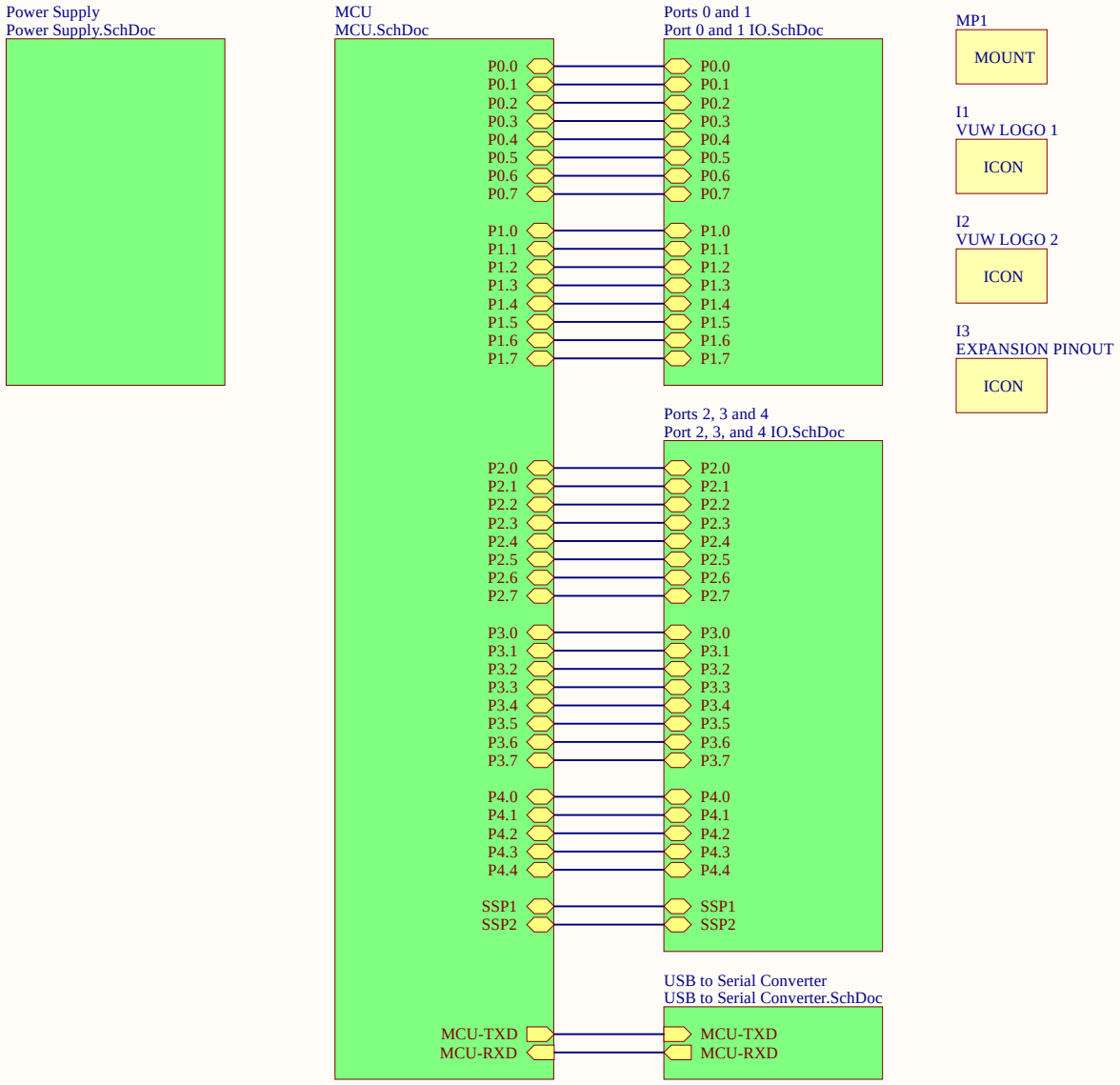


General Notes:

-Some components in certain packages (eg. resistors arrays, etc.) have not been used. These have been connected to an expansion connector (not populated) to allow retrofitting in the future. There is a Silkscreen print of the pinout of this connector on the PCB for reference.

