



Hardware Data Router

Final Presentation

Group: 9

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ECE 445

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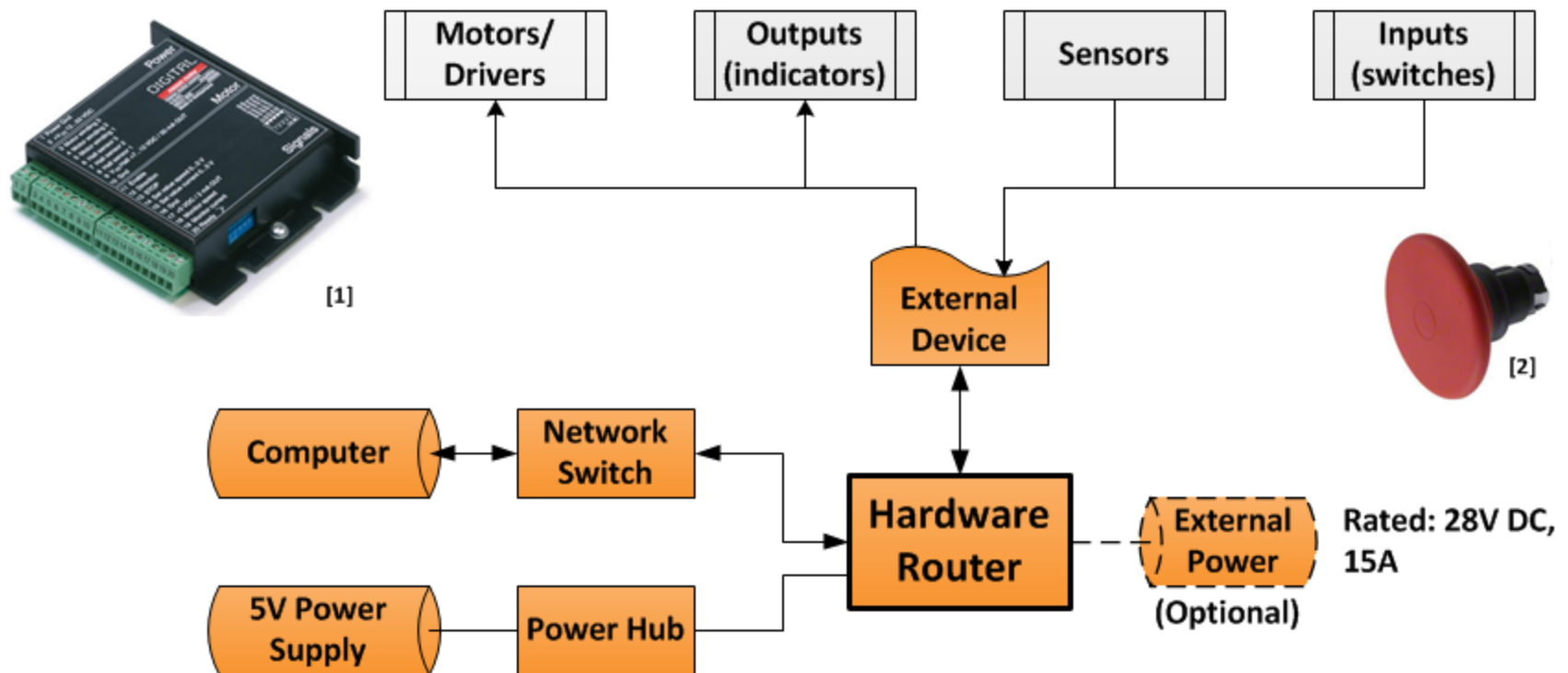
Overview

- Key Features
- System Overview
- Hardware
- Software
- Changes
- Results and Challenges
- Applications and Future Work

