Infineon BLDC Shield + XMC 4700 Relax Kit + Motor - Review
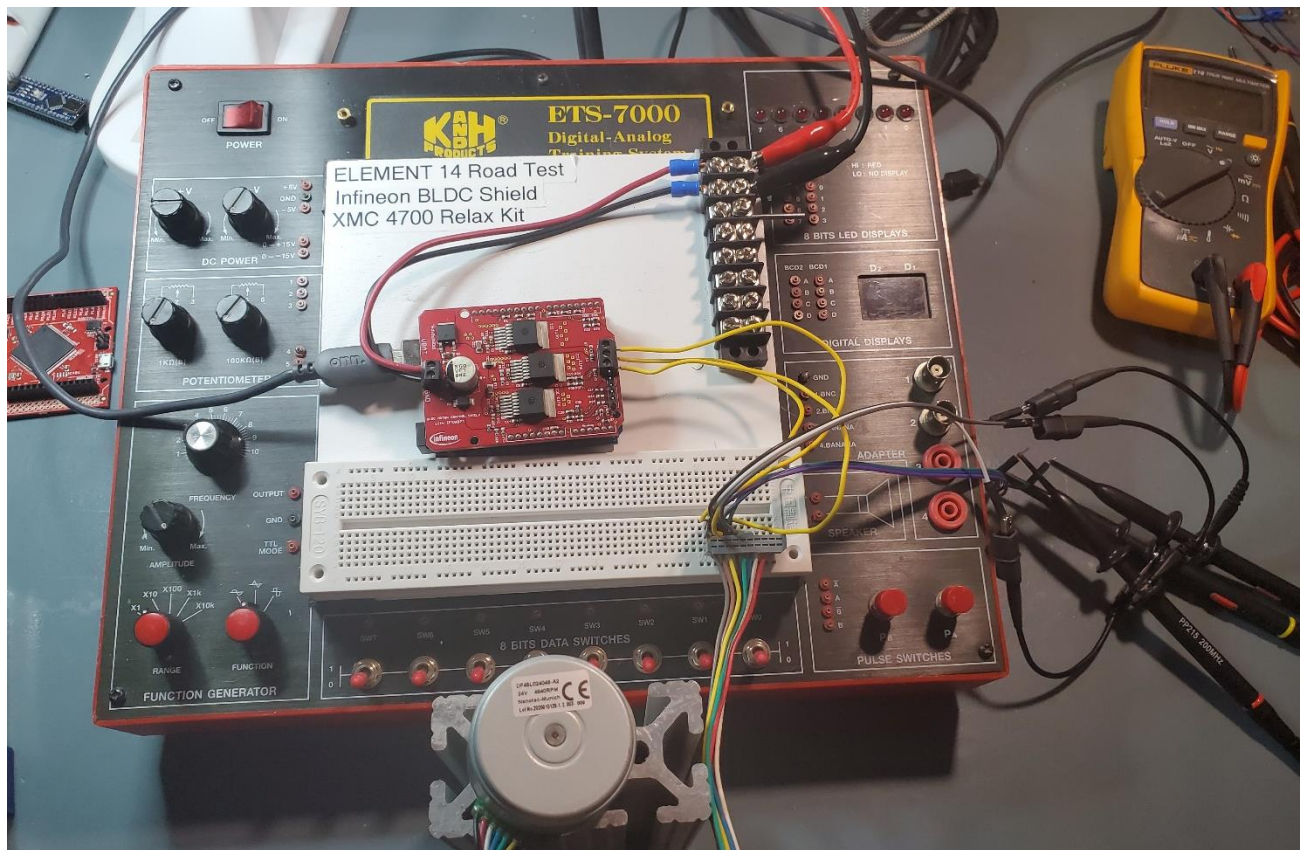
created by Roy Morris on December 26, 2020

Scoring

1. **Product Performed to Expectations:**   8

2. **Specifications were sufficient to design with:**   8

3. **Demo Software was of good quality:**   6

4. **Product was easy to use:**   7

5. **Support materials were available:**   10

6. **The price to performance ratio was good:**   8

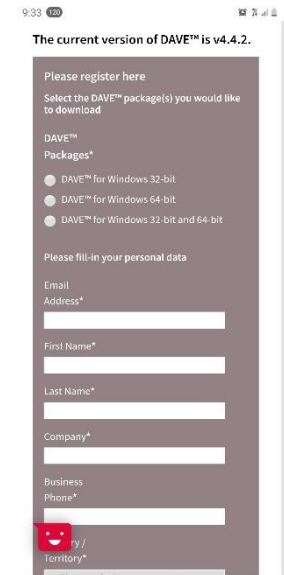**TotalScore:**   47/ 60

RoadTest: <u>Infineon BLDC Shield + XMC 4700 Relax Kit + Motor</u>

- **Evaluation Type:** Development Boards, Software, and Motors

- **Was everything in the box required?:**
  Yes, was packaged professionally.

- **Other Conponents Used**
  Arduino Uno
  Garett ML5008 Brushless Motor

- **Test Equipment Used**
  Siglent 1204X-E Four-channel O-Scope
  Siglent SPD3303X-E Power Supply
  Wanptek DPS3010U Power Supply
  Fluke 116 Multimeter

- **Software Downloaded**
  Arduino IDE
  Infineon Dave
  J-Link V 6.92
  IFX007T BLDC Library

- **Computer Used**
  HP I7 11th Gen
  16GB Ram
  512GB SSD

- **Other Equipment Used**
  Siglent 1204X-E Four-channel O-Scope
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By: Roy Morris

Software Installation

To start off I went to the Infineon web site to download the "DAVE" program. First thing was to register which was done.