- Some components should not be fitted, but have a footprint available for fitment in case of retrofitting in the future.

Power Calculations:

MCU	= 12.8mA	
Port Outputs	= 2mA	
FT232	= 24+15	= 39mA
LED's	= (2x20)+(2x7.8)+(2x7.8)	= 71.2mA
Port VCC outputs	= 6x50mA	= 300mA
5V max continuous current	= 425mA	

Using a 500mA PTC fuse should be sufficient for power input. 95% SMPS maximum duty cycle means a minimm input voltage of 5.5V.

I/O Module Max Power consumption:

Digital Outputs (including LED's)	= 48mA	@ 5V
7-seg display (all led's on)	= 30mA	@ 5V
Pull-down's	= 5mA	@ 5V
	= 83mA	@ 5V

Unreasonable to expect that all outputs will be shorted at once. Work off of 7-seg fully on and half of the Digital Outputs shorted = 59mA. Ideally I/O Module should be powered from external input. 50mA PTC Fuses should provide enough power for the I/O module in most cases.

LED resistor calclations:
GN LED has the lowest intensity. Therefore choose GN LED to consume 20mA.

GN LED brightness:
@ 35mcd, R=V/I=(5-2)/0.02=150R

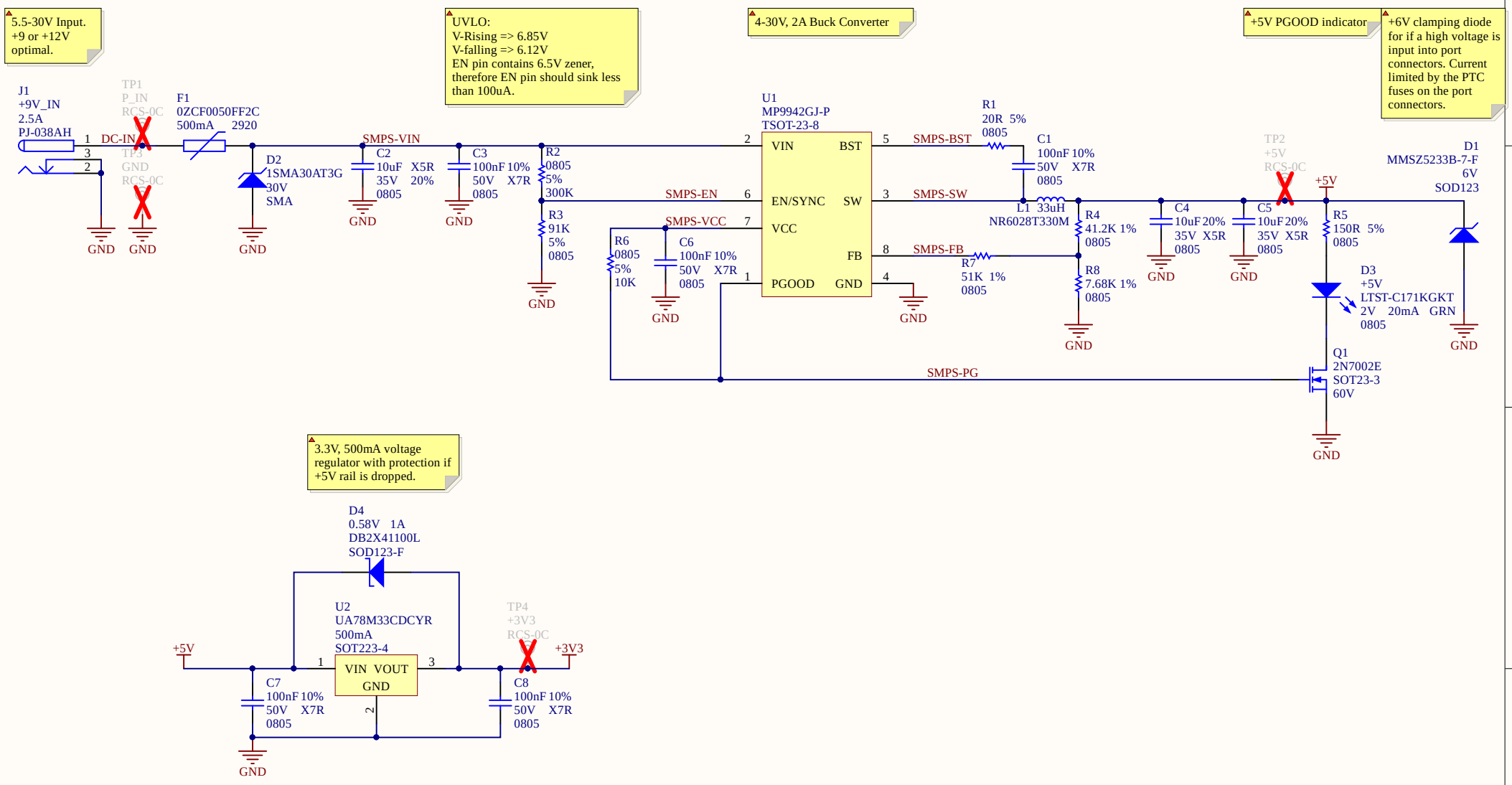
ORG LED resistance:
For 35mcd, use 35/90=0.39 of test current
Current required: 0.39*20=7.8mA
@ 35mcd, R=V/I=(5-2)/0.0078=385R-> use 390R