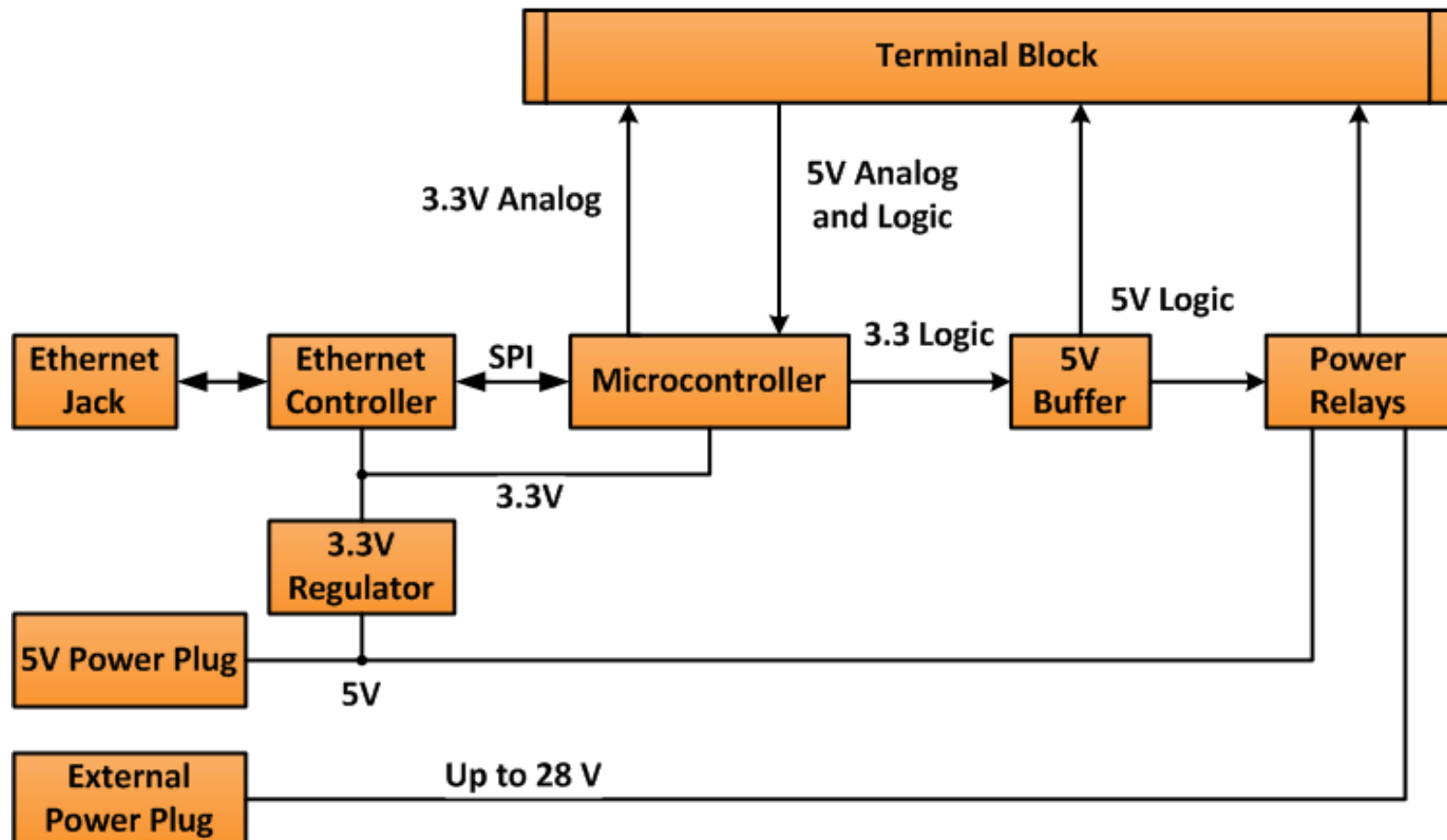
Key Features

- Ethernet interface for devices without a direct computer connection
 - Digital connection for virtually any device without an existing interface
 - Adaptable to any hardware and software
 - No specific drivers
 - General purpose pins

