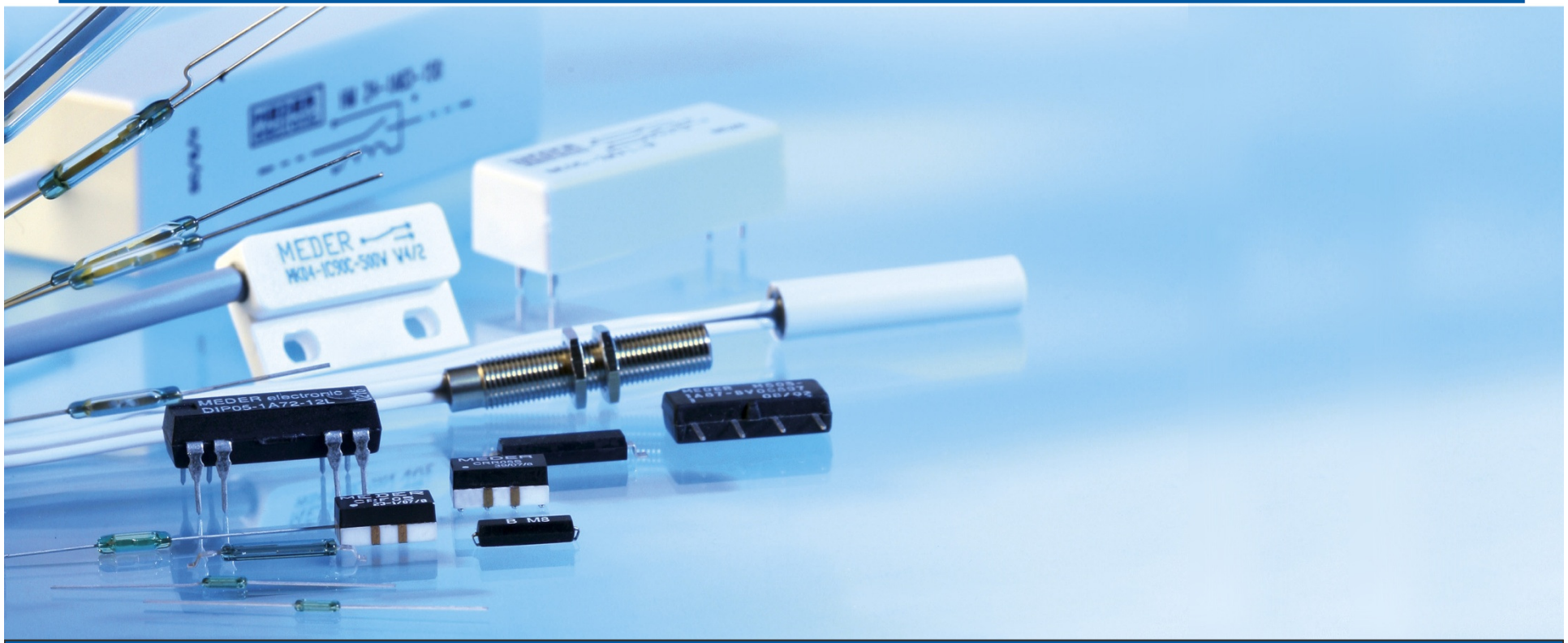
REED SWITCHES REED SENSORS REED RELAYS

MEDER electronic group



Magnets & Magnetic part I

11/05/2009

REED SWITCHES REED SENSORS REED RELAYS

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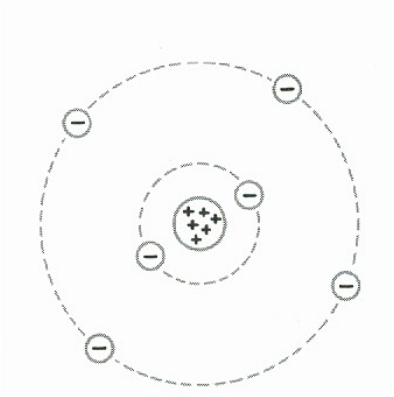
What is magnetic?