After filling out the form, I received an email back to verify my contact info. After doing so it took me to the download page where I was to download Windows 64bit version 4 of DAVE.
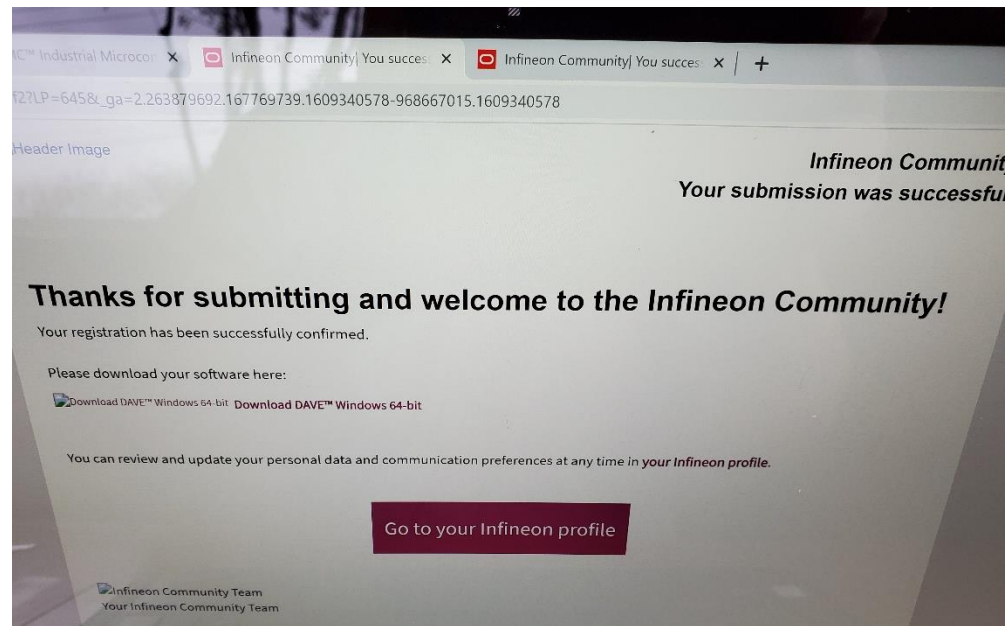
Right-click and open in another window.

Here is where I encountered the biggest problem related to the Road Test. Infineon "DAVE" program. "DAVE" was a 1.2GB download nightmare. I have about 8 hours trying to download a useful copy and 2 hours to unzip it and get it to work. The problem?

> "DAVE" kept going in loops of registering for download then getting to the download page and going right back to registering page when the download option was selected. This happened on multiple days on different networks. I brought my laptop everywhere so I could try different places and networks. It happened over and over again. I even bought a new computer, which I was going to do anyway, and you guessed it, a no go. The solution happened by right clicking the download button and then open in another window and walla, it was a go! Then the 1.2GB program began to download. Once I had the

zipped file I selected all and extract. To find the "Dave" application file was the next issue. It was buried deep in the many layers of program files. When I found it the program found most files were still not unzipped. It took 2 hours to further unzip. This whole experience was nerve racking to say the least. When I went to use it I found it to be somewhat cumbersome and at this point decided I will use the Arduino Uno board exclusively on the road test.

After going to the Arduino Uno platform I found the experience very pleasant.

IFX007T BLDC Shield
o Arduino Uno compatible headers.
o Three smart IFX007T half-bridges and capable of high-frequency PWM e.g. 30kHz
o 8–40V nominal input voltage with over-temperature and overcurrent protection.
o Brushed and brushless DC motor control up to 300W continuous load.
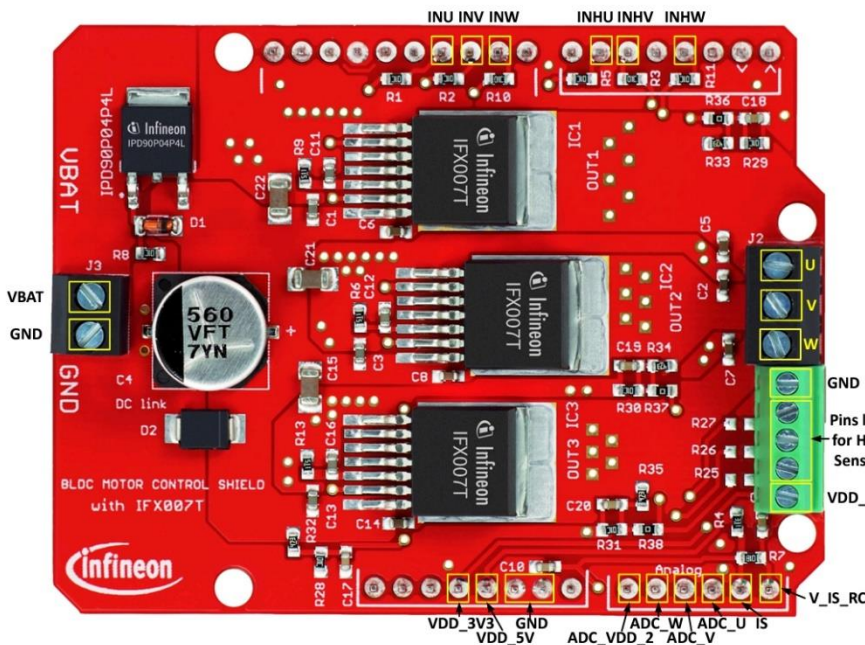

A rock solid board for driving a BLDC motor.