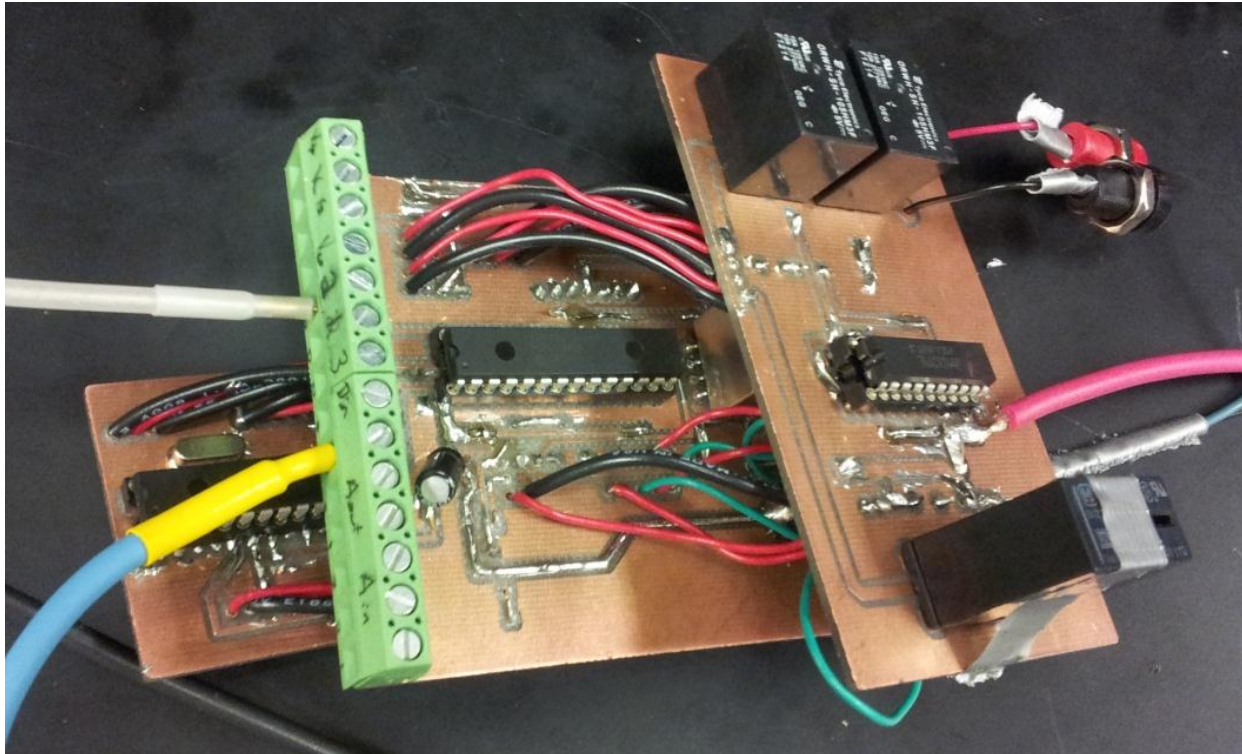
External System Block Diagram



Internal System Block Diagram



Hardware



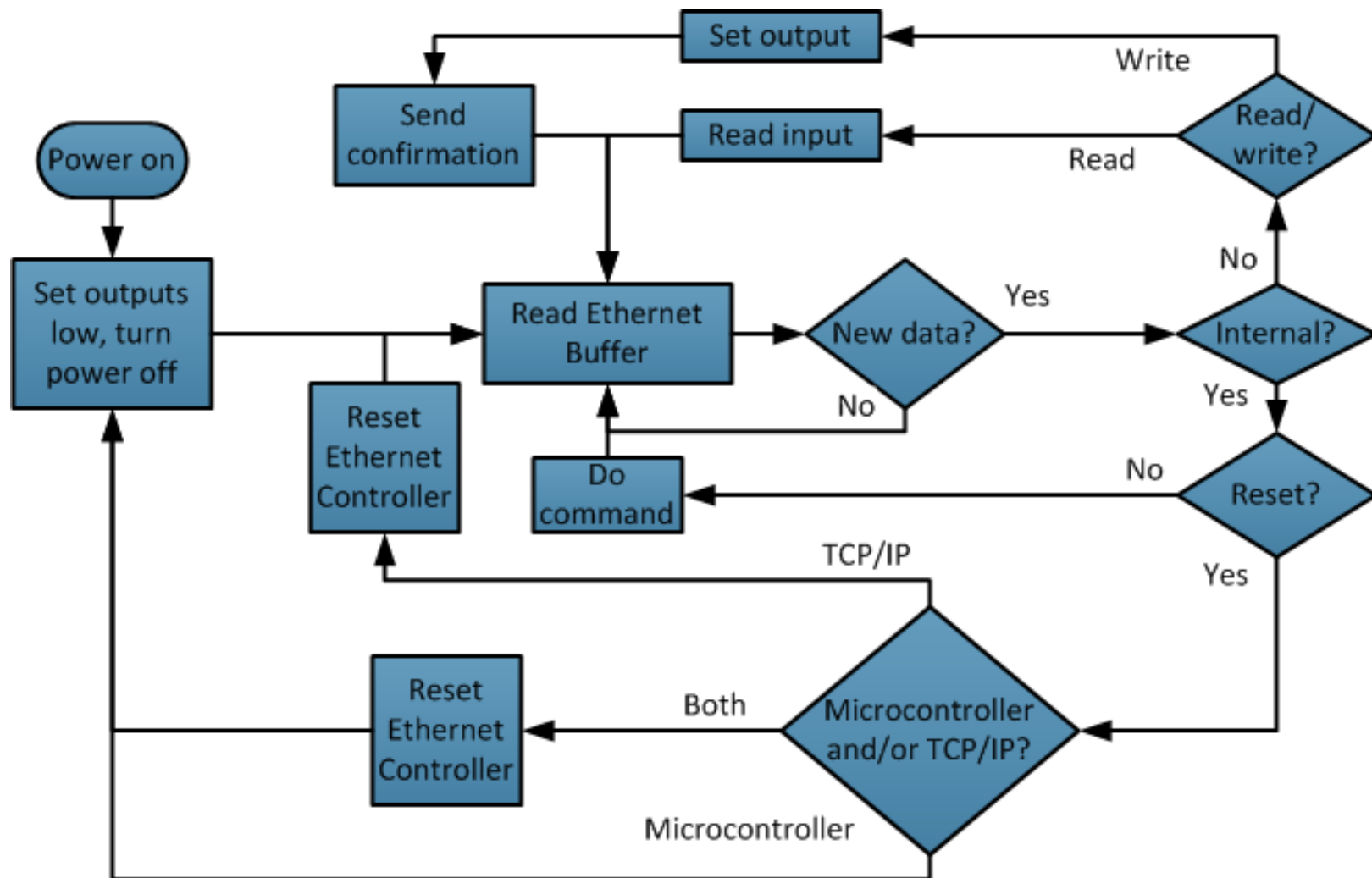
Microcontroller Selection

- dSPIC33FJ64MC802
 - Fast (clock frequency of up to 80 MHz)
 - Sizeable Program Space (16 KB)
 - DMA or Direct Memory Access
 - The CPU isn't slowed down by handling transfer from Peripherals to Memory
 - Reprogrammable Pins
 - Power Efficient
 - Sleep Modes and Clock Postscalars

