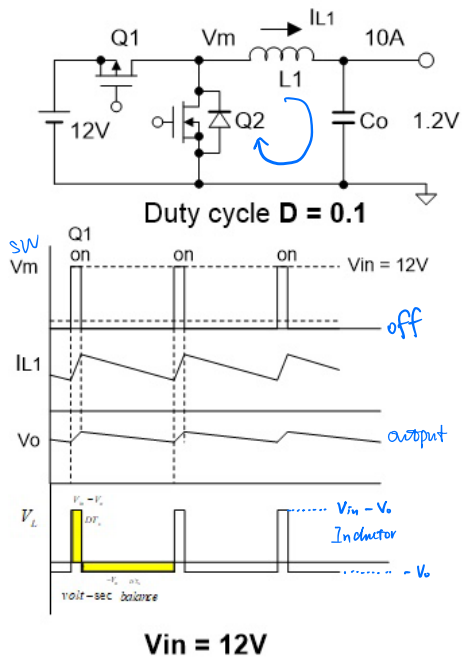
Logbook_20220618 & 19

Basic Buck Converter Circuit:



$V_L = V_{in} - V_{out}$ (on) or $-V_{out}$ (off)

$D = \frac{T_{on}}{T_s}$ $\quad 1 - D = 1 - \frac{T_{on}}{T_s}$

$(V_{in} - V_{out})\, T_{on} = V_{out} \cdot T_{off}$

$(V_{in} - V_{out}) \cdot D = V_{out}(1 - D)$

$V_{in} D - V_{out} D = V_{out} - V_{out} D$

$V_{in} \cdot D = V_{out}$

$\frac{V_{out}}{V_{in}} = D$

Buck Converter Lab Course

Oscilloscope:

Exercise 1: 10 Ohm load resistor, power supply 10V&3A
Result: V_out = 3.3V I_load = 2A

Exercise 2: Oscilloscope measures SW point, get a steady measurement by adjusting trigger level, adjusting the time-base and vertical scaling setting.
(SW: mid-point of the half bridge within the buck converter)

Exercise 3: Oscilloscope measures BG point to channel 2, add two signals in one graph.
Relation between SW and BG.

Exercise 4: Oscilloscope trigger setting.
Trigger BG rather than SW: Trigger -> Trigger Source -> Select Channel

Exercise 5: Oscilloscope measure V_out- point to channel 3.
Probe attenuation 1:1; Bandwidth limitation of this channel: 20MHz
Channel -> Bandwidth & Probe Attenuation
Current sense resistor = a low-inductance and low-resistance resistor
-> in order to get output inductor current measurement

Exercise 6: Adding labels: Channel -> Label

Exercise 7: Oscilloscope measure TG point to channel 3.
Remember the V_GS a sufficient voltage turns on MOSFET.
V_GS = Gate to source voltage; V_TG & V_BG = Gate voltage;
V_GS1 = V_TG - V_SW; V_GS2 = V_BG - V_SW.
Subtraction: Maths channel

Exercise 8: SW point measurement: Analysis -> Cursor (Horizontal&Vertical) or Meas or Statistics

Measurement: Switching frequency & Duty cycle & Peak-to-peak voltage

DataSheet and PCB Schematics:

Exercise 1: Adjust Frequency - FREQ pin: 330KHz ~ 1200KHz (p14,16,21)

GND - 0.94MHz

INTVcc - 1.44MHz

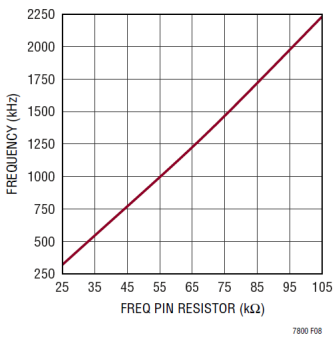
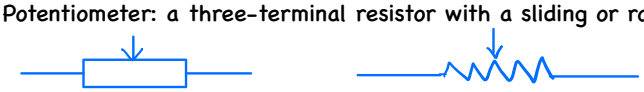


Figure 8. Relationship Between Oscillator Frequency and Resistor Value at the FREQ Pin

Resistor - GND - 320KHz ~ 2.25MHz

Resistor and potentiometer to adjust the resistance between FREQ pin and GND.

Potentiometer: a three-terminal resistor with a sliding or rotating contact that forms an adjustable resistor.



RV1 - Adjusting MOSFET switching frequency: 1MHz = 55K Ohm

RV2 - ITH Control loop behavior & Test point for overall loop stability (not clear)

Adjust feedback gain

Exercise 2: Setpoint and capture the transition of the converter between 2V and 4V output voltage.

RV3 - Setpoint1, which determine desired output voltage

RV4 - Setpoint2, which determine desired output voltage

RV3&4 - Track/SS - Vout track supply

SW1 - Switch bottom for switching between setpoint 1&2

Oscilloscope - single mode trigger (capture single event)

Exercise 3: SyncBuck on/off

On - Synchronous Buck Converter

OFF - Non-Synchronous Buck Converter: Button MOSFET replaced by diode.

Exercise 4: LC_mode - determined by PLLIN/MODE pin

PLLIN/MODE pin connected to SGND - Burst Mode;

PLLIN/MODE pin connected to INTVcc - Forced continuous;

PLLIN/MODE pin connected to < (INTVcc-1.3V) & > 1.2V - Pulse-skipping.

Exercise 5: Cap-select

Change the value of capacitance of the circuit between V_out+ & V_out-.

Cap-selected - 3 more parallel capacitors added.

Cap-unselected - only 2 parallel capacitors and one resistor to GND.

LTSpice simulation:

Exercise 1: Transient simulation 300us, take measurement of V_out, inductor current, V_swb and IN&OUT power.

Power measurement - ALT bottom. Getting circuit efficiency of P_out/P_in.

Multiple runs - {RL} load resistor 3, 4, 5 Ohm. ".op" bottom ".step param RL list 3 4 5".

Logged measurements: View -> Spice Error Log (P_out, P_in, Eff, I_out, V_out)

Measurement vs step value or another measurement: Spice error log -> "plot .step'ed .meas data"

Exercise 2: Transient events: changing values of parameters during runs

R = IF(time>0.2m, 5, 10); Resistor is 10 Ohm for 0-0.2m time and changed to 5 Ohm afterwards.

Transient at 0.2m time.

V_in = IF(time>0.25m, 10, 20); Supply voltage is 20 V for 0-0.25m time and changed to 10 V afterwards.

Exercise 3: Saving waveforms

View -> Copy Bitmap to clipboard