- The magnetic effect is created at the sub-atomic level
- An atom has a nucleus composed of protons and neutrons. Electrons encircle the nucleus



- Two things occur in an atom that produce a magnetic field
- Both by the negatively charged electrons

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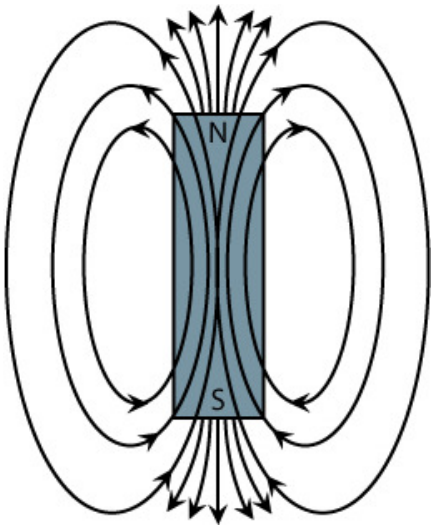
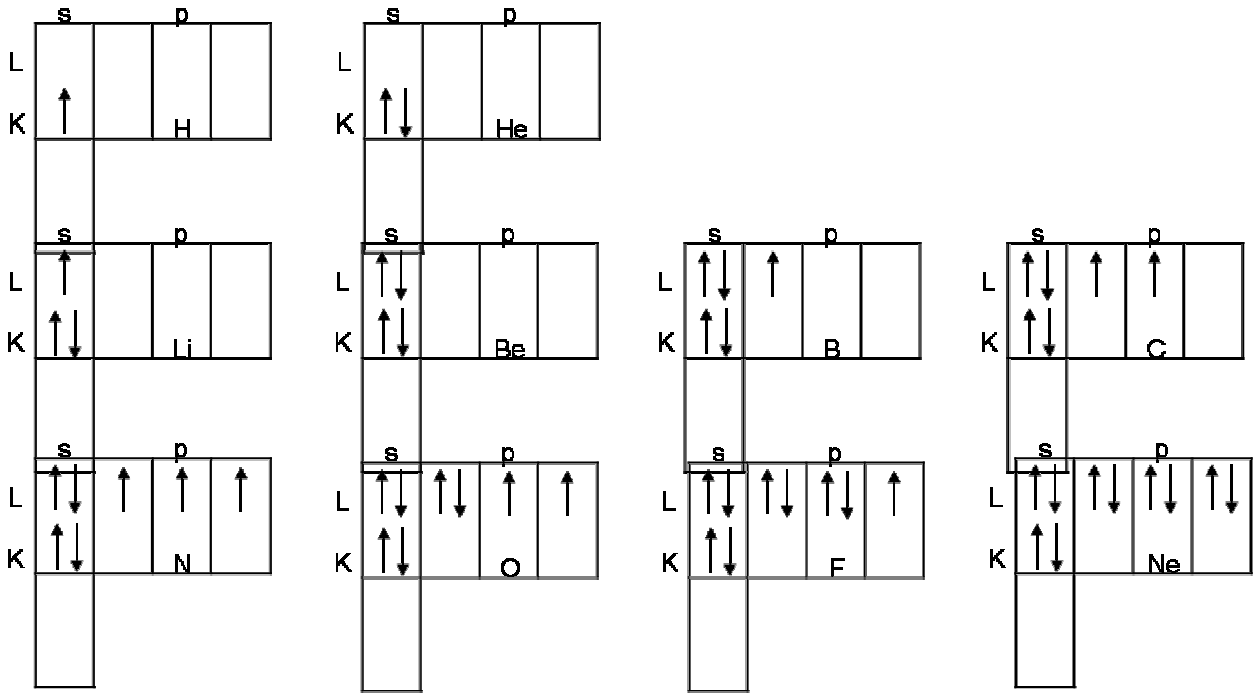
What is magnetic?



