ANALOG VS. DIGITAL

where can you stand on each side?

where can you stand on each side?

where can you stand on each side?

where can you stand on each side?

where can you stand on each side?

CONTINUOUS

any level is possible

DISCRETE

only four different levels

analog and digital clocks

Image source: Wikipedia

Image source: Wikipedia

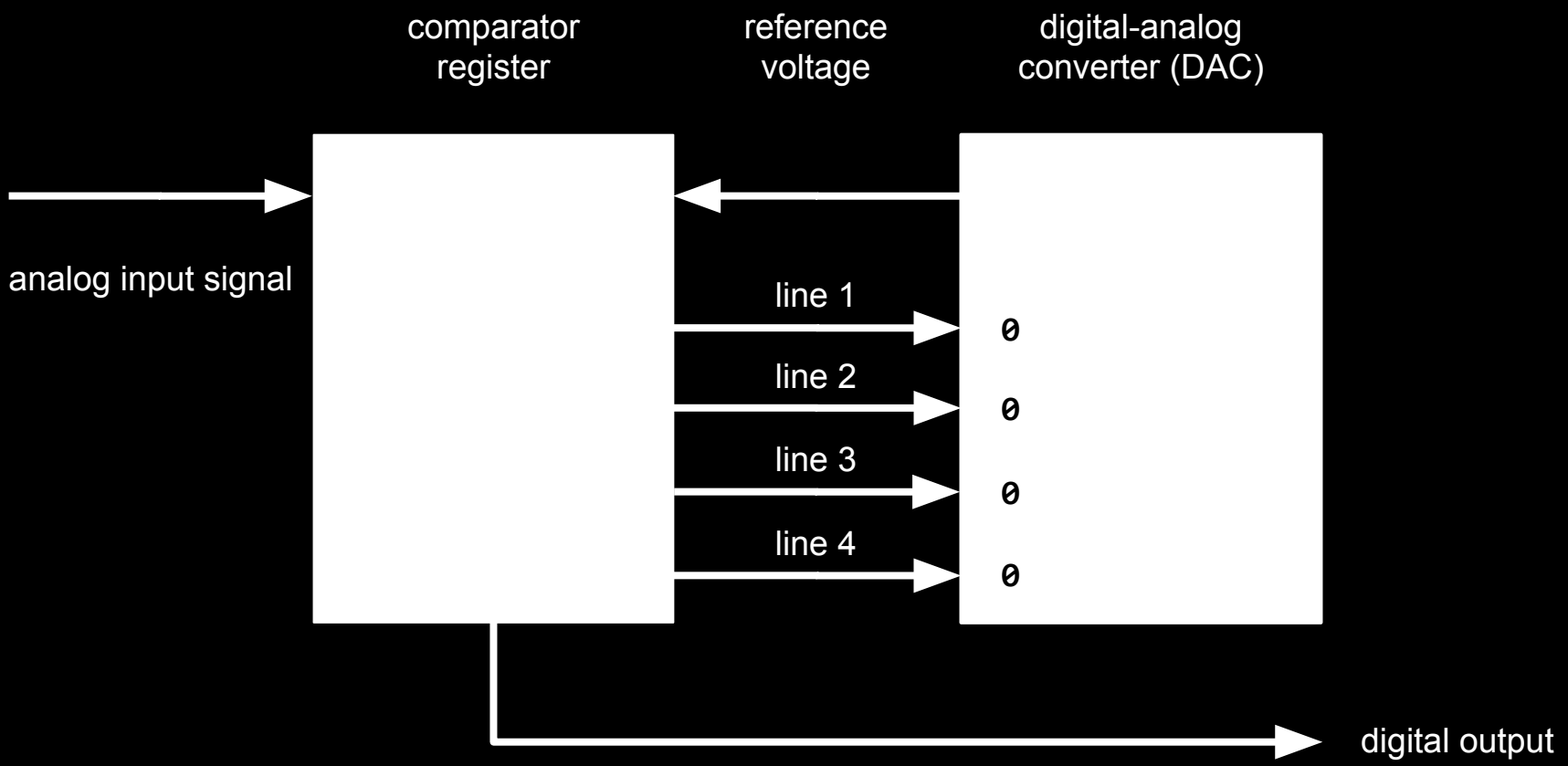
“Digitization is the representation of an object, image, sound, document or signal by generating a series of numbers that describe a discrete set of its points or samples”

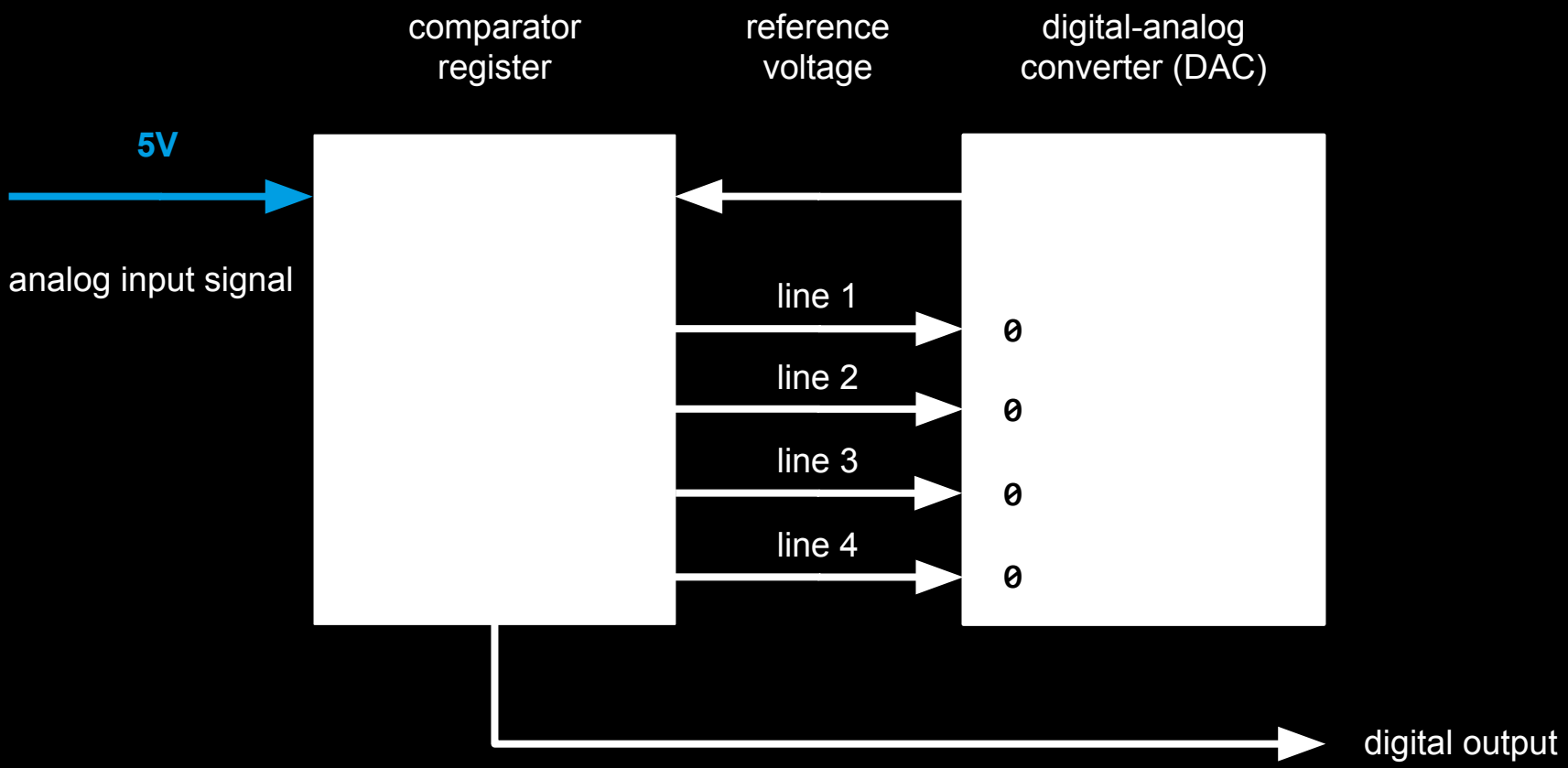
analog-to-digital converter (ADC)

