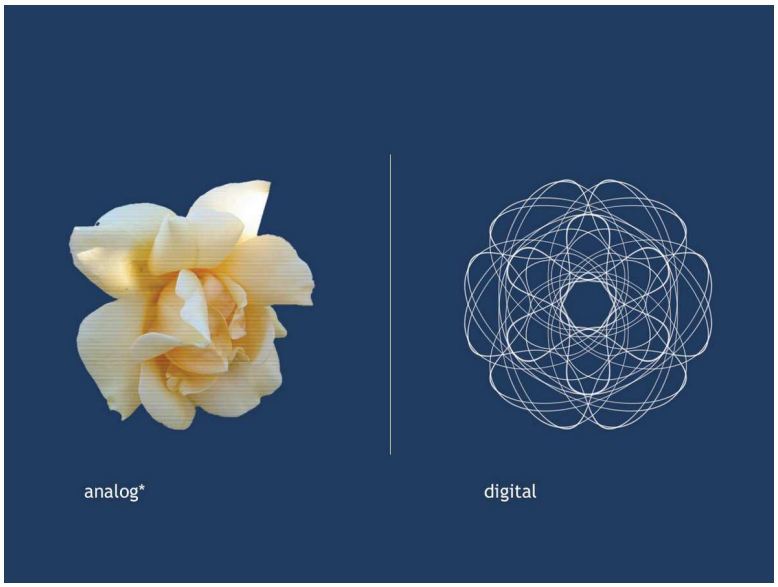
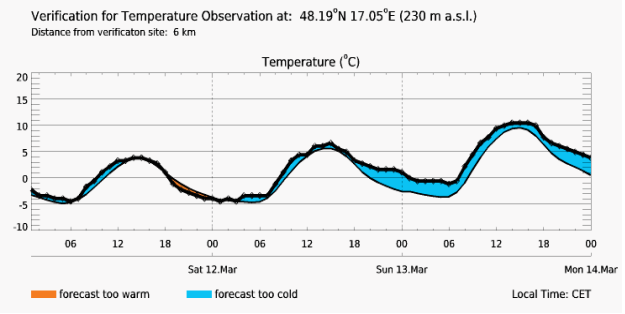


Analógový vs. Digitálny



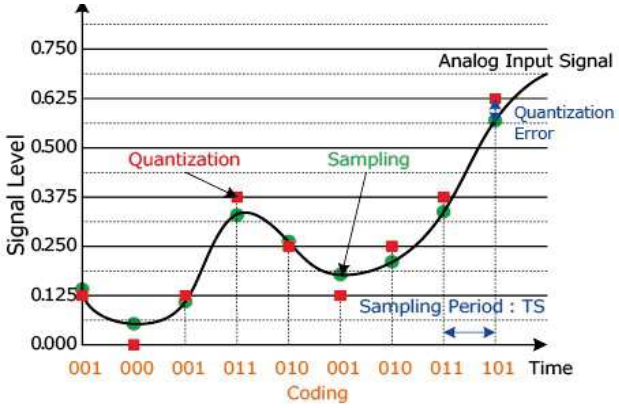
VZORKOVANIE = SAMPLING

https://www.meteoblue.com/sk/po%C4%8Dasie/historyclimate/verificationshort/bratislava_slovensk%c3%a1-republika_3060972

Analógový vs. Digitálny

KVANTOVANIE = QUANTIZATION

Analógový vs. Digitálny



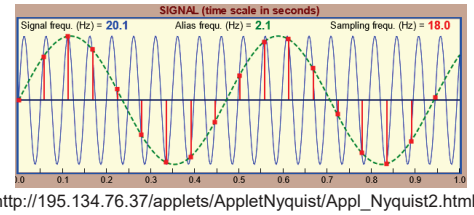
Vzorkovanie

Nyquist -- Shannon -- Koteľnikov

$$x(t) \rightarrow x_0, x_1, x_2, \ldots, x_n : x_k = x(kT)$$

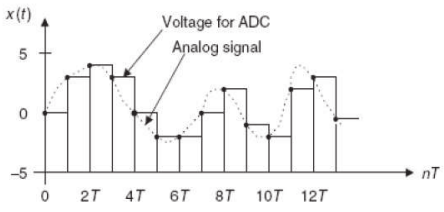
kde T je perióda vzorkovania $f_s = \frac{1}{T}$