Microcontroller

- Digital I/O capability
- Analog input
- PWM (output)
 - Sinusoid/Square Wave Outputs
 - Frequency
 - Duty Cycle
- Controlling Ethernet Controller
 - TCP/IP Stack

Data Flow



Data Transfer Protocol

- Used with any program that supports communication over Ethernet

4 bytes	m bytes	4 bytes	n bytes	...	4 bytes	x bytes	4 bytes
String <i>Length 1</i>	Relevant Data 1	String <i>Length 2</i>	Relevant Data 2	...	String <i>Length k</i>	Relevant Data k	Termination (n/h,A-Z,0-9,&)

- Length of data is defined in string *Length*
- Example: Analog Write

4 bytes	2 bytes	n bytes	4 bytes
String length	A2	Analog Waveform Properties	Termination

Predefined Instructions

- Microcontroller Status
 - Pins status
 - Reset pins
 - Set V_logic
 - Set V_external
- Analog Read – Sampled data
- Analog Write – Waveform, Frequency, Duty cycle
- Digital Read – Sampled data
- Digital Write – String of bits

Design Revisions

- Changed microcontroller package
 - “General purpose” to “motor control” series
 - Substituted larger component packages for lost or hard to handle parts

Requirements and Verifications

Requirements

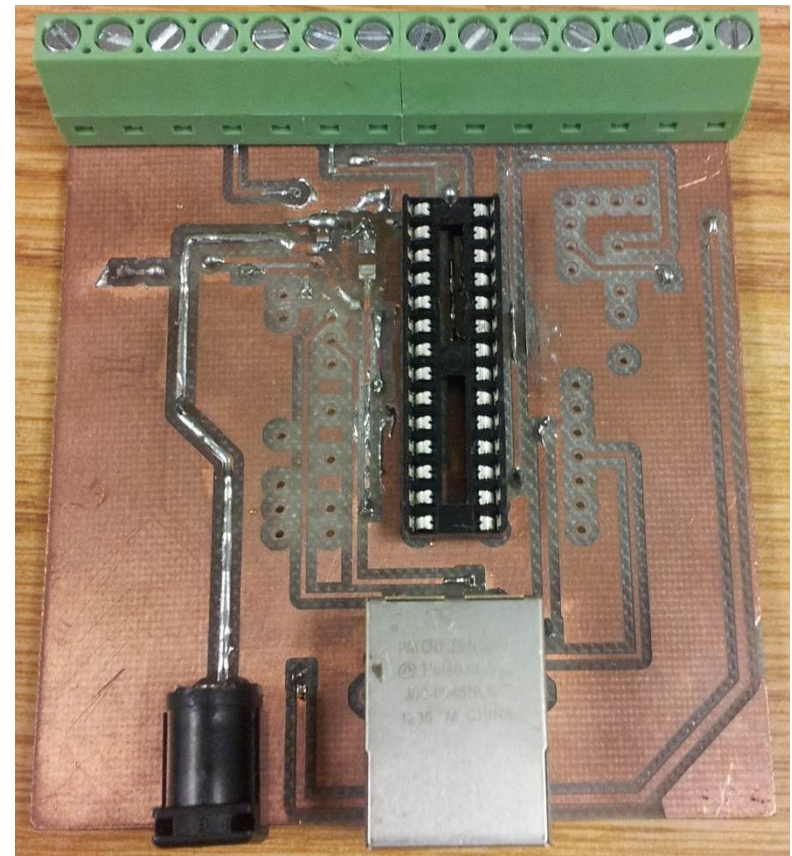
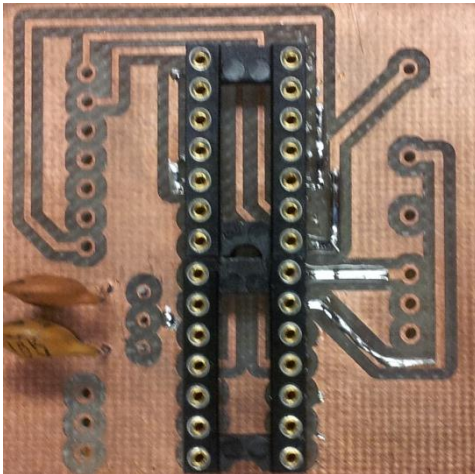
1. Hardware Router
2. Microcontroller programming
3. Ethernet Controller
4. LabVIEW program