To use the magnetic encoder provided with the Nanotec motor requires the modification of the BLDC shield with SMT resisters. Being that this is a road test I was disappointed. Why provide a motor with magnetic encoder without sending the proper board to test it? That being said I found this board excellent in controlling the Nanotec motor and to some extent the Garett motor which was outside the specs on what the board could do. The BLDC Shield comes ready for sensorless operation without changing the SMT resistors. I will be using this board on future projects! It is robust and easy to use.
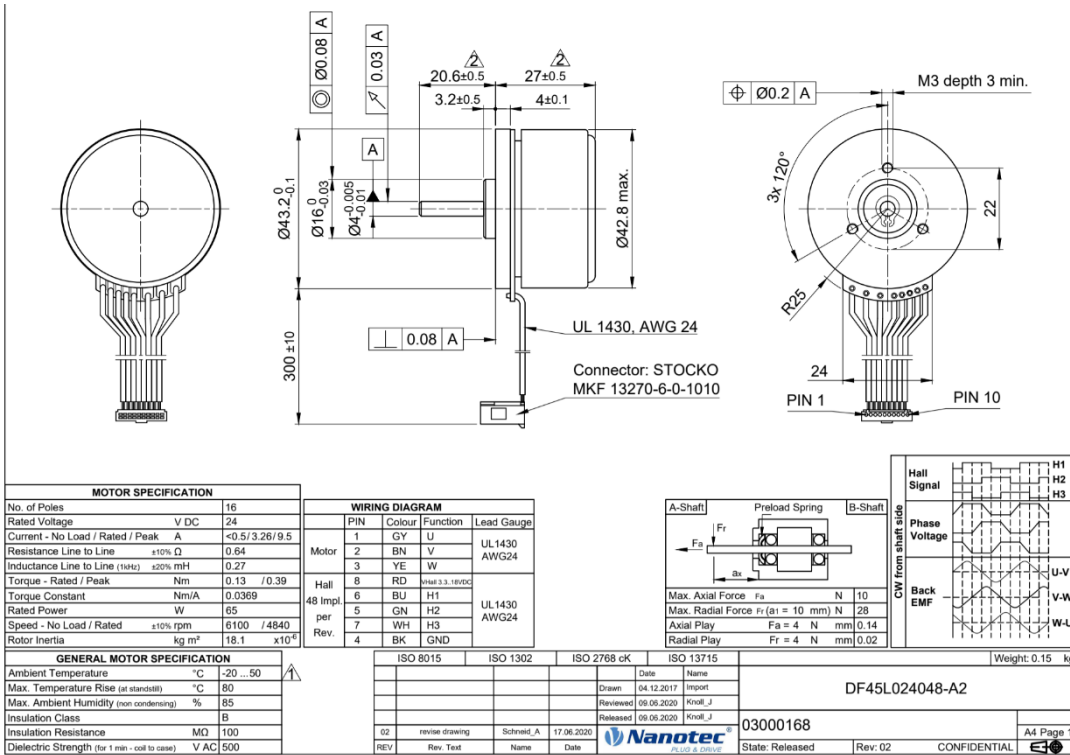
XMC4700 Relax Kit

- XMC4700-F144 Microcontroller based on ARM® Cortex®-M4 @ 144MHz, 2MB Flash and 352KB RAM.
- On-Board Debugger and Power over USB.
- Arduino hardware compatible 3.3V and 5.0 V pinout (I'm using 5V).
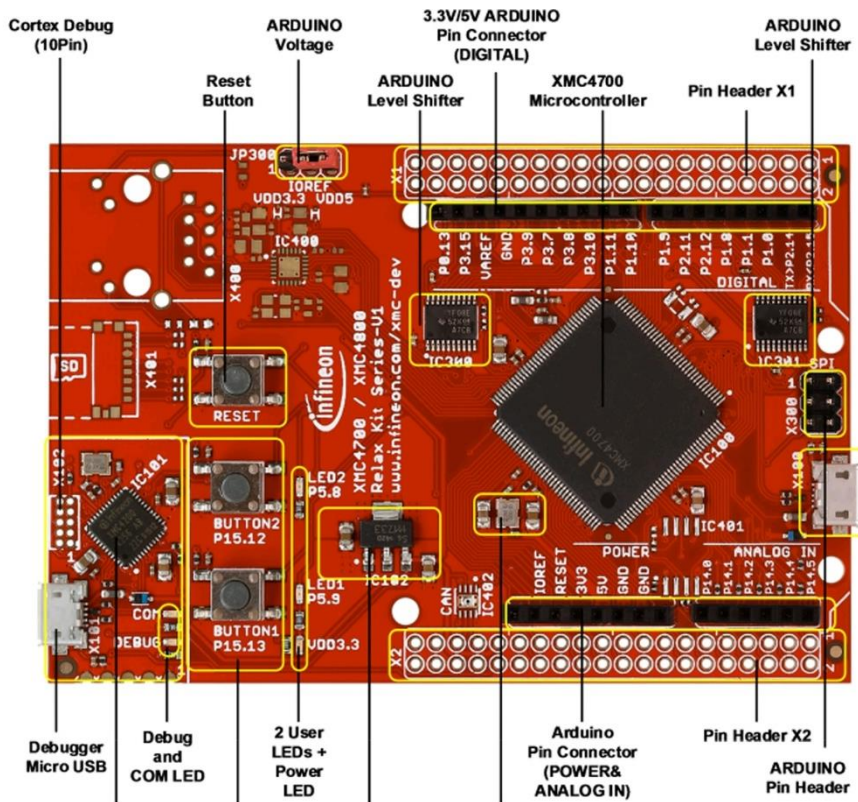
Nanotec BLDC Motor

o 16 pole motor with 3 hall positioning sensors.
o 6100 RPM No-Load operation
o 65W rated power.

This motor was exciting and powerful! I definitely plan on using it in the future!

