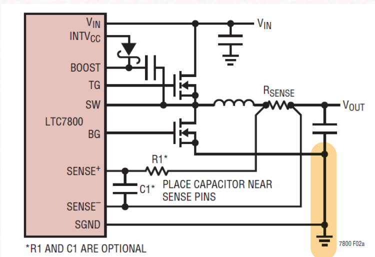
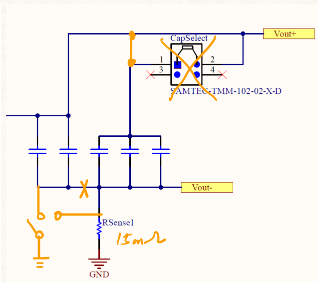
Components Choice:
Arduino nano33 iot control:
 4 Trimmer Resistors -> Digital Potentiometers
 3 Switches -> Digital Switches

RV1 & RV2 (2.22KΩ) RV3 & RV4 (50KΩ)
 - MCP413X (options: 5KΩ, 10KΩ, 50KΩ, 100KΩ)
 - MAX5394 / MAX5395 (options: 10KΩ, 50KΩ, 100KΩ)
LC_MODE Switch
- NX3L4357 single pole triple throw.
SyncBuck Switch
- SN74LVC1G3157 single pole double throw.
CapSelect Switch
- FDS8858CZ Dual N&P channel powertrench MOSFET
Remain Problem: voltage drop at switch - MOSFET: Vds



(2a) Using a Resistor to Sense Current



FDS8858CZ
Dual N & P-Channel PowerTrench® MOSFET
N-Channel: 30V, 8.6A, 17.0mΩ P-Channel: -30V, -7.3A, 20.5mΩ

Features
Q1: N-Channel
- Max $r_{DS(on)}$ = 17mΩ at V_{GS} = 10V, I_D = 8.6A
- Max $r_{DS(on)}$ = 20mΩ at V_{GS} = 4.5V, I_D = 7.3A

Q2: P-Channel
- Max $r_{DS(on)}$ = 20.5mΩ at V_{GS} = -10V, I_D = -7.3A
- Max $r_{DS(on)}$ = 34.5mΩ at V_{GS} = -4.5V, I_D = -5.6A
- High power and handing capability in a widely used surface mount package
- Fast switching speed

General Description
These dual N and P-Channel enhancement mode power MOSFETs are produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize on-state resistance and yet maintain superior switching performance.

These devices are well suited for low voltage and battery powered applications where low in-line power loss and fast switching are required.

Applications
- Inverter
- Synchronous Buck

This voltage drop can be placed at Vout- and GND, which can replace original Rsense1 (0.015 Ohm).

Controllable Load Resistance
Approach 1: Digital potentiometer as load resistance.

Iout/A	Vout/V	Rload/Ω	Pin/W	Pout/W	Efficiency
0.51	3.25	6.38	2.2	1.66	0.755
1.04	3.19	3.07	3.97	3.32	0.836
1.53	3.24	2.11	5.72	4.95	0.865
2.02	3.32	1.64	7.67	6.7	0.874
2.53	3.29	1.30	9.54	8.33	0.873
3.07	3.25	1.06	11.48	9.98	0.869
3.55	3.27	0.92	13.42	11.6	0.864
4.1	3.29	0.80	15.8	13.49	0.854

Resistance Requirement:
From Buck converter lab course, the load current should ramp up to 4A (5A is a max for load current). The graph shows load resistor variant range for 0-4A load current. As digital potentiometer minimum resistance is limited by wiper resistance - around 60 Ohm, a few ohm resistance can not be achieved by digital potentiometer.
Power Handling Capability:
The load resistance consume high power 13.5W for 4A&3.3V output. Max output power is up to 30W. Digital potentiometer only has mW power rating. (Smallest digital potentiometer X9C102 - 1K Ohm)
Conclusion: Digital potentiometer cannot be used as a dummy load for this buck converter.

Approach 2: Rheostat as load resistance with a servo motor.
It is easy to find a high power low resistance shaft potentiometer (50W & 30 Ohm wire wound ceramic potentiometer).
It is also easy to find a rotation servo motor (6V analog continuous rotation servo motor)
Arduino has a very traitor forward function to write to servo (rotate 0-360 degree)
Conclusion: This is the simplest and safest way to build a remote control resistance variable dummy load.

Approach 3: Switching a bank of fixed resistors.
Resistance Requirement & Power handling capability:
Power film resistor: MP9100 TO-247 Kool-Pak has following resistance values
& 100W continuous power rating at 25 degree case temp with heat sink

Standard Resistance Values:
Tolerance: 1% Standard

0.050 Ω	0.50 Ω	3.90 Ω	25.0 Ω
0.10 Ω	0.75 Ω	5.00 Ω	27.0 Ω
0.12 Ω	1.00 Ω	8.00 Ω	33.0 Ω
0.15 Ω	1.50 Ω	10.0 Ω	39.0 Ω
0.20 Ω	2.00 Ω	12.0 Ω	47.0 Ω
0.25 Ω	2.20 Ω	15.0 Ω	50.0 Ω
0.30 Ω	2.50 Ω	18.0 Ω	56.0 Ω
0.33 Ω	3.00 Ω	20.0 Ω	75.0 Ω
0.39 Ω	3.30 Ω	22.0 Ω	100 Ω

