DEXTER magnetic technologies

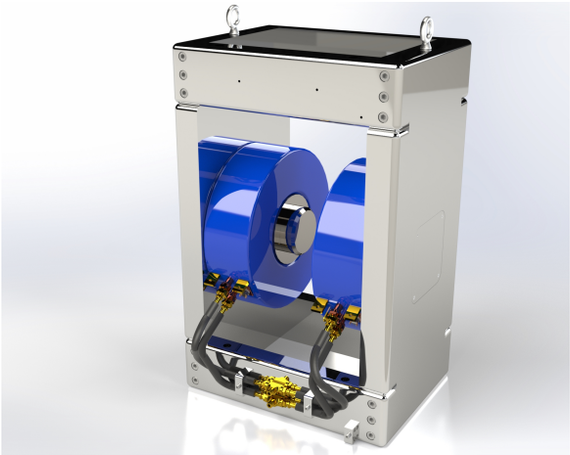
Electromagnet Overview

Electromagnets are classified as either resistive or superconducting based on the coiling wires used. Dexter's experience lies in resistive electromagnet technologies.

Electromagnets are comprised of two main elements to produce a magnetic field when powered: the coil(s) and a current source. Their general purpose is to provide a magnetic force to actuate mechanical components. The field can be manipulated by a change in current, core material, or the number of wire loops.

In contrast to permanent magnets, electromagnets can be switched off and don't require special rare earth materials. However, sometimes a selection of a unique core material can aid in a higher field output.

The three main power setups of electromagnets are Low Frequency AC, DC, and Pulse.



Electromagnets vs. Permanent Magnets

Advantages of Electromagnets

- Dynamically controllable field strength
- Can be turned off (safety, reduce power consumption)
- Can feasibly achieve higher strengths
- Assembly of device is safer
- Electromagnets don't risk demagnetization the way permanent magnets do

Advantages of Permanent Magnets

- Constantly maintains magnetic field without a drop in strength
- Can be lightweight and compact due to higher energy density of magnet material
- Can be a cost effective solution (especially since no power is needed to run/operate)
- No maintenance or cooling required as magnets do not produce heat from an energy source

801 Innovation Dr.
Elk Grove Village, Il
60007

+1 847.380.1333
www.dextermag.com

Siemensstrase 4
Freiburg, Germany
79108

+49 173 6321184
www.dextermag.eu

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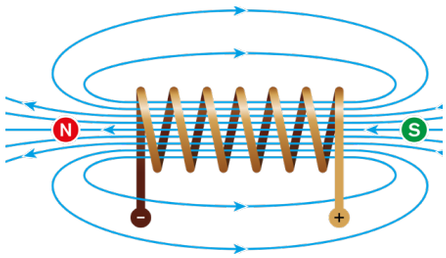

Electromagnet Setups

The three main types of resistive electromagnet power setups are AC, DC, and Pulse.

DC (Direct Current):

DC is when voltage and/or current can be applied as a constant.

In the case of electromagnets, this means a steady field value that can be maintained for long periods of time.

AC (Alternating Current):

AC is when the voltage and current are not constant, but are constantly changing, usually in a sinusoidal waveform.

Electromagnets with this waveform will have magnetic fields changing as a result and can switch between poles when the current direction is flipped.

Pulsed:

Pulsed setups are when the voltage is applied to the electromagnet for a short amount of time. One of the limits to DC and AC designs is overheating. A short pulse can handle a lot of power as it does not need to stay on. Hence, when power can be increased, very high fields can be produced

Specifications Comparison Chart

FOR REFERENCE AND GUIDANCE

Specifications	DC Electromagnets	Low Frequency AC Electromagnets	Pulse Electromagnets
Magnetic Field (T)	>1.8	> 2.0	>0.6
Field homogeneity (%)	±2%	±2%	±2%
Skew Angle (°)	<0.2°	<0.2°	<0.2°
Air gap (mm)	Fixed / Adjustable	Fixed / Adjustable	Fixed / Adjustable
Max. Energy (J)	-	-	1,600
Max. Power (W)	5,000	35,000	300
Max. Voltage (V)	80	13	2,000
Max. Current (A)	65	2,625	550 (pulse)
Frequency (Hz)	N/A	10	N/A
Power Supply	DC	AC	Pulse
Temperature Rise (°C)	30	35	30
Max. Dimensions (mm)	520 X 390 X 540	1120 X 1040 X 1460	510 X 485 X 120
Max. Weight (kg)	1,400	3000	10
Cooling Scheme	Water cooled Ambient air cooled	Water cooled Ambient air cooled	Ambient air cooled
Thermal Switch	Optional	Optional	Optional
Yoke Alloy	Carbon Steel; Iron-Co-balt-Vanadium alloys; etc.	Carbon Steel; Iron-Co-balt-Vanadium alloys; etc.	Air Core; Carbon Steel; Iron-Cobalt-Vanadium alloys; etc.