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MOTOR SPECIFICATION		
No. of Poles		16
Rated Voltage	V DC	24
Current - No Load / Rated / Peak	A	<0.5/3.26/9.5
Resistance Line to Line ±10% Ω		0.64
Inductance Line to Line (1kHz) ±20% mH		0.27
Torque - Rated / Peak	Nm	0.13 / 0.39
Torque Constant	Nm/A	0.0369
Rated Power	W	65
Speed - No Load / Rated ±10% rpm		6100 /4840
Rotor Inertia	kg m²	18.1 x10⁻⁶

GENERAL MOTOR SPECIFICATION		
Ambient Temperature	°C	-20 ...50
Max. Temperature Rise (at standstill)	°C	80
Max. Ambient Humidity (non condensing)	%	85
Insulation Class		B
Insulation Resistance	MΩ	100
Dielectric Strength (for 1 min - coil to case)	V AC	500

WIRING DIAGRAM				
	PIN	Colour	Function	Lead Gauge
Motor	1	GY	U	UL1430 AWG24
	2	BN	V	
	3	YE	W	
Hall 48 Impl. per Rev.	8	RD	VHall 3.3..18VDC	
	6	BU	H1	
	5	GN	H2	UL1430 AWG24
	7	WH	H3	
	4	BK	GND	

Garett ML5008 (NOT part of the kit)

o 12 pole motor with magnetic encoder
o 6100 RPM No-Load operation.
o 760W rated power (MAX)