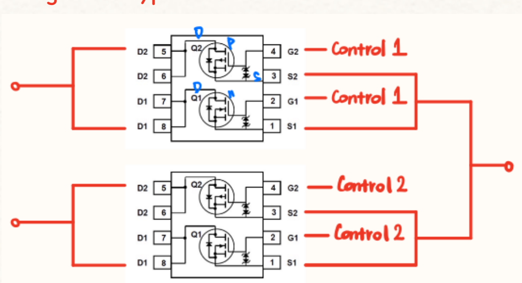
Switch design:
This lab course requires high resolution at small values, which makes the circuit for connecting fixed resistors complicated.
The load resistance range is hard to make continuous and log scale.
The switch still has the problem of voltage drop, which will impact output current and voltage of the load.
Conclusion: A bank of fixed power resistor requires complex switch circuit design.

SyncBuck Switch
- SN74LVC1G3157 single pole double throw X

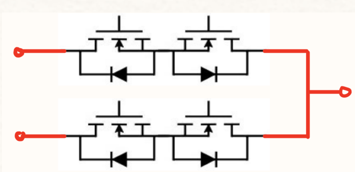
This switch has positive and negative voltage & current.
Need the same design as CapSelect switch

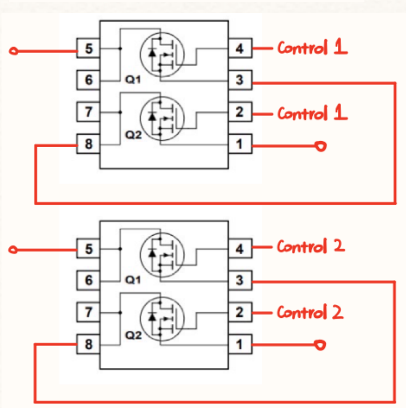
CapSelect Switch
- FDS8858CZ Dual N&P channel powertrench MOSFET X

This N&P channel MOSFET can support bidirectional current flow, but Arduino pin cannot provide the negative gate voltage of Vgs of P-type MOSFET.

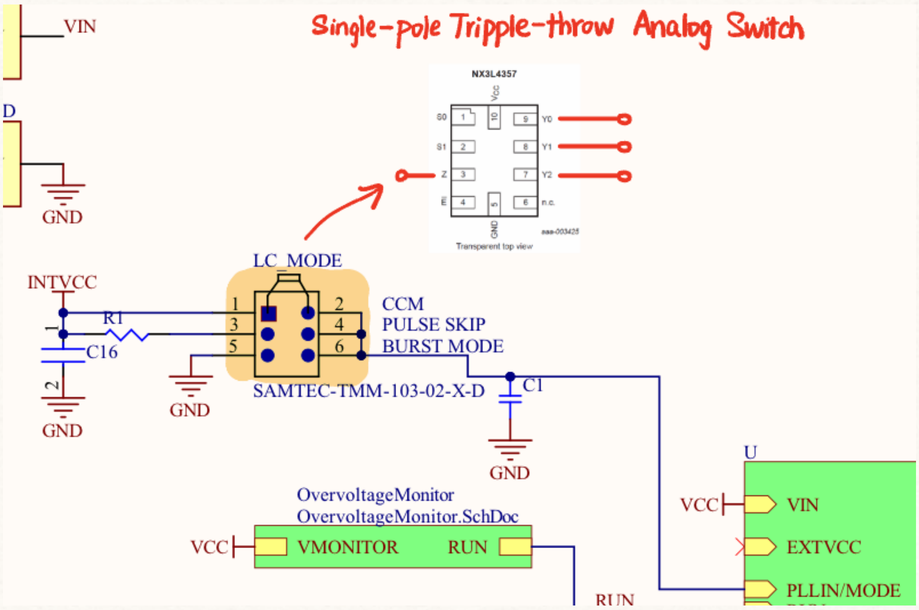


Dual N-type MOSFET: Drain and Source placed inversely to support bidirectional current flow.



