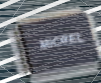


POWERING THE FUTURE: MOTOR DRIVE SOLUTIONS



MICREL®
Innovation Through Technology®

Powering the Future:

Motor Drive Solutions

Today motor control systems are used by engineers for both digital and analog technologies to conquer past challenges, including motor speed control, rotation direction, drift, and motor fatigue. The application of MCUs has given this generation of engineers the opportunity to dynamically control motor actions so that they respond to environmental stresses and conditions. This helps provide a longer operational lifetime and reduce maintenance, which equals a lower overall cost. Motor manufacturers are gravitating towards 3-Phase BLDC motors because they provide more torque for less power and have a longer operating time. This is because there's no direct contact from the commutator and electrical terminals as is found in brushed motors.

Important benefits of using BLDC motors include:

- **Higher efficiency** (75% vs. 40% of an AC motor)
- **Less heat generated**
- **Higher reliability** (no brushes to wear out)
- **Safer to operate in a dangerous environment** (no brush dust generated).
- **The use of BLDC motors in key sub-systems also reduces the overall system weight.** As the BLDC motor is commutated entirely electronically, it is much simpler to control the torque and RPM of the motor and at much higher speeds.

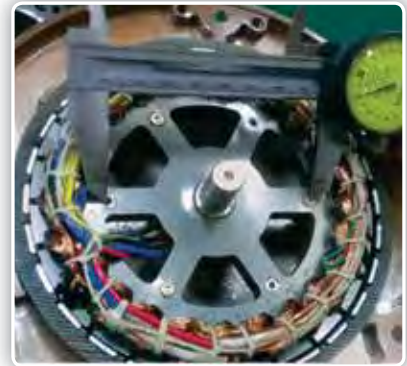
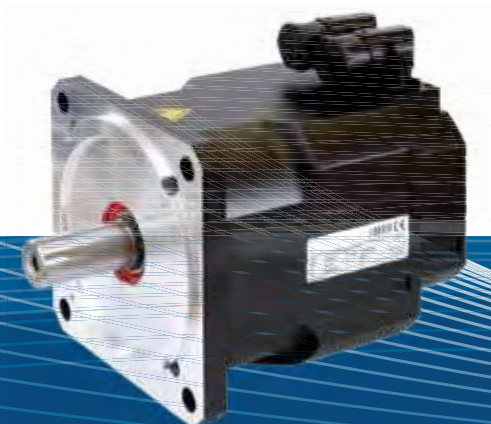


Figure 1. AC Motor Fan and BLDC Fan Rotor Winding Comparison



KEY PARAMETERS	AC MOTORS	BLDC MOTORS
Weight	100%	65%
Size	100%	55%
Efficiency	80W Full Load	30W Full Load
Speed Control	Difficult	Easy & Linear
Accuracy and Speed	3% - 5 %	0.5%
Torque Control	Poor	Excellent
RF Connectivity	Requires Extra IC Block	Easy to Implement
Multiple Speed / Direction Settings	Difficult	Easy
Safety Implementation	Difficult	Easy

Table 1. Advantages of a Brushless DC Motor vs. an AC Motor Driving the Same Load



Governments the world over are dealing with very real power deficits that are caused by insufficient electrical power grids. Moreover, there are many regions of the world that must routinely deal with blackouts during times of peak demand. The result is that these countries are now either giving subsidies or preparing to hand out subsidies for the use of more efficient BLDC motors. Micrel offers a comprehensive solution in this area: a series of robust and efficient chips that collectively reduce power and provide manufacturers with a viable and cost effective alternative to current solutions.

