

A High Power Beacon for a Deep Radiolocation in Systema Cheve, Mexico

Brian Pease, W1IR, 4/8/24

I designed a 3496Hz beacon for a successful attempt to check the accuracy of the cave map of Systema Cheve in Oaxaca, Mexico for Bill Stone. The beacon was placed as high as possible near the end of exploration nearly 12km from the entrance, but still was ~250m below the surface. I designed the largest and heaviest loop that was practical to carry to the location. Based on a description of the passage, the loop was designed to be suspended from an anchor bolt.



The beacon was powered from a 36 Volt 324 Watt-Hour lithium battery used with a hammer drill for bolting in the cave.

B36 9.0 36V BATTERY 36 volt 9.0 ah lithium ion
For Hilti hammer drill

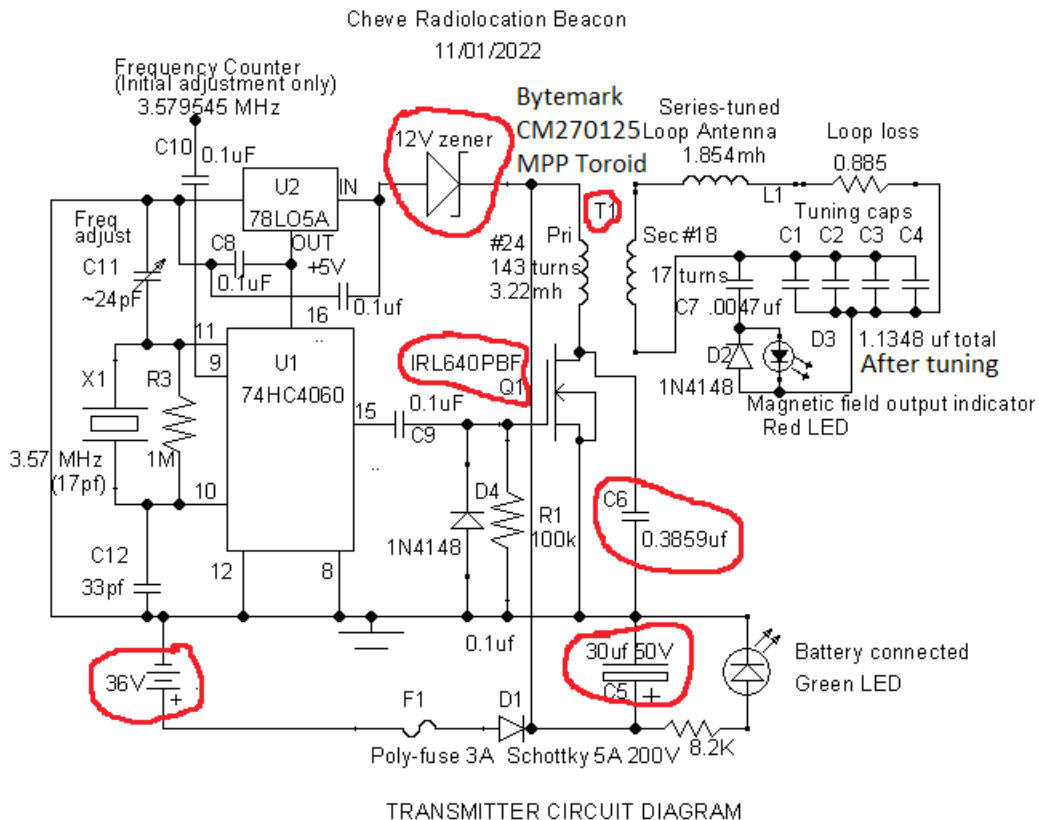
324 watt-hour rated. 300WH is the max for passenger aircraft.