As expected the 760W rating exceeded the boards specifications. The **IFX007T BLDC Shield** still ran it but under safety limiting conditions.
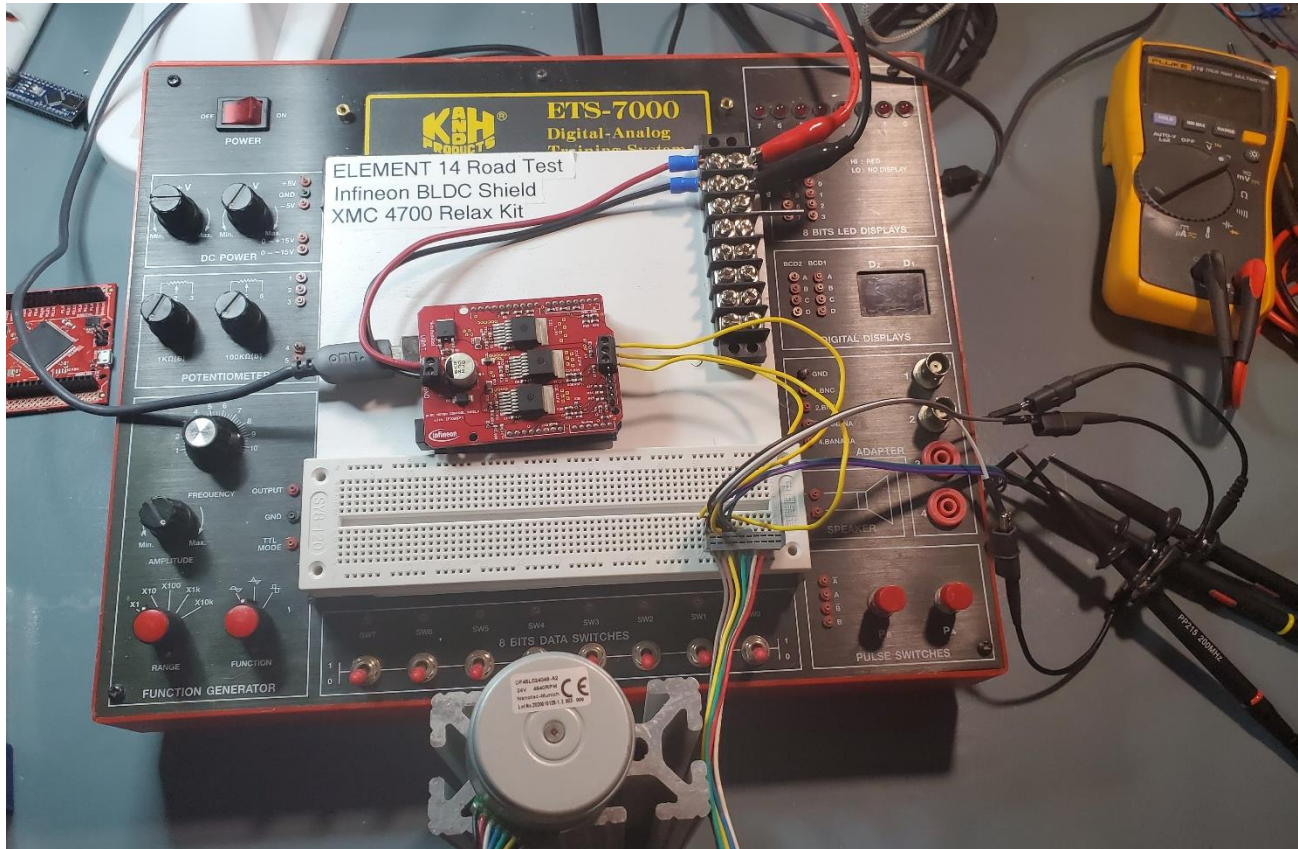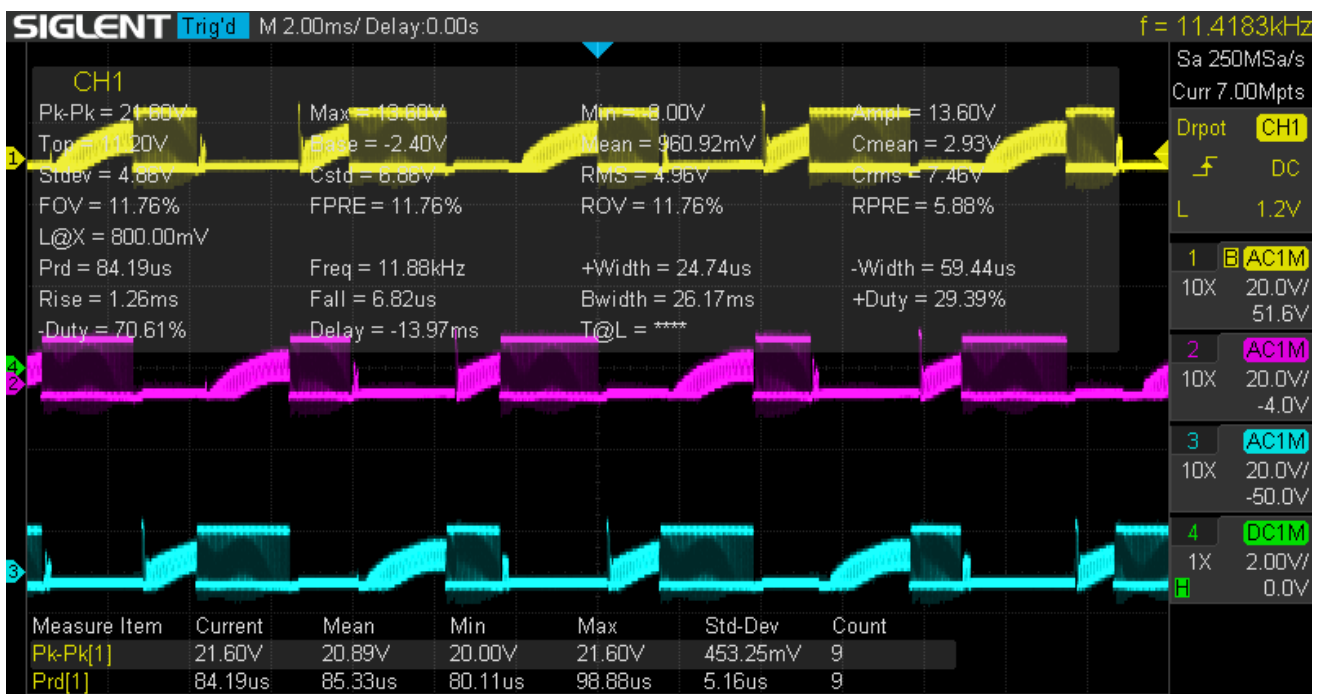
Getting Started
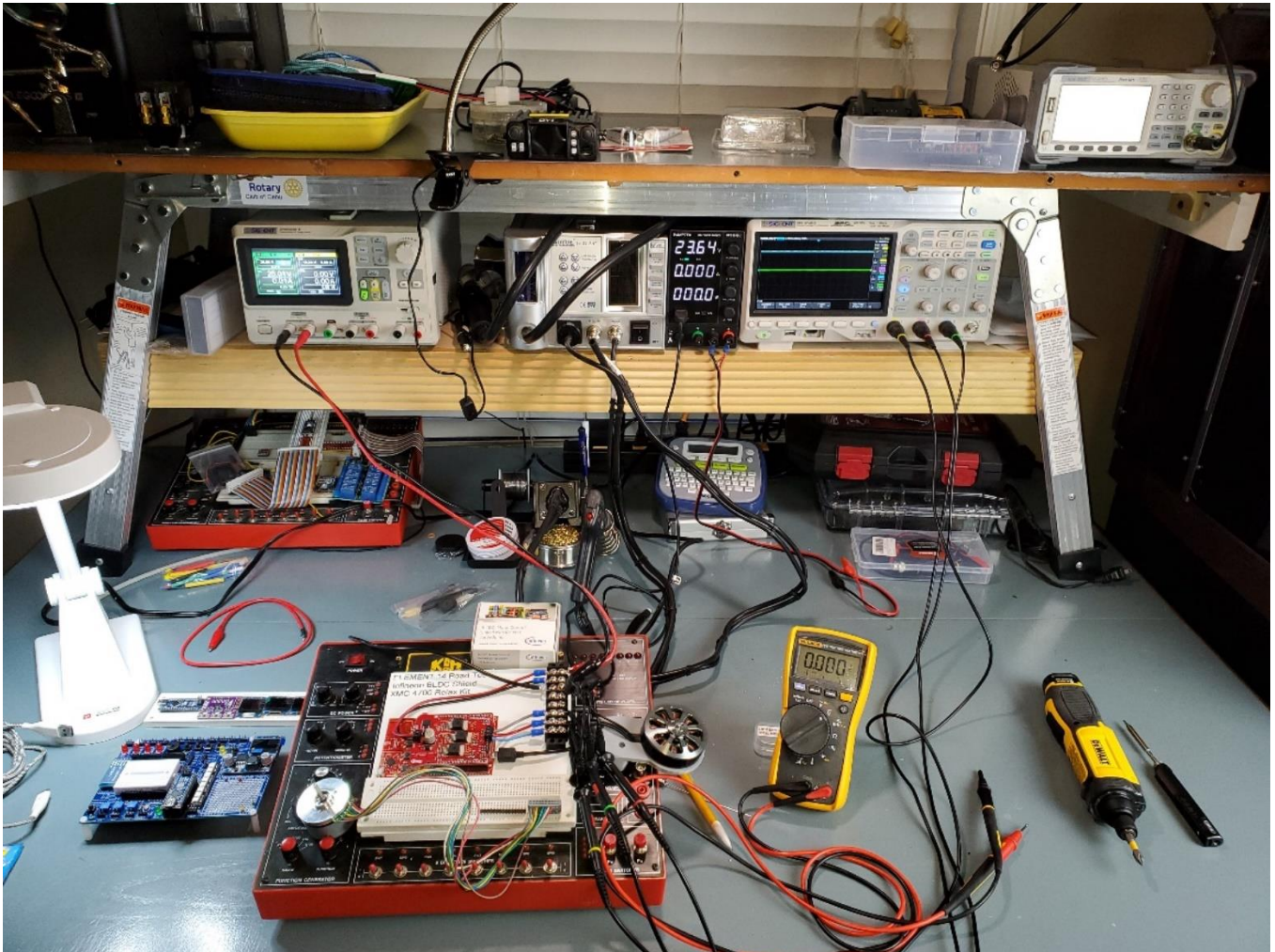
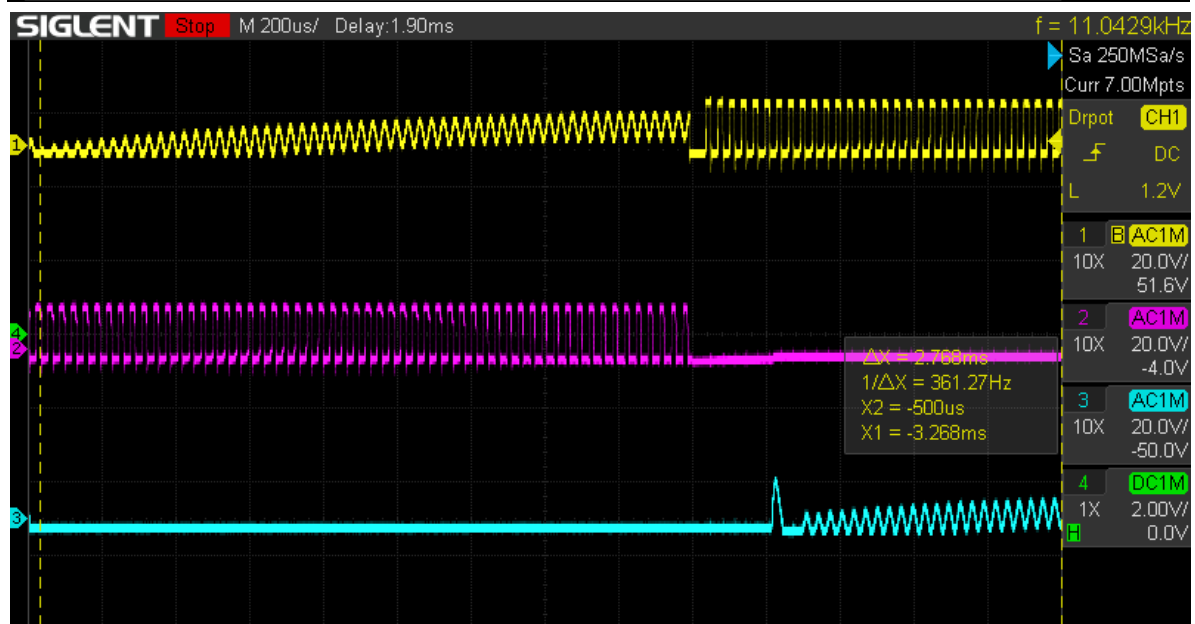**My test bench**

