Voltage and Current Dividers: What They Are and What They Do

Kirchhoff's Voltage Law states that that the algebraic sum of all the voltages in a loop must equal zero. A practical application of this law is the voltage divider, shown in the figure below.

If U_1 is a 9-V battery, R_1 a 3-Ohm resistor, and R_2 a 6-Ohm resistor, the current flowing in the circuit is

$$9 \text{ v} 3 \ \Omega + 6 \ \Omega = 1 \text{ A} 9 \text{ v} 3 \ \Omega + 6 \ \Omega = 1 \text{ A}$$

.

The voltage across R_1 would then be

$$3 \ \Omega \text{ x } 1 \text{ A} = 3 \text{ v} 3 \ \Omega \text{ x } 1 \text{ A} = 3 \text{ v}$$

,

and the voltage across R_2 would be

$$6 \ \Omega \text{ x } 1 \text{ A} = 6 \text{ v} 6 \ \Omega \text{ x } 1 \text{ A} = 6 \text{ v}$$

.

The voltage across the individual resistors is equal to the voltage across both resistors times the ratio of the individual resistance to the total resistance. The equation for calculating the voltage across resistor R_2, U_2, is also shown below.

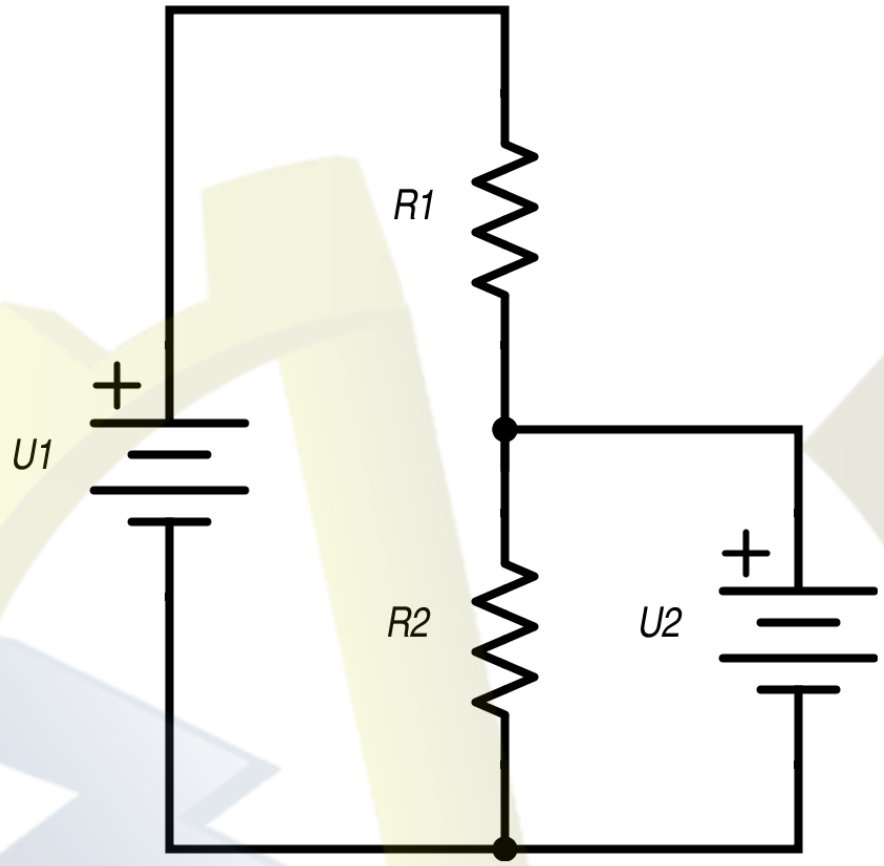

Fig. 1 Voltage Divider Circuit

U1=U1R2R1+R2U1=U1R2R1+R2

Similarly, you can divide currents. The law that governs this is called Kirchoff's Current Law. This law states, "The algebraic sum of all currents entering and exiting a node must equal zero."

To see how this works, refer to the figure below. I_T is the total current being supplied to the circuit of four parallel resistors. I_X is the current that will flow through R_X. As shown by the equation below, the fraction of I_T flowing through R_X will be equal to I_X times the ratio of R_X to the total resistance. If all of the resistors are the same value, then the current through each will be the same.

For example, if

IT=1 AIT=1 A

and

RX=R1=R2=R3=30ΩRX=R1=R2=R3=30Ω

,
then

$$RT=10\Omega RT=10\Omega$$

and
$IX=ITRTRX+RT=(1)(10)30+10=1040=0.25\ AIX=ITRTRX+RT=(1)(10)30+10=1040=0.25\ A$

.

