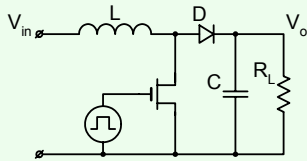
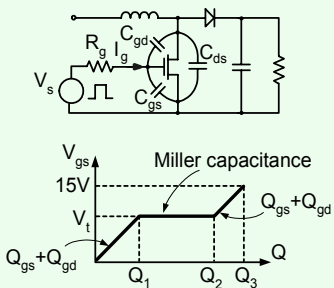


Drivers

Driving a MOSFET

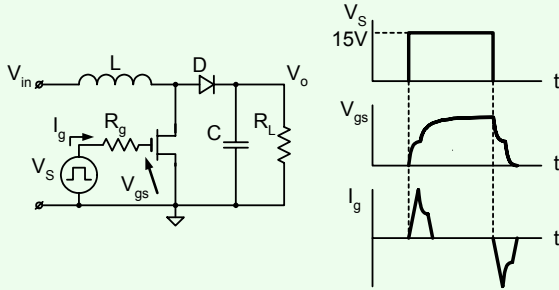


Driver Requirements

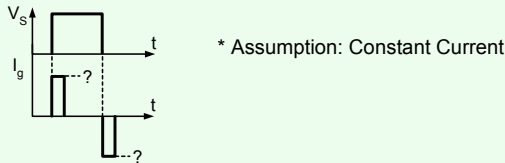


- Capacitors are non-linear

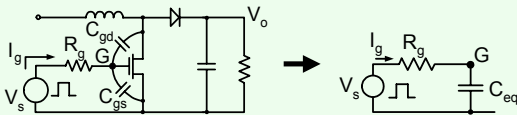
Gate Current



Calculating Required Drive

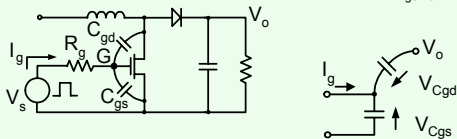


Method A: Equivalent capacitor



Gate capacitance

$$C_{eq} = \frac{Q_{total}}{V_{gs\max}}$$



$$V_{Cgs}(0) = 0 \quad \Delta V_{Cgs}(\infty) = V_{GS\max}$$

$$V_{Cgd}(0) = -V_o \quad \Delta V_{Cgd}(\infty) = V_{GS\max}$$

$$Q_{total} = V_{GS} C_{gs} + (V_{GS} + V_o) C_{gd}$$

$$C_{eq} = \frac{Q_{total}}{V_{GS\max}} = C_{gs} + C_{gd} \left(1 + \frac{V_o}{V_{GS\max}}\right)$$

Miller Effect

Gate capacitance

Calculating required I_g (constant), t_{on} :

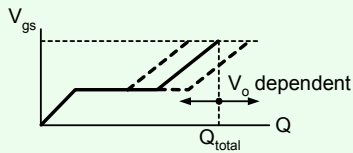
$$C_{eq} = C_{gs} + C_{gd} \left(1 + \frac{V_o}{V_{GSmax}}\right)$$

$$Q_{total} = I_g \cdot t_{on} = C_{eq} \cdot V_{gsmax}$$

$$I_g = \frac{C_{eq} V_{gsmax}}{t_{on}}$$

Calculating Required Drive

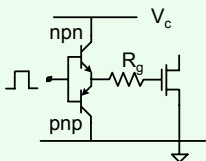
Method B: Gate Input Charge



$$Q_{total} = I_g \cdot t_{on}$$

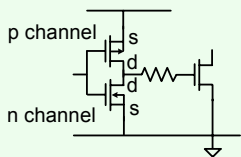
$$I_g = \frac{Q_{total}}{t_{on}}$$

Gate Drivers



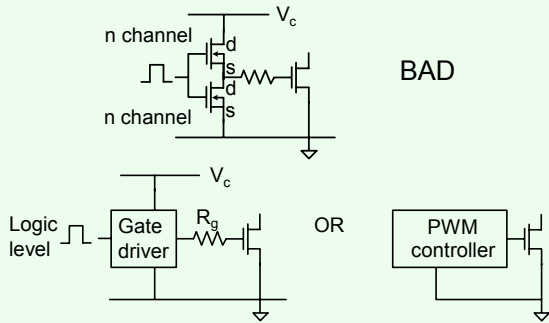
Push pull - complementary

$$V_c = V_{gsmax}$$

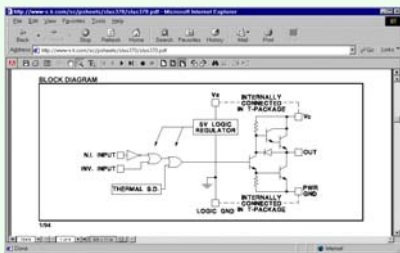


O.K. Watch for through-shoot current

Drivers

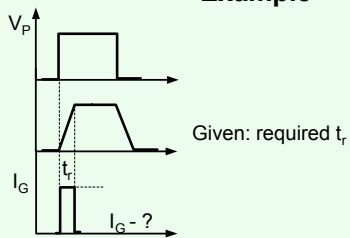


Commercial driver



- Totem pole

Example



Question: Why can I_G be considered constant ?

$$t_r \cdot I_G = \sum Q \quad I_G = \frac{\sum Q}{t_r}$$

Example

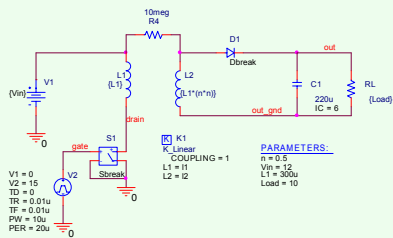
If $t_r \approx 100 \text{ nS} = 10^{-7} \text{ S}$

$\Sigma Q \approx 50 \text{ nQ}$

$I = \frac{100 \text{ nS}}{50 \text{ nQ}} = 2 \text{ A}$

Significant current !