$$f_s > 2 f_{max}$$



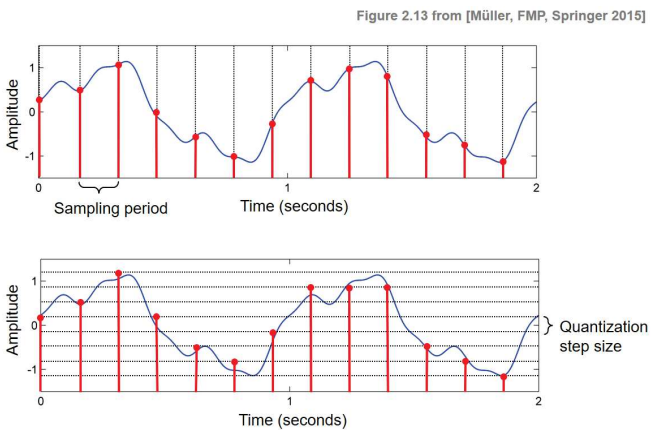
http://195.134.76.37/applets/AppletNyquist/Appl_Nyquist2.html

Rekonštrukcia

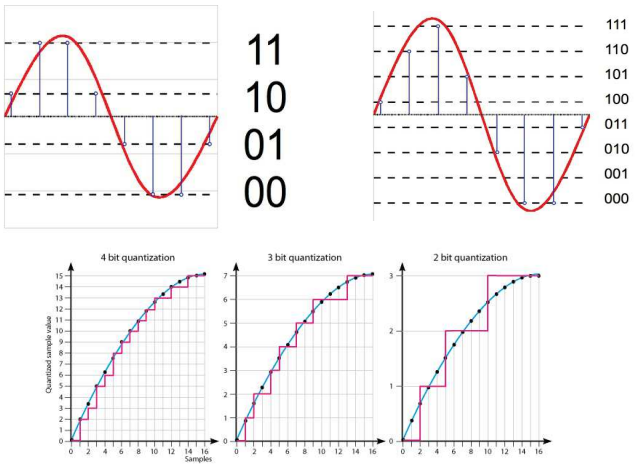


$$f_s > 2 f_{max}$$

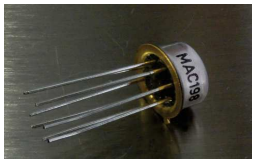
Kvantovanie

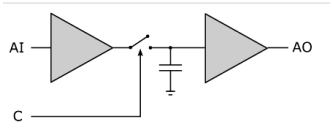


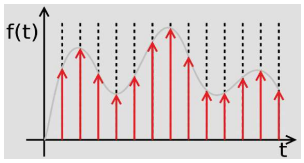
Kvantovanie

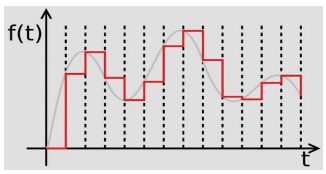


Sample & Hold

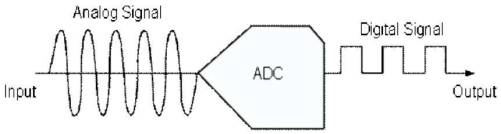


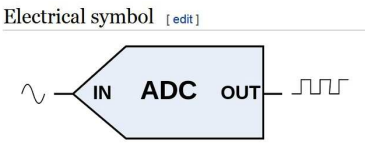




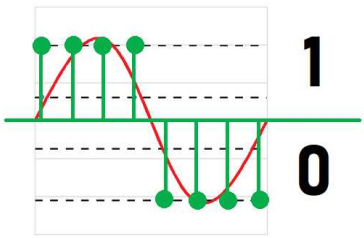


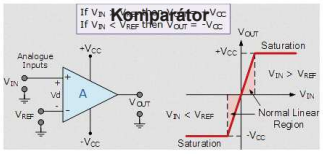
A/D prevodník I.