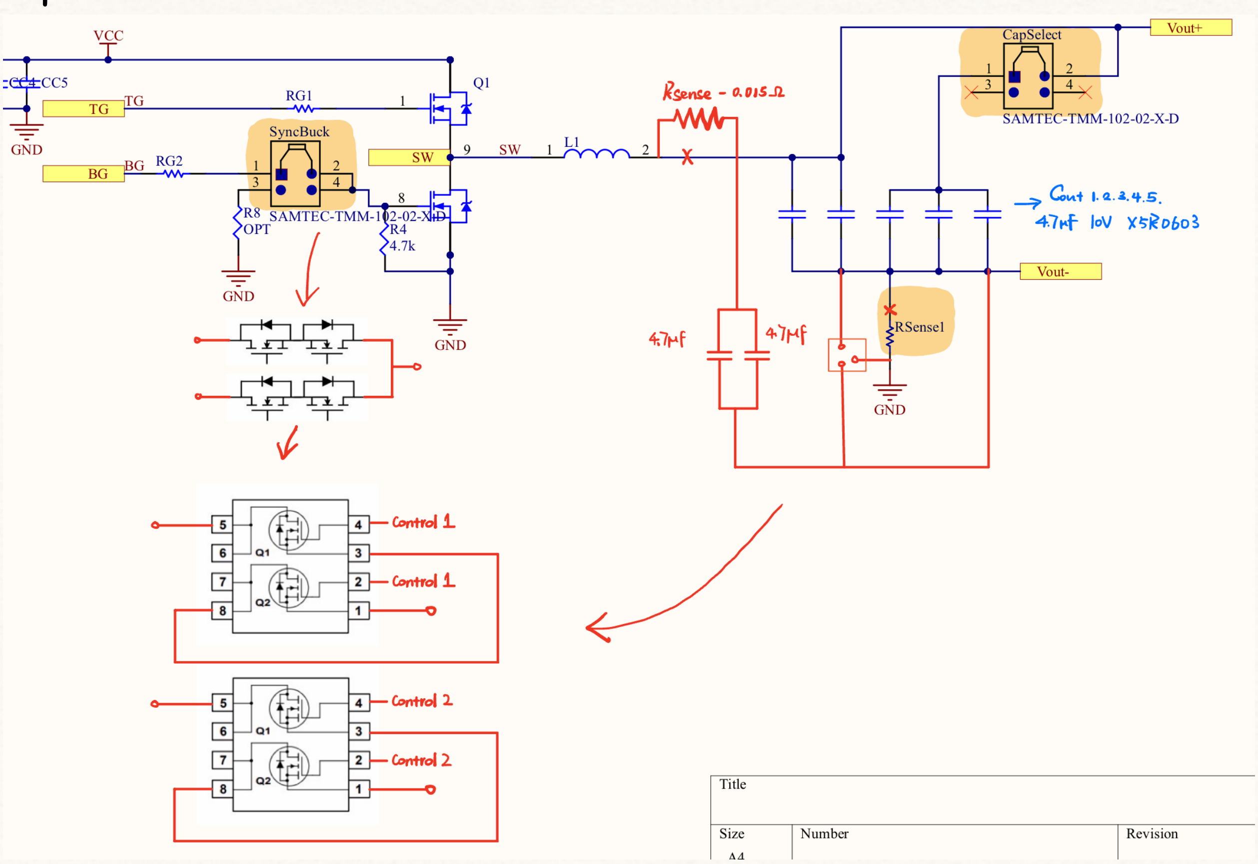


LC_MODE Switch - NX3L4357

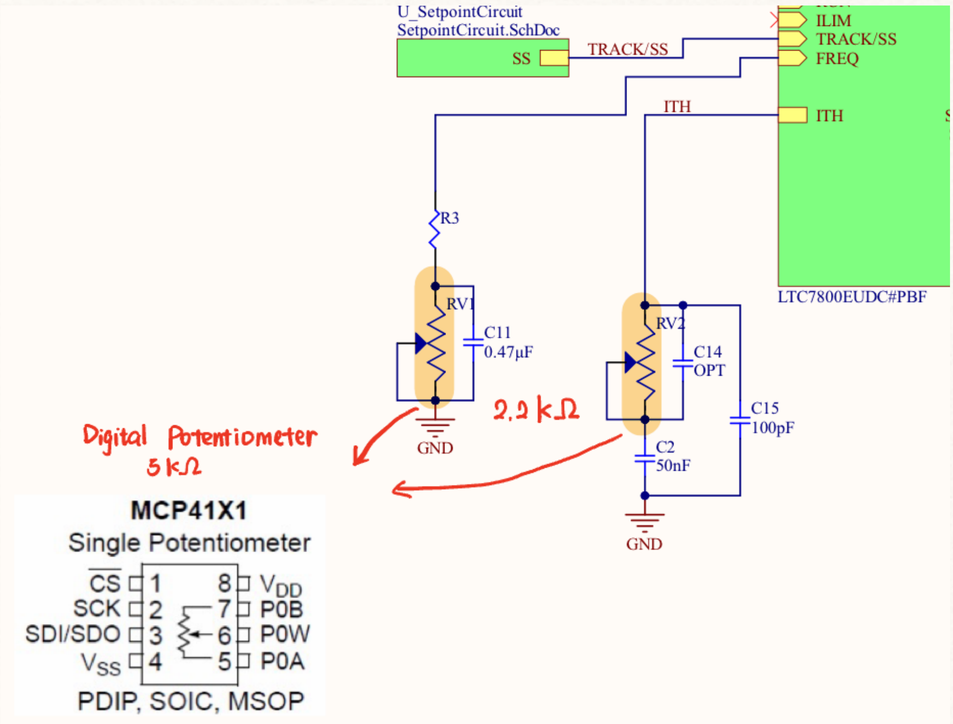


SyncBuck Switch - FDS9926A

CapSelect Switch - FDS9926A



RV1 & RV2 - MCP41X1



RV3 & RV4 - MAX5394