Road Test with Nanotec BLDC Motor
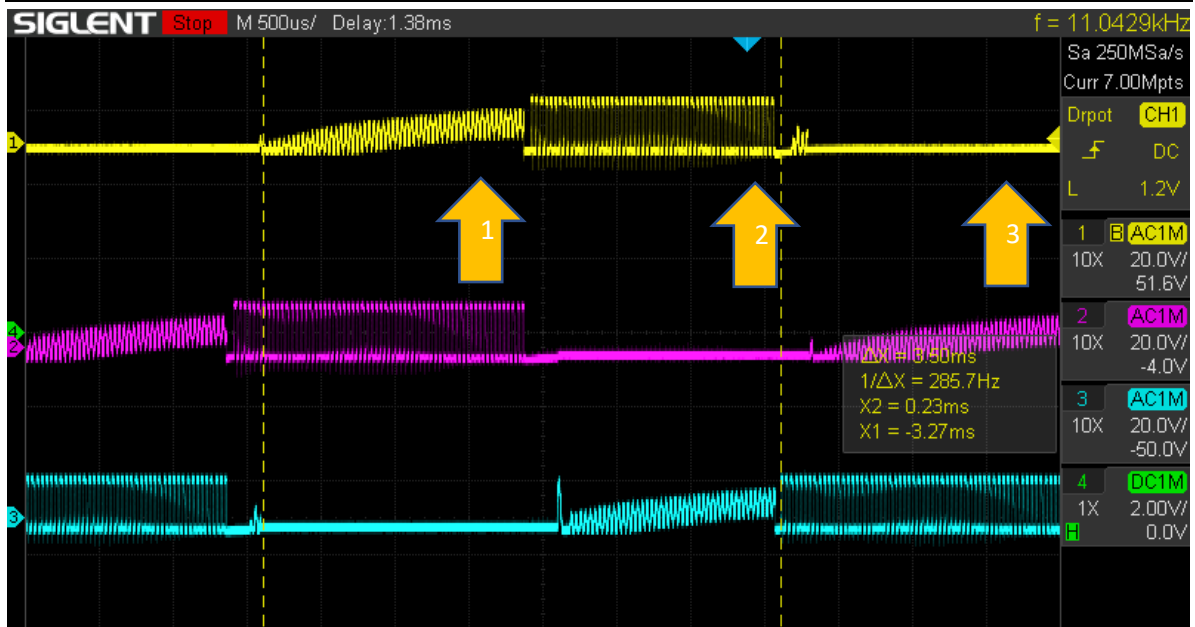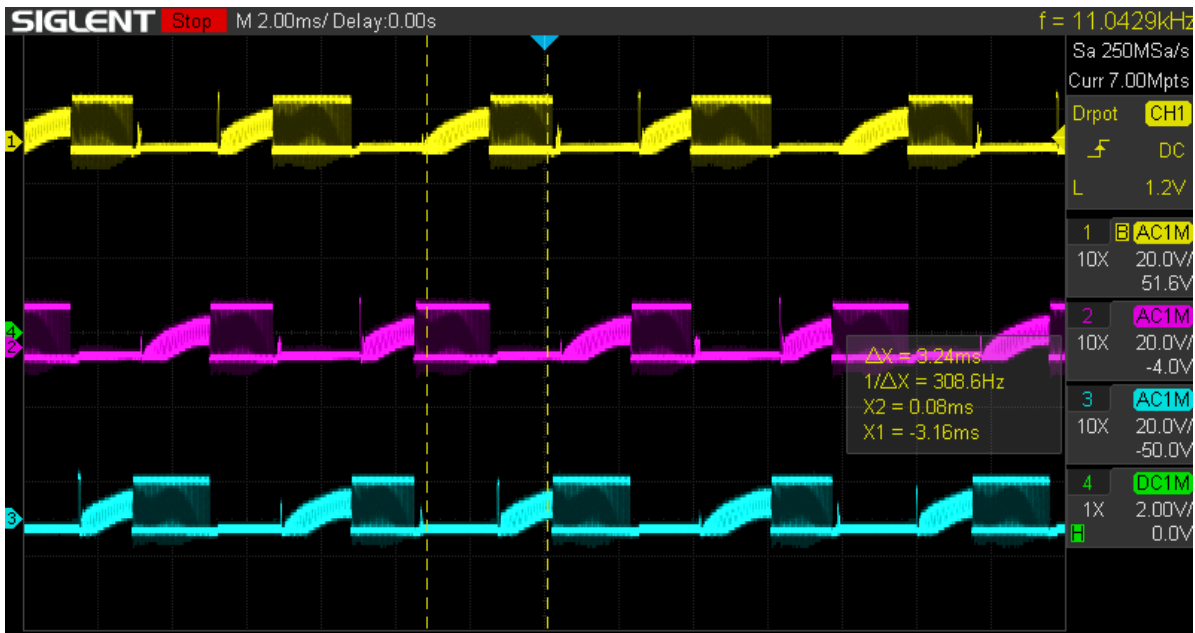