Verifications

1. Continuity tests
2. Output signals
3. Integration with microcontroller
4. Data transfer

Hardware Testing

- Continuity tests
- Simple programs



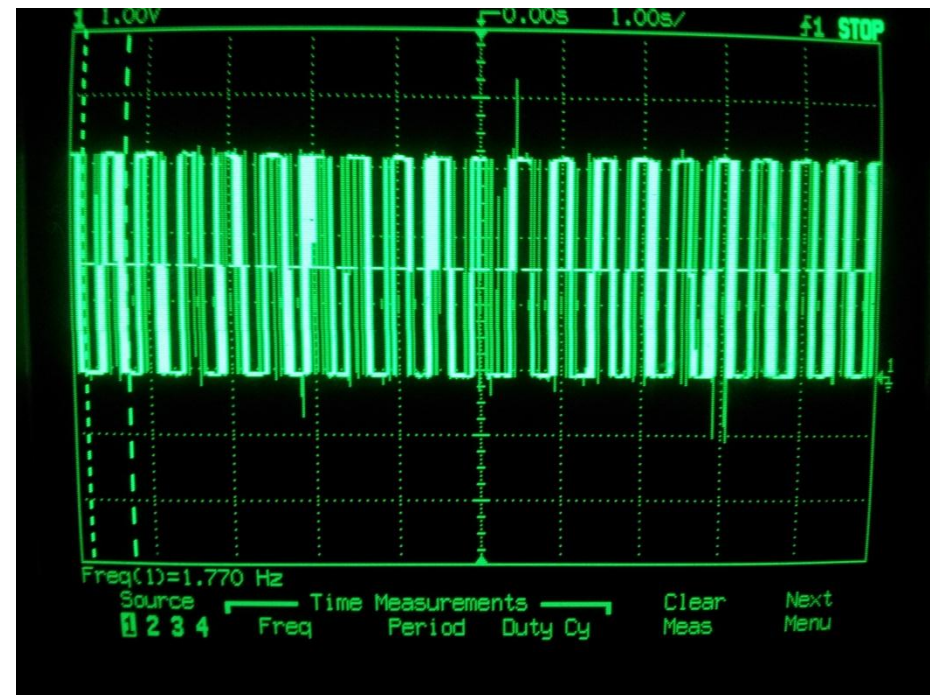
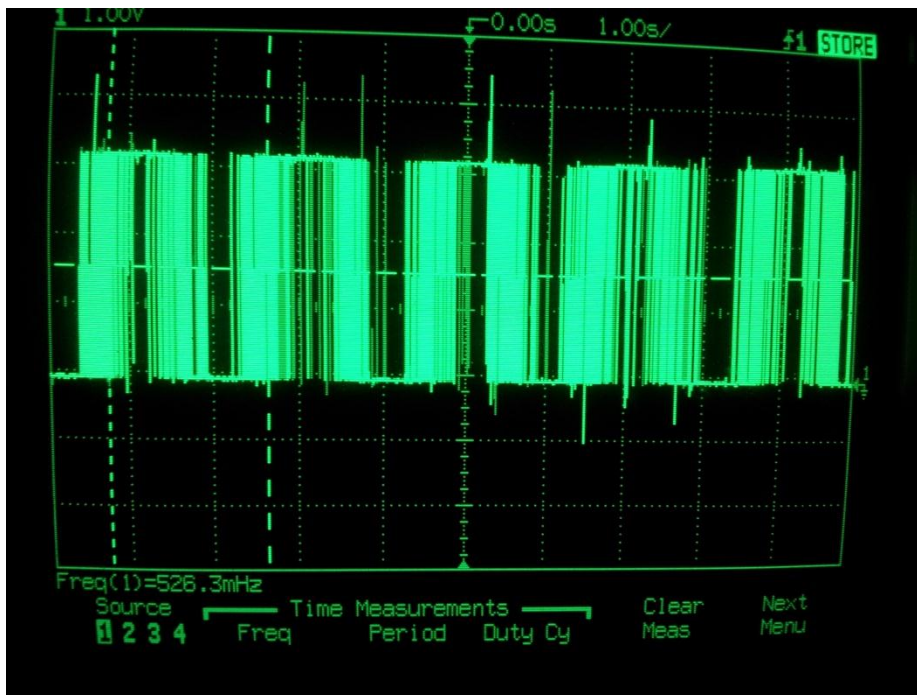
Microcontroller Testing

- PWM output
 - Frequency limits
 - Duty cycle behavior
- Digital output
- Digital input verification
 - Control of other output signals

