EXECUTIVE SUMMARY

Texas Instruments is planning on introducing a new revision of the DRV8412 which will interface with a motor control card through a DIMM100 slot. The DRV8412 is a dual full bridge pulse-width modulation (PWM) motor driver. The presence of a variety of control cards, driven by a variety of Texas Instruments microcontrollers and digital signal processors, will aid in the introduction of the DRV8412 Revision F to the market.
The use of high-end MSP430s, a family of low-power mixed-signal 16-bit microcontrollers, and C2000s, a family of high performance 32-bit microprocessors, to drive a DC motor allows more for robust control of motor speed and torque, in the presence of dynamic loads. Currently, Texas Instruments has designed a C2000 control card with software-implemented motor control; our design team has been tasked with the design and fabrication of a MSP430 control card. This MSP430 control card must exactly meet the specifications of the C2000 control card.
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INTRODUCTION

Motivation for Design of MSP430 Control Card

The electric motor was invented by Michael Faraday in 1821, and the market and demand for them has been ever-expanding since their introduction. The electric motor has grown from powering archaic printing presses and motor tools in its early yearsto powering a vast variety of devices today including fans, vacuums, hard drives, and cars to name a few. Today, there are many different categories of electric motors used to power these applications including AC Induction, Universal motor, AC Synchronous, Stepper DC, Brushless DC, and Brushed DC to name a few. Each form of motor has its own specific strengths and weaknesses which lend it to implementation in specific applications. This variety allows businesses to develop and design motors which are able to fill the needs and wants of their customers.

A great many of the applications that require motors to work also require another crucial element: control. Texas Instruments (TI) is a company that offers an assortment of products which address this need. TI offers multitudes of merchandise designed to answer consumer’s electronic needs and are currently planning on introducing a DRV8412 motor driver.

The DRV8412 is a dual full bridge pulse-width modulation (PWM) motor driver. Texas Instruments is planning on introducing their revision of the DRV8412 which will interface with a motor control card through a DIMM100 slot. TI aims to introduce this DRV motor driver with a variety of control cards able to handle different user specific needs in their applications. This diversity of control cards, driven by TI microcontrollers and digital signal processors, will aid in the successful introduction of the DRV8412 Revision F to the market.

The use of high-end MSP430s, a family of low-power mixed-signal 16-bit microcontrollers, and C2000s, a family of high performance 32-bit microprocessors, to drive a DC motor allows more for robust control of motor speed and torque, in the presence of dynamic loads. Currently, Texas Instruments has a designed a C2000 control card with software-implemented motor control; design team 4 has been tasked with the design and fabrication of a MSP430 control card. This MSP430 control card must exactly meet the specifications TI introduced with their design of the C2000 control card.
Design Team 4 (DT4) is tasked with designing the MSP430 control card to meet these specifications. This design is primarily comprised of two parts: software and hardware. DT4 must generate a new DIMM card redesigned to house the MSP430 microcontroller; this is the hardware aspect of the design. The software facet of design includes writing the code which allows the MSP430 to control the motor as well as providing an interface for this control. These are equally important tasks that need to be completed by DT4 in order to provide TI with another control card fully prepared for launch on their DRV8412 platform.
DESIGN SPECIFICATIONS

The following specifications were provided by Texas Instruments:

- Design a MSP430 control card using DIMM100 output to control the DRV8412 motor driver card.

- Spin and control a 12V brushed DC motor with the following functionality:
  - Selectable tachometer for constant speed control
  - PC interface with operating and control parameter displays
    - RPM, current, temperature, &c.

- The following documentation:
  - Schematics for the MSP430 control card.
  - Fully documented test results.
  - Operation manual, including application notes displaying real applications for the MSP430 and DRV devices.
  - Thermal calculation examples.
  - Source code, conforming to Texas Instruments ControlSUITE software standards used to control the C2000 DIMM.

![Motor Control System Block Diagram](image-url)

Figure 1: Block Diagram of a Motor Control System
PROPOSED DESIGN SOLUTION

Our design for the motor control card will utilize the MSP430F5437 microcontroller. This microcontroller is a 16-bit microcontroller with 80 pins. The C2000 microcontroller Texas Instruments is currently using is a 32-bit microcontroller with 80 pins. Our design consists of both a hardware and software side.

Hardware

The hardware part will consist of redesigning the current motor control card with the MSP430 microcontroller. Since the MSP430 microcontroller we chose and the C2000 microcontroller have the same pin count and dimensions, we will be able to use the current card design just replacing the C2000 microcontroller. The pin outputs are not the same for both of the microcontrollers, so the control card will have to be rewired for the MSP430.

Software

The software part will consist of writing code for the microcontroller to control the motor. Texas Instruments has provided our team with Code Composer Studio V4, which will be used to program the microcontroller. The programming will be written in C, but must be written to match Texas Instruments’ conventions.
PROJECT MANAGEMENT

Our team is tasked with designing a DIMM100 card using the MSP430 microcontroller as an alternative to the C2000 microcontroller DIMM100 card already designed by Texas Instruments. This MSP430 control card must interface with the DRV8412 motor driver card to spin and control different types of DC motors. Our team consists of Roy Dong, Mark Barnhill, Andrew Kleeves, Micajah Worden, Derek Brower, and Dave Seaton. The following tables break down both the technical and non-technical roles performed by each team member:

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Technical Role</th>
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<tbody>
<tr>
<td>Dave Seaton</td>
<td>Motor Interface and Control</td>
</tr>
<tr>
<td>Derek Brower</td>
<td>Hardware Development</td>
</tr>
<tr>
<td>Micajah Worden</td>
<td>Hardware Development</td>
</tr>
<tr>
<td>Roy Dong</td>
<td>Software Development</td>
</tr>
<tr>
<td>Andrew Kleeves</td>
<td>Software Development</td>
</tr>
<tr>
<td>Mark Barnhill</td>
<td>Motor Interface and Control</td>
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</tbody>
</table>

**Figure 2: Technical Roles**

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Non-technical Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dave Seaton</td>
<td>Management</td>
</tr>
<tr>
<td>Derek Brower</td>
<td>Document Preparation</td>
</tr>
<tr>
<td>Micajah Worden</td>
<td>Lab Coordinator</td>
</tr>
<tr>
<td>Roy Dong</td>
<td>Presentation Preparation</td>
</tr>
<tr>
<td>Andrew Kleeves</td>
<td>Web Coordinator</td>
</tr>
<tr>
<td>Mark Barnhill</td>
<td>Rover</td>
</tr>
</tbody>
</table>

**Figure 3: Non-Technical Roles**