Product Overview

Appliance Fan and Pump Test Data Versus Competitor A

Engineers designing appliance pump and fan applications for large home appliances such as refrigerator, dishwasher, or washer and dryer need to consider a lot of factors when carefully constructing a motor drive system to meet their application requirements. In this product overview we consider a refrigerator fan motor system using a BLDC motor driver with efficiency as the key application requirement.

TI's BLDC motor driver designs solve these efficiency challenges with low voltage BLDC motor drivers with integrated sinusoidal and field-oriented control commutation methods for achieving peak performance out of a BLDC motor. Below we compare our efficiency performance against an existing industry design from Competitor A.

Test Considerations

In this refrigerator fan application, the main consideration here is the efficiency. We are measuring the power needed to be delivered to the motor to reach specific target RPMs. There are five target RPMs: 580, 910, 960, 1000, and 1080. Using the FG output given in Hz, we can convert to the target RPM given that this is a 12-pole motor (6 pole pairs) using the equation below:

$$RPM = Hz \times \left({}^{2}/_{poles}\right) \times 60 \quad (1)$$

For this benchmarking data, we used the Competitor A design as the baseline and determined the % efficiency difference while using DRV10974 as the TI BLDC design. The DRV10974 is an 18V abs max with integrated 180-degree sinusoidal commutation and integrated MOSFETs to allow for low power applications that require a small form factor. This driver has an H+L $R_{DS(on)}$ of 750mΩ (typical) allowing for a phase drive current strength of about 1A Continuous (1.5A Peak). This device also includes a simple user interface with a slew of features including one-pin configurable start-up, a pin for forward and reverse control, an open-drain FG output for speed feedback, a resistor-configurable lead angle, current limit, and acceleration profile, and a full suite of protection features.

In this experiment we tested this design on three different refrigerator fan motors to provide data on a wider range of conditions.

Motor One

Table 1. Motor One Test Data

Target RPM	Competitor A (idle: **9.077mA**)			TI DRV10974 (idle: **0.357mA**) ADV resistor: **14k**			% Reduction of motor current
	FG (Hz)	Power (mW)	Power (mW) / FG (Hz)	FG (Hz)	Power (mW)	Power (mW) / FG (Hz)	
580	57.928	481.30	8.31	58.485	447.12	7.64	**-7.6%**
910	91.088	1076.33	11.82	91.143	1040.43	11.42	**-3.5%**
960	96.395	1196.59	12.41	96.391	1137.25	11.80	**-5.2%**
1000	100.531	1300.09	12.93	100.228	1232.09	12.29	**-5.5%**
1080	108.331	1561.54	14.41	108.466	1476.20	13.61	**-5.8%**

In motor one, we saw that system level efficiency can be improved by up to 7.6% varying across motor speeds while using DRV10974.

Motor Two

Table 2. Motor Two Test Data

Target RPM	Competitor A (idle: **9.077mA**)			TI DRV10974 (idle: **0.357mA**) ADV resistor: **14k**			% Reduction of motor current
	FG (Hz)	Power (mW)	Power (mW) / FG (Hz)	FG (Hz)	Power (mW)	Power (mW) / FG (Hz)	
580	58.217	457.27	7.85	58.392	422.70	7.24	-8.2%
910	91.136	1057.77	11.61	91.403	1035.99	11.33	-2.1%
960	95.776	1171.03	12.23	96.265	1123.05	11.67	-4.3%
1000	100.314	1271.15	12.67	100.336	1192.12	11.88	-6.6%
1080	108.218	1526.41	14.10	108.261	1442.72	13.33	-5.8%

In motor two, we saw that system level efficiency can be improved by up to 8.2% varying across motor speeds while using DRV10974.

Motor Three

Table 3. Motor Three Test Data

Target RPM	Competitor A (idle: **9.077mA**)			TI DRV10974 (idle: **0.357mA**) ADV resistor: **14k**			% Reduction of motor current
	FG (Hz)	Power (mW)	Power (mW) / FG (Hz)	FG (Hz)	Power (mW)	Power (mW) / FG (Hz)	
580	57.996	460.66	7.94	58.065	425.06	7.32	-8.4%
910	91.315	1079.95	11.83	90.684	1065.89	11.75	-1.3%
960	96.023	1200.72	12.50	96.266	1157.63	12.03	-3.7%
1000	99.959	1289.33	12.90	100.144	1236.78	12.35	-4.2%
1080	108.560	1539.19	14.18	108.040	1462.54	13.54	-5.2%

In motor three, we saw that system level efficiency can be improved by up to 8.4% varying across motor speeds while using DRV10974.

One of the key value propositions of DRV10974 is the ability to enter into a low-power mode when the motor is not spinning to conserve additional power as shown by the idle current in the table above.

As shown in the data above, TI's DRV10974 outperforms competitor A at all target speeds across different motors offering engineers the best efficiency for their low voltage fan applications. Consider this when designing your next low voltage appliance fan system.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265