BLU LED resistance:
For 35mcd, use 35/90=0.39 of test current
Current required: 0.39*20=7.8mA
@ 35mcd, R=V/I=(5-3.3)/0.0078=217R-> use 220R

Title	**Microcontroller Kit Overview**		
Size: A4	Number:1	Revision:1.3	
Date: 6/07/2016	Time: 1:39:27 PM	Sheet 1 of 6	
File: \\lido.ecs.vuw.ac.nz\bpothoven\Electronic Designs\Microcontroller Kits\C8051 Kit\Rev 1.3\Microcontroller Kit (v1.3).Sch			

Victoria University of Wellington
Victoria University of Wellington
Kelburn Parade
Kelburn
Wellington

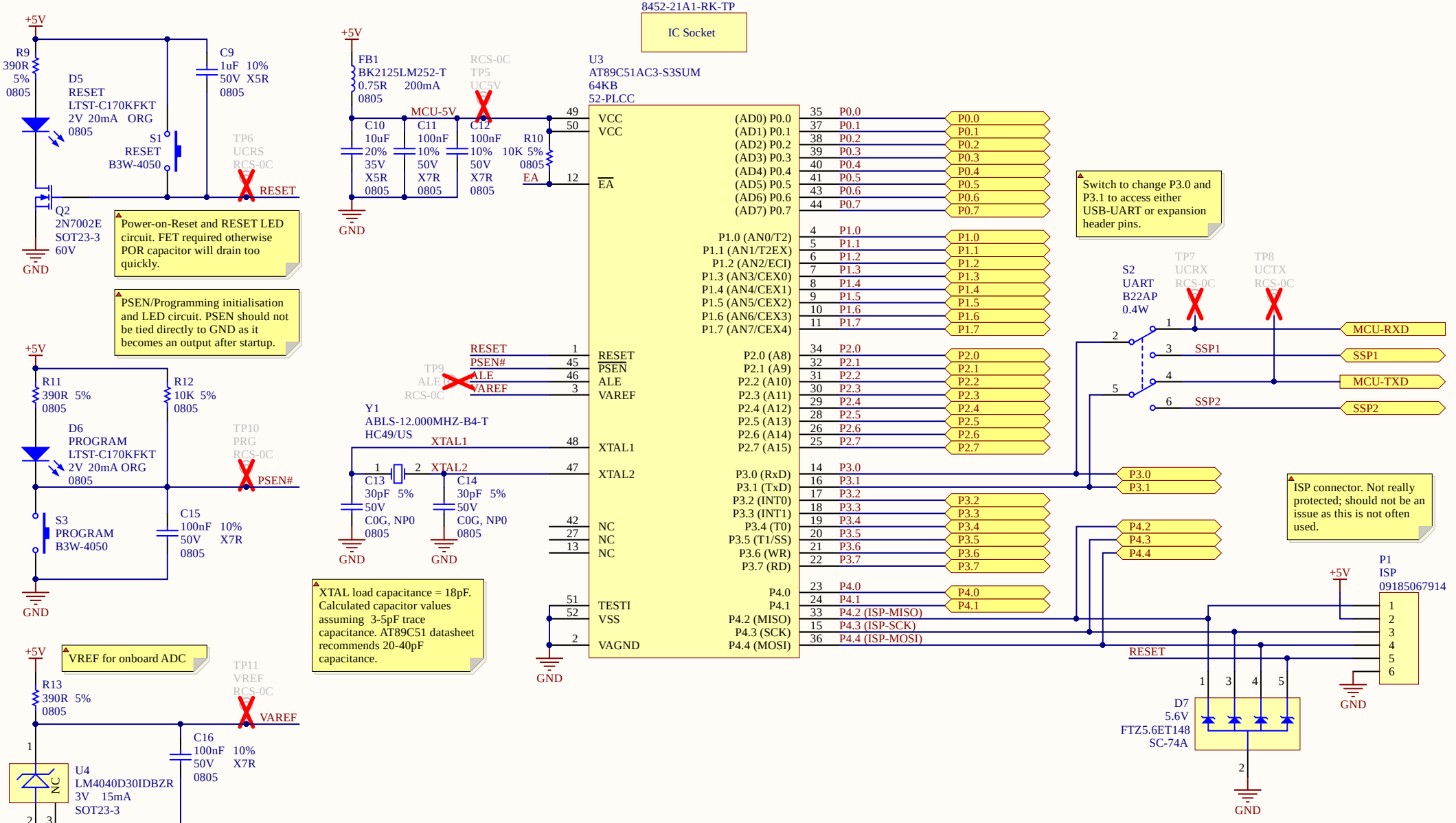
Altium



Title	**Power Supply**		
Size: A4	Number:2	Revision:1.3	
Date: 6/07/2016	Time: 1:39:27 PM	Sheet 2 of 6	
File: \\lido.ecs.vuw.ac.nz\bpothoven\Electronic Designs\Microcontroller Kits\C8051 Kit\Rev 1.3\Power Supply.SchDoc			

Victoria University of Wellington
Victoria University of Wellington
Kelburn Parade
Kelburn
Wellington 6012