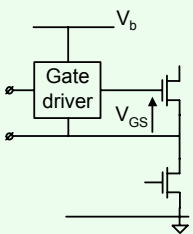
Exercise



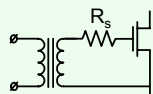
- Replace the switch with a mosfet, put a 10 Ohm resistor in series with gate and measure the input current to gate

High-Side Drive

The problem



Possible solution :
Transformer coupling



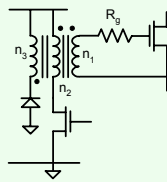
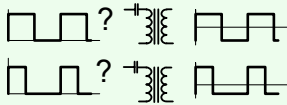
Problem

1. Wide range of D_{on}

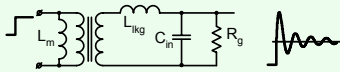
Driver isolation

Possible solution :

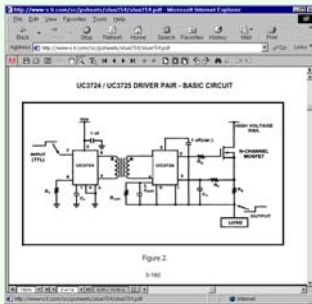
Like Forward



Problem #2 - Leakage

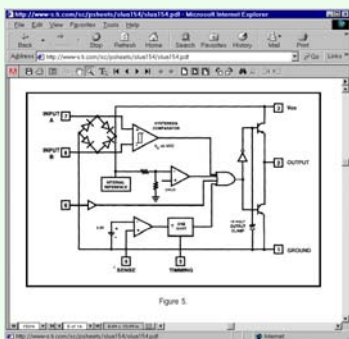


Transformer isolation

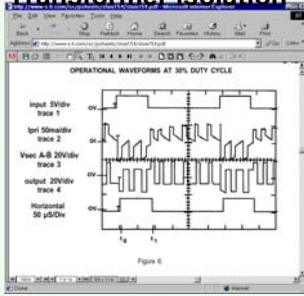


- Power and signal pass via transformer – High Frequency modulation

Transformer isolation



Transformer isolation

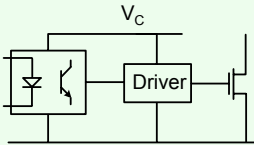


- Signal coding and reconstruction

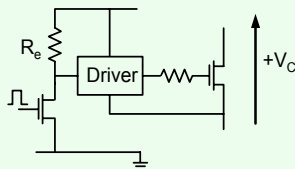
Driver isolation

Solution #2: Optical

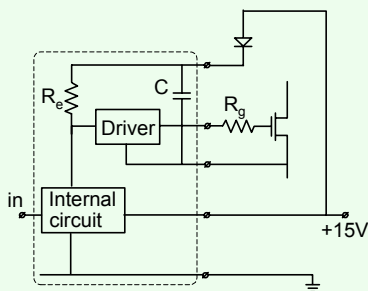
V_C - floating supply



Solution #3
Potential offset



Potential offset + floating C supply



Available for HB, FB

buffer stage designed for minimum driver production. Propagation delays are matched for use in high frequency applications. The channel can be used to drive an N-channel MOSFET or IGBT in the high side configuration up to 500 or 600 volts.

16 Lead PDIP
IR2110-2/IR2113-2

16 Lead SOIC
IR2110S/IR2113S

Typical Connection

up to 500V or 600V

TO LOAD

IR2110/IR2113

Functional Block Diagram

UV LEVEL DETECT

PULSE GEN

PULSE FILTER

UV DETECT

DELAY

VDD-VDD LEVEL SHFT

Low-side drive

TO ANALOG CIRCUITRY

VDD

VDD

OUT

PWRGD

POWER STABIL

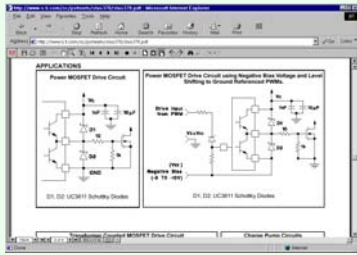
POWER GROUND

Open Loop Test Circuit

This test fixture is useful for exercising many of the UC3825A/B, UC3825A/B functions and measuring their specifications. As with any wideband circuit, careful grounding and bypass procedures should be used. The use of a ground plane is highly recommended.

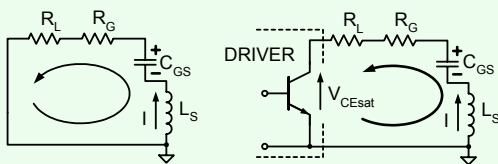
UC3825A/B UC3825A/B

Steering diodes

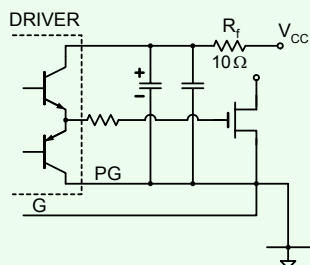


- Why the diodes ?

Turn "off"

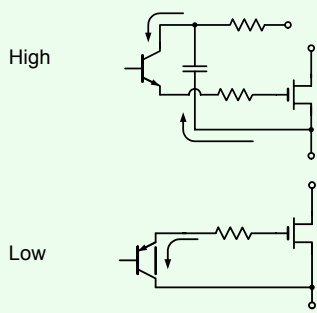


Lock current close to source



Trace current path to make sure current is locked

Current path



Real life example