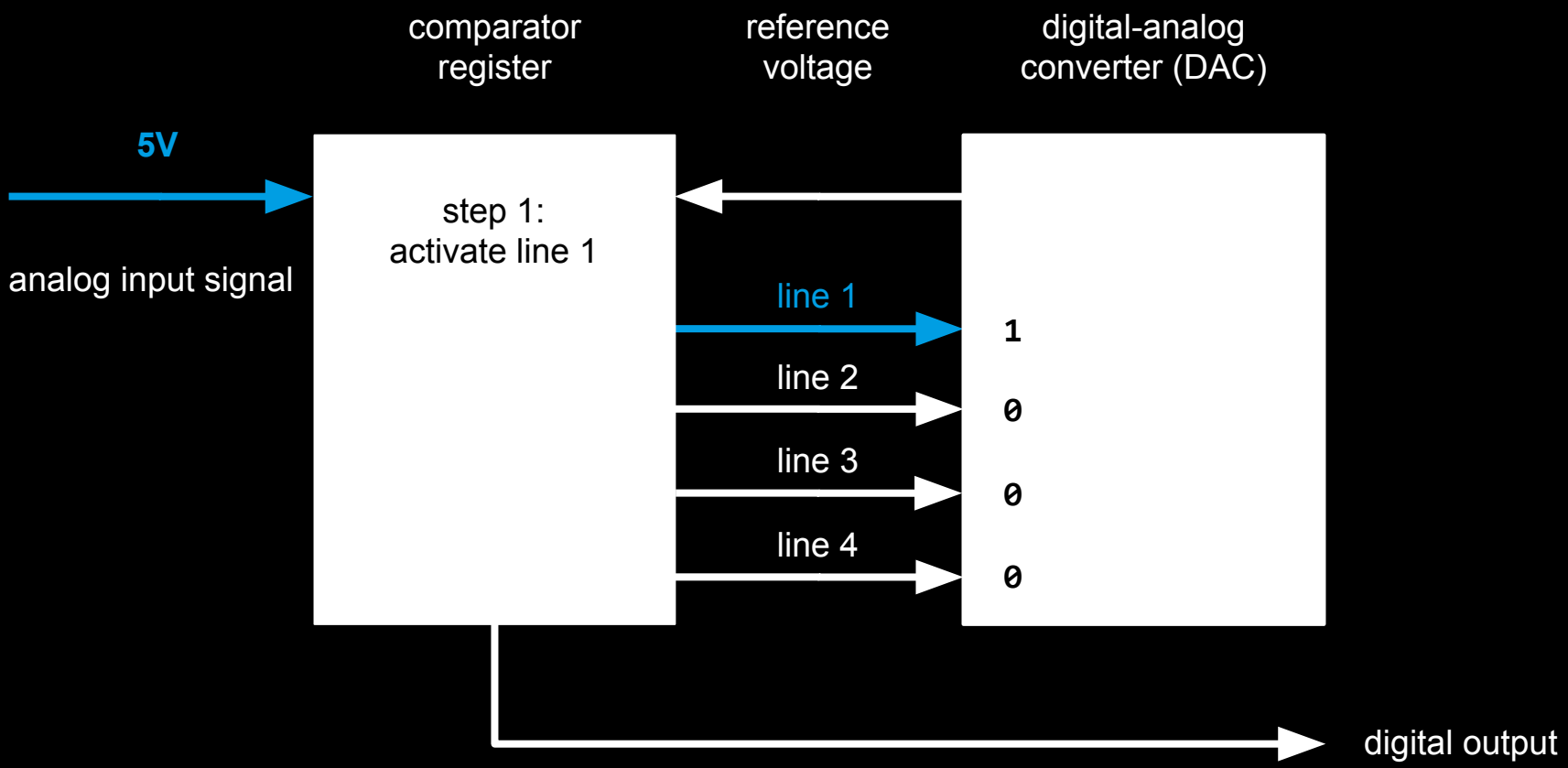
measuring of the analog signal

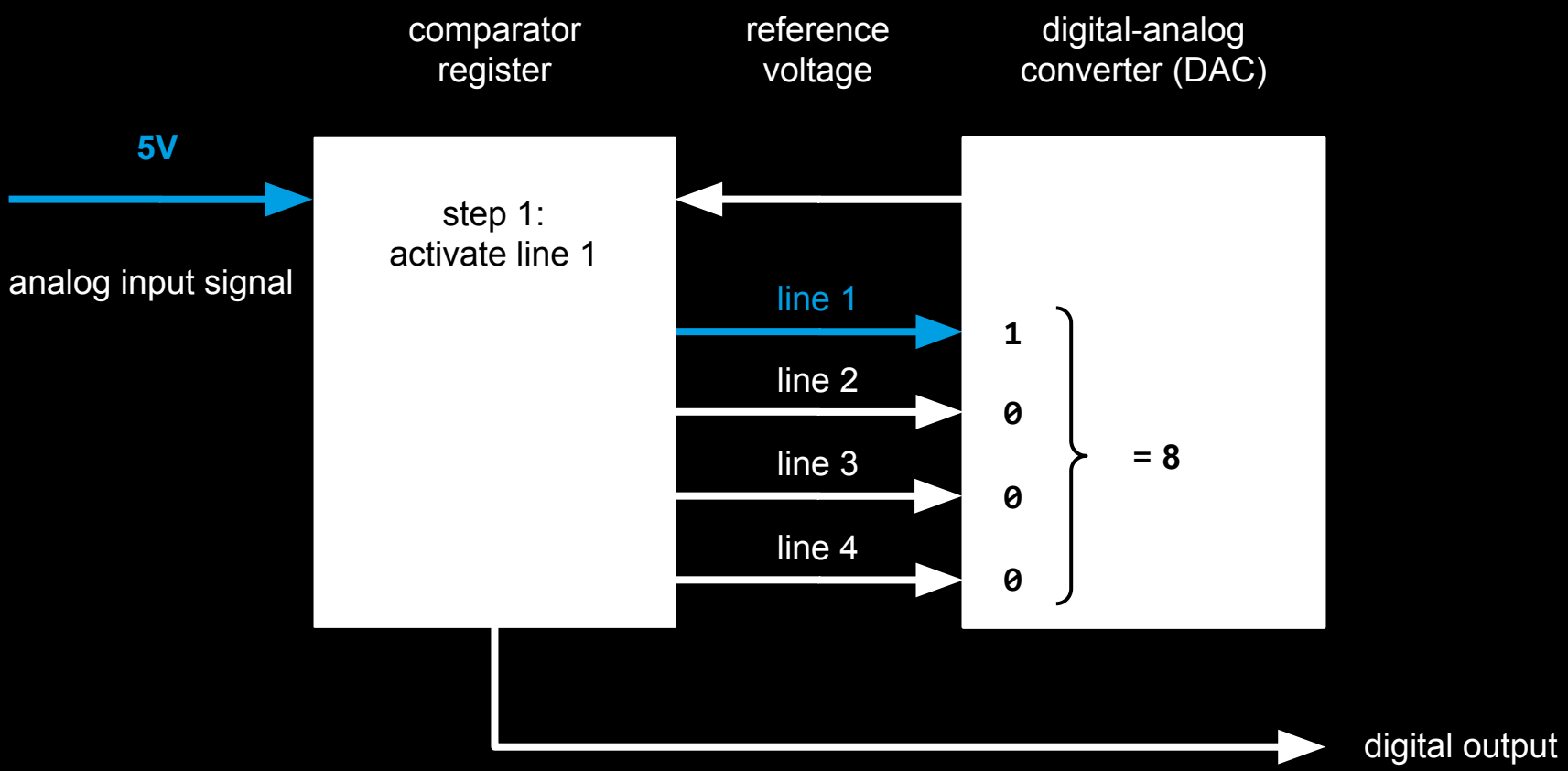
turning the measurement into a series of 1 and 0

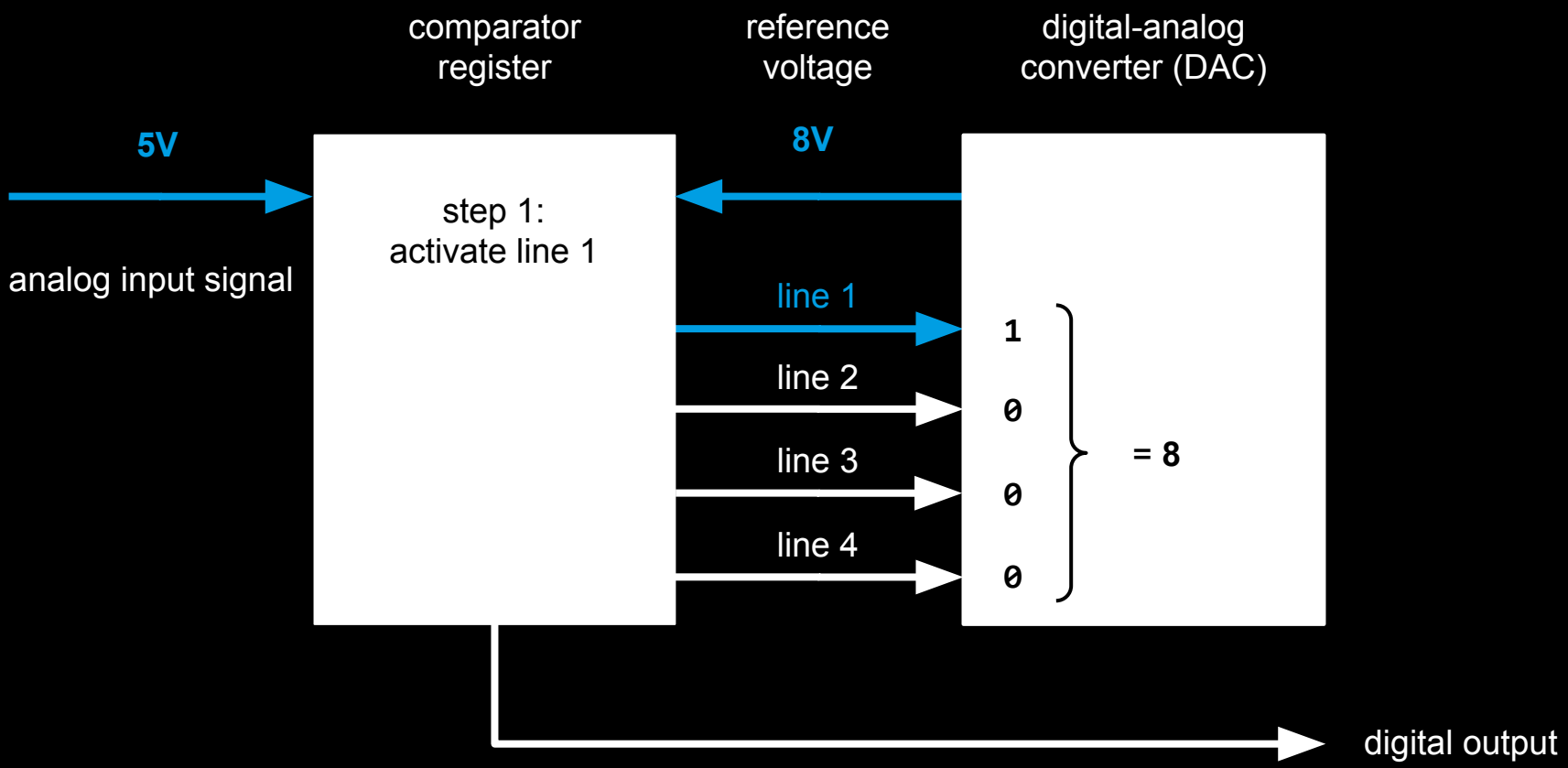
encoding the series of numbers in binary and assign meaning

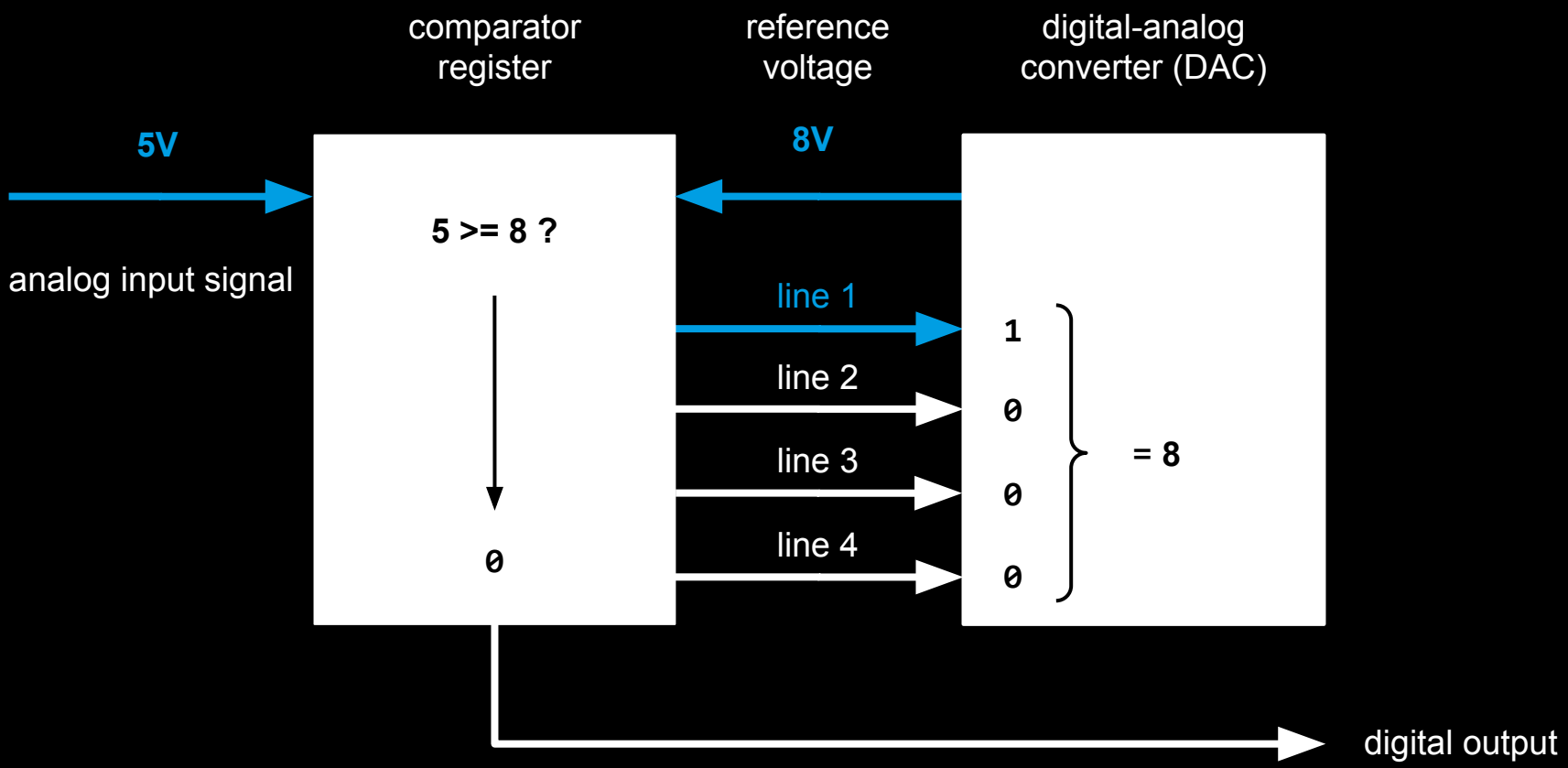

comparator
register
reference
voltage
digital-analog
converter (DAC)
analog input signal
line 1
line 2
line 3
line 4
0
0
0
0
digital output

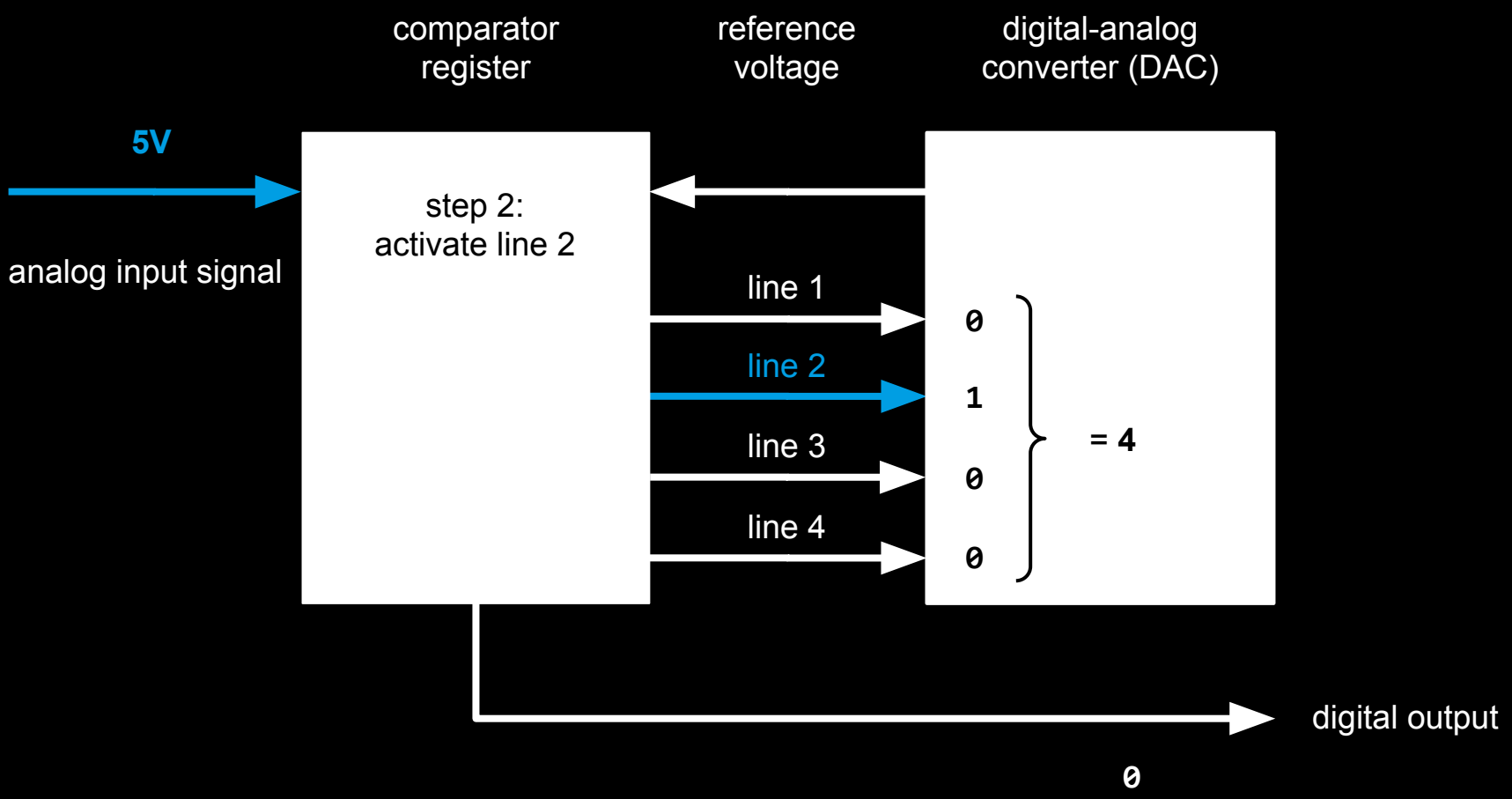

comparator register
reference voltage
digital-analog converter (DAC)
5V
analog input signal
line 1
line 2
line 3
line 4
0
0
0
0
digital output

