

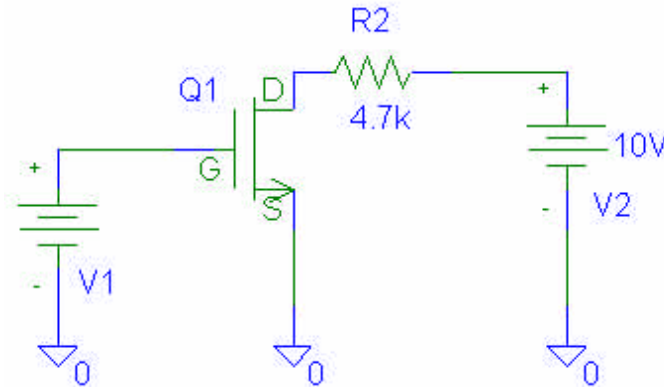
Répétition 7 : Le transistor MOSFET à canal n

1 Rappels sur le transistor MOSFET à canal n

- Caractéristiques i_D - v_{DS}
- Modes de fonctionnement

2 Exercice 1

Soit un transistor NMOS avec $K = 2 \text{ mA V}^{-2}$ et $V_t = 1,5 \text{ V}$. Soit le circuit suivant avec $R_2 = 4,7 \text{ k}\Omega$ et $V_2 = 10 \text{ V}$. Si l'on souhaite obtenir une tension $v_{DS} = 6,2 \text{ V}$, comment doit-on choisir V_1 ?



3 Exercice 2

Considérons le même circuit. Maintenant, $V_t = 2 \text{ V}$, $V_1 = 2,8 \text{ V}$, $V_2 = 12 \text{ V}$ et $R_2 = 5,6 \text{ k}\Omega$.

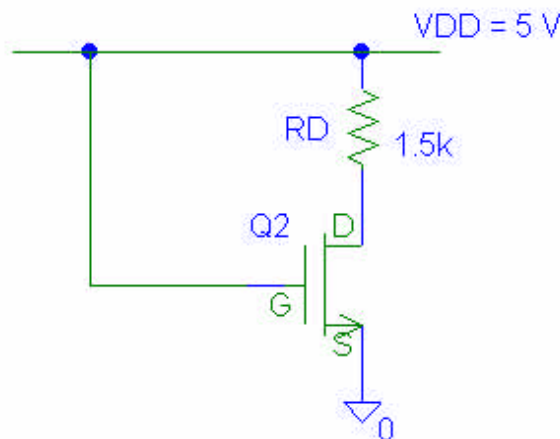
Quel sera le K maximal qui permettra d'être en saturation ?

Pour résoudre l'exercice, supposez être à la limite.

Sol. : $K = 3,13 \text{ mA V}^{-2}$.

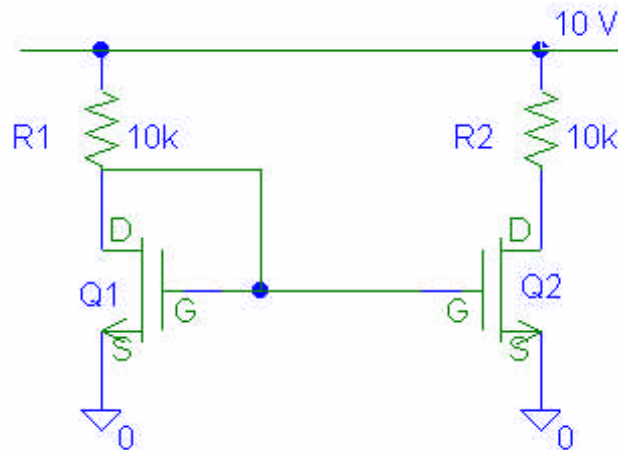
4 Exercice 3

Dans quelle région opère le transistor MOS si $R_D = 1,5 \text{ k}\Omega$, même question pour $R_D = 500 \Omega$. On suppose $K = 0,5 \text{ mA V}^{-2}$, $V_t = 2,5 \text{ V}$.