MARKET SEGMENTS AND APPLICATIONS

SEGMENTS	DRIVING FORCE	APPLICATIONS
Automotive	Fuel Savings Higher Efficiency and Reliability	Electrical Pumps Power Steering Wipers
White Goods	EU-Drive Towards Clean Energy and Power Efficiency	Washers Dryers Refrigerators Air Conditioners
Industrial	EU-“Inverter Drive” Power Efficiency	Pumps Fans Heaters
Home Appliance	Clean Energy and Power Efficiency Government Subsidy	Blenders Refrigerators HVAC



Table 2. Key Areas for Brushless DC Motor Drives

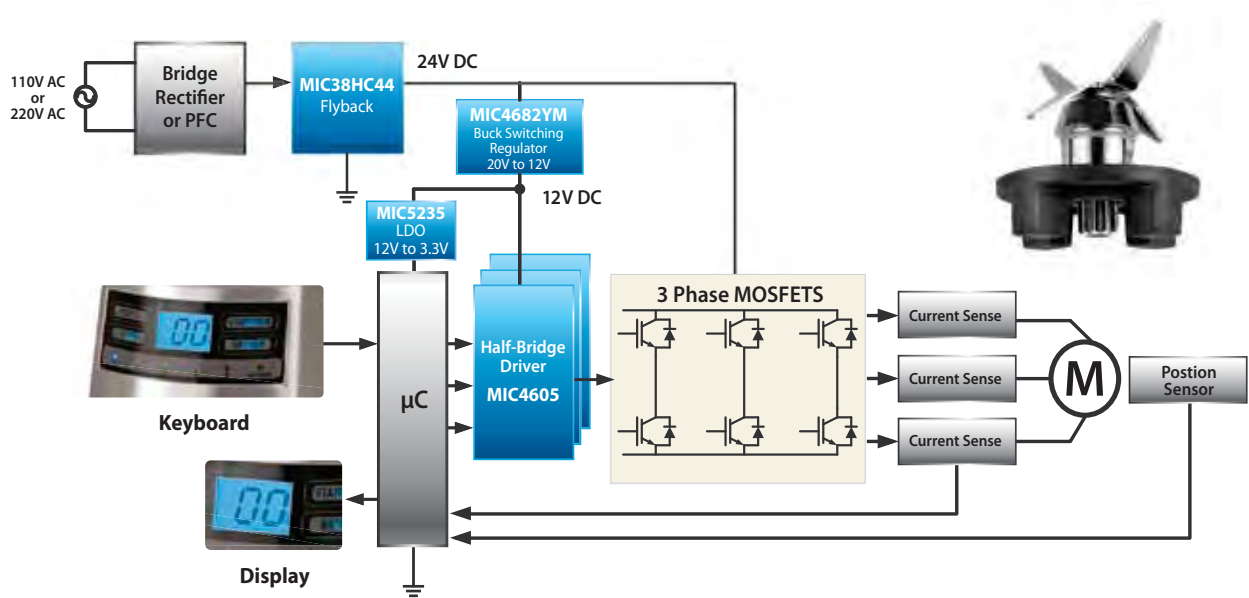


Figure 2. Typical Functional Block Diagram of a Brushless DC Blender



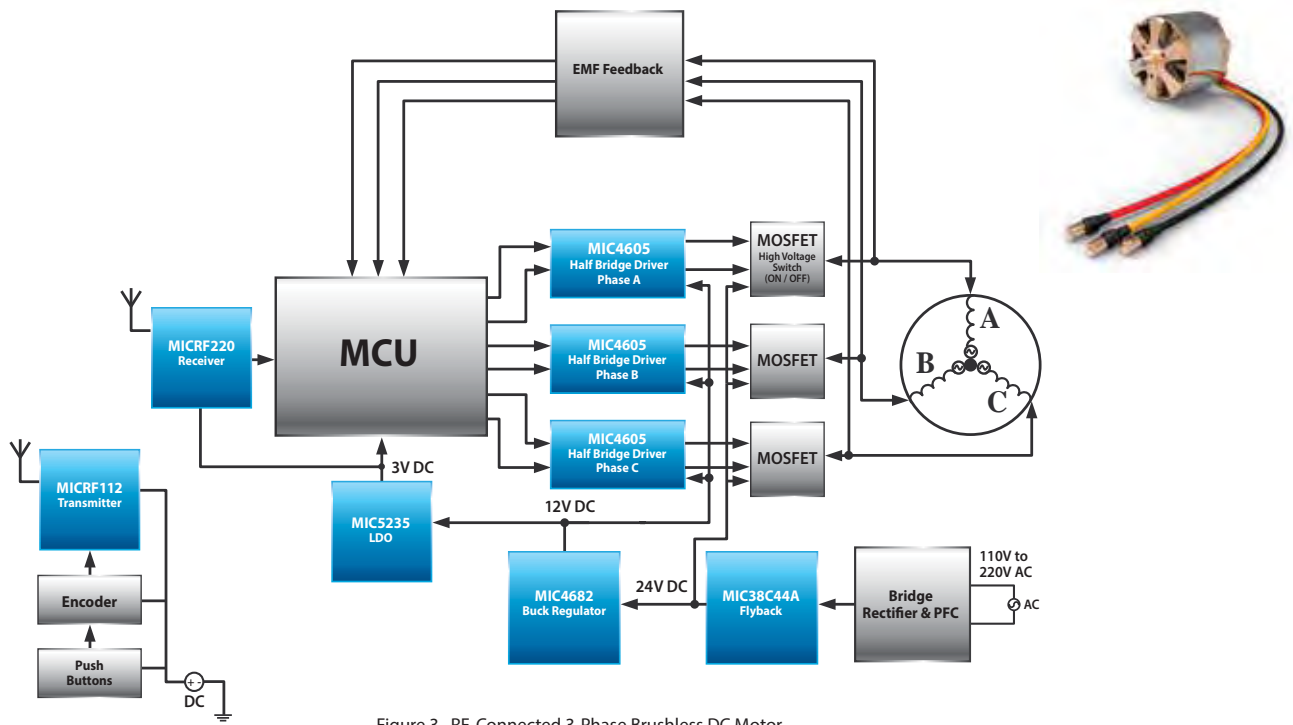


Figure 3. RF-Connected 3-Phase Brushless DC Motor

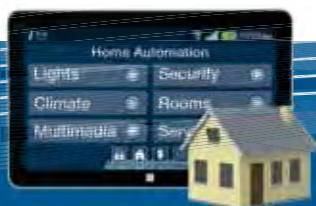
BLOCK	DEVICE	FUNCTION	BENEFIT
RF Receiver	MICRF220	Receives data wirelessly in the 300MHz to 450MHz frequency range.	One of the easiest to implement receivers on the market. Greater control distance.
LDO	MIC5235	Provides 3.3V supply for microcontroller and peripherals.	Fast response time allows the use of small ceramic capacitors.
RF Transmitter	MICRF112	Transmits data wirelessly in the 300MHz to 450MHz frequency band.	Operates as low as 1.8V for longer operation from coin battery.
Buck Regulator	MIC4682	Provides regulated 5V rail to system.	Programmable current limit allows designers to use the smallest inductor possible.
Half Bridge MOSFET Driver	MIC4605	Provides the appropriate gate-to-source voltage and current sink to turn ON/OFF the MOSFET.	Adaptive-Dead-Time circuitry protects against shoot-through and optimizes power efficiency.
Flyback Controller	MIC38C44A	Controller for AC/DC power supply.	Simple flyback topology can be used as primary winding for feedback control.

The need to migrate towards higher efficiency BLDC motors in many markets and applications is becoming increasingly commonplace. This is due to certain key benefits:

- Higher efficiency (75 percent vs. 40 percent of an AC motor)
- Lower heat generation
- Higher reliability (no electrical contacts)
- Safer to operate in a dangerous environment (no brush dust generated).

By using the BLDC motor in key sub-systems, the weight can also be reduced. This means that the application can offer better fuel economy in vehicles. As the BLDC motor is entirely

commutated electronically, it is much easier to control the torque and RPM of the motor at much higher speeds. Around the world, many countries are facing insufficient power due to electrical power grid deficiencies. A small number of countries are now either giving subsidies or getting ready to give out subsidies for the use of more efficient BLDC motors. The BLDC deployment is but one of the many trends addressing the green initiative to save the world's precious resources without adversely impacting everyone's ways of life.