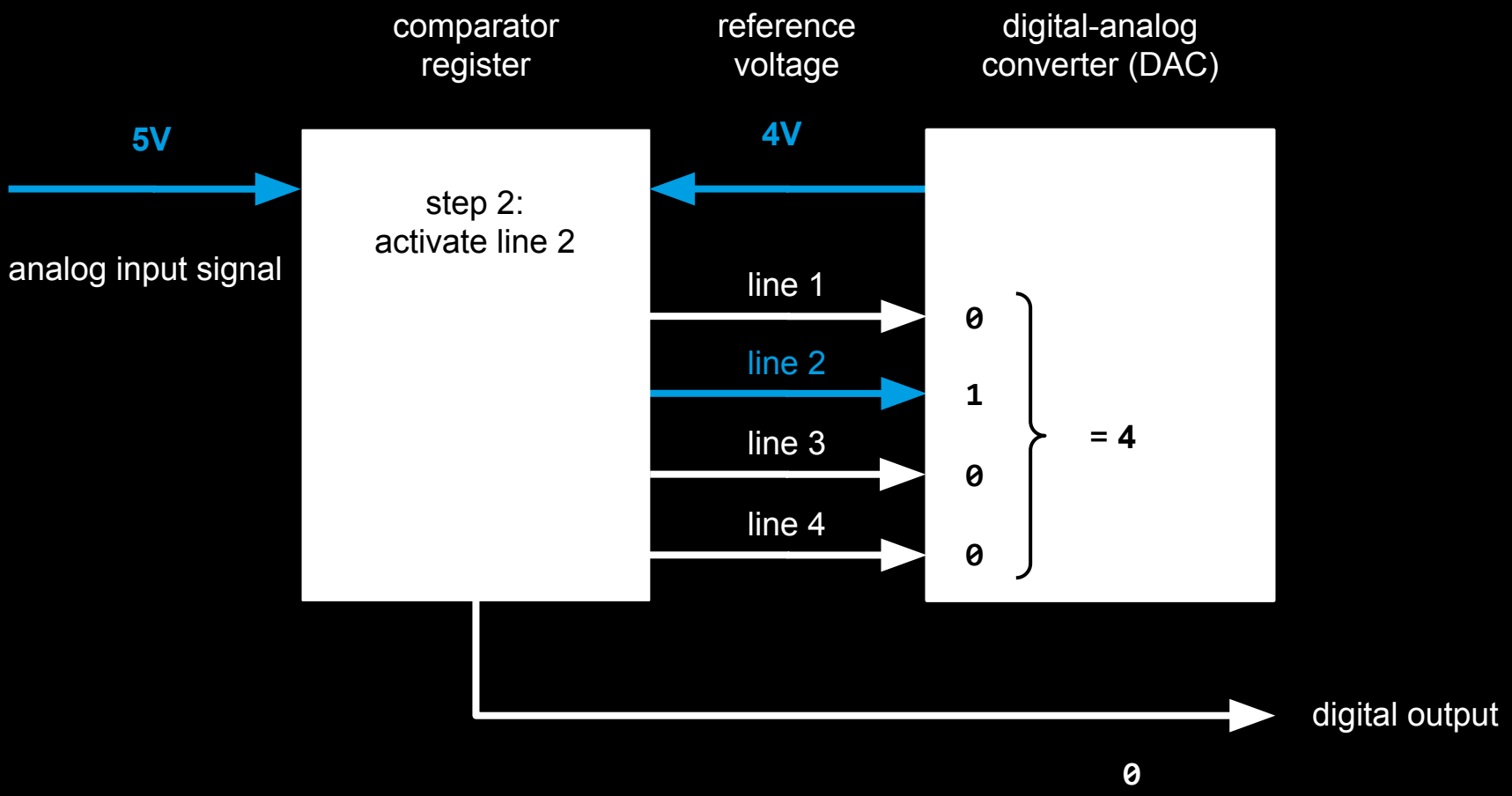

comparator register
reference voltage
digital-analog converter (DAC)
5V
analog input signal
step 1: activate line 1
line 1
line 2
line 3
line 4
1
0
0
0
digital output

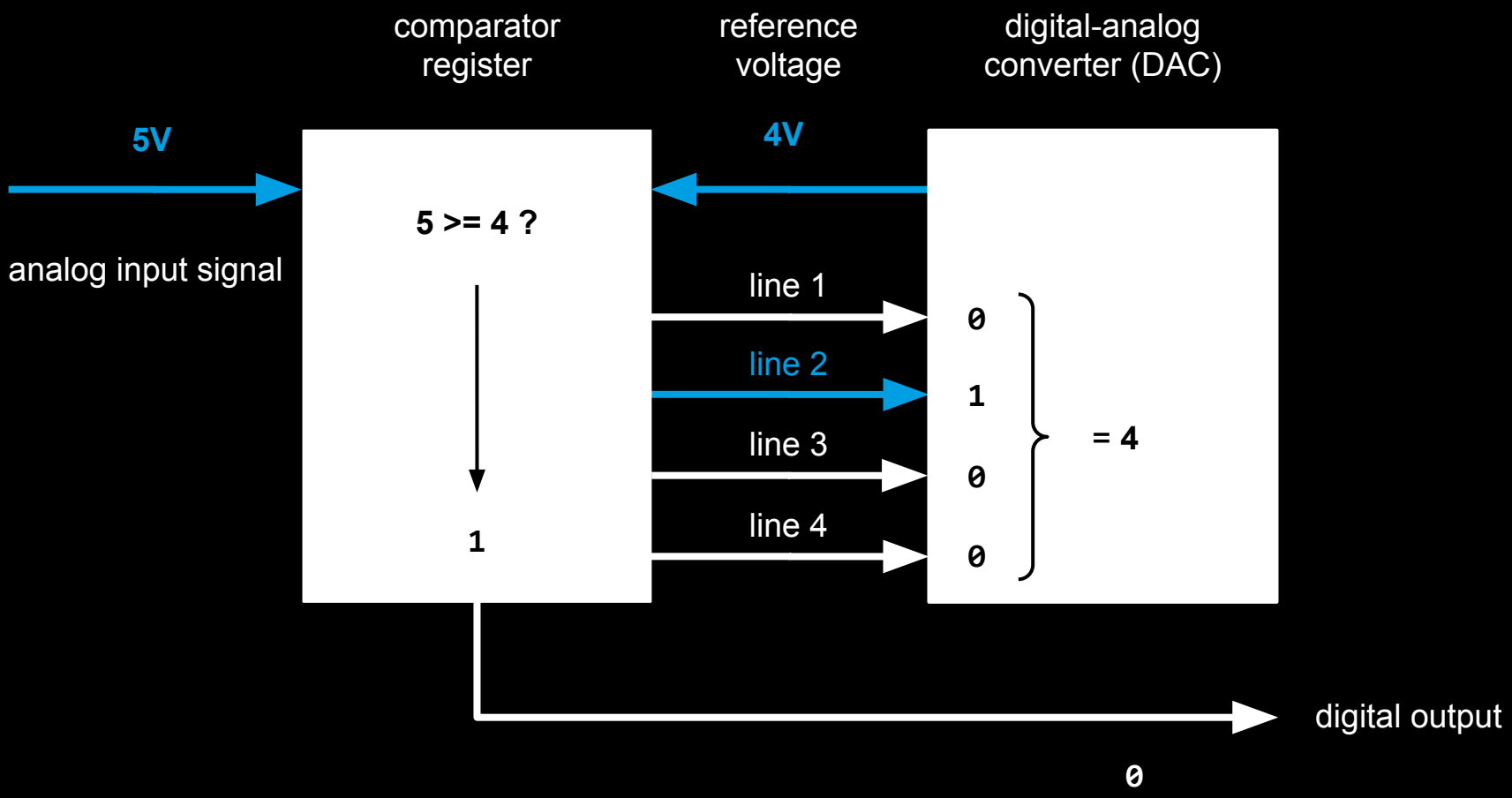

comparator register
reference voltage
digital-analog converter (DAC)
5V
analog input signal
step 1: activate line 1
line 1
line 2
line 3
line 4
1
0
0
0
= 8
digital output

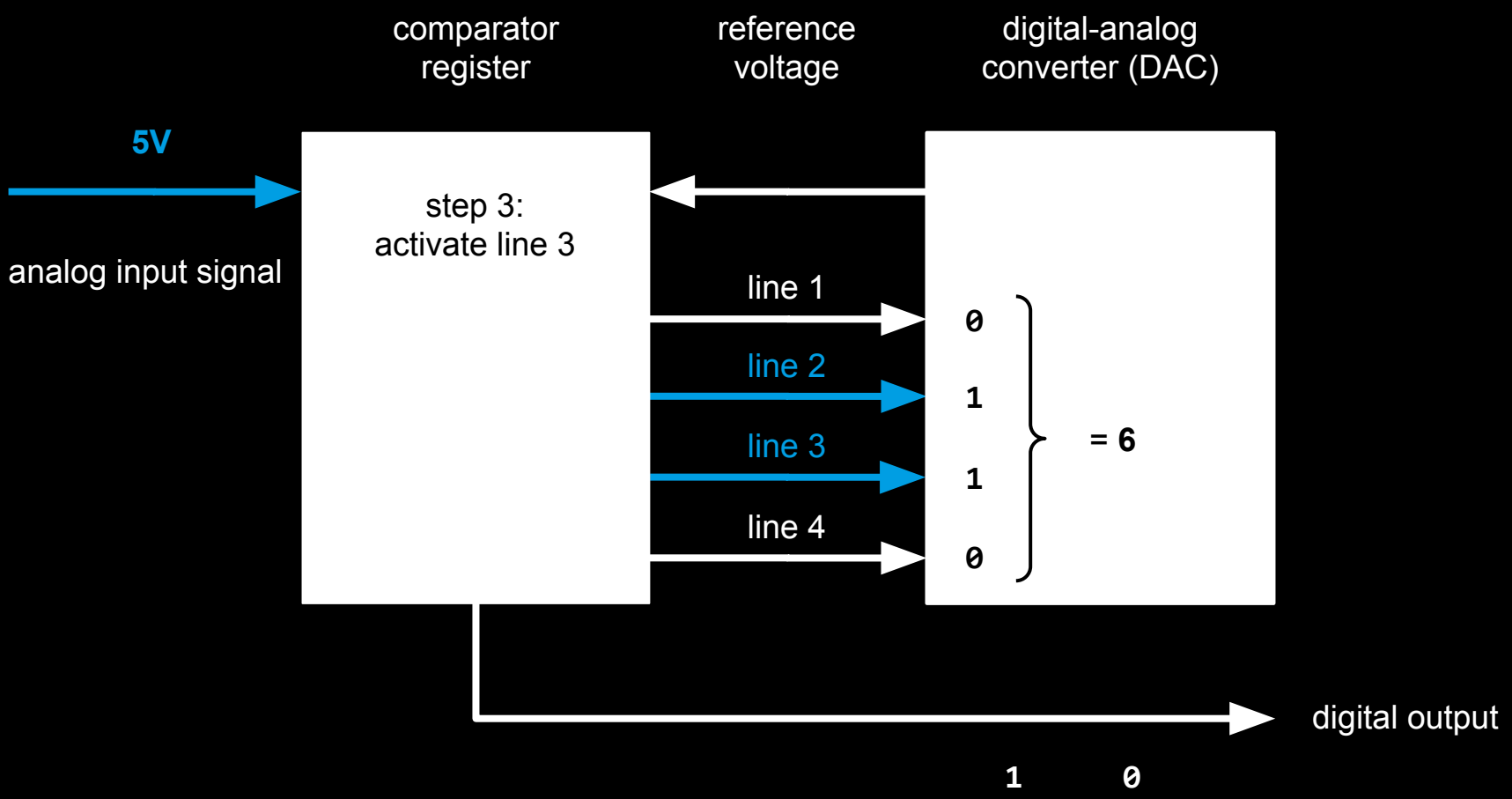

comparator register
reference voltage
digital-analog converter (DAC)
5V
8V
step 1: activate line 1
analog input signal
line 1
line 2
line 3
line 4
1
0
0
0
= 8
digital output

