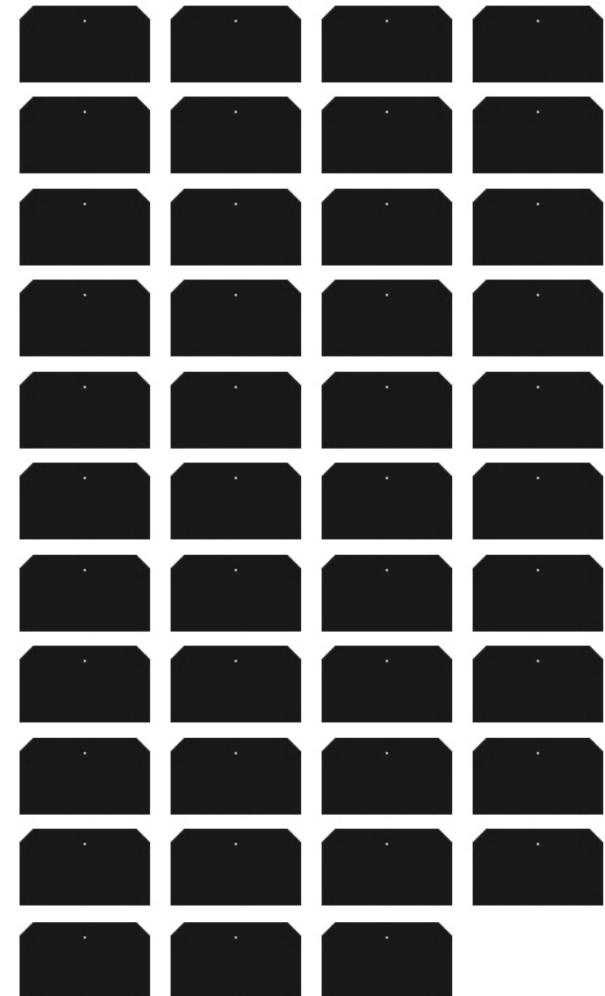
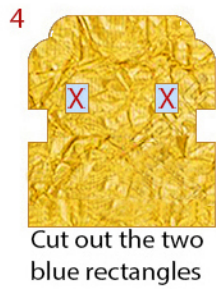


Diagram illustrating the removal of the battery cover and the battery from the back of the phone.

- 1**: Red square indicating the location of the battery cover latch.
- 12**: Blue rectangle indicating the location of the battery cover.
- 17**: Blue circles indicating the location of the battery cover screws.
- 18**: Blue circle indicating the location of the battery cover latch.
- 16**: Blue circle indicating the location of the battery cover latch.
- 21-22**: Blue circles indicating the location of the battery cover screws.
- 19 - 20**: Blue rectangle indicating the location of the battery cover.
- Remove**: Blue circles indicating the location of the battery cover latch.



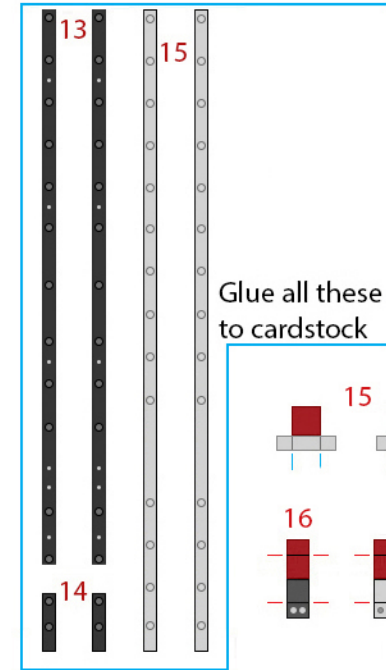
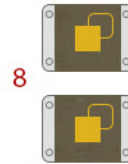
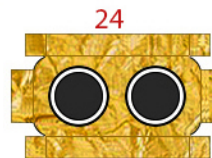
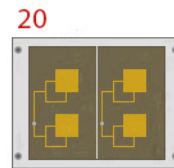
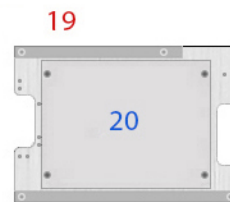
Cut out the two
blue rectangles