O-Scope Leads
1   Yellow   U   Common (-)
2   Red   V   Common (-)
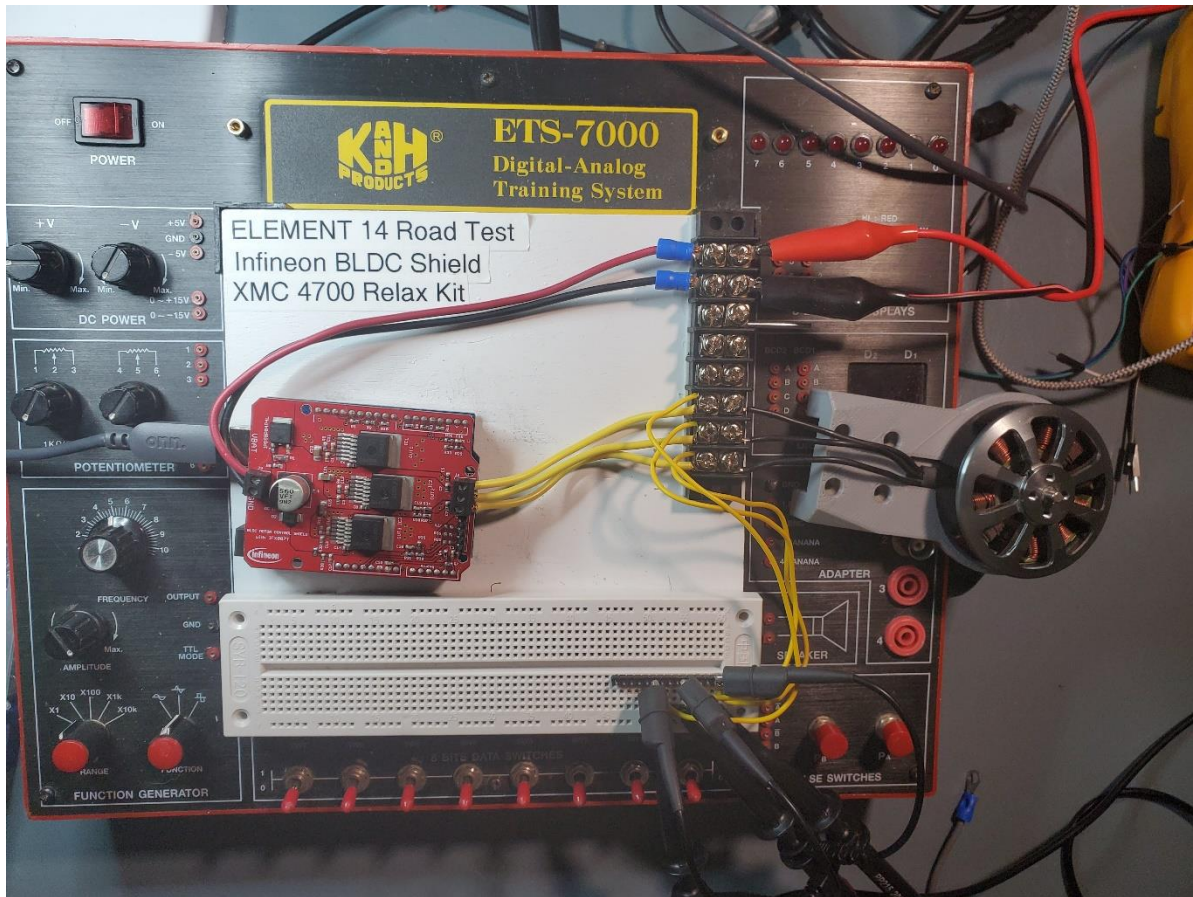3   Blue   W   Common (-)