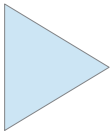




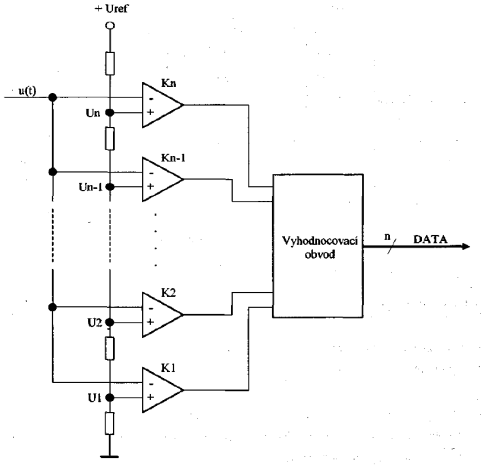
A/D prevodník



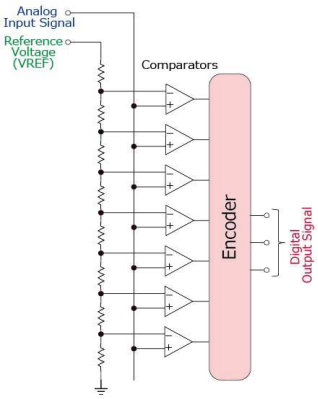




Paralelný A/D prevodník

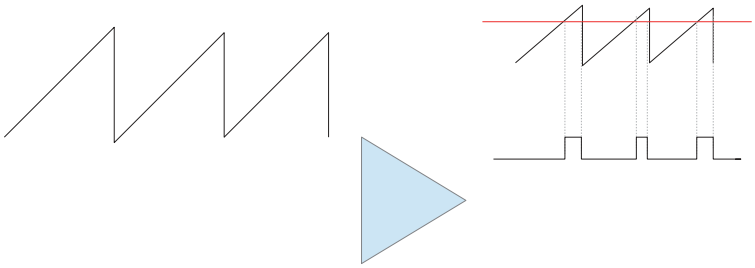


A/D prevodník



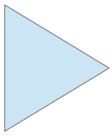
Flash-Type A/D Converter Circuit Diagram