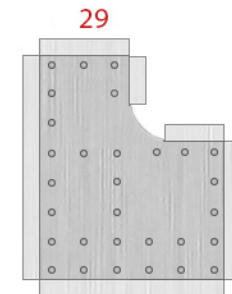
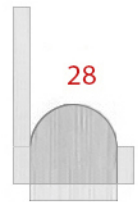
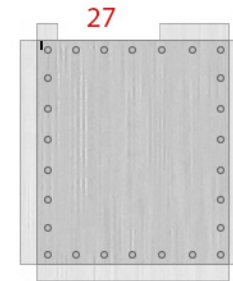
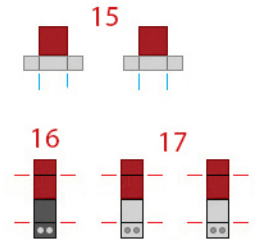
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Glue to two layers of cardstock

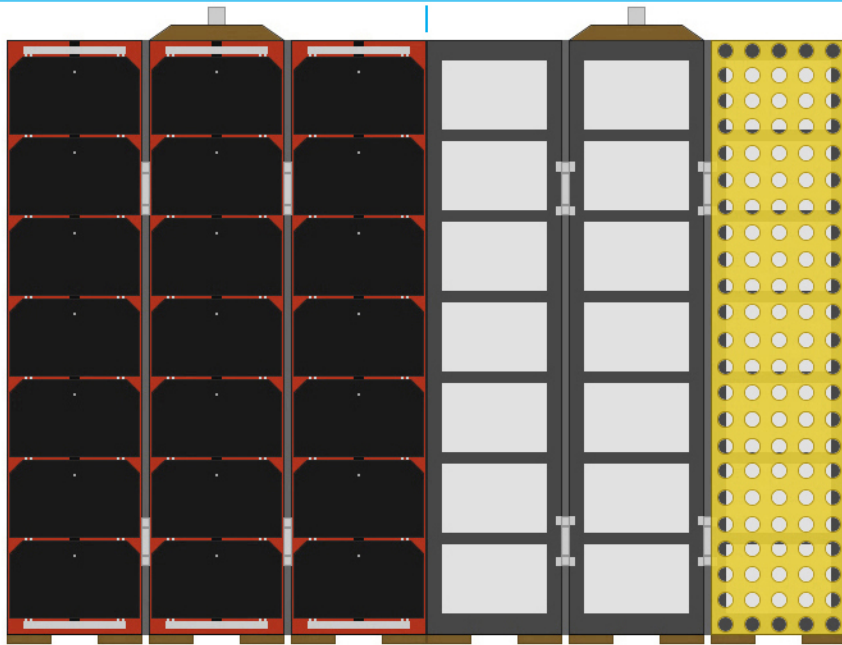


Glue all these
to cardstock

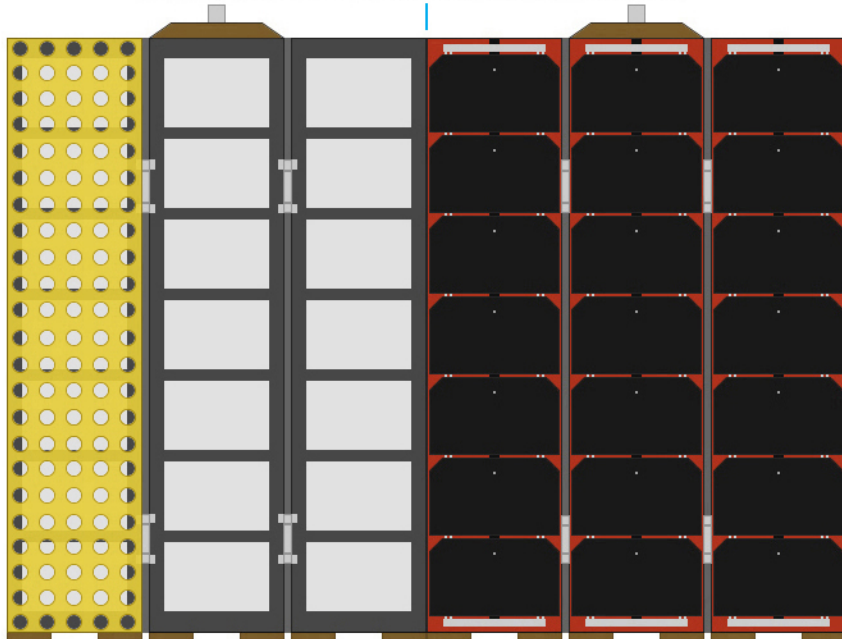


MARCO (Mars Cube One) MarCo-B

