

OpenGrab Electro Permanent Magnet

NicaDrone.com

EPM688-V3.x

General Description

The EPM688-V3.x is an Electro Permanent Magnet, combining the advantages of electro and permanent magnets.

The magnetic domains in the AlNiCo magnets are aligned in a particular orientation as to form a magnetic circuit with a ferrous target plate. A short, 20us pulse current of 300A @ 475V is generated by discharging the main PET capacitor through a Thyristor full bridge into the copper winding generating a field of 100kAm. This is done 3 times to archive full turn on. Several pulses are used with decreasing amplitude and directing to demagnetize the EPM. The key advantage is a very strong electromagnet that does not consume energy during steady state operation only during cycling

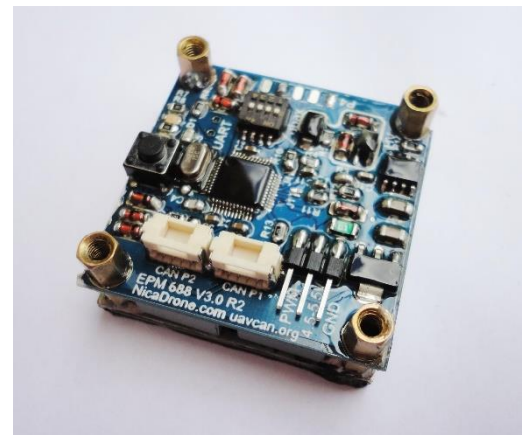
The device supports UAVCAN, RC PWM and Push Button operation.

Applications

- Cargo lifting in UAVs
- Robot work holding
- Education demonstration of magnetic properties

Features

- 4.5-5.5V Vcc
- PWM signal
- UAVCAN
- Minimal steady state power <10mW
- Short cycle time
- Onboard NXP LPC11C24 with Can transceiver and UART bootloader
- Open source firmware available on GitHub



Recommended Operational Conditions

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Symbol	Parameter	Value	Unit
Tcycle on	Time to complete one cycle	0.75	s
Tcycle off	Time to complete one cycle	1.2	s
Fmx	Max holding force	200	N
Vin	Optimal operating voltage range	4.75-5.5	V
Vinmax	Maximum input voltage	6.5	V
I _{max}	Maximum current draw during cycle execution	1000	mA
PWM on	Minimum signal high	1.75	ms
PWM off	Maximum signal high	1.25	ms
PWM error	PWM outside this range will be ingnored	<0.75 and >2.25	ms
Mass		65	g
Trange	Termperature range for optimul perfomrance	-40 to +70	degC

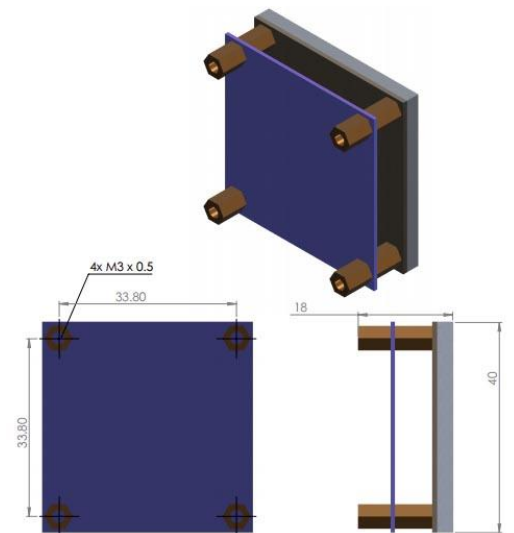


Figure 1 Drawing

Warnings

The winding inside the AlNiCo magnet are 0.2mm underneath a black epoxy. Dirt or metal shavings can be crushed into the epoxy and causing an insulation break down. This normally destroys one of the Thyristors.

There are several high voltage traces on the PCB covered by conformal coating. Pressing a finger on for example T1 while switching will probably cause an electric shock. It has similar effect then a strong cup of coffee.

One should never exert any force on the PCB when using the EPM. All the forces should be coupled to the M3 brass standoff.

Getting started

UAVCAN

TODO

Push button

Connect 5V and GND to the PWM connector and push the button while the device is mated with a ferrous target like the supplied target square.

PWM

Connect a RC receiver or Pixhawk with 50Hz PWM output. Use a 3 position switch for off, Neutral and on.

Theory of operation:

The LPC1114 drives a Mosfet connected to a transformer in a flyback configuration to charge the main PET capacitors to up to 475V. A Thyristor bridge is used to discharge the capacitor in either direction throw the winding inside the AlNiCo material.

An on command consist of charging and discharging the capacitors 3 times.

An off command consist of charging and discharging the capacitors several times with changing direction and decreasing amplitude, effectively degaussing the AlNiCo material.

LED

Green LED blinking slowing: everything ok

Green LED blinking fast: error

Firmware update

The device can be flashed via a standard 3.3V or 5V FTDI cable. Please refer to the firmware section of the Git Repo

Useful links

[GitHub repo, source and mechanical drawings](#)

[UAVCAN documentation](#)

[NicaDrone.com, purchase](#)

[PCB layout and schematics](#)