

RESEARCH ARTICLE**A REVIEW ON NOISE REDUCTION OF BRUSHED D.C. MOTOR****Utkarsh Pateriya*, Ajay Srivastava, Rajiv Singh and Birendra Vikram Singh**

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ABSTRACT

Speed of the Brushed DC motors can be varied by changing the operating voltage or the strength of the magnetic field. Depending on the connections of the field to the power supply, the speed and torque characteristics of a brushed motor can be altered to provide steady speed or speed inversely proportional to the mechanical load. The electrical noise generated by a DC motor falls into two categories electromagnetic interference (RF interference) and the electrical noise generated on the power rail. This paper deals with the techniques to reduce the noise reduction of Brushed DC motor. The RF interference can couple into other portions of the circuit and cause circuit malfunction and performance degradation. The motor induced RF noise can significantly decrease the usable RF range. Reduction in the level of RF interference, motors should be placed as far away from sensitive circuits as physically possible. Motor's metal casing typically provides enough shielding capability for reducing the over-the-air RF interference, but an extra metal enclosure should provide much better RF interference reduction capability. To reduce the level of RF interference, motors should be placed as far away from sensitive circuits as physically possible, for more reduction extra metal enclosure should also be provided. We also found that for suppressing RF interference in case of common mode interference, simple LC low pass filter is incorporated. Elimination of other electrical noises is also done by attaching motor with simple speed controller. Higher order LC filters can further improve the noise-filtering performance.

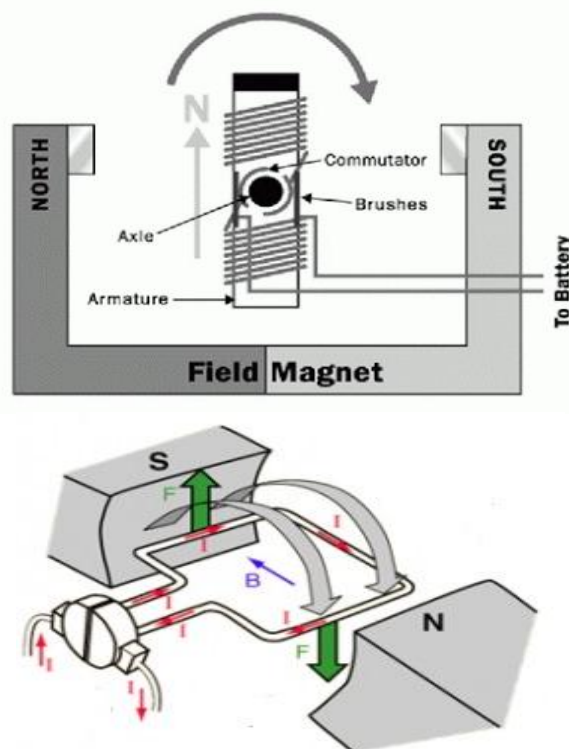
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INTRODUCTION

A brushed DC motor is an internally commutated electric motor designed to be run from a direct current power source. Brushed motors were the first commercially important application of electric power to driving mechanical loads, and DC distribution systems were used for more than 100 years to operate motors in commercial and industrial buildings. A conventional brushed DC Motor consist basically of two parts, the stationary body of the motor called the Stator and the inner part which rotates producing the movement called the Rotor or "Armature" for DC machines.

Brushed DC motors can be varied in speed by changing the operating voltage or the strength of the magnetic field. Depending on the connections of the field to the power supply, the speed and torque characteristics of a brushed motor can be altered to provide steady speed or speed inversely proportional to the mechanical load. Brushed motors continue to be used for electrical propulsion, cranes, paper machines and steel rolling mills.

Since the brushes wear down and require replacement, brushless DC motors using power electronic devices have displaced brushed motors from many applications.

**Fig.1** Brushed DC motor

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In the above diagram to the right, it shows that commutator supplies electric current externally, also when electric current flows through the coil, magnetic field B produces force F which in-turn produces the torque which turns the DC Motor. Brushed motors tend to generate a lot of noise (both acoustical and electrical), and the electrical noise can interfere with RF circuits and even logic circuits if not isolated properly, leading to erratic behaviours. This kind of noise-induced erratic behavior can sometimes be very hard to trace and debug. The electrical noise generated by a DC motor falls into two categories electromagnetic interference (RF interference) and the electrical noise generated on the power rail.

