AMPED – CAPSTONE PROJECT

CUESEF PROPOSAL FOR EQUIPMENT PURCHASES

AMPED'S CAPSTONE CUESEF FUNDING PROPOSAL

Abstract

This document contains the CUESEF funding proposal, submitted by *Amped* for the ELEC 4907 Engineering Project. This proposal contains a detailed list of the items requiring funding and the associated costs. After purchasing, the equipment will be maintained by *Amped*. We are requesting funding of approximately $200 to acquire hardware for both research and implementation of our unit.

Group Introduction

"Amped" will henceforth refer to the capstone project group consisting of Anthony Eid, Matthew Kang, Greg Kiar, Wade Skinner, and Daniel Stone, under the supervision of Prof. Leonard MacEachern. The goal of the project is to design and build a unit that utilizes electromyography (EMG) to detect muscle contractions, and subsequently applies electrical muscle stimulation (EMS) to assist said contractions.

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History of the Project

The project will use foundational EMG monitoring technology developed by Prof. Leonard MacEachern's previous capstone projects. The original unit used electrodes placed on the user's muscles to read electrical signals, which were subsequently converted to a digital signal output. *Amped* will implement several additions and improvements to this original system: updated firmware with reduced overhead and increased performance, EMS circuitry, integration of the EMS and EMG units to form a single product.

Funding

The Request

As previously stated, we are developing an EMS unit to function in tandem with an EMG unit. To achieve this, various components will be required for the purposes of both research and implementation. These components are not available in the Department of Electronics laboratories.

Slendertone® FLEX Pro ARMS

A Slendertone® FLEX Pro ARMS served as an example of a commercially available EMS unit that facilitates muscle development. The device was studied to determine appropriate waveforms for our application as well as reverse engineer some of the circuitry needed to produce such waveforms. The device was purchased at a wholesale retailer to minimize cost.

Other Hardware Components

Various parts are necessary in order to build the EMS unit. When possible, components were requested directly from the OEM in order to reduce costs. An integral component of the EMS unit is a DC-DC boost circuit, as high voltages are required to effectively stimulate human muscles. Two prototype DC-DC boost converters were designed using PWM step-up controller chips that were obtained as free samples from the manufacturer. As these step-up chips have surface mount pins, the following breakout boards were required in order to implement them.
4 PROTO-BOARD ADAPTER MICROMAX-10
4 PROTO-BOARD 8PIN SOIC 8PIN SIP

The DC-DC boost converter also requires a power switching MOSFET. From the requirements listed on the datasheets of the step-up chips, it was determined that the MOSFETs available in the electronics labs would not meet our requirements, as the MOSFET has to be able to sustain high voltages while also having a fast switching speed. Many different components were considered and we were able to narrow our selection to three different parts. All three parts were ordered such that they could all be tested to determine which component was most suited to our application.
5 MOSFET N CH 30V 14A 8SOIC
5 MOSFET P-CH 40V 3.4A 6-TSOP
5 MOSFET N-CH 30V 70A TO251A

The DC-DC boost converter also requires a fast-switching diode in order to minimize quiescent current loss in the circuit. Again, the diodes in the lab were not suitable for our application, as an ultra-fast diode was

necessary to meet this requirement, therefore the following component was ordered.
5 DIODE ULTRA FAST 200V 1A SMA

Finally, a current sense resistor was required for the DC-DC boost converter in order to prevent a high short circuit current from damaging the PWM step-up chips. This resistor needed to be sufficiently small (<1 ohm) such that it would not increase the power consumption of the circuit, or introduce a large voltage drop. As the smallest resistors available in the lab are around 10 ohm, the following part was ordered to meet our requirements.
4 RESISTOR CURRENT SENSE 0.05 OHM

The output of the DC-DC boost converter will be used to drive a MOSFET based switching circuit in order to generate semi-arbitrary waveforms. As the output voltage would be around 150 V, the switching MOSFET would have to be capable of handling large voltages. The following parts were selected to meet this requirement.
5 MOSFET N-CH 200V 600MA 6-TSOP
5 MOSFET N-CH 600V 300MA TO-92

Budget

Item	Proposed Revenue Source	Amount	Total
Slendertone® FLEX Pro ARMS			
	CUESEF	$ 89.99	$ 89.99
4 PROTO-BOARD 8PIN SOIC 8PIN SIP			
	CUESEF	$ 4.36	$ 17.24
4 PROTO-BOARD ADAPTER MICROMAX-10			
	CUESEF	$ 3.41	$ 13.48
5 MOSFET N-CH 30V 70A TO251A			
	CUESEF	$ 0.78	$ 3.90
5 MOSFET N-CH 200V 600MA 6-TSOP			
	CUESEF	$ 0.63	$ 3.15
5 MOSFET P-CH 40V 3.4A 6-TSOP			
	CUESEF	$ 0.70	$ 3.50
5 MOSFET N CH 30V 14A 8SOIC			
	CUESEF	$ 0.81	$ 4.05
5 MOSFET N-CH 600V 300MA TO-92			
	CUESEF	$ 0.56	$ 2.80
5 DIODE ULTRA FAST 200V 1A SMA			
	CUESEF	$ 0.60	$ 3.00
4 RESISTOR CURRENT SENSE 0.05 OHM			
	CUESEF	$ 0.86	$ 3.43
4 DO1813H Series High Current Power Inductors			
	Amped	$ 0.88	$ 3.52
4 MAX1605EUT			
	Amped	$ 4.52	$ 18.08
4 MAX668EUB+			
	Amped	$ 6.40	$ 25.60
Group funded			
Subtotal:			$ 47.20
HST:		$ 6.14	
Shipping:		$ 16.00	
Total:			$ 69.34
CUESEF			
Subtotal:			$ 144.54
HST:		$ 18.79	
Shipping:		$ 16.00	
Total:			$ 179.33

Other Information

Throughout the development cycle we will need to purchase more parts as we cannot account for everything we need. Parts that are expected to be purchased are microcontrollers, boost converters, inductors, transducers, textiles, and application-specific electrodes. Through this funding we are looking to cut down our personal expenses.

Conclusion

Amped requires several components to successfully complete the ELEC 4907 Engineering Project. These components include a Slendertone® FLEX Pro ARMS and other small hardware components. The total cost is $248.67 and the amount requested from CUESEF is $179.33. The equipment will be stored on the third floor of Azrieli Pavilion, and our group and supervising professor will be responsible for the ongoing maintenance of the purchased equipment.