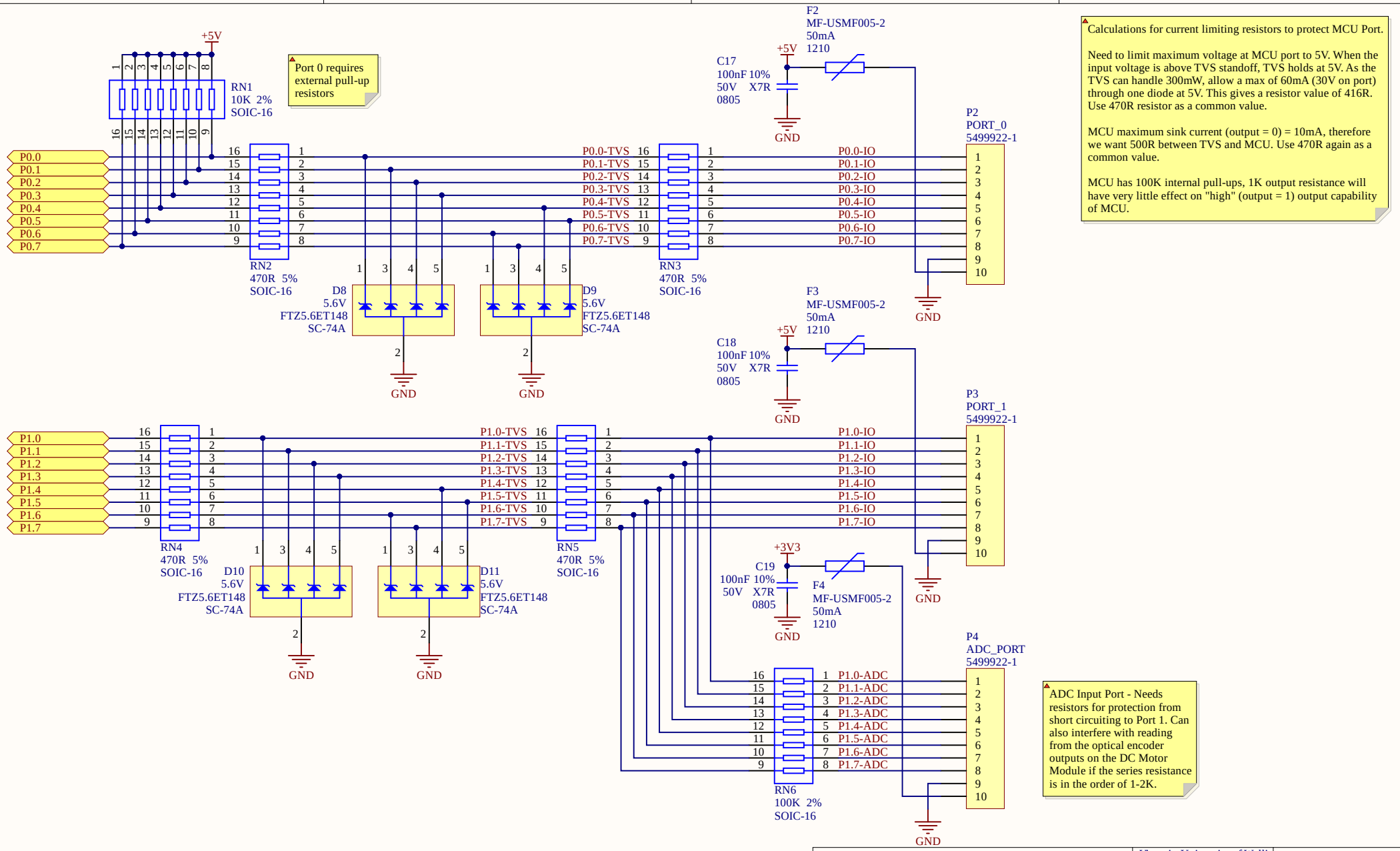
Altium



Title	*MCU*	
Size: A4	Number:3	Revision:1.3
Date: 6/07/2016	Time: 1:39:27 PM	Sheet 3 of 6
File: \\lido.ecs.vuw.ac.nz\bpothoven\Electronic Designs\Microcontroller Kits\C8051 Kit\Rev 1.3\MCU.SchDoc		

Victoria University of Wellington
Victoria University of Wellington
Kelburn Parade
Kelburn
Wellington 6012

Altium


Port 0 requires external pull-up resistors
RN1
10K 2%
SOIC-16
+5V
P0.0
P0.1
P0.2
P0.3
P0.4
P0.5
P0.6
P0.7
RN2
470R 5%
SOIC-16
RN3
470R 5%
SOIC-16
D8
5.6V
FTZ5.6ET148
SC-74A
D9
5.6V
FTZ5.6ET148
SC-74A
GND
P0.0-TVS
P0.1-TVS
P0.2-TVS
P0.3-TVS
P0.4-TVS
P0.5-TVS
P0.6-TVS
P0.7-TVS
P0.0-IO
P0.1-IO
P0.2-IO
P0.3-IO
P0.4-IO
P0.5-IO
P0.6-IO
P0.7-IO
F2
MF-USMF005-2
50mA
1210
C17
100nF 10%
50V X7R
0805
P2
PORT_0
5499922-1
F3
MF-USMF005-2
50mA
1210
C18
100nF 10%
50V X7R
0805
P3
PORT_1
5499922-1
P1.0
P1.1
P1.2
P1.3
P1.4
P1.5
P1.6
P1.7
RN4
470R 5%
SOIC-16
RN5
470R 5%
SOIC-16
D10
5.6V
FTZ5.6ET148
SC-74A
D11
5.6V
FTZ5.6ET148
SC-74A
P1.0-TVS
P1.1-TVS
P1.2-TVS
P1.3-TVS
P1.4-TVS
P1.5-TVS
P1.6-TVS
P1.7-TVS
P1.0-IO
P1.1-IO
P1.2-IO
P1.3-IO
P1.4-IO
P1.5-IO
P1.6-IO
P1.7-IO
+3V3
C19
100nF 10%
50V X7R
0805
F4
MF-USMF005-2
50mA
1210
P4
ADC_PORT
5499922-1
RN6
100K 2%
