Product Overview

Cordless Vacuum Cleaner BLDC Motor Efficiency Test Data vs Competitor F

Engineers designing cordless vacuum cleaners such as stick vacuums or vacuum robots need to consider many factors when carefully constructing a motor drive system to meet the application requirements. This product overview considers a suction motor system using a BLDC motor driver with two key challenges in mind, powerful suction and motor efficiency.

TI's BLDC motor driver designs solve these challenges with efficient and ultra-high speed capable devices like MCT8329A (up to 3kHz) and MCF8329A (up to 1.8kHz) for high performance and long battery life. These devices also feature code-free single-shunt trapezoidal and field-oriented control, forward and reverse windmilling support, configurable motor start and stop options, optional closed-loop speed or power control, high gate drive strength and power capability, and much more to solve motor control challenges.

This document compares the speed and efficiency performance of TI devices against a device from Competitor F.

Test Considerations

In a suction motor system there are two testing conditions to considered, when the suction orifice is open and when the suction orifice is closed. In cordless vacuum cleaner systems, the suction motor running at high speed creates a powerful suction that pulls air and debris through the suction hose. If the hose orifice is open, that creates maximum load on the suction motor. If the orifice is closed or partially closed, the load on the suction motor decreases. Typically, constant power control is used with or without flux weakening to increase the motor speed to create a stronger suction when the orifice is partially closed. This is to assist with strong cleaning of corners, furniture, and other typical surfaces. Given those two testing conditions, the measured parameters are as follows:

- Input voltage (V), input DC current (A), and DC power (W)
- Electrical frequency (Hz)
- Winding RMS current (A) - average of all the three winding current RMS values

Table 1, Figure 1, and Figure 2 show the comparison data when the suction orifice is open.

Table 1. Test Data Comparison With Suction Orifice *Open*

Design	Input Voltage (V)	Input DC Current (A)	DC Power (W)	Frequency (Hz)	Winding Current RMS (A)	% Reduction of Motor Current Compared to Inbuilt Controller
Competitor F	36	5.56	200.1	**625**	9.02	0
MCF8329	36	5.57	200.5	**621**	7.73	–14.3%
MCT8329	36	5.84	210	**626**	7.99	11.4%

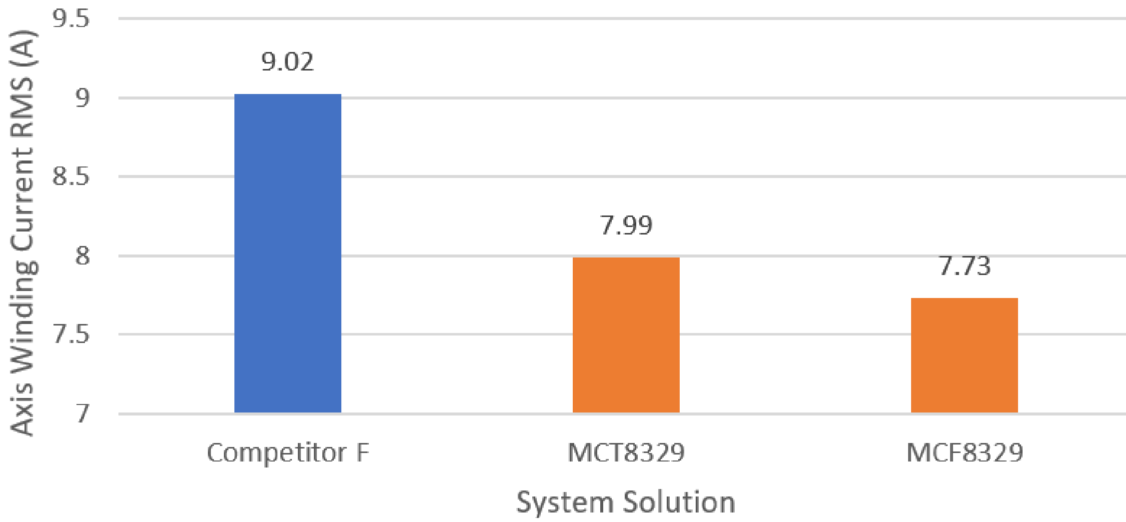

Figure 1. Open Orifice Winding Current Comparison

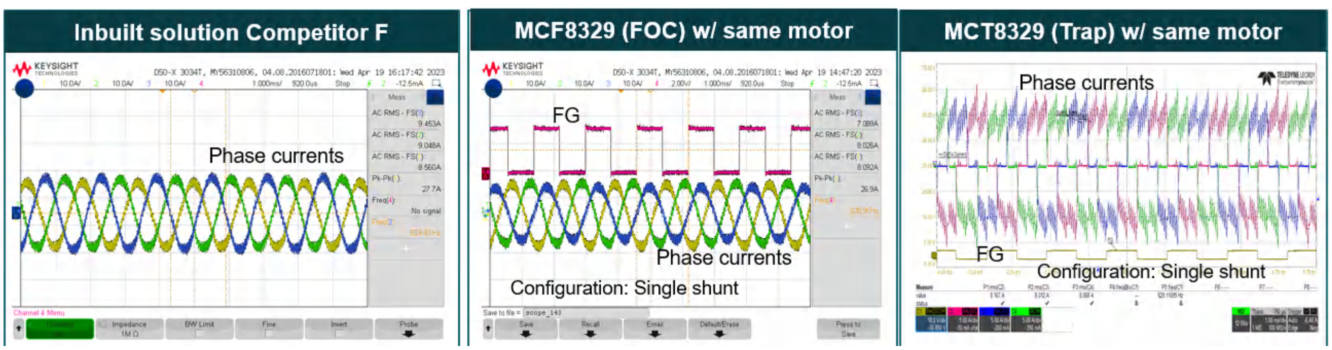

Figure 2. Motor Drive Design Comparison at 200W, Suction Orifice Open

Table 1 shows the % reduction of motor current that was able to be achieved on the MCx designs. This data shows how each MCx8329 design reduces motor current; therefore, lowering motor heating while achieving the same suction performance.