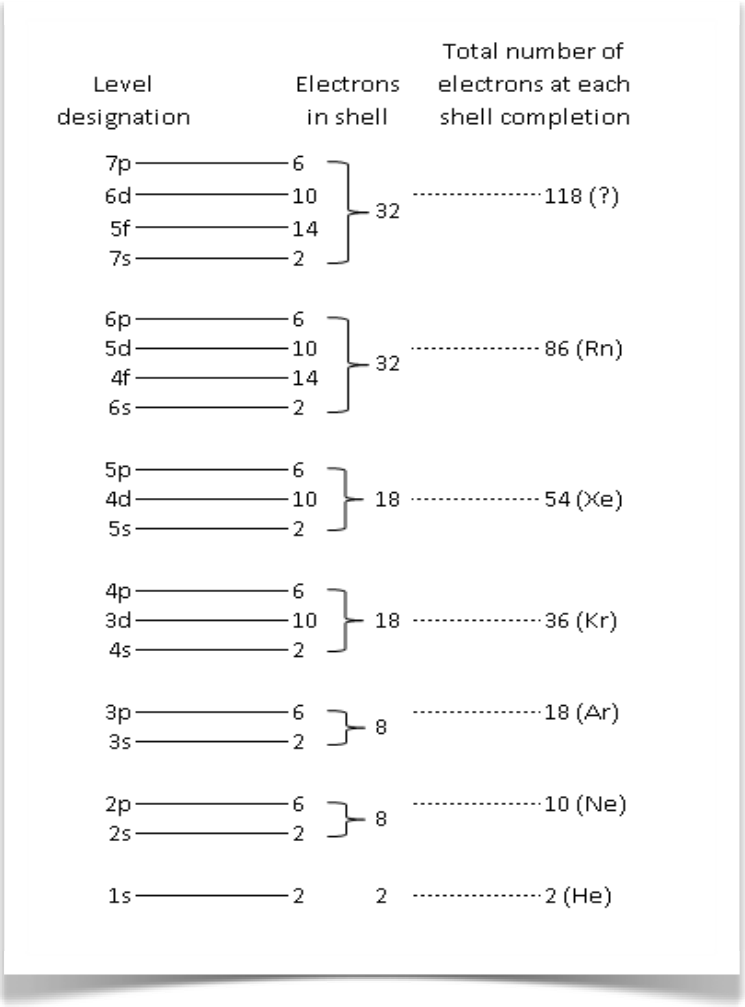
Dipole



REED SWITCHES REED SENSORS REED RELAYS

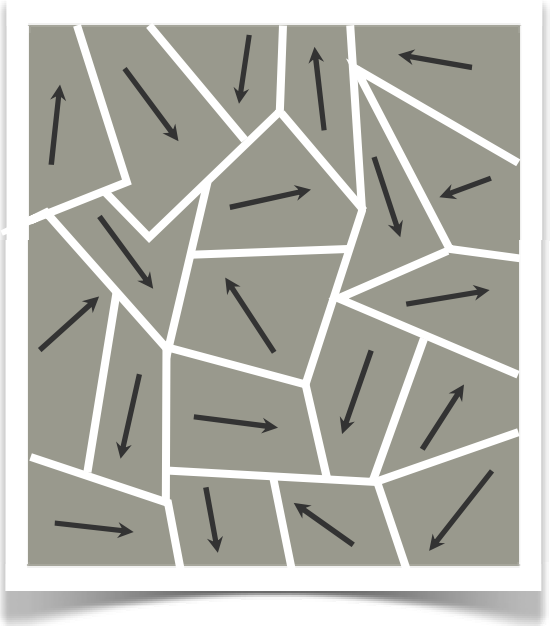
What is magnetic?

- A dipole is in essence a tiny magnet. In most elements the dipoles align themselves with an equal and opposite dipole, effectively canceling out any net overall effect.
- In several elements this is not the case (many metals). They are not canceled out within the atom itself.
- However, when the atoms are grouped with themselves many billions of times over as with a piece of iron, the net effect is canceled within its bulk material.