SOIC-16
P1.0-ADC
P1.1-ADC
P1.2-ADC
P1.3-ADC
P1.4-ADC
P1.5-ADC
P1.6-ADC
P1.7-ADC
Calculations for current limiting resistors to protect MCU Port.
Need to limit maximum voltage at MCU port to 5V. When the input voltage is above TVS standoff, TVS holds at 5V. As the TVS can handle 300mW, allow a max of 60mA (30V on port) through one diode at 5V. This gives a resistor value of 416R. Use 470R resistor as a common value.
MCU maximum sink current (output = 0) = 10mA, therefore we want 500R between TVS and MCU. Use 470R again as a common value.
MCU has 100K internal pull-ups, 1K output resistance will have very little effect on "high" (output = 1) output capability of MCU.
ADC Input Port - Needs resistors for protection from short circuiting to Port 1. Can also interfere with reading from the optical encoder outputs on the DC Motor Module if the series resistance is in the order of 1-2K.
Title Port 0 and 1
Size: A4
Number:4
Revision:1.3
Date: 6/07/2016
Time: 1:39:27 PM
Sheet 4 of 6
File: \\lido.ecs.vuw.ac.nz\bpothoven\Electronic Designs\Microcontroller Kits\C8051 Kit\Rev 1.3\Port 0 and 1 IO.SchDoc
Victoria University of Wellington
Victoria University of Wellington
Kelburn Parade
Kelburn
Wellington 6012
Altium