Three 60 Degree cycles with the off state on the third arrow

The BLDC motor works by trapezoidal commutation. It is a DC controlled three phase system. The current is controlled two at a time with a third always being turned off. The waveforms created from my oscilloscope highlights this perfectly. The three IFX007T chips drives each winding for 120 degrees then is off for the next 60 degrees. The voltage control is by Pulse-Width-Modulation (PWM) which is applied in the appropriate sequence.
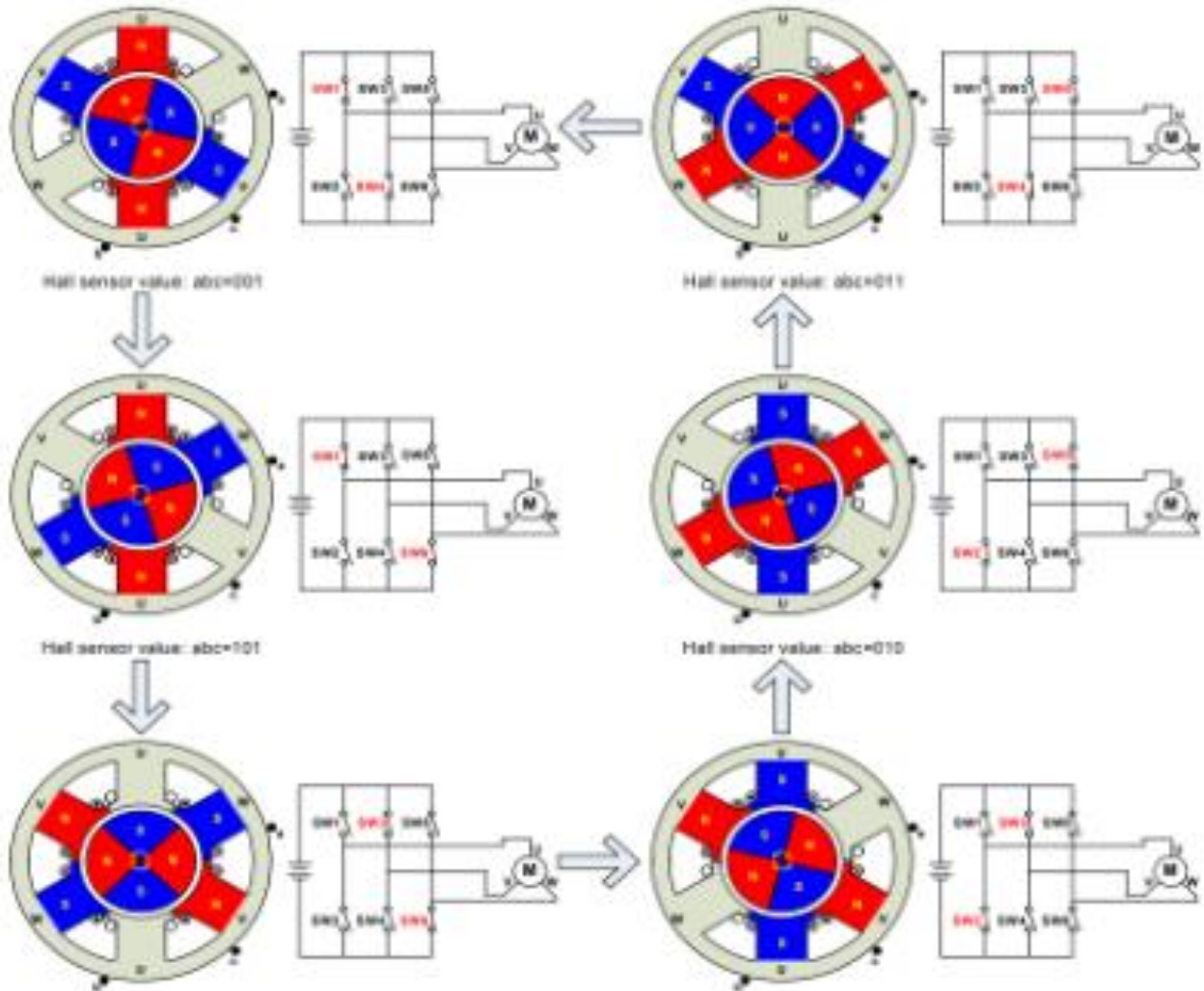
The XMC4700 microcontroller or Arduio Uno generates the PWM signal which is fed to 3 of the IFX007T driver ICs on the shield and they facilitate in the smooth running of the Nanotec 16-pole BLDC motor.

Road Test with Garett ML5108 Motor

O-Scope Leads

1	Yellow	U	Common on Red
2	Red	V	Common on Blue
3	Blue	W	Common on Yellow

Since the Garett ML5108 motor is beyond the specs of the **IFX007T BLDC Shield** I wanted to check it anyway but the board has a thermal and current safety cutoff so all I could get is a 1 second run time before they engaged. Unfortunately this is all the waveforms I could get.
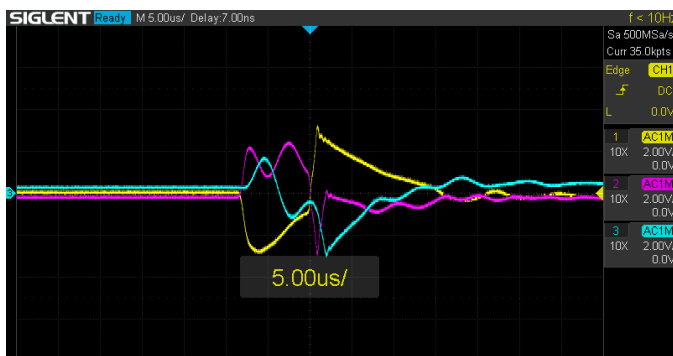
Questions Asked On Element 14

Have you measured the currrent profile while you run through the various speeds?

Yes, Increase in current gave a higher speed and was linear.

Have you put the motor under load and tested the over current features?

Yes, The Nanotec motor grinds to a stop and the poles hold the motor stationary at 16.65 volts @ .75 amps and 12.4 volts 1.04 amps under load.

What motor library did you use with the Arduino?

Used pole counter and Sensorless BLDC

Did the vendor supply it or just a public available library?

Supplied by vendor

Summary

While the start of this Road Test was somewhat irritating with the software download the ending was great! I learned a great deal more about BLDC motors, how they work and how to control them. I do like the kit provided and would recommend it to anyone who needs to control a small BLDC motor or like me wants to learn more about them.

I would like to suggest for future versions of the IFX007T board to include a way to use jumpers to be able to select whether you are using hall effect sensors or not. It would increase the experience in using this board, It would also be good to have someone look at the Dave program and identify the small issues and fix them.

I would like to thank Element 14 and Infineon for picking me to test their product. It was a good experience!

Sincerely,

Roy Morris