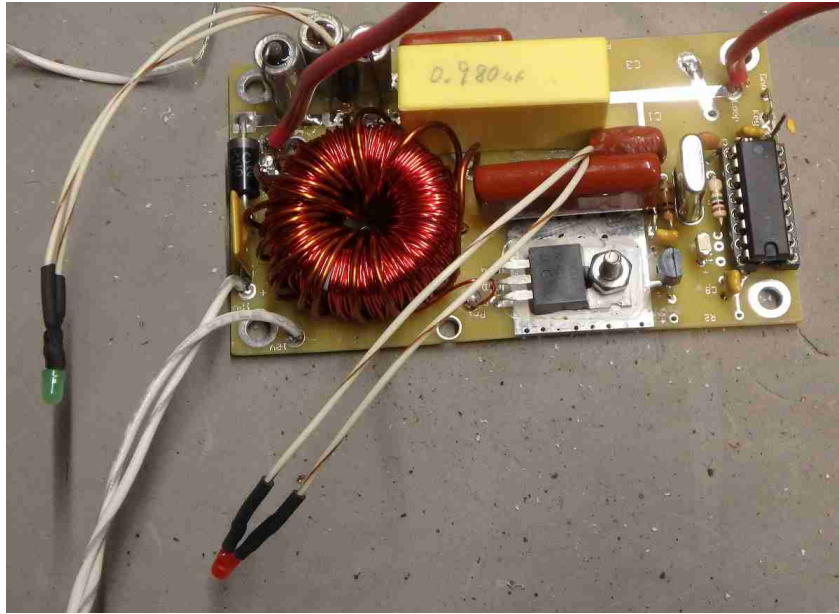


Can only be shipped
ground by shipper
with HAZMAT training
Can't just go to UPS or
FedEx.

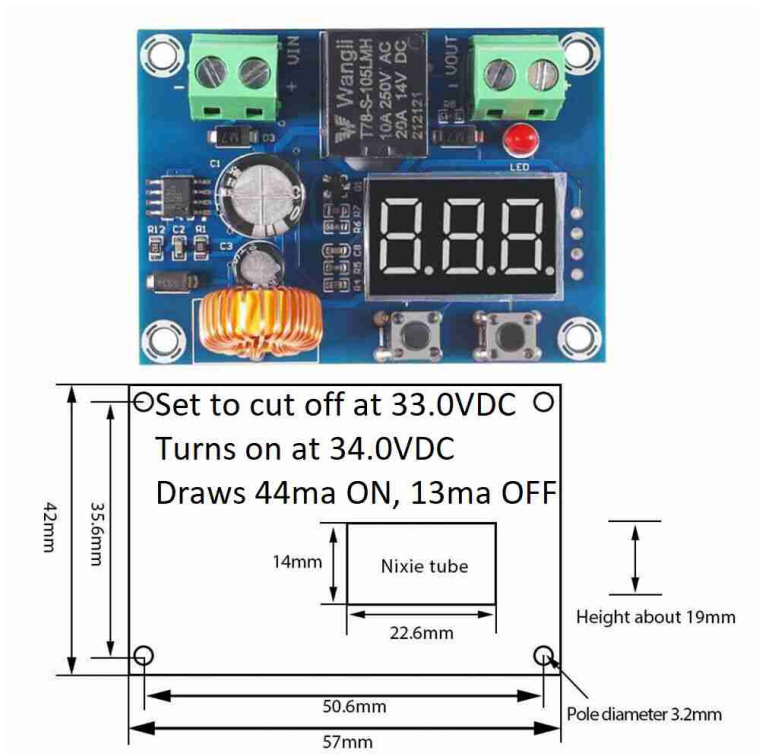


The high voltage required changing the MOSFET (Q1) and DC filter capacitor (C5) to higher voltage devices. The heat dissipation of the 5V regulator (U5) would be exceeded, which resulted in the addition of a 12V 1W Zener diode to reduce the input voltage to U5. T1 and C6 were altered to match the Class-E amplifier to the loop antenna and raise the DC input power to ~27 Watts. The efficiency is 78%, with most of the loss in the toroid. The Magnetic Moment is 151 Amp-Turns-mtr².





The green LED is battery power, red is AC loop current
 The beacon draws about 760mA at 36VDC



Because we are connecting directly to the battery cells without protection, I added a programmable low voltage cutoff device between the beacon and the battery. This acts as a battery tester on start-up and allows unattended operation of the beacon, which is shut off at 30VDC to protect the battery.



The test setup used for tuning. The oscilloscope shows the Class-E drain waveform. The loop was hanging 5 ft off the floor.



Corey Hackley assembled the beacon electronics in a protective case and teamed with the photographer, Sean Lewis, for the successful radiolocation near Camp 7 in Cheve 8 April 2023. On the surface I located ground zero with an accuracy of about +/- 3mtrs given the extreme depth. Ground zero was only 20 meters from the GPS location derived from the cave map! The signal was strong with good nulls in all directions. I then estimated depth by going 90m horizontally from ground zero where I found the null angle to be 30 degrees from vertical, which makes the depth 250m (820ft), the deepest location I have ever done. Also, this technique tends to underestimate the depth.