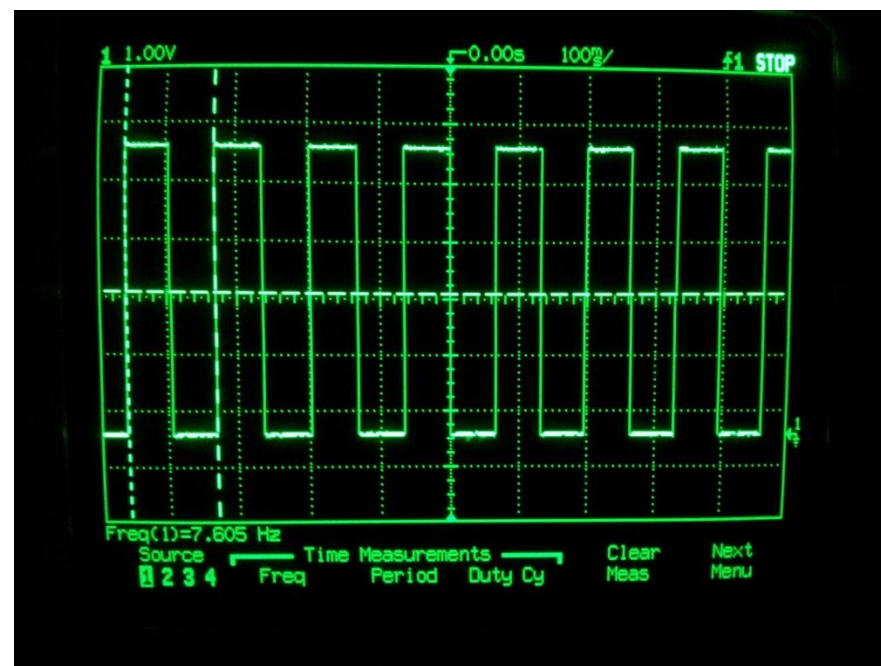
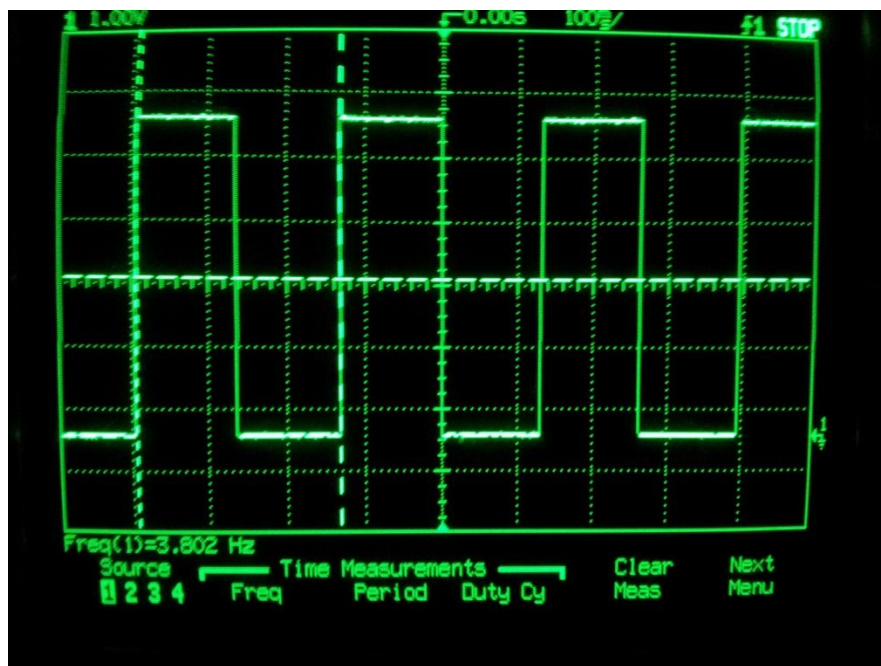
PWM Output Frequency and Duty Cycle

Program Set PWM Frequency (KHz)	Measured Resulting PWM Frequency (KHz)	Measured Duty Cycle when Duty Cycle was Supposed to be 70.1% (%)	Measured Duty Cycle when Duty Cycle was Supposed to be 82.3% (%)
39.1	41.49	70	80
41.49	41.49	70	80.1
50	51.88	66.6	
60	62.21	70	
62.21	62.21	70	80.1
70	77.82		
77.82	77.82	68.9	81.3
80	88.89	64.4	
100	103.9	66.6	
500	623.1	50	
623	623.1	50	
700	623.1	50	
1000	623.1	50	