5 Exercice 4

Soit le circuit suivant :



Dans quelle région fonctionne Q_1 ?

Que vaut V_{DS1} ? (S'aider des expressions de I_{D1})

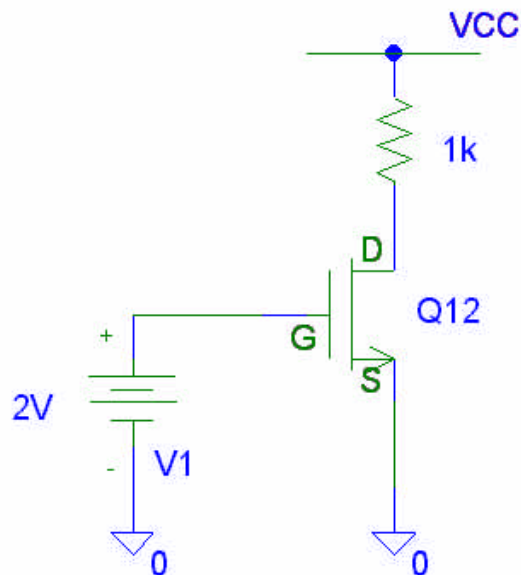
Prouver que Q_2 est saturé et calculer V_{DS2} .

On suppose $K = 1,8 \text{ mA V}^{-2}$, $V_t = 1,2 \text{ V}$.

Sol. : $V_{DS1} = 1,86 \text{ V}$, $I_{D1} = 0,8 \text{ mA}$.

6 Exercice 5

On souhaite ne pas endommager le transistor MOS dans le circuit suivant. Comment doit-on choisir V_{CC} . On sait que $K = 1 \text{ mA V}^{-2}$, $V_t = 1 \text{ V}$, $P_{max} = 50 \text{ mW}$.



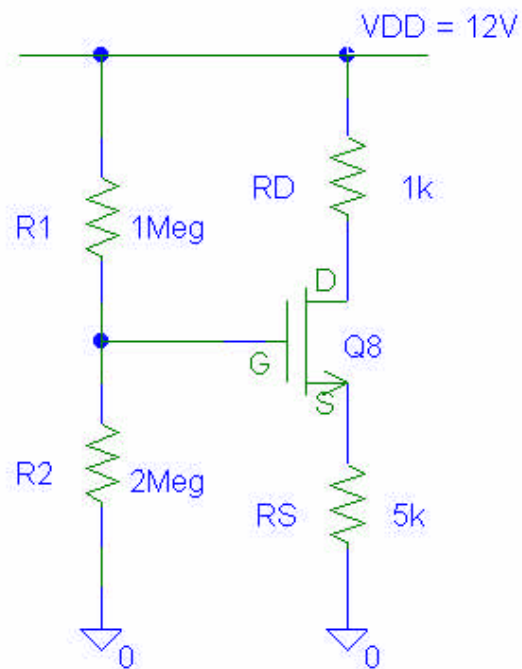
7 Exercice 6

La fiche technique du MOSFET à enrichissement à canal n 2N7008 indique $I_{D(on)} = 500 \text{ mA}$ (minimum) à $V_{GS} = 10 \text{ V}$ et $V_{GS(th)} = 1 \text{ V}$. Déterminez I_D à $V_{GS} = 5 \text{ V}$.

(Fiche technique en annexe).

8 Exercice 7

Placer Q sur la droite de courant I_D pour le circuit ci-dessous. On suppose $K = 0,5 \text{ mA V}^{-2}$, $V_t = 2 \text{ V}$.



Solutions : $V_{DS} = 6,42 \text{ V}$ et $V_{GS} = 3,36 \text{ V}$.