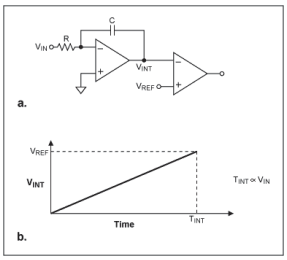
Integračný A/D prevodník



Integračný A/D prevodník

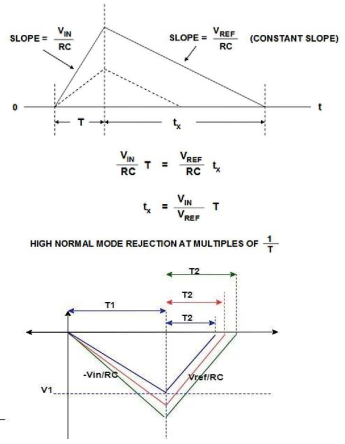
Single-Slope ADC Architecture

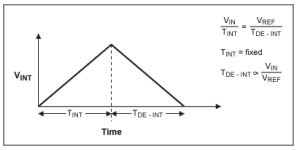




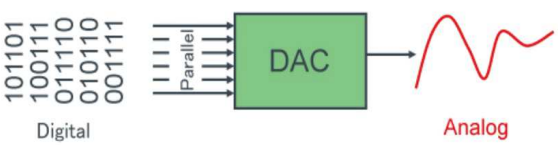
Integračný A/D prevodník

Dual-Slope ADC Architecture

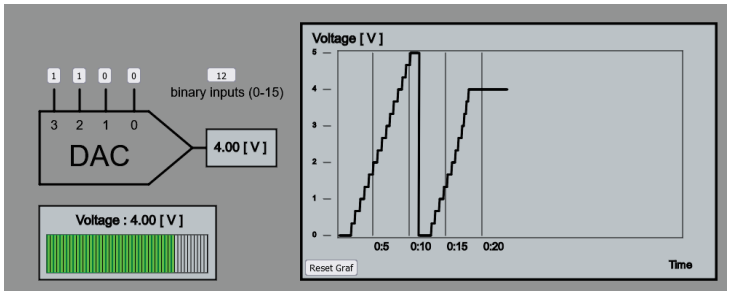




D/A prevodník

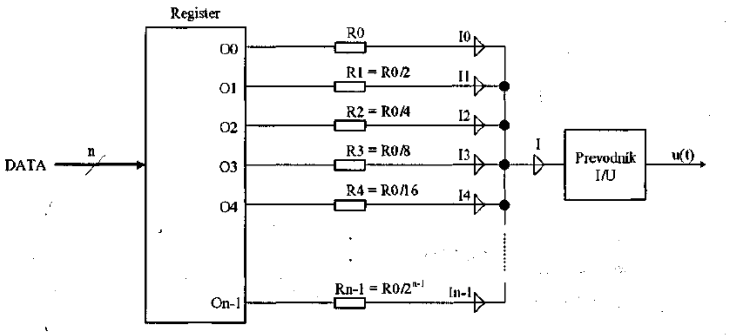


D/A prevodník



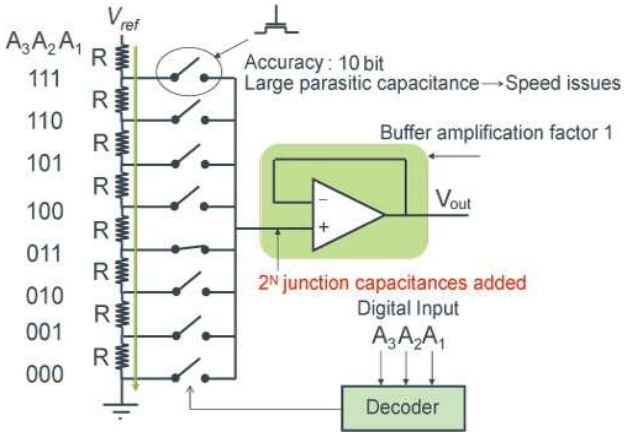
https://senzor.robotika.sk/mmp/anim/dac.html

D/A prevodník



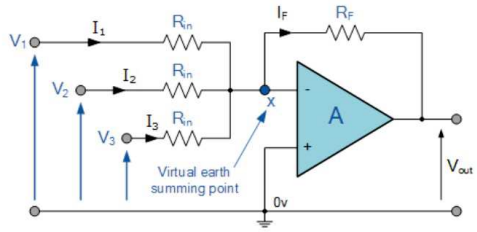
OBR. 51. D/A prevodník s váhovými odpormi

D/A prevodník



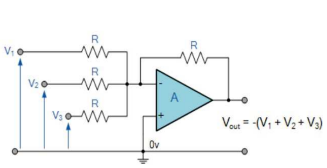
Sumátor

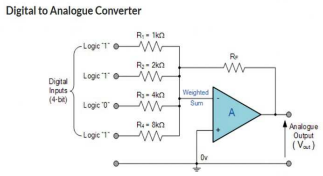
Summing Amplifier Circuit



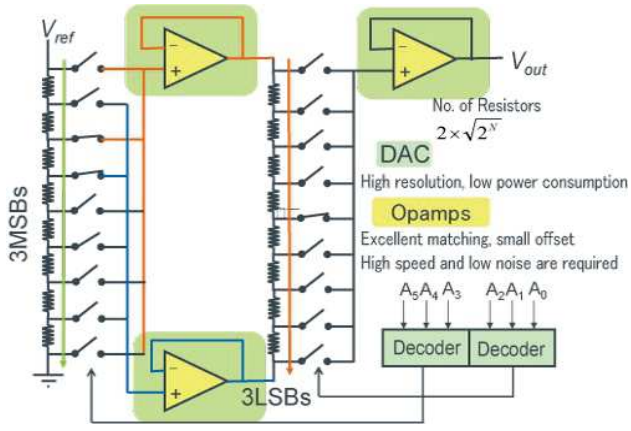
$$-V_{OUT} = V_1\left(\frac{R_f}{R_1}\right) + V_2\left(\frac{R_f}{R_2}\right) + V_3\left(\frac{R_f}{R_3}\right) \ldots \text{etc}$$

Sumátor



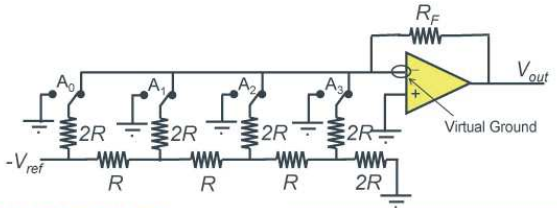


D/A prevodník



Zdroj: https://www.rohm.com/electronics-basics/ad-da-converters/da-converter-configurations

D/A prevodník



Switch → Partial Resistance

Switch dimensions are made to be proportional to the amount of current

$MOSFET\left(\frac{W}{L}\right)$ is made proportional to the current

$$V_{out} = R_F\left(I_r \cdot A_0 + \frac{I_r}{2} \cdot A_1 + \frac{I_r}{2^2} \cdot A_2 + \frac{I_r}{2^3} \cdot A_3\right)$$