Electromagnetic radiation can be difficult to diagnose, as EMI can often manifest itself in ways that are hard to detect. Users can run tests for weeks or months without realizing that EMI is degrading the accuracy of measurements. Once an issue has been detected, it can be difficult to distinguish EMI from other noise sources. Radio Frequency Interference or EMI Interference is disturbance that affects an electrical circuit due to either electromagnetic induction or electromagnetic radiation emitted from an external source. The disturbance may interrupt, obstruct, the effective performance of the circuit. These effects can range from a simple degradation of machine. The source may be any object, artificial or natural, that carries rapidly changing electrical currents, such as an electrical circuit, the Sun or the Northern Lights. This paper deals with the techniques to reduce the noise reduction of Brushed DC motor.

METHODS AND METHODOLOGY

Noise production in Brushed DC motor

When a motor runs, the commutator switches the direction of the electricity that flows in the windings. Though the system keeps the motor running, occasional spark occurs between brushes and commutator at the timing of the commutation. The spark is one of the causes of the electrical noise. Especially when the motor starts from its position, comparably higher current, flows into the windings. Higher current usually causes higher noise. Also the similar noise happens when brushes stays unstable on the surface of the commutator, the input to the motor is much higher than expected and so on. Other factor may be an insulation created on the commutator surface, which results in unstable flow of the electricity.

Reduction of RF interference

The RF interference can couple into other portions of the circuit and cause circuit malfunction and performance degradation. The motor induced RF noise can significantly decrease the usable RF range.

The level of RF interference is dependent on various factors ie type of the motor (brushed or brushless), driving waveform and load can all impact the severity of the RF interference. Typically, brushed motors generate more RF interference than their brushless counterparts. But the design of the motor, regardless of the type, also affects the RF leakage greatly. A small brushed motor can sometimes generate magnitudes more

RF interference than a carefully designed more powerful motor. The required equipments will be Simple LC low pass filter and Metal Enclosure

Eliminating Electrical Noises

Another source of electrical noise comes from the power rail. Since power supply has a non-zero internal resistance, the non constant motor current flow during each rotation period would translate into voltage ripples across the power terminals. The equipments are Oscilloscope, Capacitor of Capacitance >1 milli Farad, 4 AA NiMh battery with no filter, Simple LC low pass filter (capacitance=100 nano farad, Choke=10mH), Simple Speed Controller and H-Bridge.

RESULTS AND DISCUSSION

DC motor due to its high revolving speed can cause noise during its operation. In particular, the DC motor used in various applications can give discomfort to users due to noise, therefore it is necessary to rectify this problem. For reducing RF Interference motors should be placed as far away from sensitive circuits as physically possible. Motor’s metal casing typically provides enough shielding capability for reducing the over-the-air RF interference, but an extra metal enclosure should provide much better RF interference reduction capability. It is important that in either case, the metal casing (either the motor casing or the metal enclosure) should be properly grounded (e.g. via ground strap at a single point).

The RF signals generated by the motor can also be coupled into the circuit, which forms what is known as the common mode interference. This type of interference cannot be eliminated by shielding, but can be reduced effectively via a simple LC low-pass filter. The noise could be generated by either the brushes (commutation). Easiest fix for brush noise (which would be random or 'static') is a capacitor right across the PMDC motor leads, something like a 1 μF, 100V ceramic capacitor might be a good starting point.

For further reducing the electrical noise, further filtering at the power source is needed. Typically, this is done by adding a larger capacitor (e.g. 1000uF and above) across the power terminals to lower the effective resistance of the power supply and thus improve transient response. The Fig. 1 and 2 show a couple of typical circuits for filtering out motor electric noise.