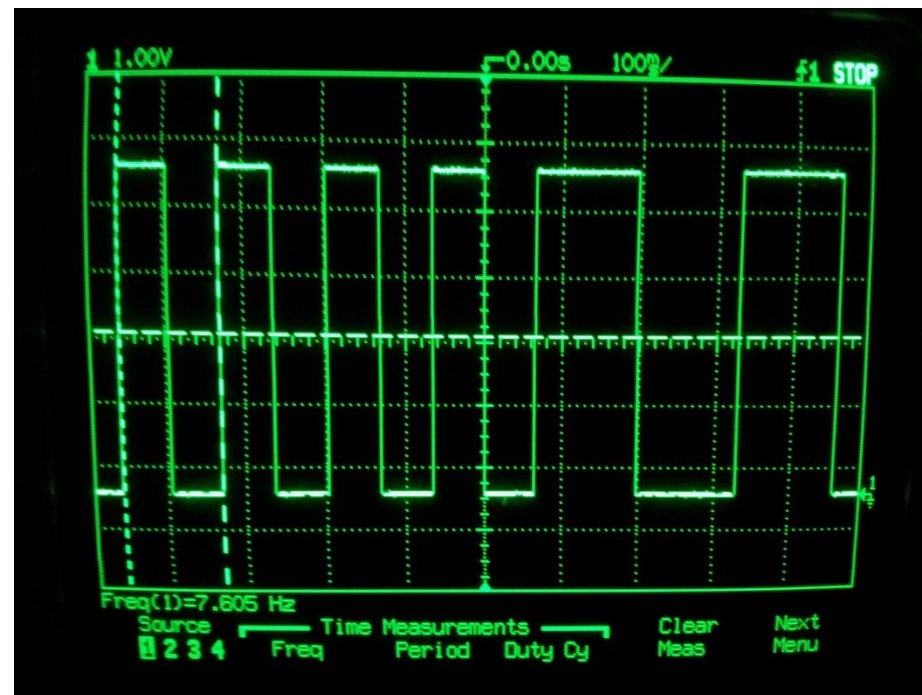
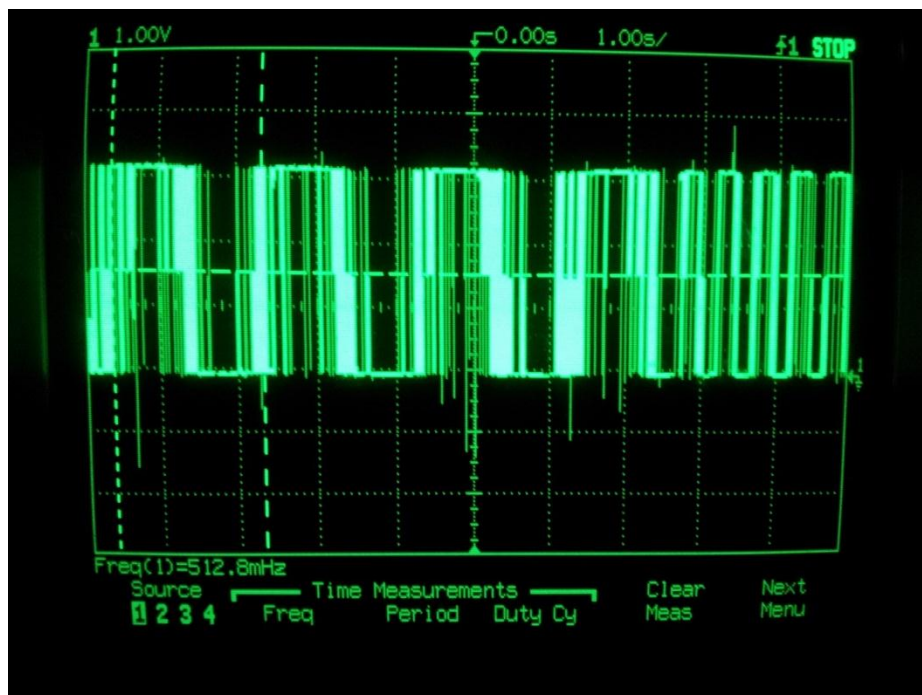
Sinusoid Wave from PWM