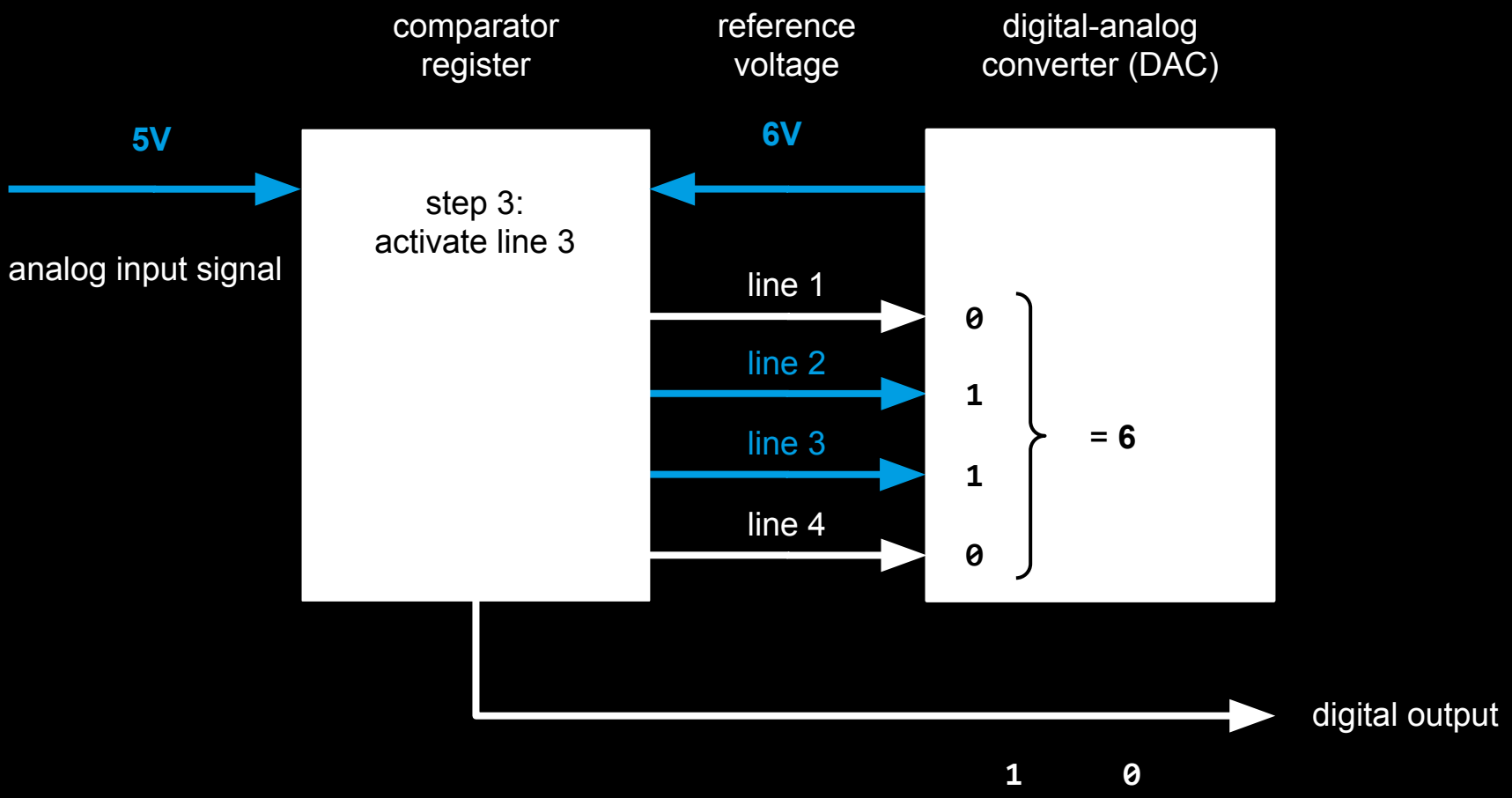

comparator
register
reference
voltage
digital-analog
converter (DAC)
5V
8V
5 >= 8 ?
analog input signal
line 1
line 2
line 3
line 4
1
0
0
0
= 8
0
digital output

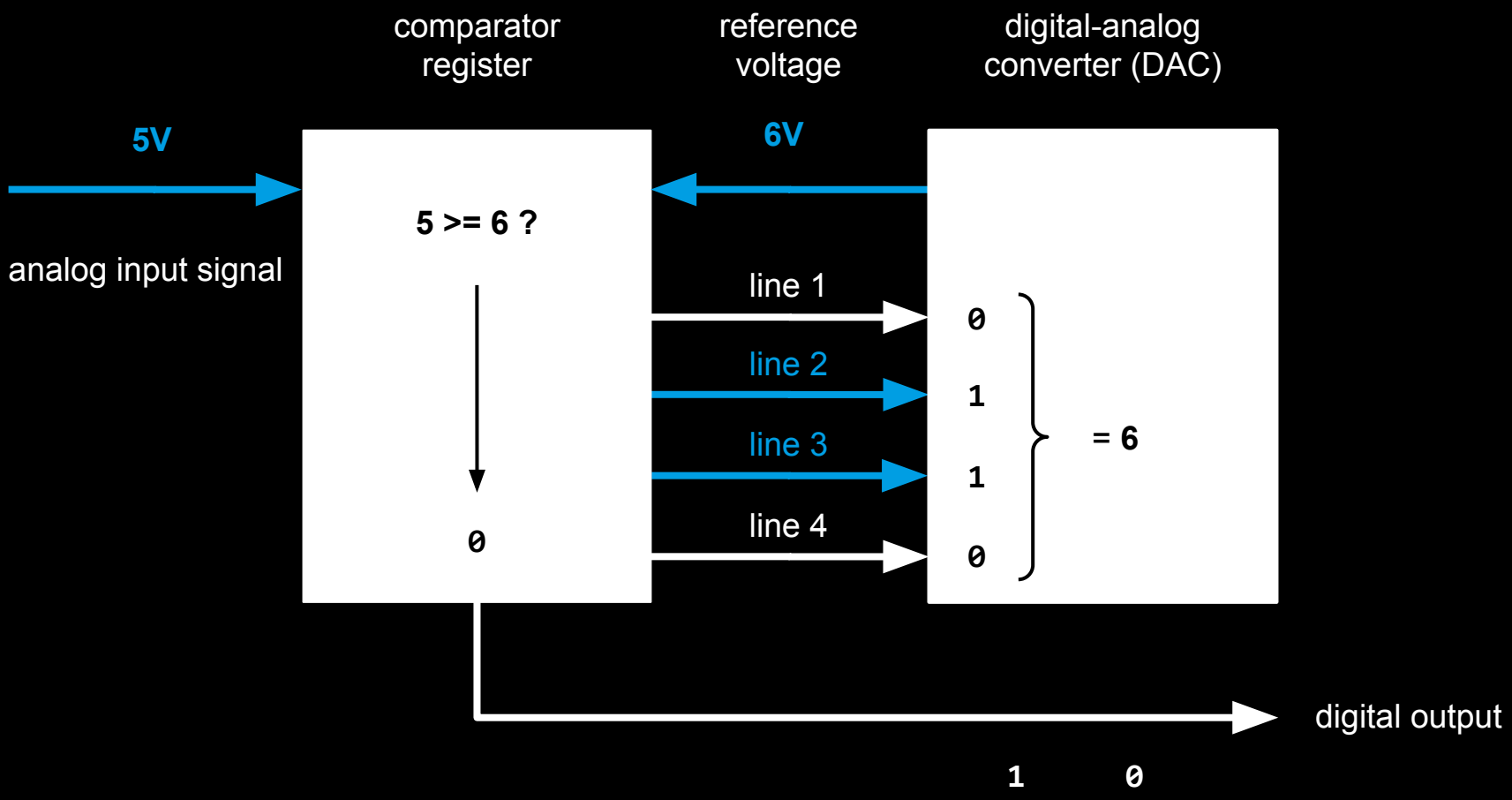

comparator register
reference voltage
digital-analog converter (DAC)
5V
analog input signal
step 2: activate line 2
line 1
line 2
line 3
line 4
0
1
0
0
= 4
digital output
0

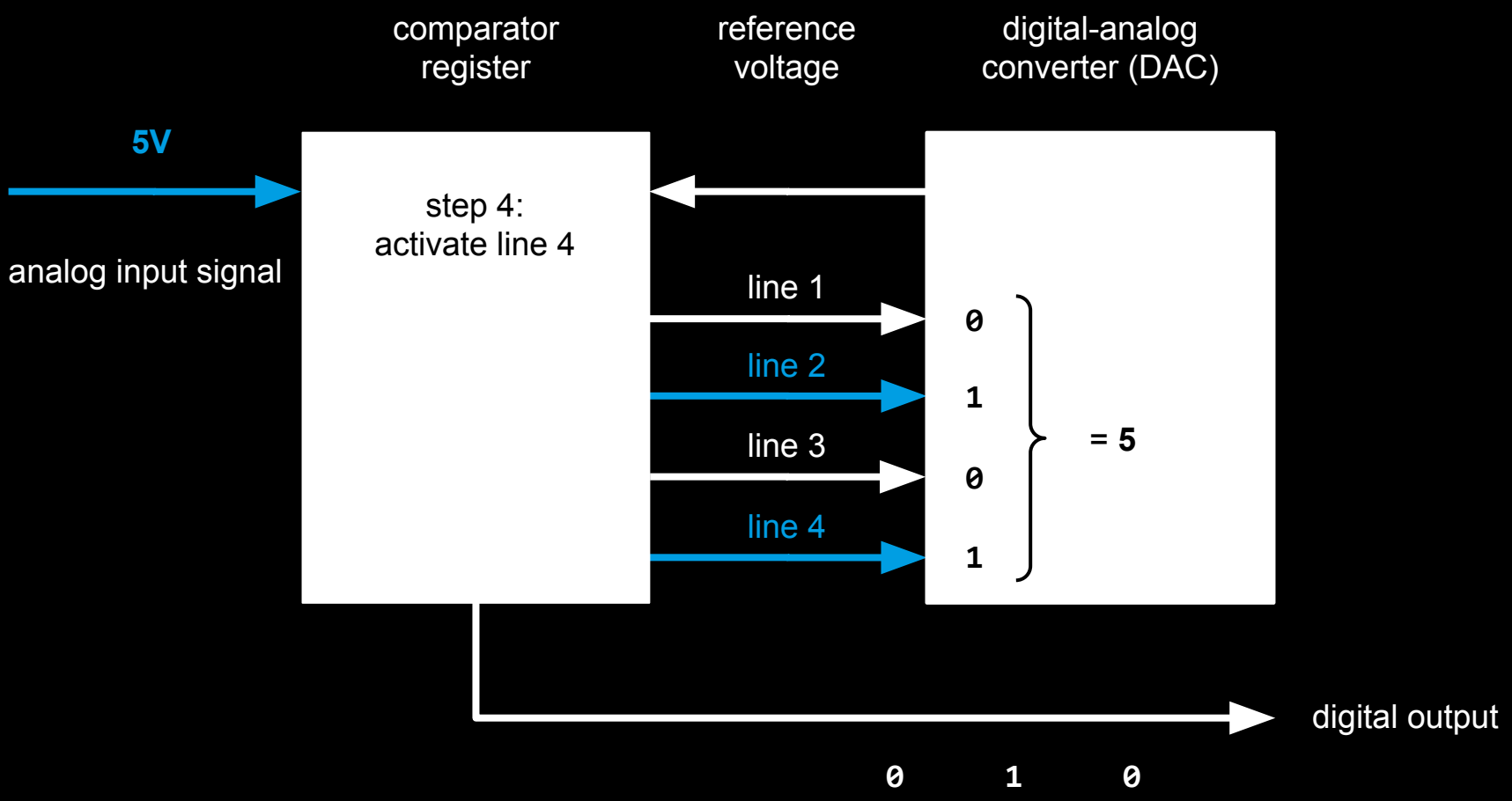

comparator register
reference voltage
digital-analog converter (DAC)
5V
4V
step 2: activate line 2
analog input signal
line 1
line 2
line 3
line 4
0
1
0
0
= 4
digital output
0

