Conestoga College
Institute of Technology and Advanced Learning

Document Title	Project Functional Specification
Revision	1
Date Issued	January 16, 2015
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Department	School of Engineering and Information Technology
Program	Electronic Systems Engineering
Audience	ESE Semester 4 Faculty
Author	Marcin Czajkowski, Student
Reviewers	Mike Jarabek, Professor
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Revision History

Revision	Description of Change	Effective Date
1	New Document Release	Jan. 16, 2015

Contents

1. Introduction:

As part of the semester for year 2 for studies in Electronic Systems Engineering it is required to implement a project that will give students the opportunity to study and apply design principles for the creation of embedded systems hardware and software.

Additional tasks that a student will be learning through implementation of the project are:

- Populate and test PCB boards
- Design and simulate test diagnostic systems
- Use schematic capture as well as read specification of parts/systems vendors
- Create PCB manufacturing data
- Create a detailed documentation regarding project specifications and scheduling of the project

2. Scope of the Document:

The scope of the Project Functional Specification document is to present hardware specifications needed to implement the HCS12 embedded PCB. This document will be subjected to numerous revisions as the project progresses and the aspects of the project are added through the semester. This document shall include:

- List of related documents supporting the project
- Cost targets of the components and services needed to finish the project
- Configuration options of the embedded system
- Detailed specification such as:
    - Performance
    - Port usage
    - Communication options
    - External cabling details
    - Physical size and physical constraints
    - Power requirements
- Regulatory requirements
- Reliability and service

3. Chapter I – List of Related Documents

3.1. Purpose:

The purpose of this chapter is to attach documentation related to the project. The documentation will be attached as links. Some documents might require special access permissions to be viewed. Contact document author if issues persist.

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3.2. Documents list:

#	Document tile	Revision	Document purpose	Link
1	LM22675 Specs	L	To present specifications of LM22675	link
2	Project Charter	2.7	To present project IV requirements	link
3	Notes For Design Verification	5.0	MCU pin specifications	link
4	Port Mapping	6	Port mapping and pin outs of the MCU	link
5	PCB tolerances and design requirements	N/A	PCB design and tolerances	link
6	DC motor encoder connections	N/A	Pin out of the DC motor connector	link
7	Board outline	8	PCB outline and connector placements	link
8	Camera conx pinout	2	Camera connection pin out	link
9	Motor encoder	N/A	Motor speed feedback diagram	link
10	MAX3232	7	MAX3232 Data Sheet	link
11	Altium Resource/Documentation	N/A	Webpage for Altium Designer support	link
12	Absolute Maximum Ratings for Soldering SNOA549C	N/A	Soldering ratings for National Semiconductors	link

4. Chapter II – Cost Target

4.1. Purpose:

The purpose of the Cost Target chapter is to track the expenses of the parts and services required to finish the project. This chapter will keep an updated BOM as well as any quotes obtained from the vendors.