Expansion header to allow access to the spare pins of various components. Footprint for 10X2 0.1" spacing headers. Not fitted.

P6
EXPANSION
DSP1 DSP2 DSP3 RSP41 RSP51 RSP61 RSP11 RSP21 RSP31 SSP2
PSP3 PSP2 PSP1 RSP42 RSP52 RSP62 RSP12 RSP22 RSP32 SSP1

P2.0 P2.1 P2.2 P2.3 P2.4 P2.5 P2.6 P2.7
RN7 470R 5% SOIC-16
P2.0-TVS P2.1-TVS P2.2-TVS P2.3-TVS P2.4-TVS P2.5-TVS P2.6-TVS P2.7-TVS
RN8 470R 5% SOIC-16
P2.0-IO P2.1-IO P2.2-IO P2.3-IO P2.4-IO P2.5-IO P2.6-IO P2.7-IO
D12 5.6V FTZ5.6ET148 SC-74A
D13 5.6V FTZ5.6ET148 SC-74A
C20 100nF 10% 50V X7R 0805
F5 MF-USMF005-2 50mA 1210
P5 PORT_2 5499922-1

P3.0 P3.1 P3.2 P3.3 P3.4 P3.5 P3.6 P3.7
RN9 470R 5% SOIC-16
P3.0-TVS P3.1-TVS P3.2-TVS P3.3-TVS P3.4-TVS P3.5-TVS P3.6-TVS P3.7-TVS
RN10 470R 5% SOIC-16
P3.0-IO P3.1-IO P3.2-IO P3.3-IO P3.4-IO P3.5-IO P3.6-IO P3.7-IO
D14 5.6V FTZ5.6ET148 SC-74A
D15 5.6V FTZ5.6ET148 SC-74A
C21 100nF 10% 50V X7R 0805
F6 MF-USMF005-2 50mA 1210
P7 PORT_3 5499922-1