Digital Out



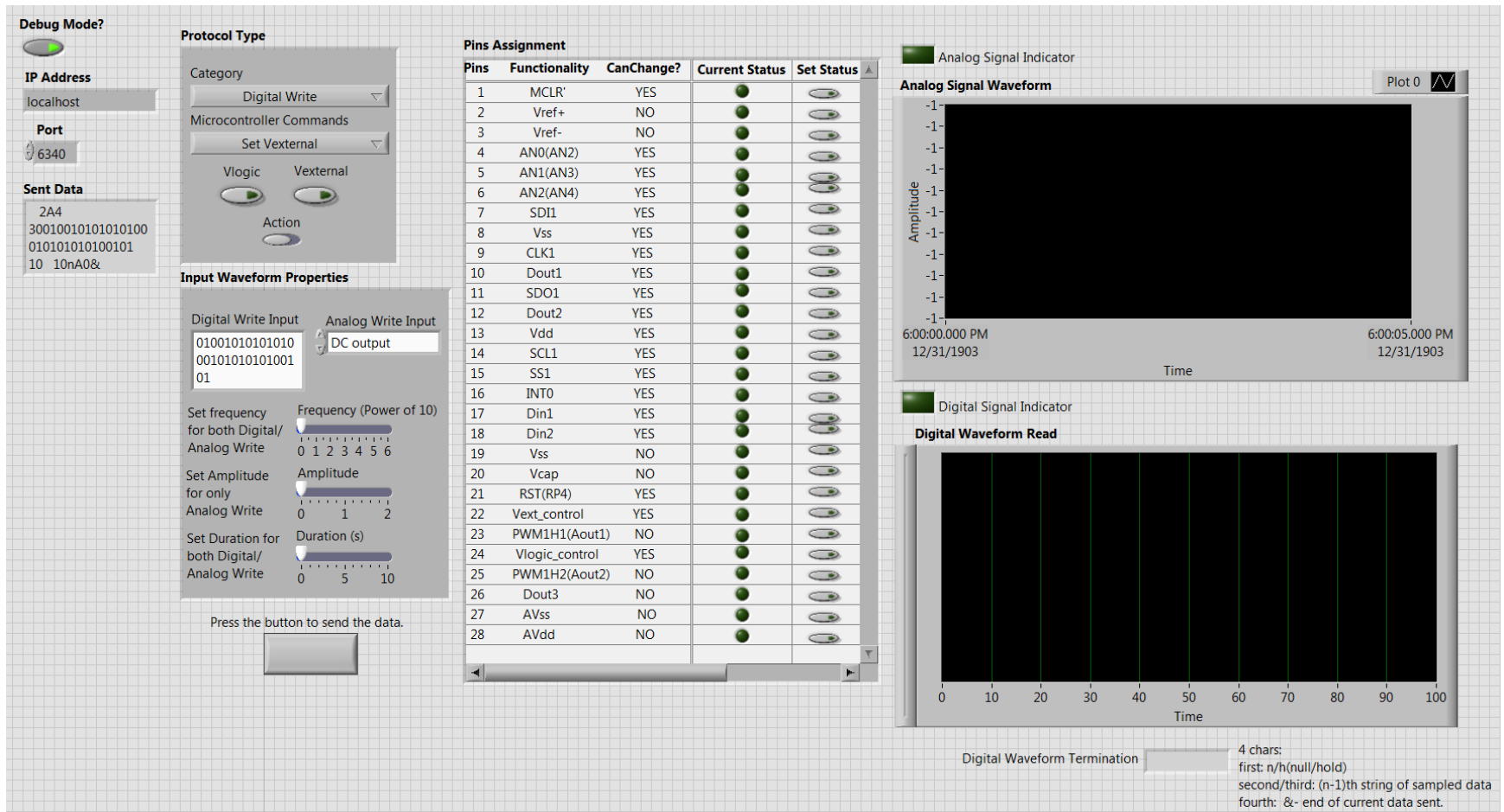
Digital In



Ethernet Controller Testing

- Successfully compiled
- Simulation ran completely through
- Outputs set to light LEDs at parts of the main loop
- Only the clock select and reset lines were high

LabVIEW Program

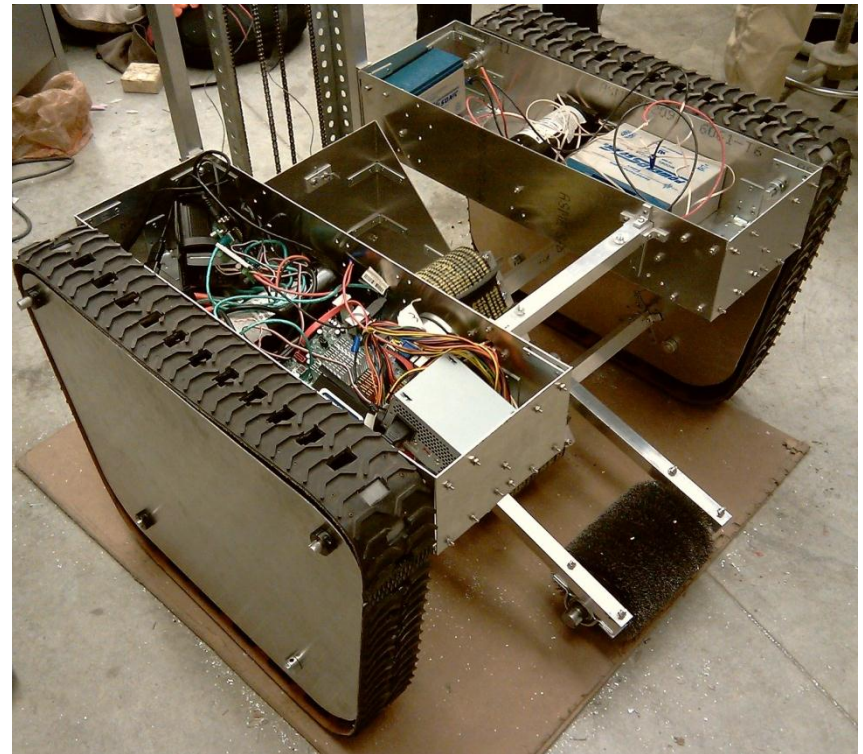


Recommendations and Improvements

- Surface mount packages
 - More pins available
 - Easier layout
 - More power efficient
- Interior board planes
- Consistent package sizes used
- Upgrading to a 12V power source

Future Applications

- Simplification of interface with robotic components
 - Individual motor controls
- Distributed network controlled devices
 - Lights, sensors...



Acknowledgements

- Justine Fortier
- Professor Singer and ECE 445 staff
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- Generous funding from Illinois Robotics in Space (IRIS)



References

- [1]
http://www.maxonmotorusa.com/medias/sys_master/8797281583134/PRODUKTBUILD-DECV_50_5_305259-Detail.jpg
- [2]
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