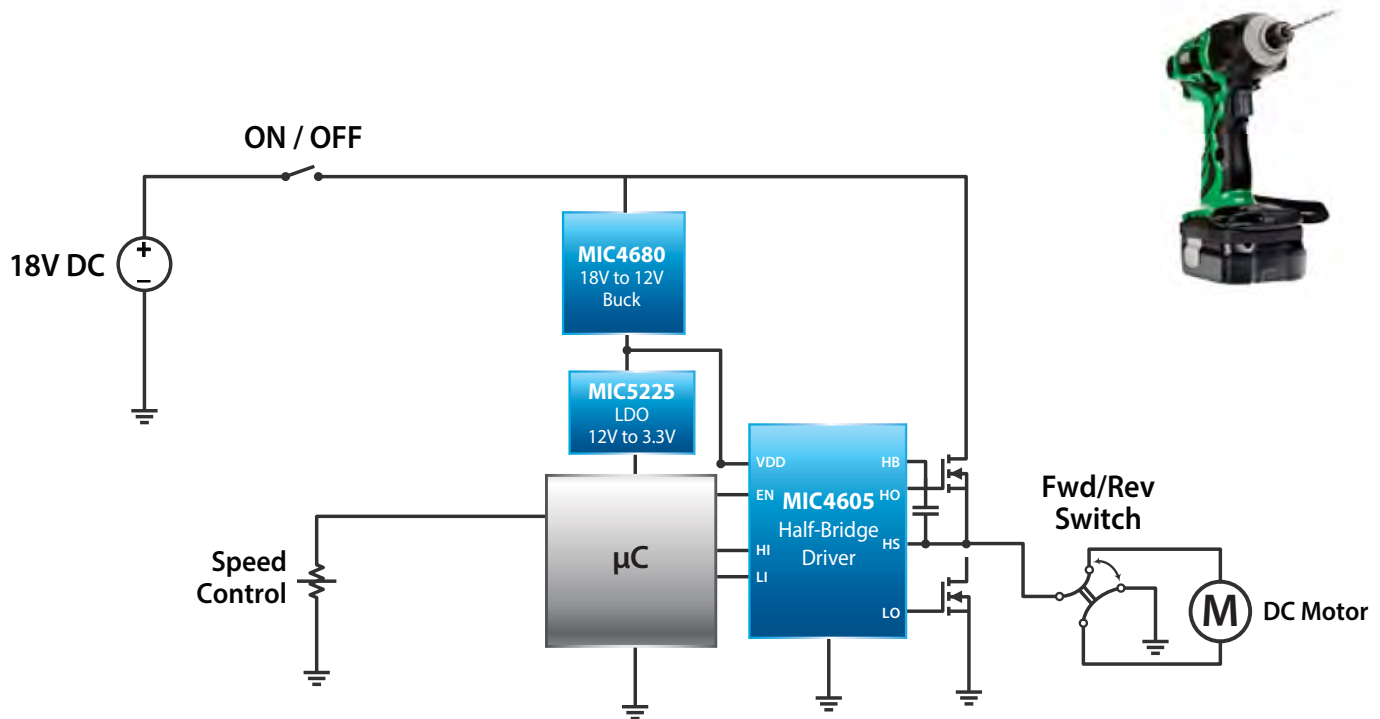


Figure 4. Typical Functional Block Diagram of a 18V Brushless DC Motor Control.

MICREL ADVANTAGES IN MOTOR DRIVE

- **Power Drivers.** Micrel maintains the **broadest line of MOSFET/IGBT drivers in the industry.** Key parameters include fast propagation delay and high peak voltage. An example is the Micrel MIC4605 family that can withstand up to 85V of back-EMF motor voltage.
- **Voltage References and Supervisors.** Micrel offers an extensive line of these devices that are critical to the operations of MCUs. Examples include the MIC811, MIC2775, and the MIC1232 voltage supervisors.
- **Op Amps/Comparators.** Micrel has a line of low power op amps and comparators. These devices are critical to the precision feedback control of servo systems. Examples include the MIC6270, MIC841N, and the MIC833.
- **LDOs.** Micrel offers the broadest line of LDOs in the industry including the fastest transient LDO, lowest input LDO, lowest drop out LDO, and highest current LDO. Examples include the MIC49150, MIC29150, MIC5235, and the MIC5283.
- **DC/DC Switching Regulators.** Micrel also offers an extensive line of DC/DC converters with the highest efficiencies. These are used in auxiliary power applications. Examples include the MIC2605 Boost and MIC4682 Buck (Step-Down) switching regulators.





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