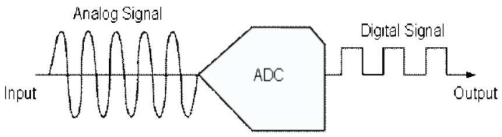
$$I_r = \frac{V_{ref}}{2R}$$

ALE! 16-bit audio -> R s presnosťou 1/ (2^16), t.j. 1 : 65 536
Nakvalitnejšie komerčné R majú ±0.005%, čo zodpovedá 1 : 20 000 (iba ~14-bit)

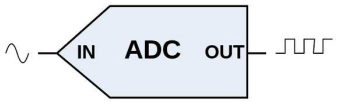
K tomu ešte ten problém, že prúd pretekajúci cez R ho zahrieva a spôsobuje tak rádovo vyššiu nepresnosť.

Preto sa používa oversampling až na MHz a PWM modulácia + RC filter, lebo 0 a 1 nepotrebuje presné rezistory...

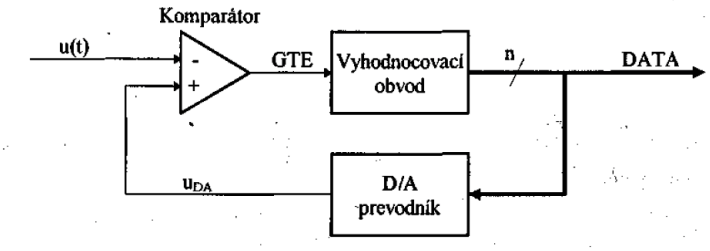
A/D prevodník II.



Electrical symbol [edit]