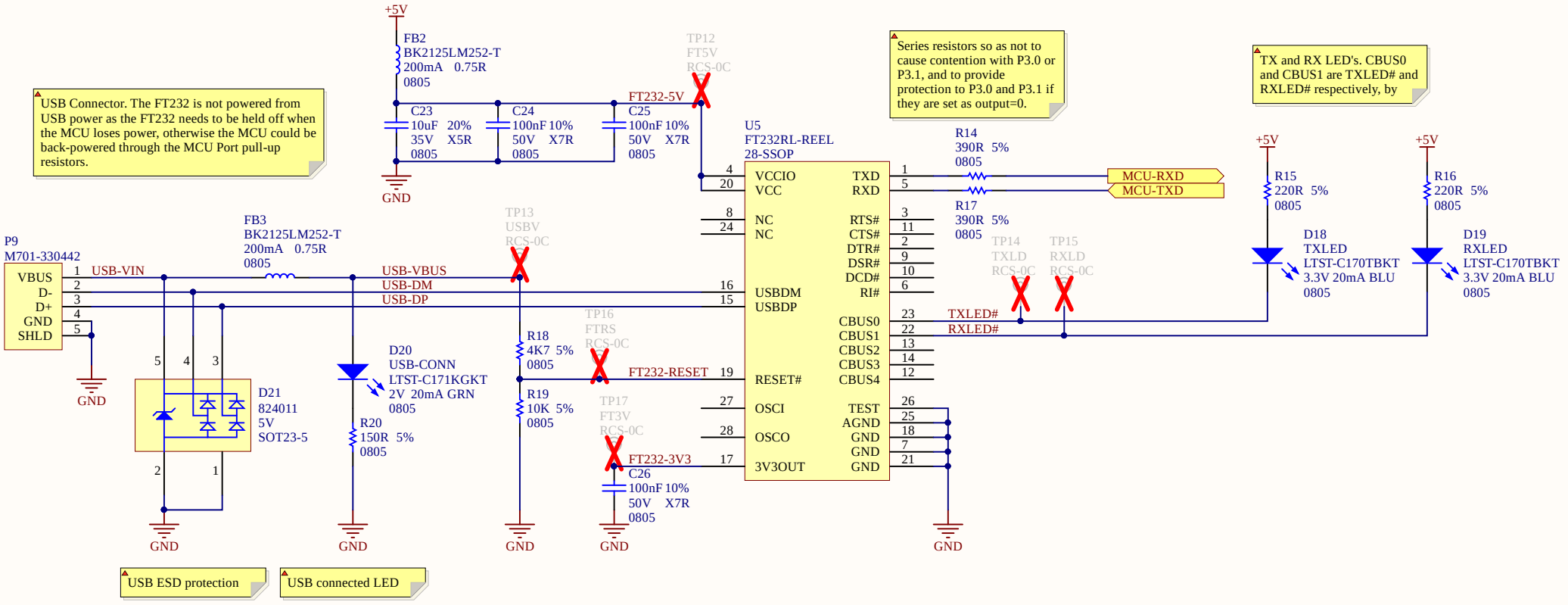
P4.0 P4.1 P4.2 P4.3 P4.4
RSP11 RSP21 RSP31 RSP12 RSP22 RSP32
RN11 470R 5% SOIC-16
P4.0-TVS P4.1-TVS P4.2-TVS P4.3-TVS P4.4-TVS RSP41 RSP51 RSP61
RN12 470R 5% SOIC-16
P4.0-IO P4.1-IO P4.2-IO P4.3-IO P4.4-IO RSP42 RSP52 RSP62
DSP1 DSP2 DSP3
PSP1 PSP2 PSP3
D16 5.6V FTZ5.6ET148 SC-74A
D17 5.6V FTZ5.6ET148 SC-74A
C22 100nF 10% 50V X7R 0805
F7 MF-USMF005-2 50mA 1210
P8 PORT_4 5499922-1

+5V GND

Title	**Port 2, 3, and 4 IO**	
Size: A4	Number:5	Revision:1.3
Date: 6/07/2016	Time: 1:39:27 PM	Sheet 5 of 6
File: \\lido.ecs.vuw.ac.nz\bpothoven\Electronic Designs\Microcontroller Kits\C8051 Kit\Rev 1.3\Port 2, 3, and 4 IO.SchDoc		

Victoria University of Wellington
Victoria University of Wellington
Kelburn Parade
Kelburn
Wellington 6012

Altium



Title	**USB to Serial Converter**		
Size: A4	Number:6	Revision:1.3	
Date: 6/07/2016	Time: 1:39:27 PM	Sheet 6 of 6	
File: \\lido.ecs.vuw.ac.nz\bpothoven\Electronic Designs\Microcontroller Kits\C8051 Kit\Rev 1.3\USB to Serial Converter.SchDoc			

Victoria University of Wellington
Victoria University of Wellington
Kelburn Parade
Kelburn
Wellington 6012

Altium