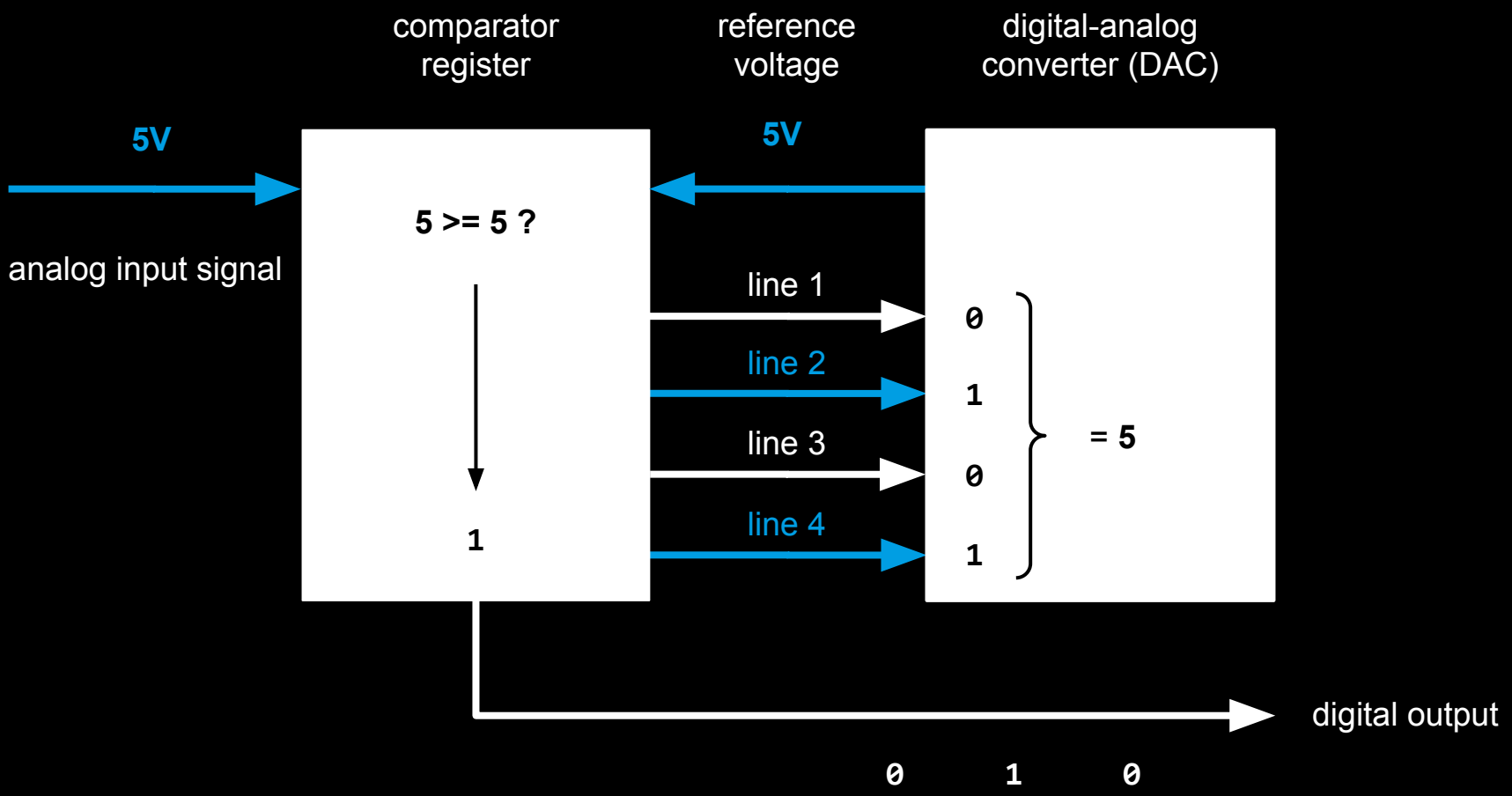

comparator register
reference voltage
digital-analog converter (DAC)
5V
4V
5 >= 4 ?
analog input signal
line 1
line 2
line 3
line 4
0
1
0
0
= 4
1
digital output
0

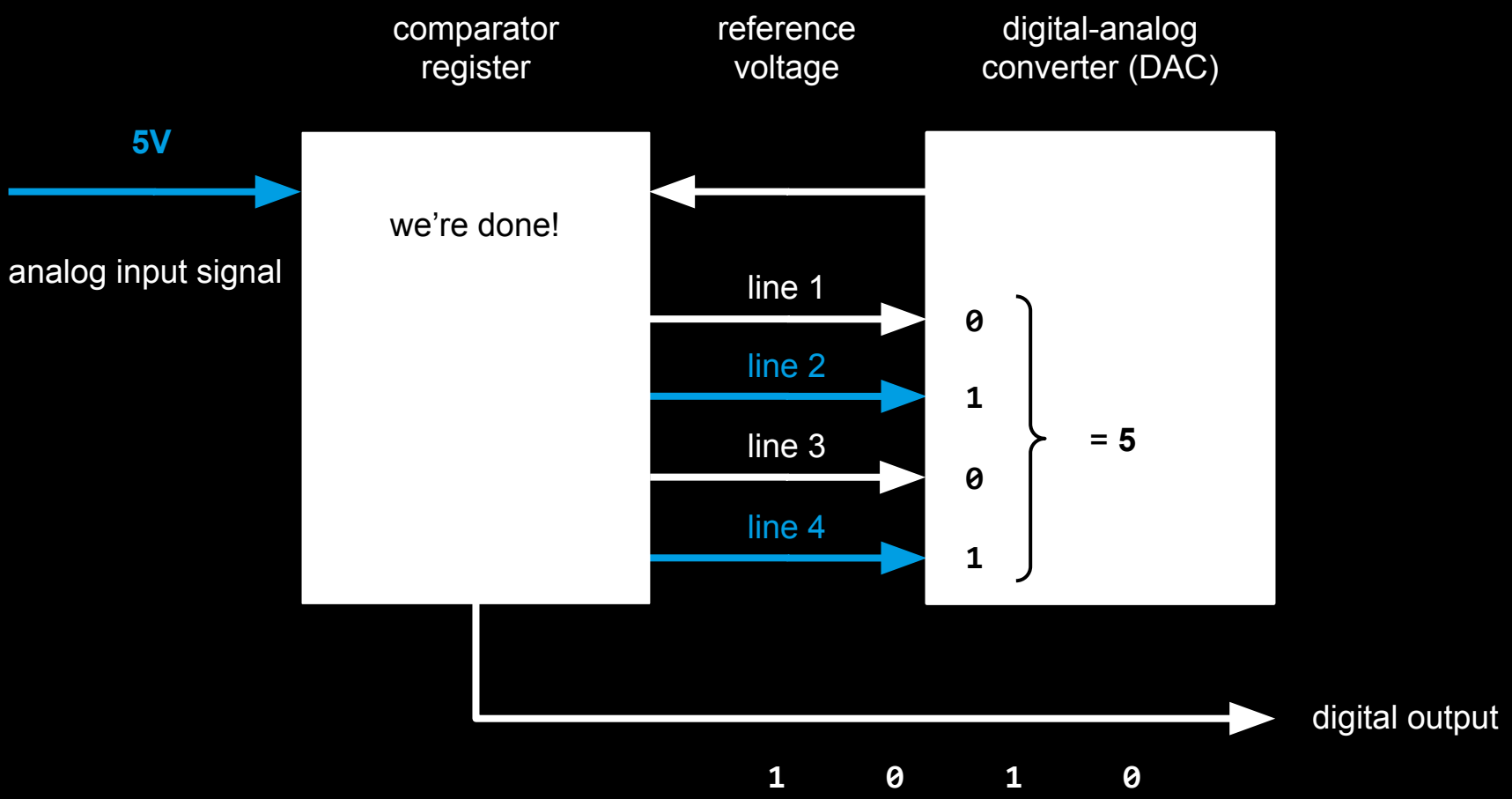

comparator register
reference voltage
digital-analog converter (DAC)
5V
analog input signal
step 3: activate line 3
line 1
line 2
line 3
line 4
0
1
1
0
= 6
digital output
1 0


comparator register
reference voltage
digital-analog converter (DAC)
5V
6V
analog input signal
step 3: activate line 3
line 1
line 2
line 3
line 4
0
1
1
0
= 6
digital output
1 0

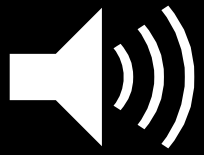

comparator
register
reference
voltage
digital-analog
converter (DAC)
5V
6V
analog input signal
5 >= 6 ?
0
line 1
line 2
line 3
line 4
0
1
1
0
= 6
digital output
1
0


comparator register
reference voltage
digital-analog converter (DAC)
5V
analog input signal
step 4: activate line 4
line 1
line 2
line 3
line 4
0
1
0
1
= 5
digital output
0 1 0


comparator register
reference voltage
digital-analog converter (DAC)
5V
5V
analog input signal
5 >= 5 ?
1
line 1
line 2
line 3
line 4
0
1
0
1
= 5
digital output
0 1 0


comparator register
reference voltage
digital-analog converter (DAC)
5V
analog input signal
we're done!
line 1
line 2
line 3
line 4
0
1
0
1
= 5
digital output
1 0 1 0

so, what analog signal is measured?



A **continuous** wave is transformed into an array of **discrete numbers** representing pressure.

