Digital Motor Control for Hybrid-Electric Aircrafts

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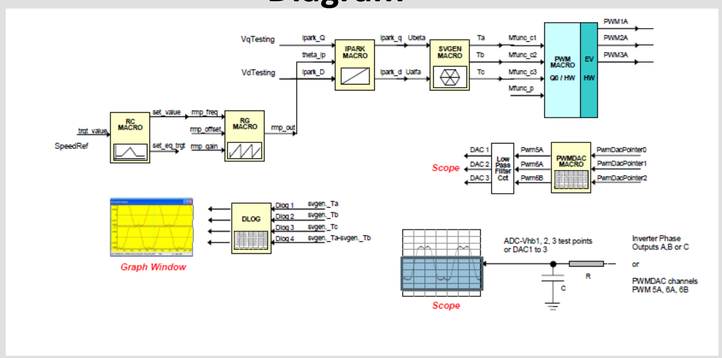
Introduction

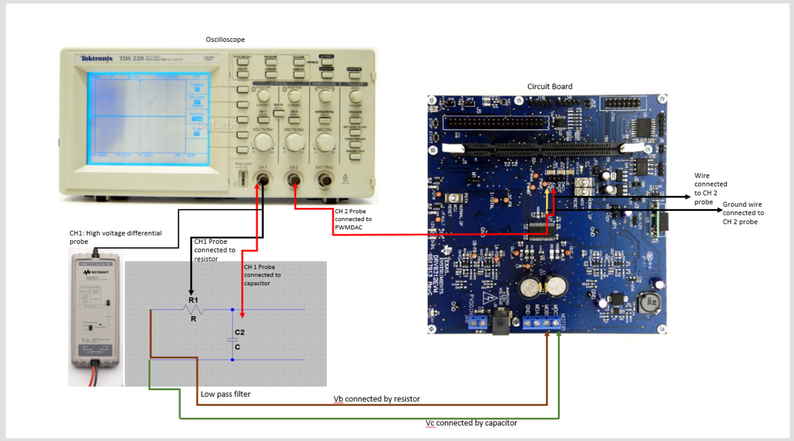
Transforming aviation to improve aircraft shapes, propulsion and efficiency has led to studies for future electric aircraft that consume only half as much fuel and reduce more than 50 percent of current emissions. NASA's X-57 'Maxwell' is an all-electric plane that has 14 electric motors turning propellers. Testing multiple digital motor control drivers through fractional horsepower development kits and software allow understanding of the basic operation of the motor.

Experimental Setup

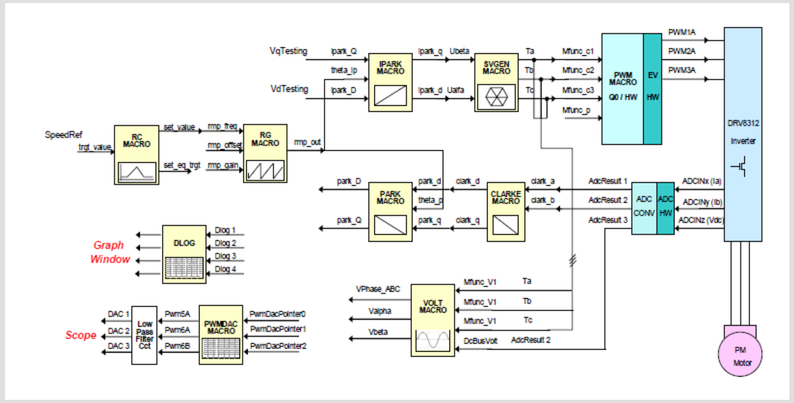
Incremental System Build Block Diagram



In this step the motor is disconnected and peak to peak measurements are taken.

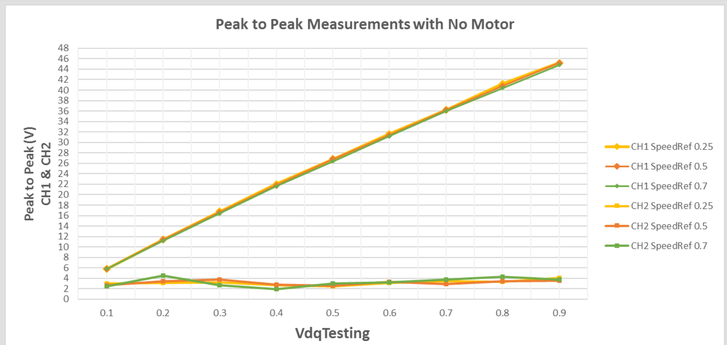


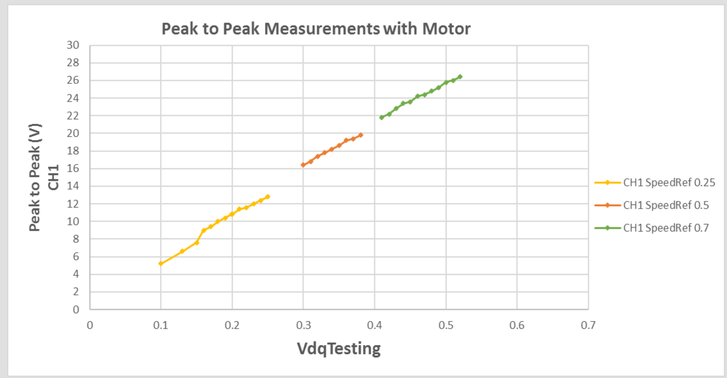
The diagram displays the actual setup of the first level experiment where the motor is disconnected. CH 1 is the voltage probe (10:1 ratio) connected to low pass filter, and CH 2 is connected to the PWMDAC pins on the circuit board.



In the second level the motor is connected to the circuit board where CH 1 is the voltage probe at 10: 1 ratio and CH 2 is the current probe at 100mV/amps.

Results





Conclusion(s)

No Motor:

- The line-to-line output voltage varies with VdqTesting linearly.
- The output of the PWMDAC voltage appears to be automatically scaled, probably because the maximum voltage swing is limited to 5Volts, in addition the internal F28069 computations are dealt with on a per – unit basis. In CH2 the minimum occurs at 0.4 and 0.5 VdqTesting values.
- The results also indicate that changing the speed reference do not effect the peak to peak measurements.

With Motor:

- The CH1 data indicates that the motor starts to run at various VdqTesting values.
- At lower speedRef the peak to peak measurements are lower as compared to the higher speedRef.

Reference(s):

- Oscilloscope High Voltage Differential Active Probes . (2017, July 27). Retrieved from http://www.keysight.com/en/pc-1659316/oscilloscope-high-voltage-differential-active-probes?nid=-32554.0&cc=US&lc=eng

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