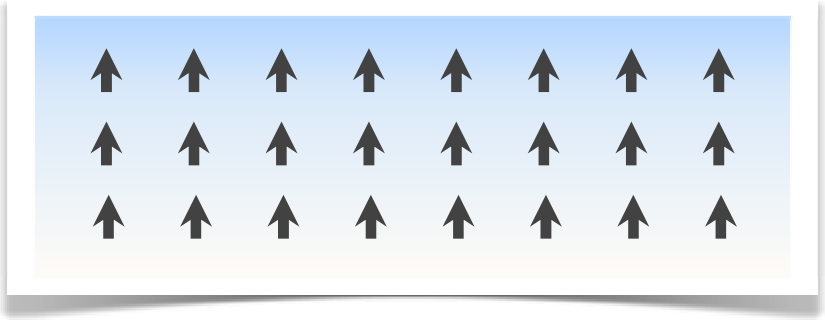


What is magnetic?

- However, there are a few of these elements, where the dipoles are free to move when brought into a magnetic field, and these dipoles will align themselves and will become ‘locked in place’ in the crystal’s lattice structure.



- This is what we now call a permanent magnet as pictured below



Magnet Properties

- All magnets have different properties
- The properties of each allow us to selectively use them in different applications
- Key properties when using magnets in relays are the following:
  - Ability to magnetize and demagnetize easily
  - Magnetic stability at low temperature and high temperature

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Magnet properties – Magnetizing & Demagnetizing

- Many times particularly for a Form B (NC) or latching reed relay it is notably helpful to be able to mag and demag a given magnet to adjust the precise activate and deactivate points
- For most stable results the magnets should be fully magnetized and then demagnetized to the best operating point
- The AlNiCo series are usually best for this
- Sintered magnets are very good as well

Magnet properties – Temperature Effects

- When magnets are to be used above 150 ℃ care should be taken to select magnets that are more stable at high temperatures
- Probably the most stable at high temperatures are the AINiCo series and for rare earth samarium cobalt (SmCo) is the best
- Most magnets are relatively stable at temperatures 0 ℃ and below

Magnet Type	Low temp	High Temperature	Comments
SmCo Magnets	Stable to 4ºK	Stable to 250ºC	Below 20ºC magnetic strength will rise slightly
NdFeB	Stable to 15ºK	Stable to 160ºC	Below 20ºC magnetic strength will rise slightly
Alnico magnets	Stable to near 0ºK	Stable up to 550ºC	Most stable of all magnetic materials
Ferrite magnets	Stable to -10ºC	Stable to 250ºc	At -20ºC they suffer a permanent loss of magnetism

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Magnet properties – Magnetic Strength

- Magnetic strength is often an important selection that determines the distance in which a sensor will open and close
- If there are other magnetic fields or ferromagnetic materials in the area, they will have to be taken into consideration as well

Magnet properties – Size

- Size will also determine the operate points of the sensors
- Potentially the greatest sensing distance is achieved when matching up size and strength of the magnet

Images courtesy of amazingmagnets.com

Magnet properties – Curie Temperature

- The Curie temperature of a magnet is the temperature when the magnetic properties of a magnet are lost
- The temperatures are usually quite high; however, they can be and are reached in several applications
- (the Curie temperatures for several magnets are listed in part II of “Magnets & Magnetics” coming up in the November issue of the MEDER Newsletter)

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Magnet properties – Magnetic Stability

- Depending upon the application, stability can be an important parameter if the sensing distance for a given sensor need to be very accurate. Careful evaluation of the magnet specification needs to be considered

Magnet properties – Shock

- Strong shock can change the magnetic strength for a given magnet. If an application calls for an environment involving shock, care must be taken in selecting the correct magnet
- Shock can become a factor in a Form B (NC) or latching relay where relay-handling at the customer site can cause enough shock to alter the operation points

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End of part I

Content of part II:

- Types of magnets
- What are the effects of stacking magnets in series and in parallel?
- When does the strength of a magnetic field adversely affect the reed switch?