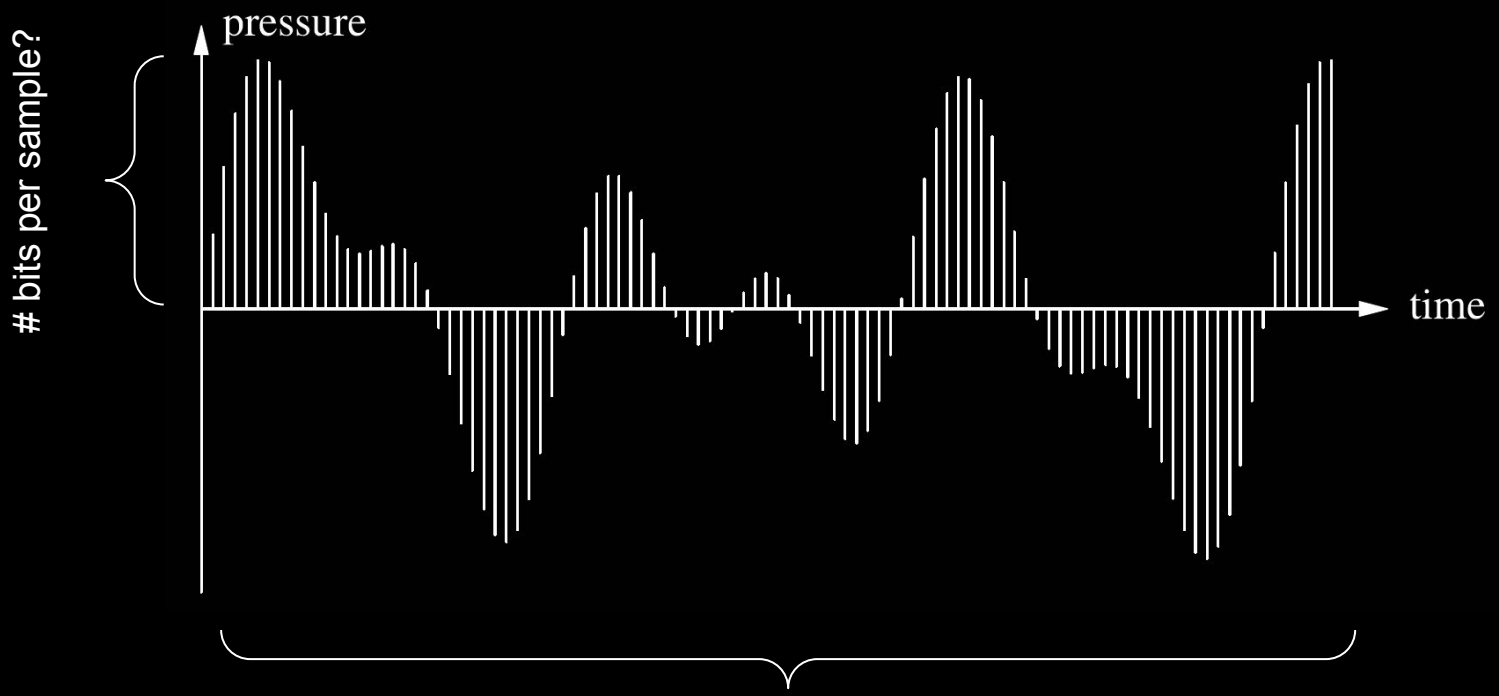


image sensor

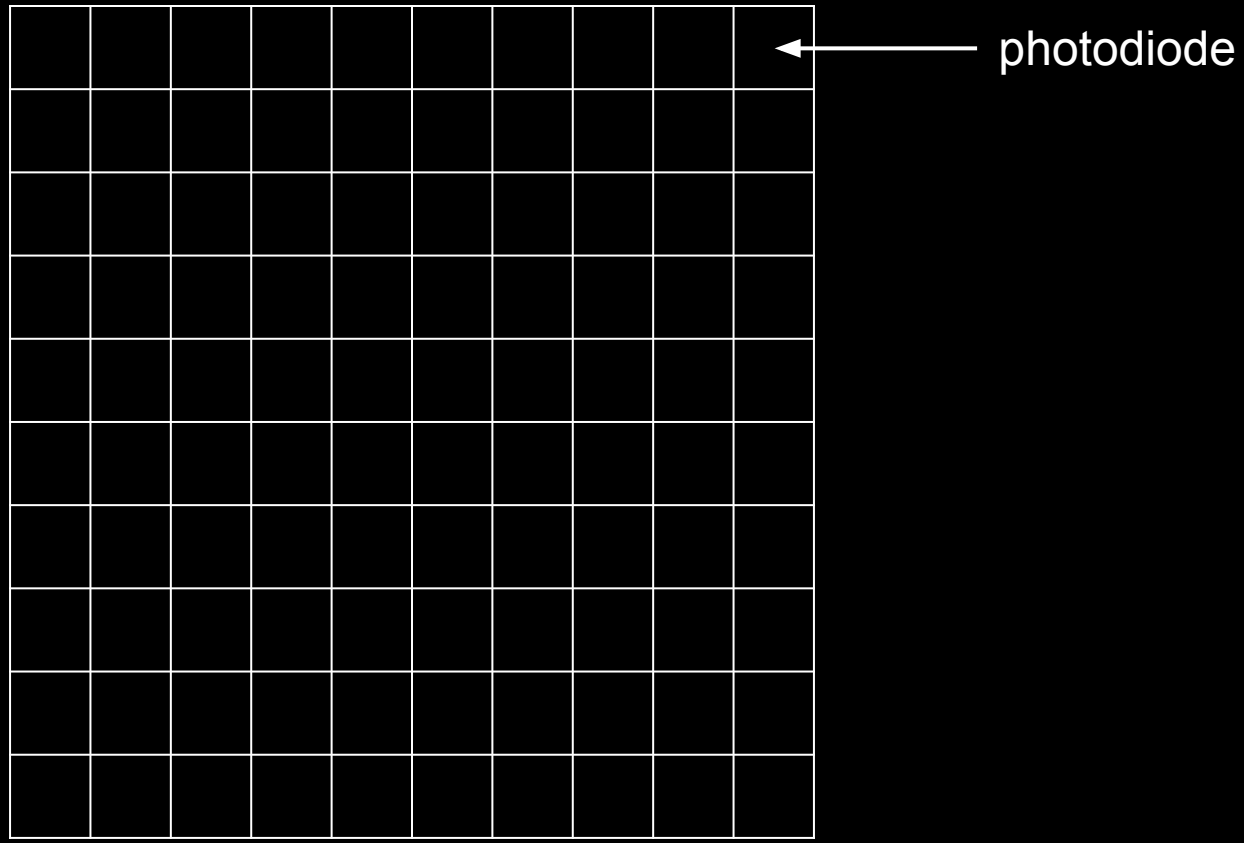
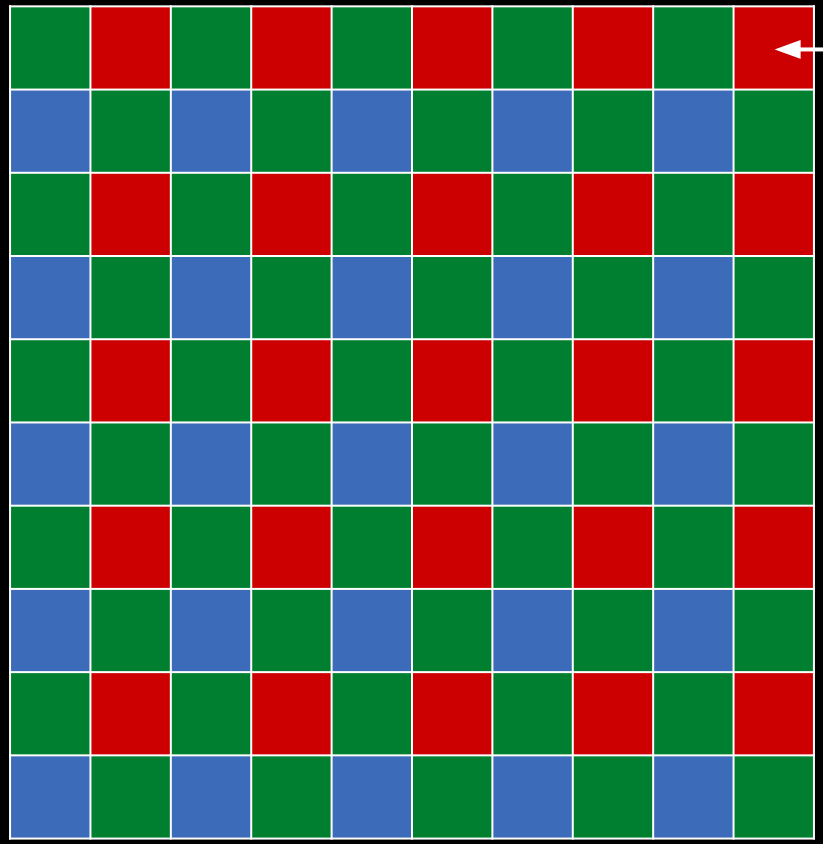
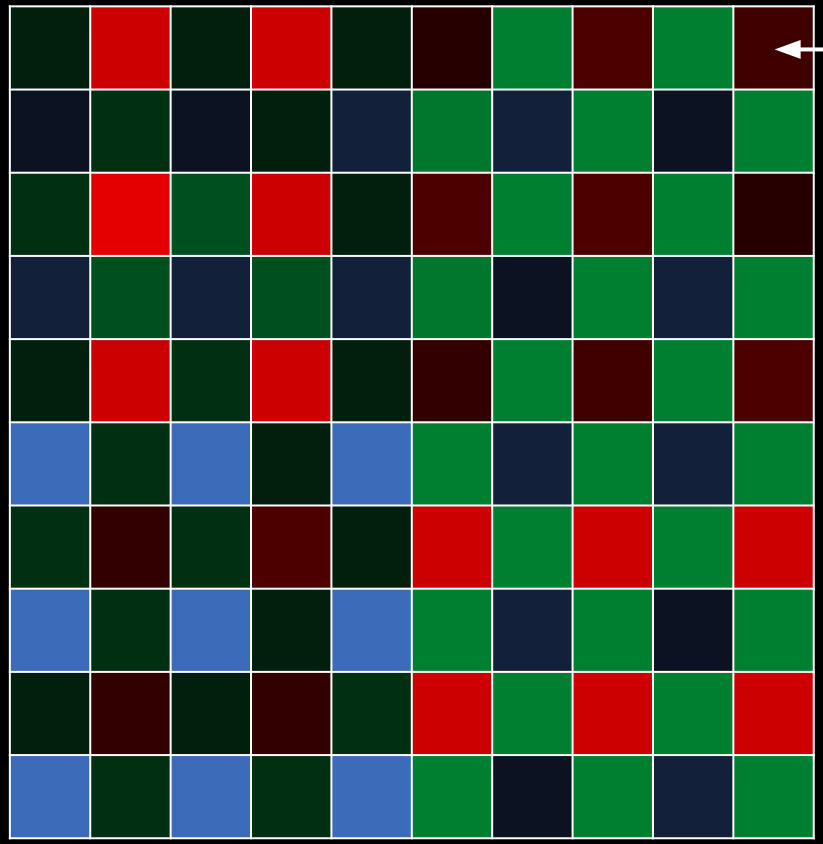