4.2. BOM

BOM	MCU						
#	Part name	Designator	Value	DigiKey#	Price/Unit	Quantity	Total
1	Microcontroller	U_CPU1	MC9S12C32CFUE25	MC9S12C32CFUE25-ND	$ 12.95	1	$ 12.95
2	Header	H1_BDM	2x3	952-1921-ND	$ 0.36	1	$ 0.36
3	Header	H2_VRH, H3_VRL	1x2	S1212E-02-ND	$ 0.55	2	$ 1.10
4	Switch	SW1_RESET	SPST	CKN9085CT-ND	$ 0.39	1	$ 0.39
5	Resistor	R_BDM, R_RESET	10.0K 1% 1/8W 0805	RMCF0805FT10K0CT-ND	$ 0.13	2	$ 0.26
6	Resistor	R_Y2	10M 1% 1/8W 0805	311-0.0ARCT-ND	$ 0.13	1	$ 0.13
7	Resistor	R_Y1	0Ω 1% 1/8W 0805	CR0805-JW-106ELFCT-ND	$ 0.13	1	$ 0.13
8	Crystal	Y1	16MHz	XC694CT-ND	$ 1.27	1	$ 1.27
9	Capacitor	C_Y1, C_Y2	CER 22pF 50v 0805	399-1113-1-ND	$ 0.13	2	$ 0.26
10	Capacitor	C_VDDR, C_VDDX1, C_VRH1	TANT 10uF 10V 0805	511-1685-1-ND	$ 0.93	3	$ 2.79
11	Capacitor	C_VDDX_2, C_VRH2	CER 0.01uF 50V 0805	490-8297-1-ND	$ 0.53	2	$ 1.06
12	Capacitor	C_VR_PWR	CER 0.1uF 50V 0806	1276-1007-1-ND	$ 0.13	1	$ 0.13
13	Inductor	L1	10uH 189MA 2.1Ω 1210	541-1673-1-ND	$ 0.90	1	$ 0.90
						Subtotal	$ 21.73
BOM	Serial Port						
#	Part name	Designator	Value	DigiKey#	Price/Unit	Quantity	Total
1	MAX3232	U_SER1	MAX3232CSE	MAX3232CSE+-ND	$ 4.10	1	$ 4.10
2	DB9	J_DB9	D-SUB FEMALE DB9	AE10921-ND	$ 0.97	1	$ 0.97
3	Capacitor	C1	CER 47000pF 50V 0805	399-1166-1-ND	$ 0.13	1	$ 0.13
4	Capacitor	C2, C3, C4	0.33uF ±20% 50V	493-2125-1-ND	$ 0.31	3	$ 0.93
5	Capacitor	C_BYPASS	0.1UF 50V 20%	493-2121-1-ND	$ 0.31	1	$ 0.31
						Subtotal	$ 6.44
BOM	SMPS 5V(x2)						
#	Part name	Designator	Value	DigiKey#	Price/Unit	Quantity	Total
1	LM22675	U_PS1_A,U_PS1_D	LM22675MR-ADJ/NOPB	LM22675MRE-ADJ/NOPBCT-ND	$ 5.79	2	$ 11.58
2	DIODE SCHOTTKY	D1_5V5A,D1_5V5D	B240A-13-F	B240A-FDICT-ND	$ 0.68	2	$ 1.36
3	Inductor	L1_A,L1_D	22UH 2.2A	SRN8040-220MCT-ND	$ 0.78	2	$ 1.56
4	Capacitor	Cbst_A,Cbst_D	10000pF 50V 0805	399-1158-1-ND	$ 0.13	2	$ 0.26
5	Capacitor	Cout_A,Cout_D	10uF 10V 0805	399-4925-1-ND	$ 0.26	2	$ 0.52
6	Capacitor	Cin_A,Cin_D	1uF 100v 0805	445-4497-1-ND	$ 0.97	2	$ 1.94
7	Capacitor	Cinx_A,Cinx_D	2.2uF 35v 0805	587-1438-1-ND	$ 0.31	2	$ 0.62
						Subtotal	$ 17.84
				Project Total	$ 46.01	Date:	1/16/2015

4.3. Total cost target

Currently the cost target of the finished product is approximately $200. The above estimate presents only the current known parts that must be acquired.

5. Chapter III - Specifications and Performance

5.1. Purpose:

The purpose of this chapter is to present detailed hardware and software specifications regarding configurations, ports usage, cabling details and system communications.

5.2. Hardware Specifications:

5.2.1. Ports:

- RS232
  The serial communication between the MCU and the peripherals will be implemented through MAX3232 IC. The MAX IC will be connected to Port S on MCU (refer to document 4 in 3.2 Documents List for pin out of Port S on MCU)
- BDM connector will be used for programming of the embedded system
- MCU port T will be used for stepper motor coil RC Servo and Encoder. Port P will serve as PWM module (refer to document 4 in 3.2 Documents List for MCU port pin outs)
- Port A on the MCU will serve as LCD connection (refer to document 4 in 3.2 Documents List for MCU port pin outs)
- Other ports TBD

5.2.2.Communication and cabling:

