A. Summary
This Voltage Divider consists of one P-Channel MOSFET and one N-Channel MOSFET as a switch and two resistors as a simple DC voltage divider. The combination of these two functional pieces makes the circuit possible to be controlled by an analog power to divide the input voltage when the switch is on and cut off the power consumption when the switch is off.

B. Schematics

![Schematic of Switchable DC Voltage Divider](image)

C. Direction for Use and Disuse
For using the circuit, connect the input pin to a target DC voltage source and connect switch (on/off) pin to a controlled voltage source (ex. an output pin of a microcontroller). When the switch pin gets a HIGH input (over the threshold voltage of the N-channel MOSFET), the N-channel MOSFET will become linear status and work as a short circuit to set the gate pin of P-channel MOSFET to ground, and make the P-channel MOSFET as a short circuit too. While the switch pin gets a LOW input (normally 0 volts), the N-channel MOSFET will work as an open circuit and the connection through a high resistance resistor will make the gate pin to such a high voltage level in order to make the P-channel MOSFET work as an open circuit.

Warning: DO NOT connect input pin to AC voltage source, MOSFET might not able to work properly under a high frequency voltage source. Also, the MOSFET will block all input voltage below the threshold voltage. In addition, AC voltage source may make the reverse Drain-Gate Voltage of P-channel MOSFET so high that it might burn and lead to accident.
D. Example and Pspice Simulation Results.

In this example M1 is IRF530 N-channel MOSFET, and M2 is IRF9530 P-channel MOSFET. R1 is 1M ohms resistor, R2 is 2k ohms resistor and R3 is 1k ohms resistor.

With Vin is a 14V battery, this circuit could do as a switchable voltage divider which could make the output voltage roughly equal to one third of input voltage.

\[ V_{out} = Vin - Vin \times \left( \frac{R_2 + R_3}{R_1} \right) \]

To test this circuit, PSpice is used.

1. Switch is off.

PSpice program:

```
MONITOR
VS 3 0 DC 1
VLG 1 0 0
R1 3 2 1000K
R2 4 5 2K
R3 5 0 1K
M1 2 1 0 0 IRF530
M2 3 2 4 3 IRF9530
.DO VS 14 12.8 0.1
.MODEL IRF530 NMOS(Level=3 Gamma=0 Delta=0 Eta=0 Theta=0 Kappa=0
Vmax=0 Xj=0
  +  Tox=100n Uo=.6 Rs=.5853m Kp=20.73u W=68 L=2u Vto=3.191
  +  Rd=38.69m Rds=444.4K Cbd=1.151n Pb=.8 Mj=.5 Fc=.5 Cgso=876.7p
  +  Cgdo=115.5p Rg=3.519 Is=2.938E-18 N=2 Tt=390n)
.MODEL IRF9530 PMOS(Level=3 Gamma=0 Delta=0 Eta=0 Theta=0 Kappa=0
Vmax=0 Xj=0
  +  Tox=100n Uo=300 Phi=.6 Rs=.576 Kp=10.57u L=1.4 L=2u Vto=-3.745
  +  Rd=66.13m Rds=444.4K Cbd=1.249n Pb=.8 Mj=.5 Fc=.5 Cgso=1.578n
  +  Cgdo=1.249n Rg=3.519 Is=2.938E-18 N=2 Tt=390n)
.OP
.PROBE
.END
```

The Vout result:
2. Switch is on:

PSpice program

   Monitor Circuit

   VS 3 0 DC 1

   VLG  1 0 5

   R1  3 2 1000K

   R2  5 6 2K

   R3  6 0 1K

   M1  2 1 0 0 IRF530

   M2  3 2 5 3 IRF9530

   .DC VS 14 12.8 0.1

   .model IRF530 NMOS(Level=3 Gamma=0 Delta=0 Eta=0 Theta=0 Kappa=0

   Vmax=0 Xj=0

   +  Tox=100n Uo=.68 Rs=58.53m Kp=20.73u W=.68 L=2u Vto=3.191

   +  Rd=38.69m Rds=444.4K Cbd=.151n Pb=8 Mj=5 Fc=.5 Cgso=876.7p

   +  Cgdo=261.4p Rg=4.63 Is=1.861p N=1 Tt=125n)

   .model IRF9530 PMOS(Level=3 Gamma=0 Delta=0 Eta=0 Theta=0 Kappa=0

   Vmax=0 Xj=0

   +  Tox=100n Uo=300 Phi=.6 Rs=.1576 Kp=10.57u W=1.4 L=2u Vto=-3.745

   +  Rd=66.13m Rds=444.4K Cbd=1.249n Pb=.8 Mj=5 Fc=.5 Cgso=1.578n

   +  Cgdo=115.5p Rg=3.519 Is=2.938E-18 N=2 Tt=290n)

   .OP

   .PROBE

   .END

And the Vout result:
3. As the figure shows above, when the switch is off, Vout goes to zero (roughly). And, when the switch is on, Vout goes to one third of input voltage.