image sensor



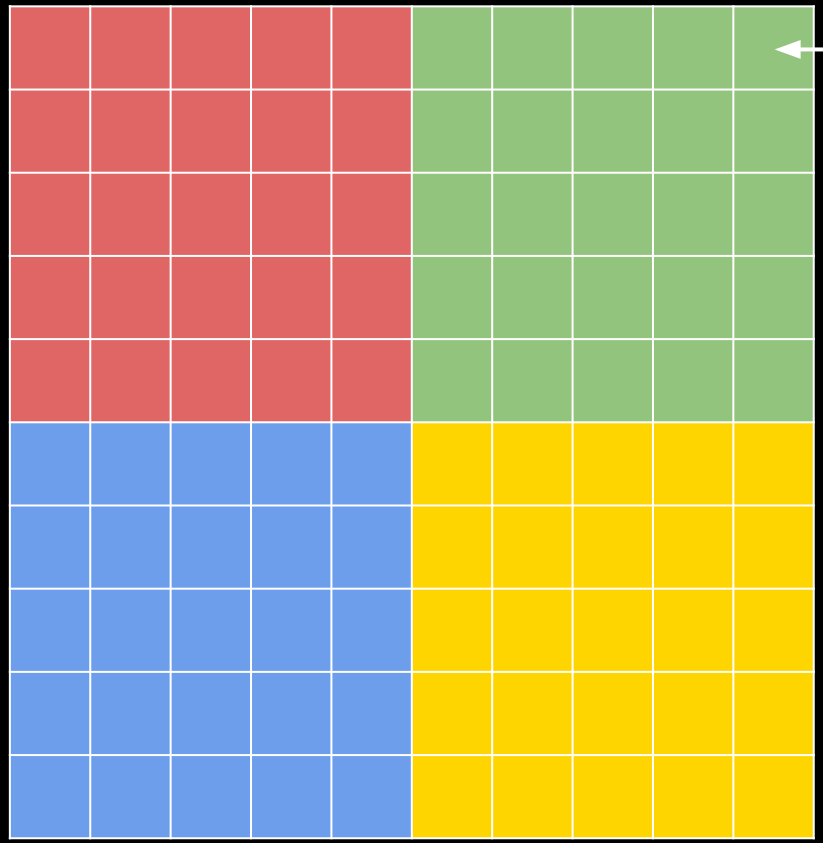
color filter on top of photo-diodes

image sensor



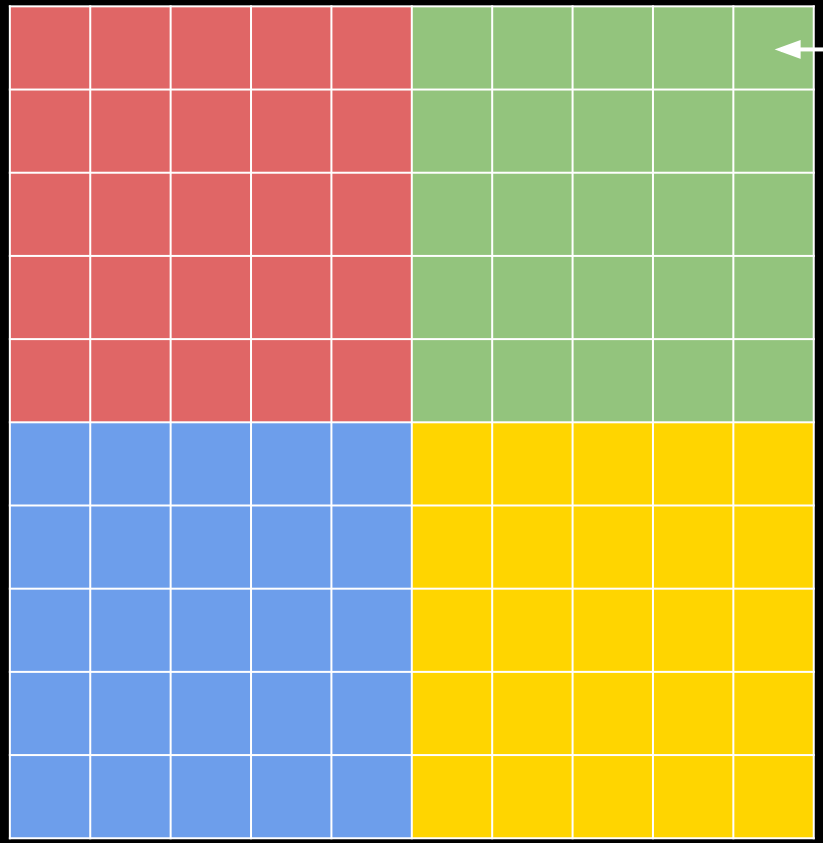
light passed through filter

image sensor



de-mosaiced
pixel colors

image sensor



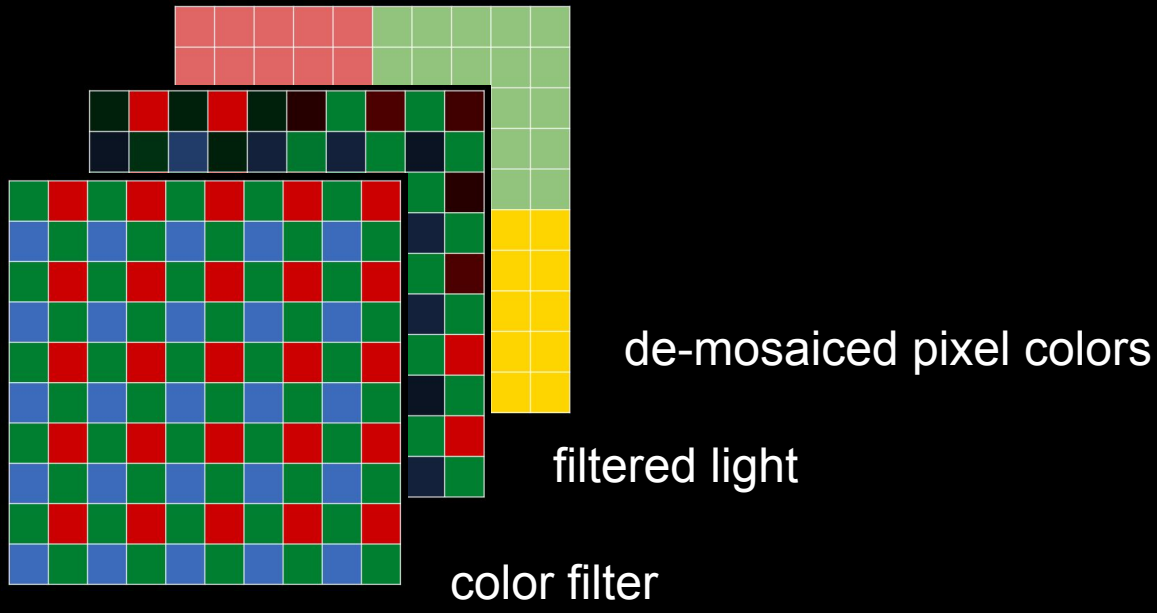
de-mosaiced
pixel colors

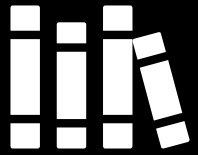
#E06666

#93C47D

#6D9EEB

#FFD500


de-mosaiced pixel colors
filtered light
color filter



typing text

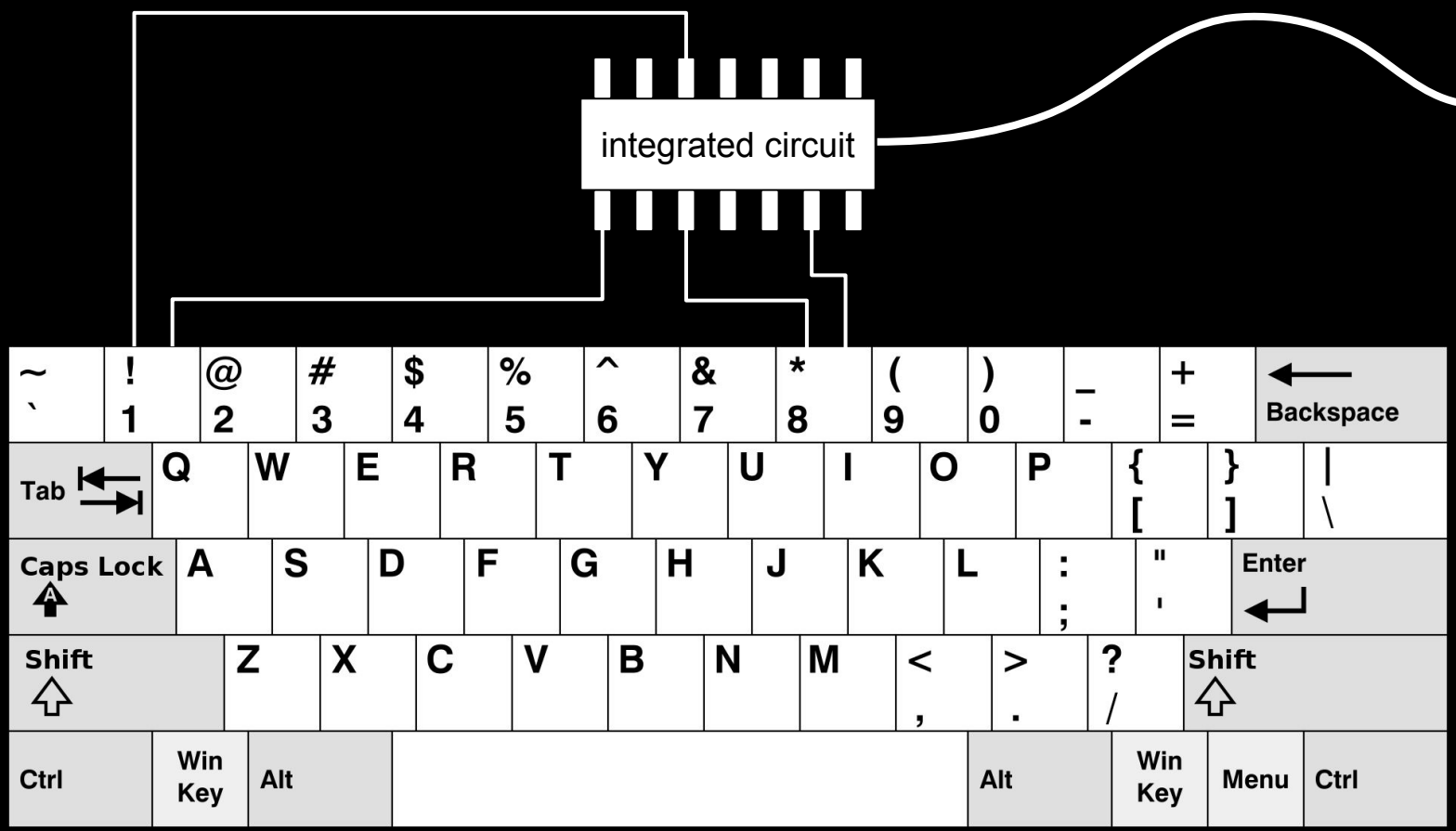


Image source: Wikipedia

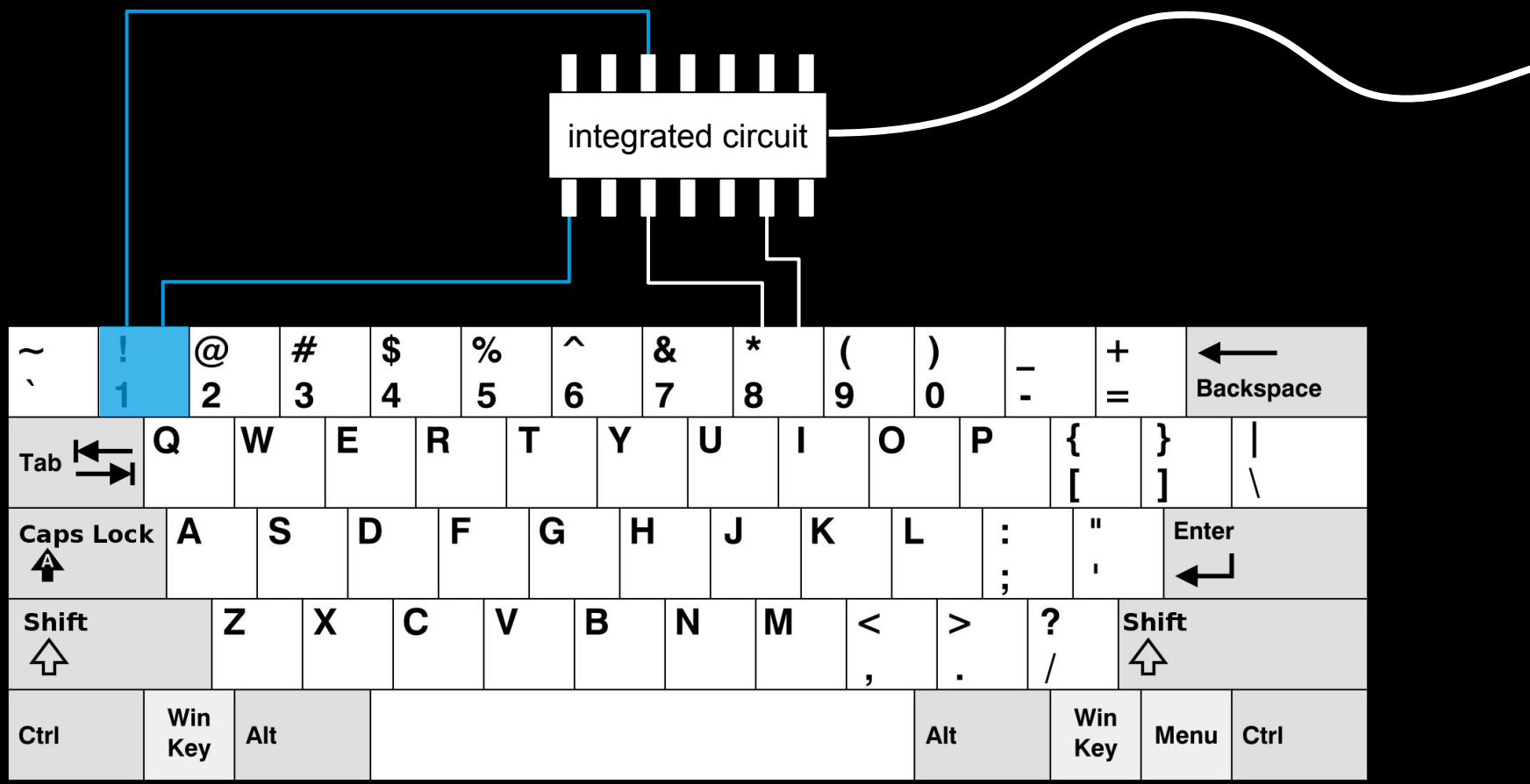


Image source: Wikipedia

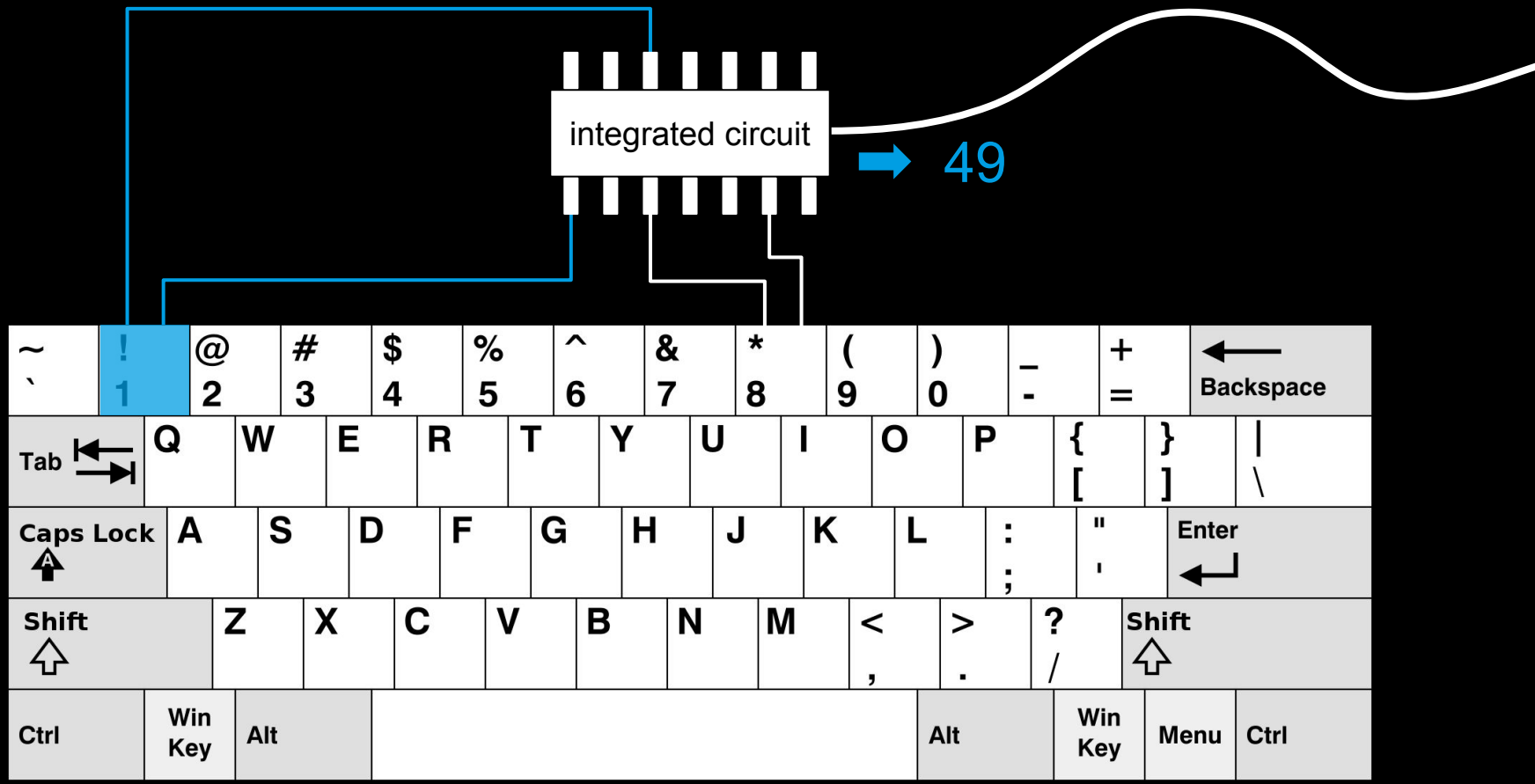


Image source: Wikipedia

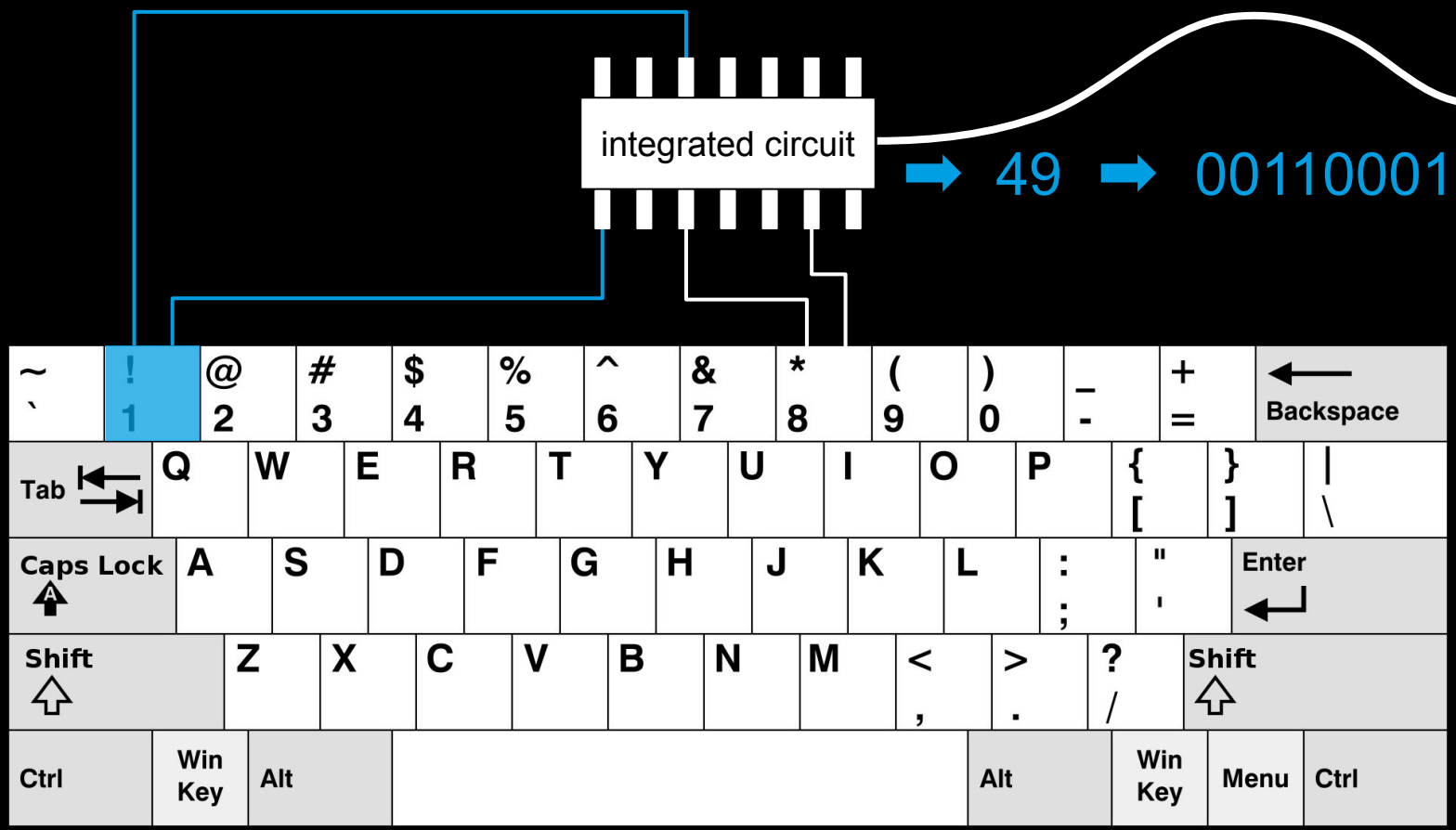


Image source: Wikipedia