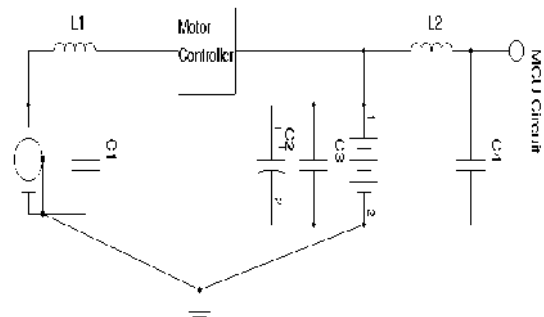


Fig. 2 Motor with simple Speed Controller

The above filtering scheme is used for uni directional motor driving circuit.

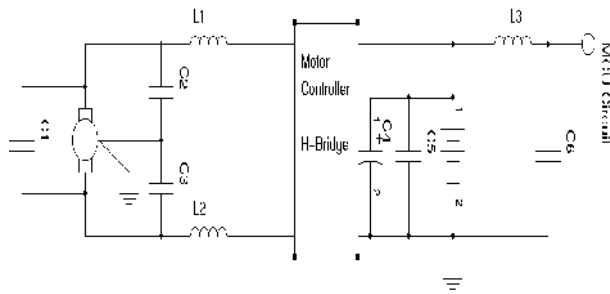


Fig.3 Motor with H-bridge

It is used in bi-directional purpose, in this scenario (e.g. using an H-Bridge), two sets of LC filters should be used, but in general, the capacitors on the motor side are several hundred nano-farads and the inductors are several milli-henries. Higher order LC filters can further improve the noise-filtering performance but are rarely necessary.

CONCLUSIONS

We have successfully studied and analysed the Electrical Noise reduction in brushed dc motor, Firstly we have discussed various causes that produces noise in Brushed DC motor, Electrical Noises may be categorised as RF interference and other electrical noises produced on power rail. Then in this Paper we have provided methods for reducing Electrical noises as well as Suppressing RF Interference so as to improve motor behaviour. To reduce the level of RF interference, motors should be placed as far away from sensitive circuits as physically possible, for more reduction extra metal enclosure should also be provided. We also found that for suppressing RF interference in case of common mode interference, simple LC low pass filter is incorporated. Elimination of other electrical noises is also done by attaching motor with simple speed controller. Higher order LC filters can further improve the noise-filtering performance.

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References

1. Augusztinovicz, Barát, F. Z. J; P, Pfliegel, Granát. Noise Analysis and Noise reduction of TEMIC 83298 and 83300 Motors. Research report, Vol. I-III., Budapest University of Technology and Economics, Dept. of Telecommunications, Budapest, 1997 (In Hungarian)
2. Bhimbra P.S. (2012). Electrical Machinery. Khanna Publishers. Pp : 360-539.
3. Kang, H. (1995). The study of the DC Motor noise and vibration SAE 951350, pp 2460.
4. Kim, J.S. (2003). A study on the active balancing system for high speed rotating machinery, Ph.D. Dissertation, Ajou University
5. Pfliegel, P. F; Augusztinovicz, J. Granát. Noise Analysis and Noise Reduction of Small DC Motors. Deptt. of Telecommunications, Budapest University of Technology and Economics 1111 Budapest, Stoczek u.2.
6. Sujatha C. (1989). 'Vibration and Acoustics-measurement and signal analysis' Tata McGraw hill publication, First edition.
7. Takashi Miyakita, Atsushi Ueda, Makoto Futatsuka, Tsukasa Inaoka, Megumi Nagano, and Wasaku Koyama (2004). 'Noise exposure and hearing conservation for farmers of rural Japanese communities' *Journal of Sound and Vibration*, Vol. 277.
8. Timár-Peregrin, L(1992). Noise and vibration of electrical machinery. In: Noise and Vibration Control Engineering, (Eds: L.Beranek and I.Vér), John Wiley, New York, Chap. 20.
9. Web site kerrywong.com/2012/01/26/a-short-guide-on-motor-electrical-noise-reduction/mabuchi-motor.co.jp/en_US/technic/t_0203
10. Websitemabuchi-motor.co.jp/en_US/technic/t_0203 http://www.electronic-s-tutorials.ws/io/io_7.