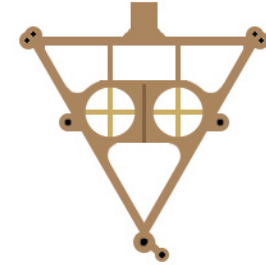
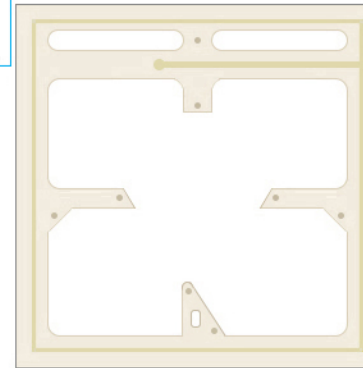
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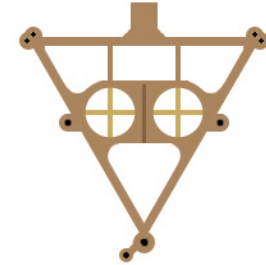
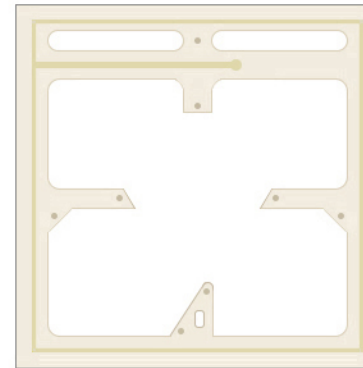
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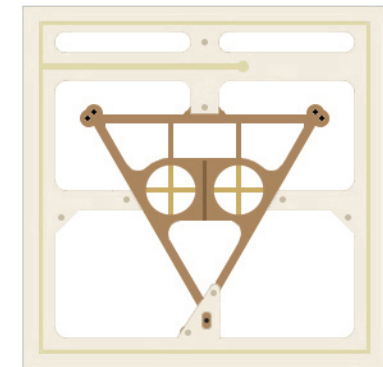
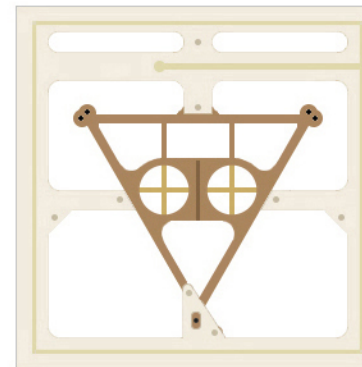
Detailed Version