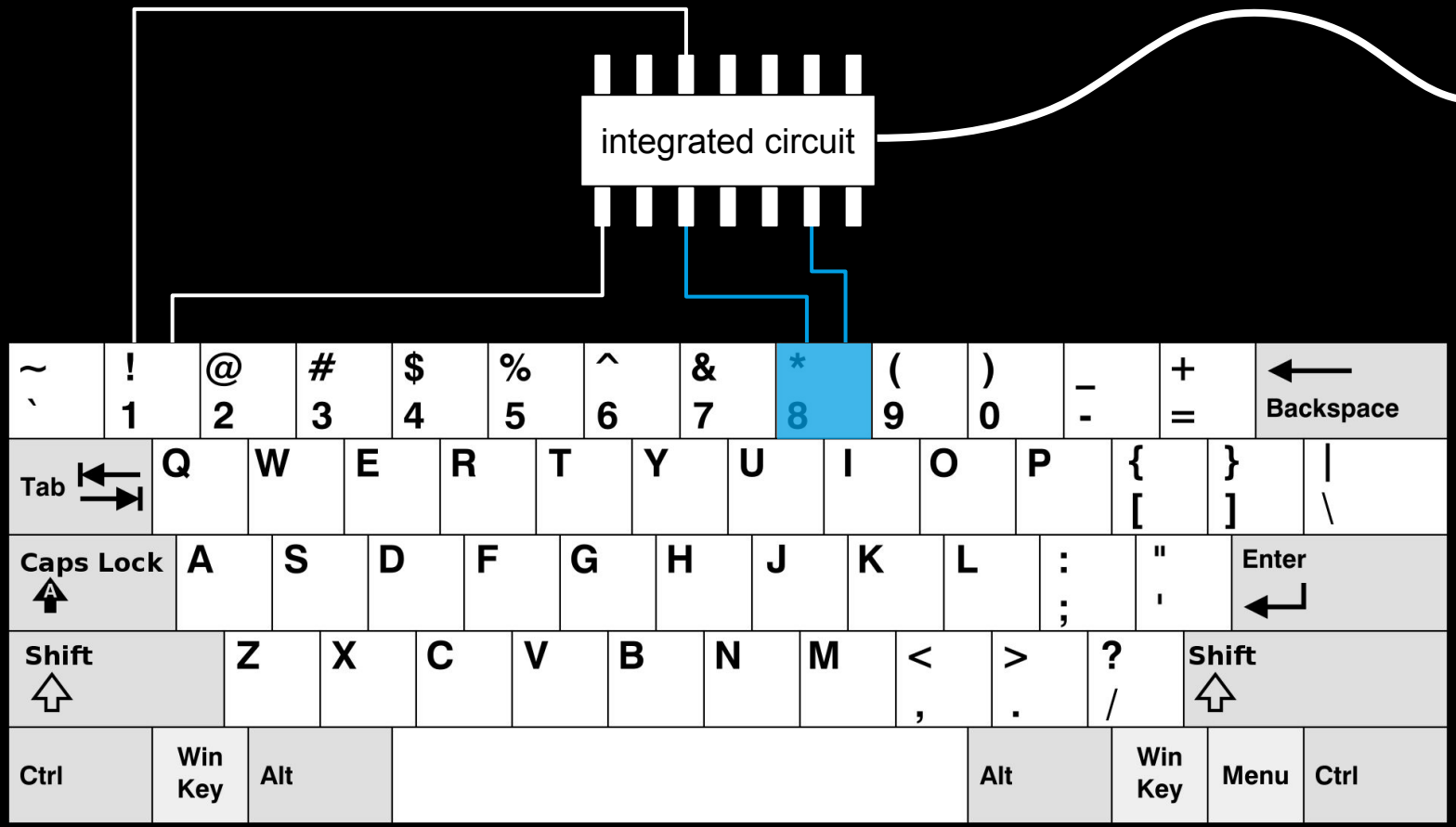


Image source: Wikipedia

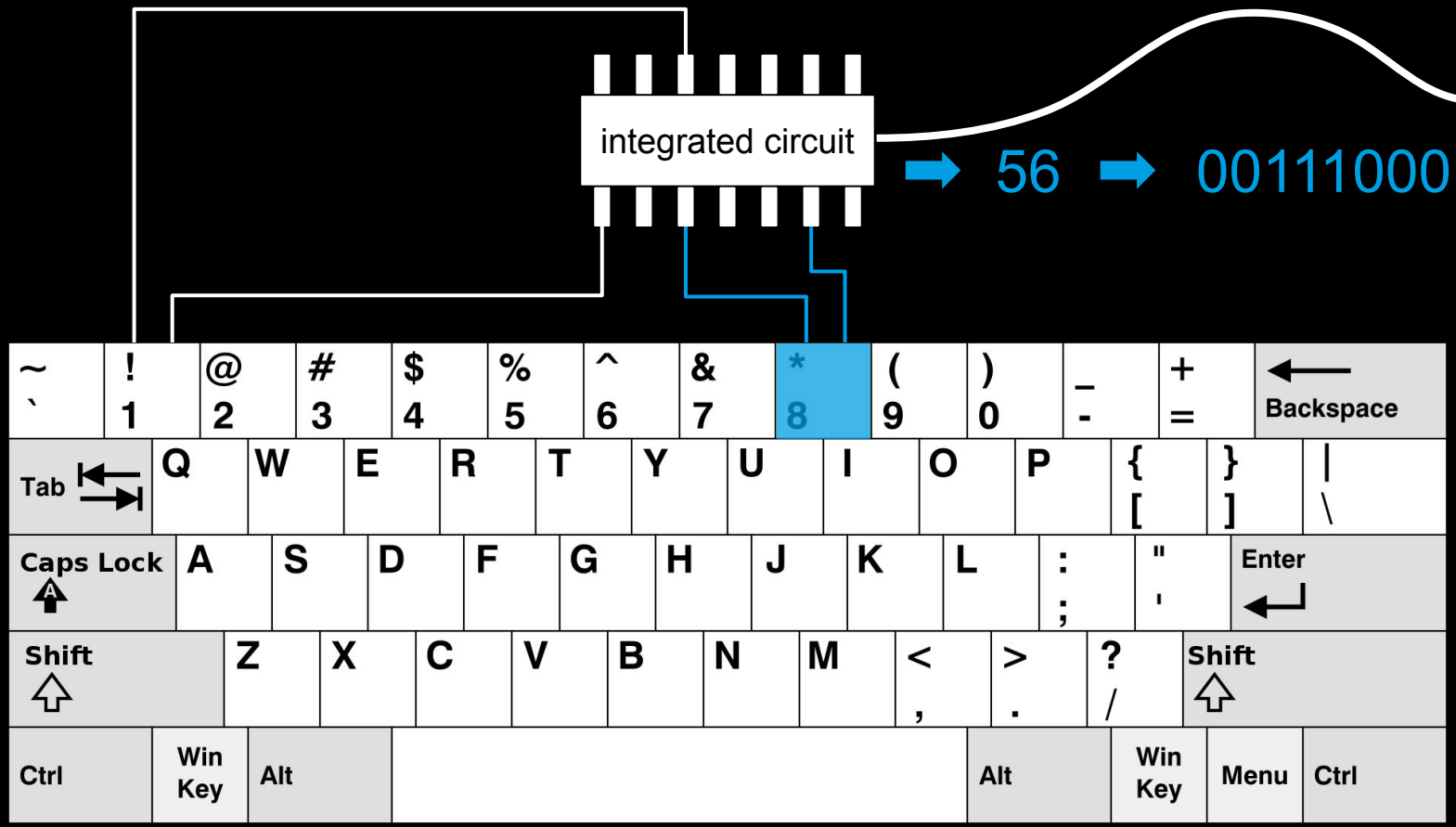
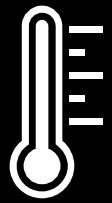


Image source: Wikipedia

scanning text

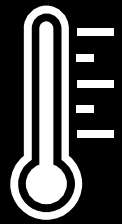
+

optical character recognition (OCR)



temperature sensor

A thermometer measures the temperature using a proxy, such as electrical resistance. The result is a change in voltage, which can be converted into a temperature.



```
1100 0101 1101 1110
1001 0110 1111 0100
0000 0111 1111 0001
```

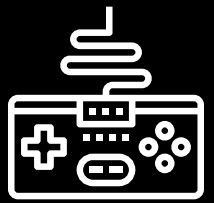
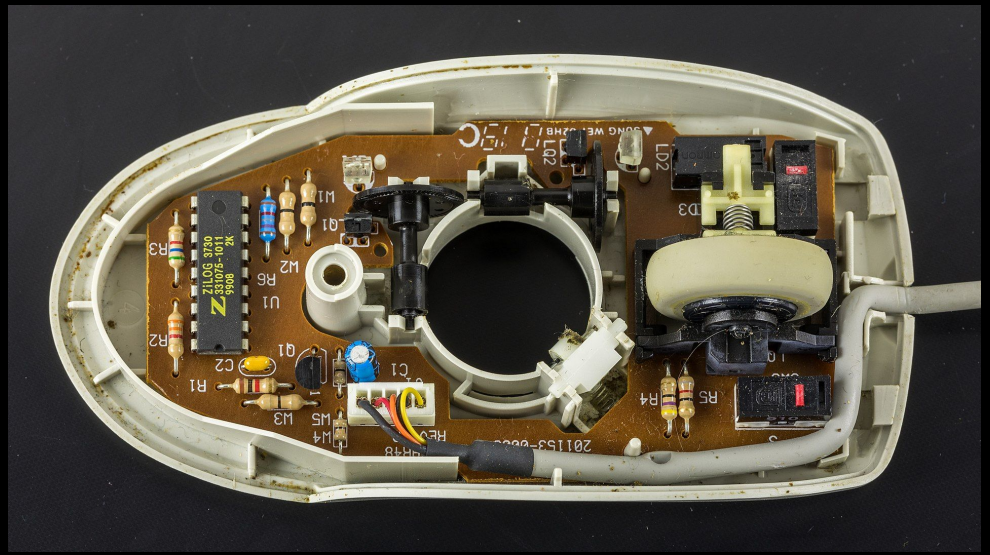


Image source: Wikipedia

Image source: Wikipedia



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