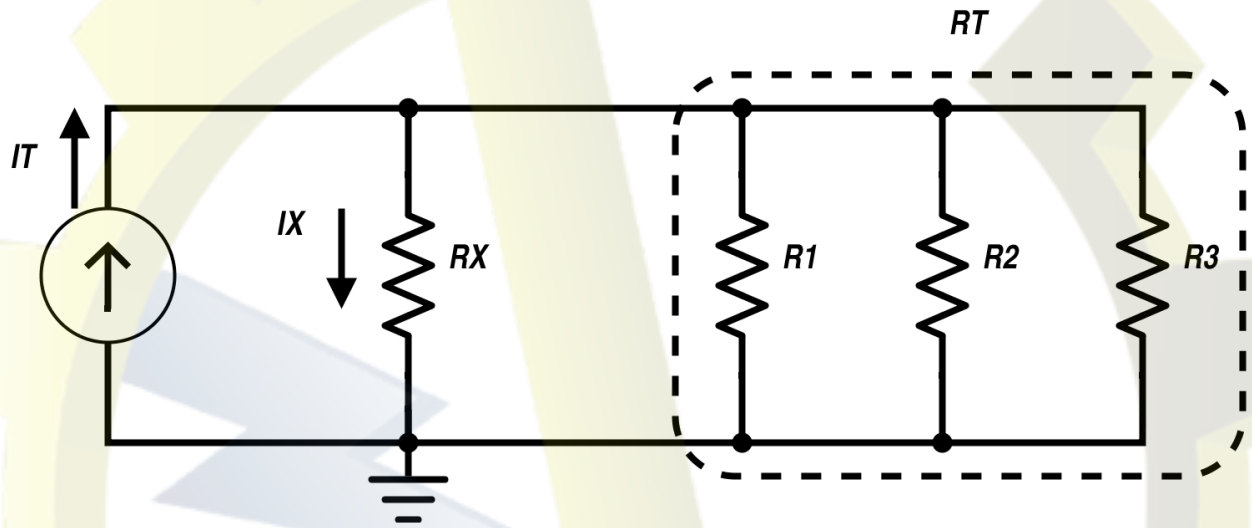

Fig. 2 Current Divider Circuit

$IX=ITRTRX+RTIX=ITRTRX+RT$

Application

Voltage and current dividers have many practical applications. For example, in the circuit shown below, R_2 is a photoresistor, which changes value as the intensity of the light impinging on it changes. The voltage across R_2, U_2, is then a measure of light intensity. You could use this to sense the level of sunlight, or the presence or absence of an object between a light source and the photoresistor. There are, of course, many other applications for voltage and current divider circuits.

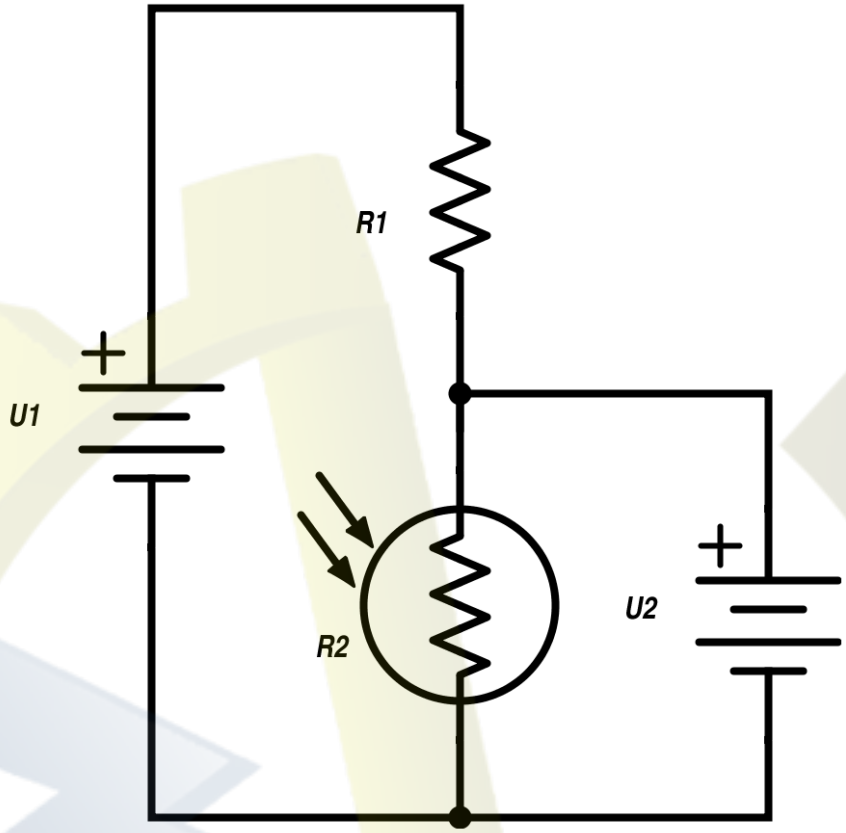

Fig. 3 Voltage Divider Application

U2=U1R2R1+R2U2=U1R2R1+R2