- TBD

5.2.3. Hardware configuration:

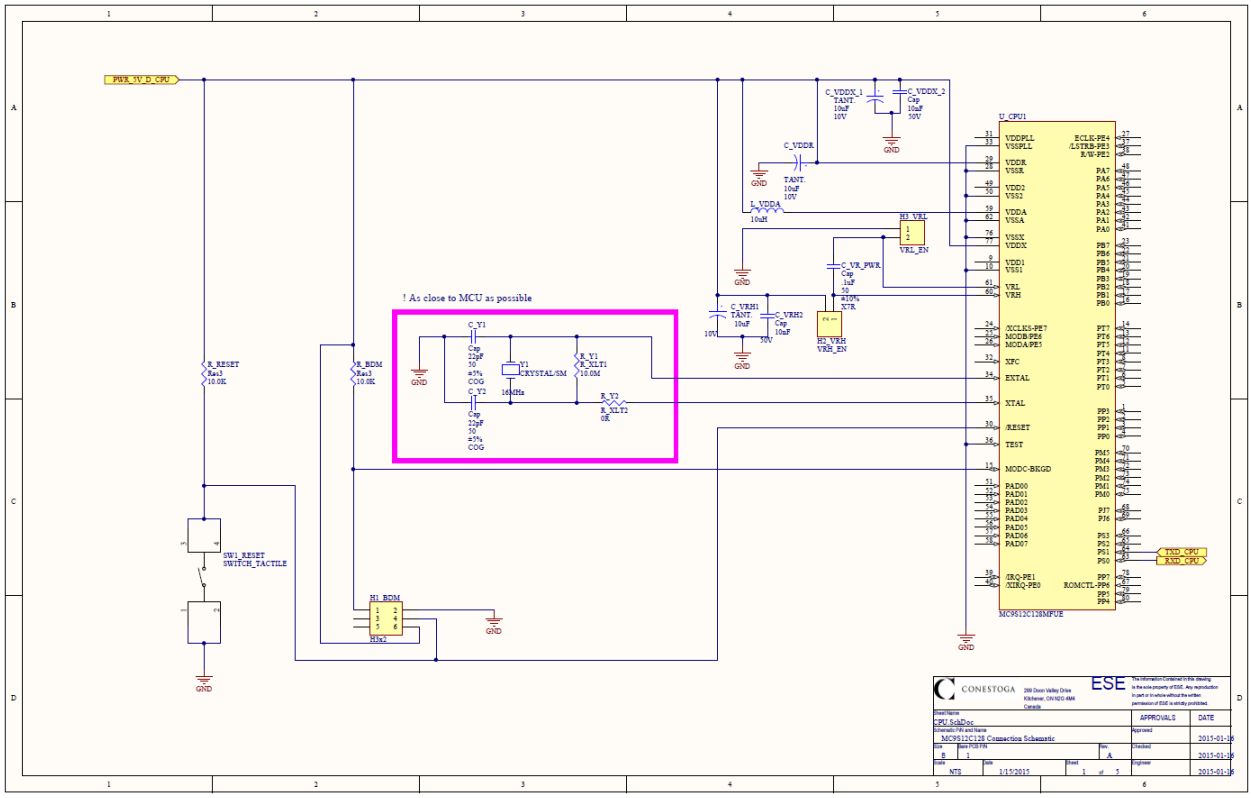
- TBD

5.2.4. Physical Constraints:

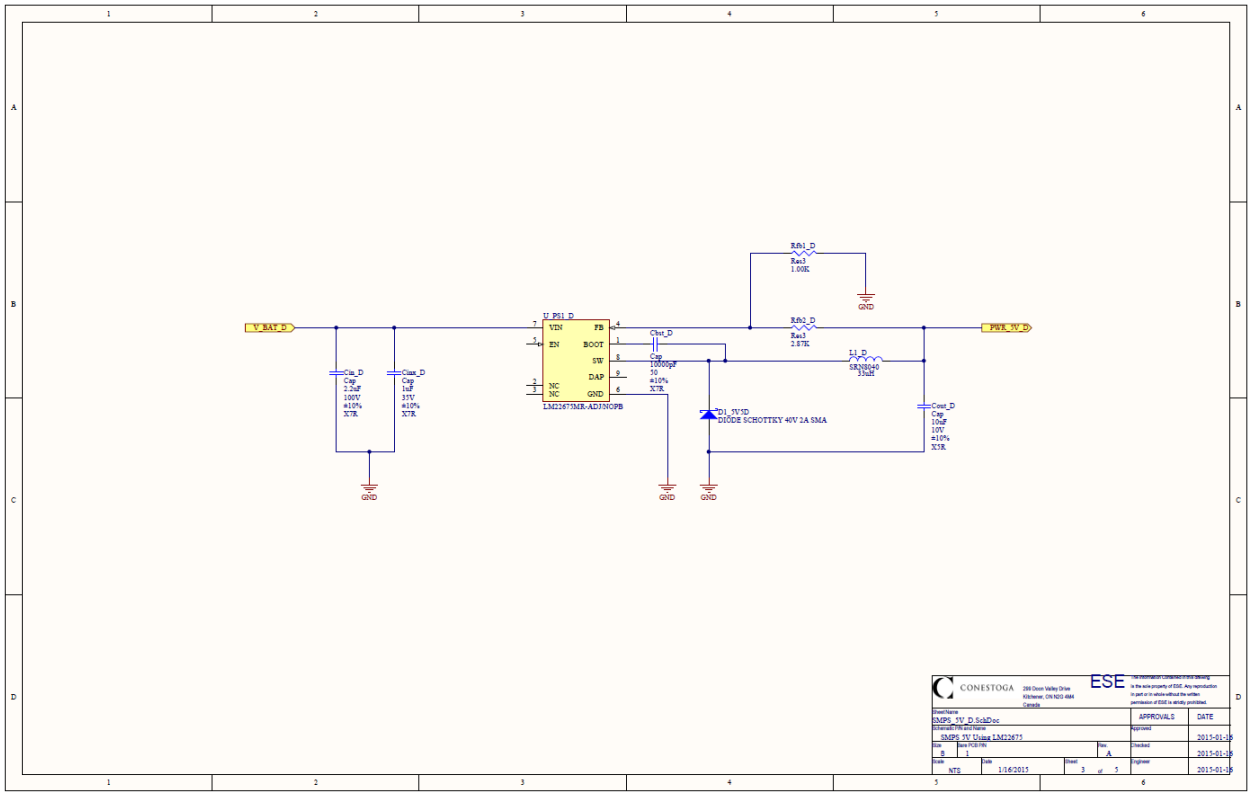
- Refer to refer to document 5 and 7 in 3.2 Documents List for the board physical constraints and layout options. Further details TBD
- Constraints regarding component placement – TBD