**N-Channel Enhancement-Mode
Vertical DMOS FETs**

Ordering Information

BV _{DSS} / BV _{DGS}	R _{DS(ON)} (max)	I _{D(ON)} (min)	Order Number / Package
			TO-92
60V	7.5Ω	500mA	2N7008

Features

- Free from secondary breakdown
- Low power drive requirement
- Ease of paralleling
- Low C_{ISS} and fast switching speeds
- Excellent thermal stability
- Integral Source-Drain diode
- High input impedance and high gain
- Complementary N- and P-channel devices

Applications

- Motor controls
- Converters
- Amplifiers
- Switches
- Power supply circuits
- Drivers (relays, hammers, solenoids, lamps, memories, displays, bipolar transistors, etc.)

Absolute Maximum Ratings

Drain-to-Source Voltage	BV _{DSS}
Drain-to-Gate Voltage	BV _{DGS}
Gate-to-Source Voltage	± 30V
Operating and Storage Temperature	-55°C to +150°C
Soldering Temperature*	300°C

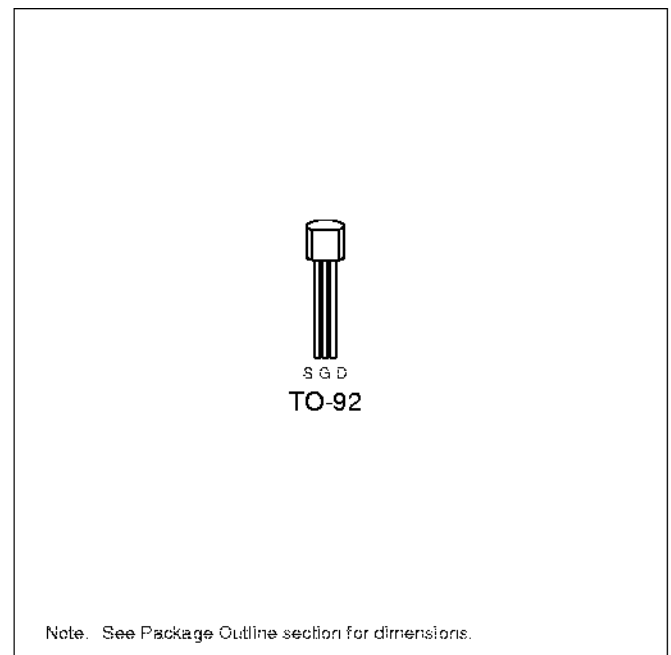
* Distance of 1.6 mm from case for 10 seconds.

Advanced DMOS Technology

These enhancement-mode (normally-off) transistors utilize a vertical DMOS structure and Supertex's well-proven silicon-gate manufacturing process. This combination produces devices with the power handling capabilities of bipolar transistors and with the high input impedance and positive temperature coefficient inherent in MOS devices. Characteristic of all MOS structures, these devices are free from thermal runaway and thermally-induced secondary breakdown.

Supertex's vertical DMOS FETs are ideally suited to a wide range of switching and amplifying applications where high breakdown voltage, high input impedance, low input capacitance, and fast switching speeds are desired.

Package Option



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Supertex inc. does not recommend the use of its products in life support applications and will not knowingly sell its products for use in such applications unless it receives an adequate "products liability indemnification insurance agreement." Supertex does not assume responsibility for use of devices described and limits its liability to the replacement of devices determined to be defective due to workmanship. No responsibility is assumed for possible omissions or inaccuracies. Circuitry and specifications are subject to change without notice. For the latest product specifications, refer to the Supertex website: <http://www.supertex.com>. For complete liability information on all Supertex products, refer to the most current databook or to the Legal/Disclaimer page on the Supertex website.

