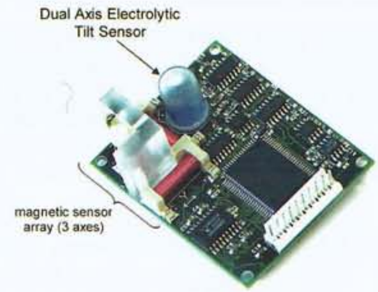
'Electronic Gimbaling' with Electrolytic Tilt Sensors Improves Digital Compass Performance



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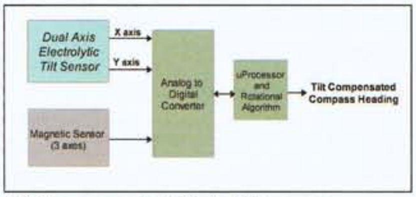
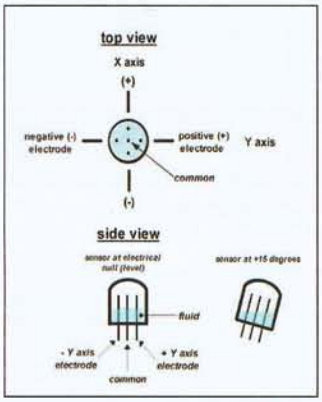
The magnetic compass has been in existence for nearly a thousand years. They have evolved from simple mechanical devices into the electronic/digital compasses of today. These electronic versions use various types of 'magnetic sensors' to measure the earth's low-level magnetic field. These measurements are then mathematically converted into a directional output reading known as 'azimuth' or 'heading'.

Electronic compasses have many distinct advantages over their mechanical predecessors, most notably their improved accuracy, and the ability to interface directly into various control and navigation systems.



Tilt Compensated Digital Compass

The earth's magnetic field, which is three dimensional, consists of two horizontal (X and Y axes) and one vertical (Z axis) component. One inherent characteristic of the aforementioned magnetic sensors is that in order for the heading indication to remain true, the X and Y axis sensors must remain horizontal (level). If not, the Z-axis component, whose magnitude varies with geographic location, is induced into the X and Y sensors, translating into significant heading errors.



Dual axis tilt sensor platform

The earliest remedy to this problem was 'mechanical gimbaling'. This involved mounting the compass in the middle of two rings, which would pivot at right angles to each other. When tilted, the compass would remain level, negating the effects of the Z axis component.

Though somewhat effective, this design had many shortcomings (size, shock and vibration susceptibility, slow response, etc.), relegating them to non-critical navigational applications.

The ultimate solution to the problem came in the form of 'electronic gimbaling'. Also known as 'electronic tilt compensation', this method employs a dual axis tilt sensor to measure the X and Y axes deviation, or 'pitch and roll' from true level. By combining the tilt sensor output information with a Z-axis magnetic sensor reading, the X and Y axes magnetic sensor readings (which determine heading) can be mathematically rotated back to the horizontal plane. Once this is accomplished, the heading can be accurately calculated.

Electronic tilt compensation has become the industry standard. By eliminating the mechanical aspects from the design, reliability and performance are intrinsically improved. In addition, this method enables the ability to compensate for nearby magnetic (ferrous) effects, thereby nullifying externally generated accuracy errors.

The type sensor most favored by compass manufacturers to measure the pitch and roll angles is a dual axis electrolytic tilt sensor. This is mainly due to their low cost/high performance ratio, and compact size.

The operating principal for an electrolytic tilt sensor is as follows. An electrically conductive fluid (electrolyte) is sealed within a glass or ceramic cavity, to conduct between a common, positive and negative electrode. When at electrical null (i.e. level), both electrodes are evenly submerged within the fluid, which remains level due to gravity. This produces a balanced (equal) signal output between the positive and negative electrodes, and common.

As the sensor is rotated about its sensitive axis, the amount of surface area submerged within the fluid will increase for one electrode, and simultaneously decrease for the other, thereby creating an imbalance in the output. This imbalance, or ratio, of one electrode to the other is directly proportional to the angle of rotation.

Contact Spectron Glass and Electronics at www.spectronsensors.com.