5.2.5. PCB Design

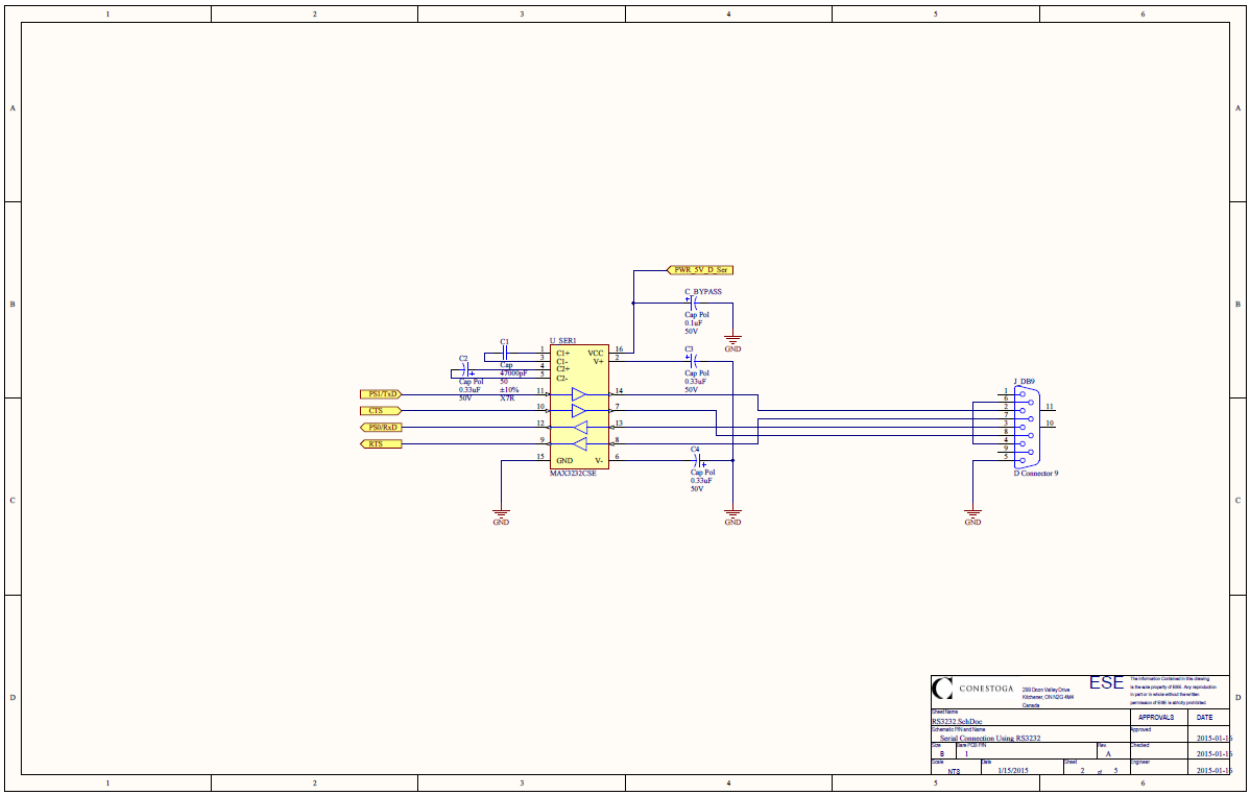
- MCU connections



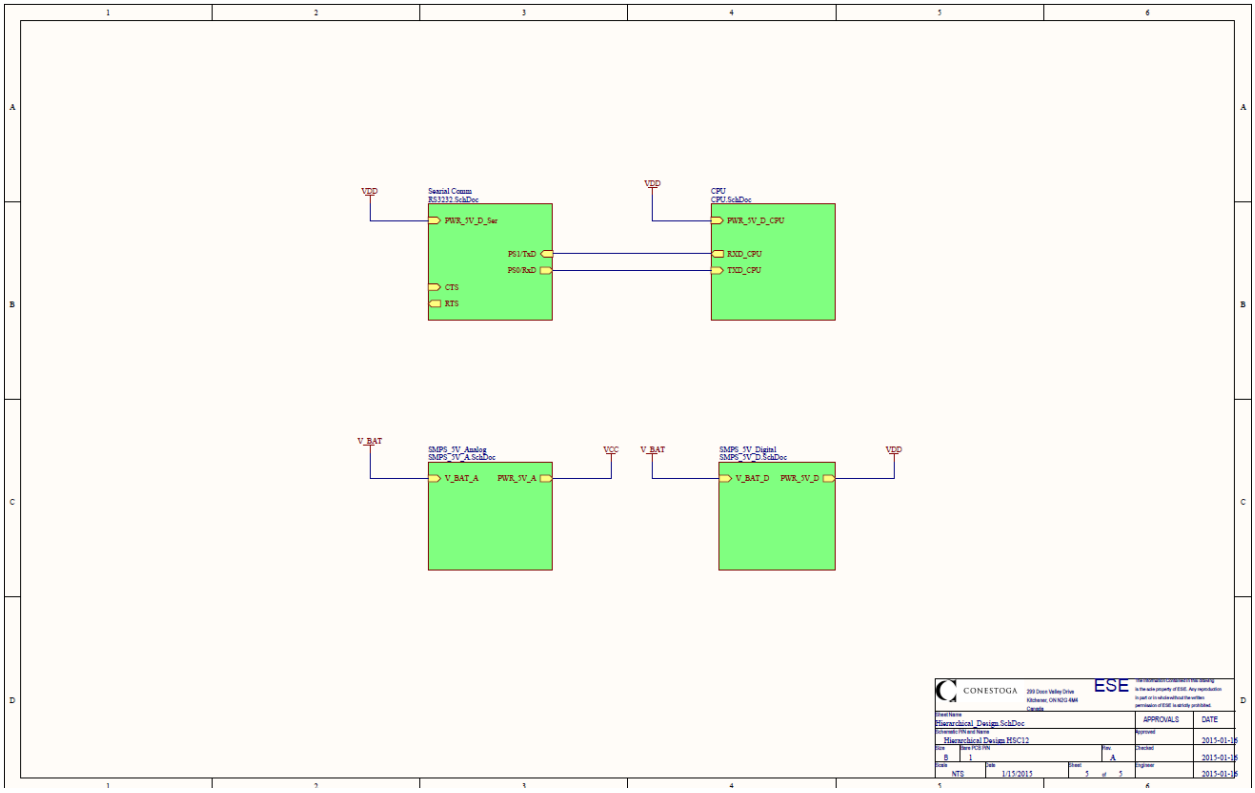
- SMPS 5V power supply



- RS3232 connections



- Hierarchical design



5.2.6. Power requirements

- Power supplies requirements:
  - Two 5V SMPS and one linear 3.3V power supplies are required
- Maximum power consumption per chipset – TBD and tested (it varies on configuration)

5.3. Software Specifications

5.3.1. Programming environment

- The programming development environment for the HSC12 will be Code Warrior suite (refer to document 11 in 3.2 Documents List for software documentation)
- Other software specifications TBD

6. Chapter IV – Regulatory Requirements

6.1. Purpose:

The purpose of this chapter is track regulatory requirements that shall be kept during the design phase.

6.2. ESD Requirements

- Design for LM22675 require to comply with JEDEC document JEP155 500-V HBM
- Other requirements TBD

6.3. Soldering Requirements

- Refer to document 12 in 3.2 Documents List for National Semiconductor products soldering specs
- IPC standard that will be applied for this project - TBD