Thermal Characteristics

Package	I_D (continuous)*	I_D (pulsed)	Power Dissipation @ $T_C = 25^\circ\text{C}$	θ_{jC} $^\circ\text{C/W}$	θ_{jA} $^\circ\text{C/W}$	I_{DR}^*	I_{DRM}
TO-92	230mA	1.3A	1W	125	170	230mA	1.3A

* I_D (continuous) is limited by max rated T_j

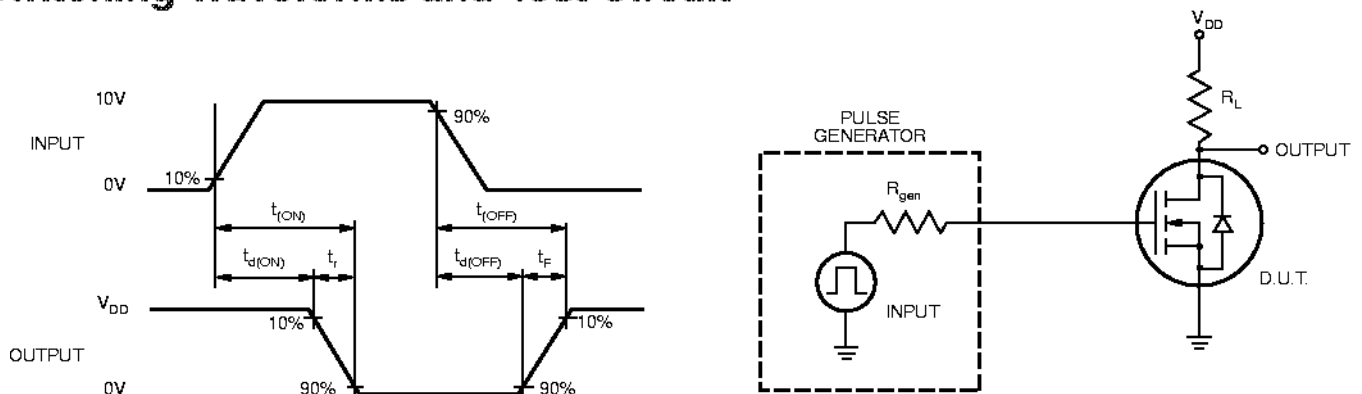
Electrical Characteristics (@ 25°C unless otherwise specified)

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	60			V	$I_D = -10\mu\text{A}$, $V_{GS} = 0\text{V}$
$V_{GS(th)}$	Gate Threshold Voltage	1		2.5	V	$V_{GS} = V_{DS}$, $I_D = 250\mu\text{A}$
I_{GSS}	Gate Body Leakage			100	nA	$V_{GS} = \pm 30\text{V}$, $V_{DS} = 0\text{V}$
I_{DSS}	Zero Gate Voltage Drain Current			1	μA	$V_{GS} = 0\text{V}$, $V_{DS} = 50\text{V}$
				500	μA	$V_{GS} = 0\text{V}$, $V_{DS} = 50\text{V}$ $T_A = 125^\circ\text{C}$
$I_{D(ON)}$	ON-State Drain Current	500			mA	$V_{GS} = 10\text{V}$, $V_{DS} \geq 2V_{DS(ON)}$
$R_{DS(ON)}$	Static Drain-to-Source ON-State Resistance			7.5	Ω	$V_{GS} = 5\text{V}$, $I_D = 50\text{mA}$
				7.5	Ω	$V_{GS} = 10\text{V}$, $I_D = 500\text{mA}$
G_{FS}	Forward Transconductance	80			mS	$V_{DS} = 10\text{V}$, $I_D = 0.2\text{A}$
C_{ISS}	Input Capacitance			50	pF	$V_{GS} = 0\text{V}$, $V_{DS} = 25\text{V}$ $f = 1\text{MHz}$
C_{OSS}	Common Source Output Capacitance			25		
C_{RSS}	Reverse Transfer Capacitance			5		
$t_{(ON)}$	Turn-ON Time			20	ns	$V_{DD} = 30\text{V}$, $I_D = 200\text{mA}$, $R_{GEN} = 25\Omega$
$t_{(OFF)}$	Turn-OFF Time			20		
V_{SD}	Diode Forward Voltage Drop			1.5	V	$I_{SD} = 150\text{mA}$, $V_{GS} = 0\text{V}$

Notes:

- All D.C. parameters 100% tested at 25°C unless otherwise stated. (Pulse test: 300 μs pulse, 2% duty cycle.)
- All A.C. parameters sample tested.

Switching Waveforms and Test Circuit



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