Table 2, Figure 3, and Figure 4 show the comparison data when the suction orifice is closed.

Table 2. Test Data Comparison With Suction Orifice *Closed*

Design	Input Voltage (V)	Input DC Current (A)	DC Power (W)	Frequency (Hz)	Winding Current RMS (A)	% Reduction of Motor Current Compared to Inbuilt Controller
Competitor F	36	5.63	202.7	**1020**	12.4	0
MCF8329	36	5.4	194.4	**1070**	5.02	**–59.5%**
MCT8329	36	5.55	199.8	**1050**	5.08	**–59%**

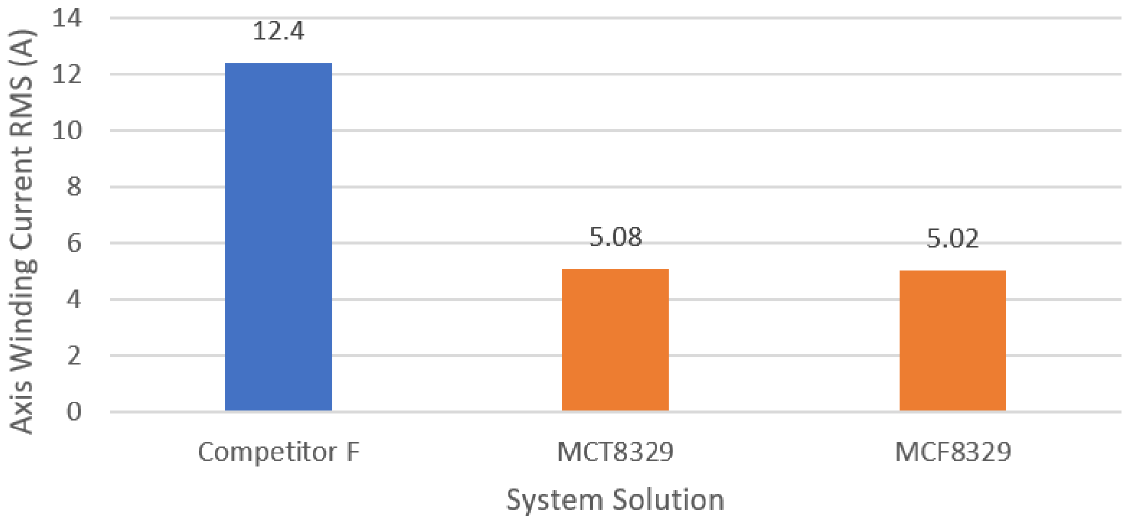

Figure 3. Closed Orifice Winding Current Comparison

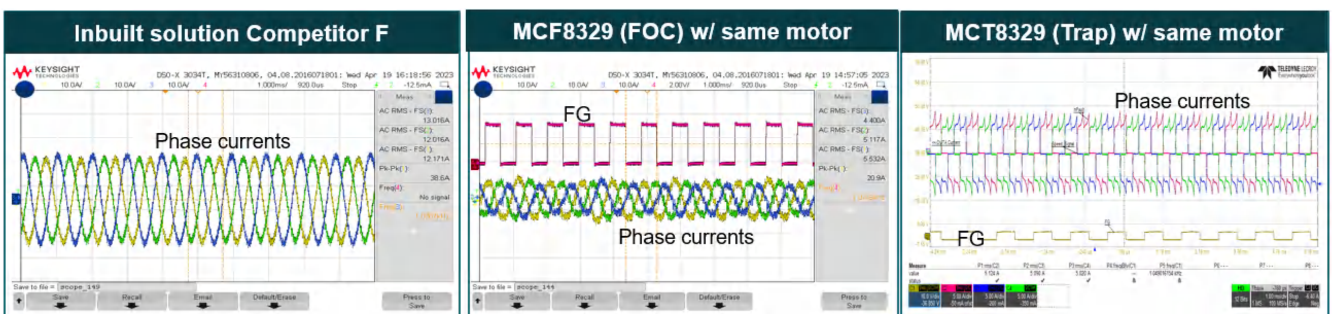

Figure 4. Motor Drive Design Comparison at 200W, Suction Orifice Closed

Table 2 shows how TI's MCx8329 designs can enable up to a 50% reduction in motor current during operation while achieving the same or improved speed compared to the existing industry design.

TI's highly configurable, integrated, sensorless trapezoidal or field-oriented motor control algorithms enable this performance improvement on existing industry designs. This efficiency gain while maintaining the same speed can greatly improve battery life and motor life with lower motor heating without any losses in suction performance. Consider this when designing the next BLDC suction motor system.