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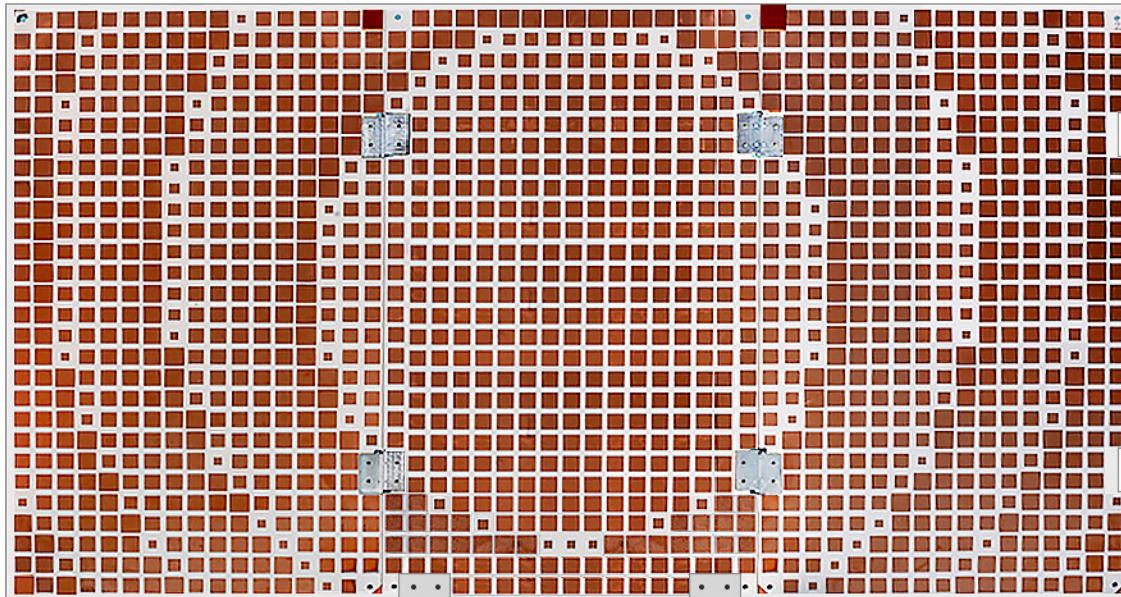


Simple version

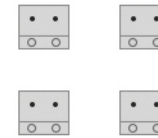
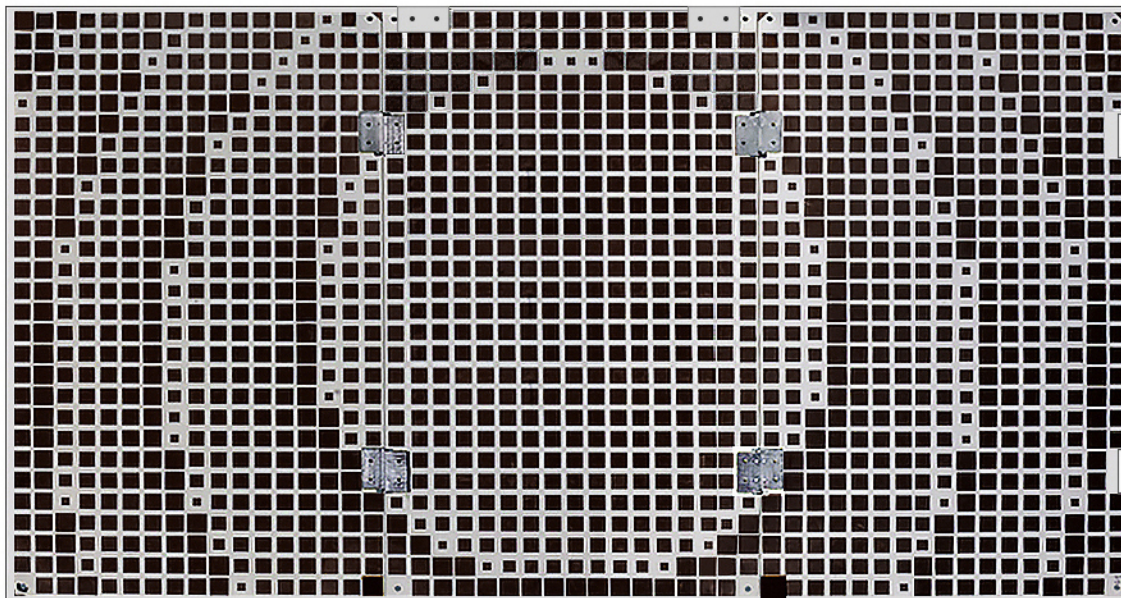


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Optional detail parts, includes 1 spare