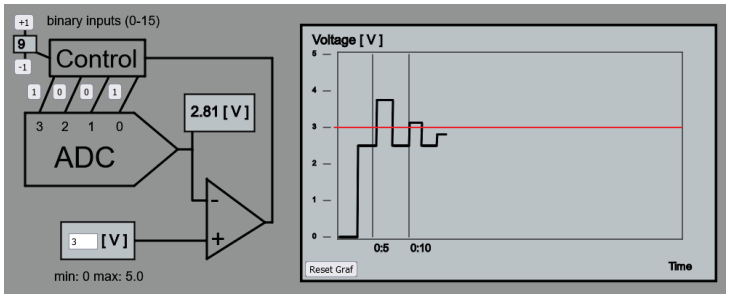


A/D prevodník

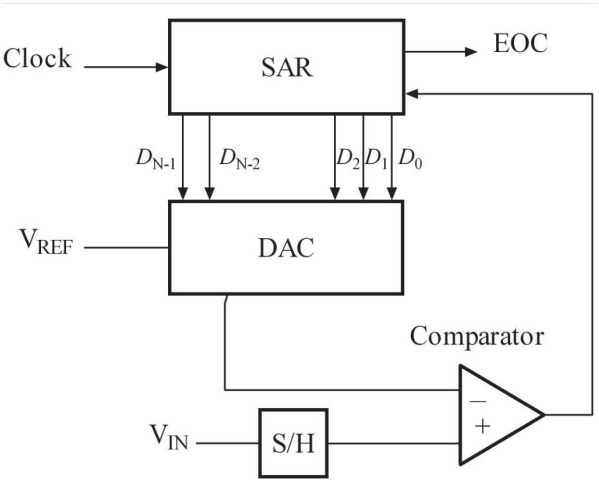


OBR. 49. A/D prevodník s postupným prevodom

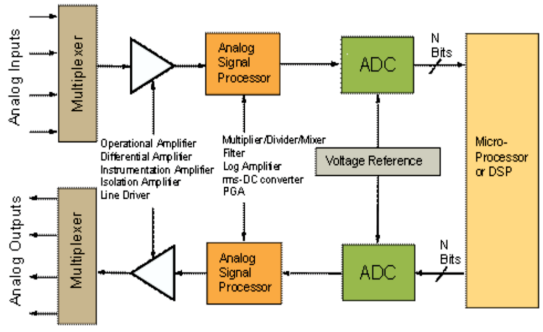
A/D prevodník



https://senzor.robotika.sk/mmp/anim/sac.html

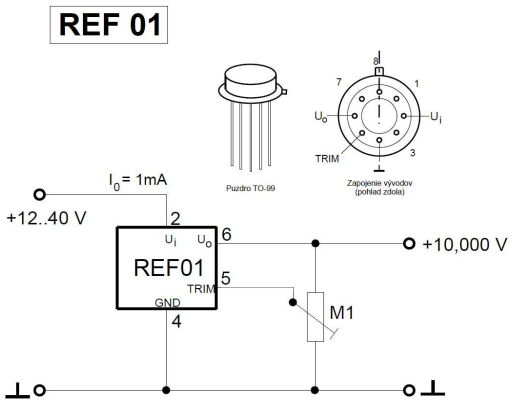


A/D prevodník



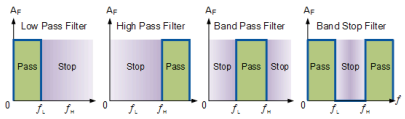
Referenčné napätie

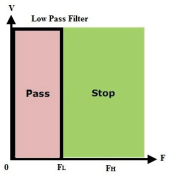
2.1.2 Trojsvorkový zdroj referenčného napätia REF-01

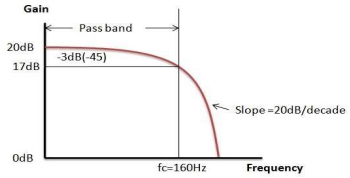


Filter

Ideal Filter Response Curves

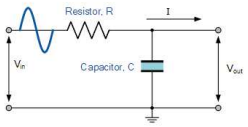




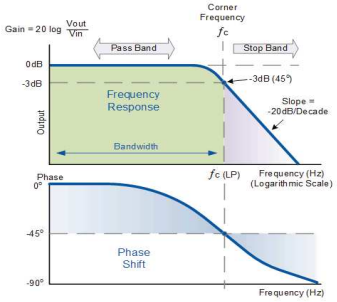


Filter

RC Low Pass Filter Circuit

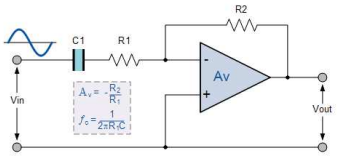


Frequency Response of a 1st-order Low Pass Filter

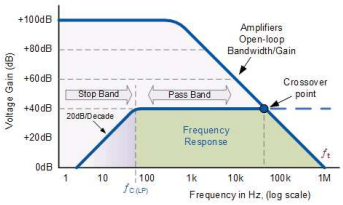


Filter

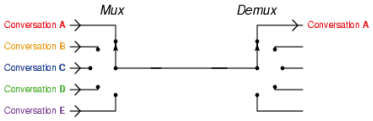
Inverting Operational Amplifier Circuit

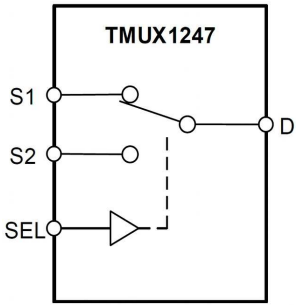


Frequency Response Curve

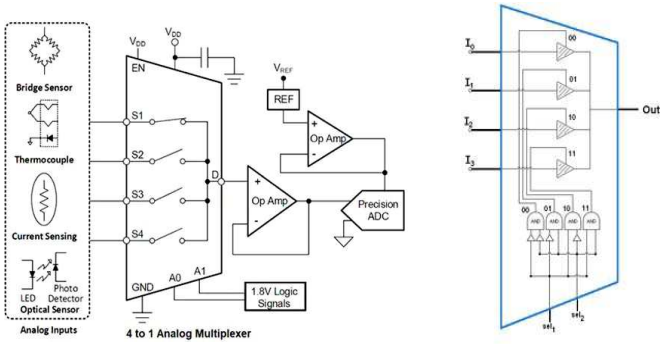


Multiplexer



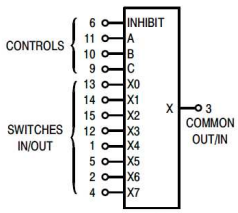


Multiplexer



Multiplexer

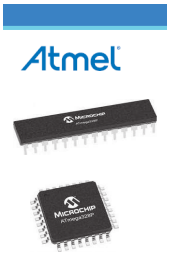
MC14051B
8−Channel Analog Multiplexer/Demultiplexer

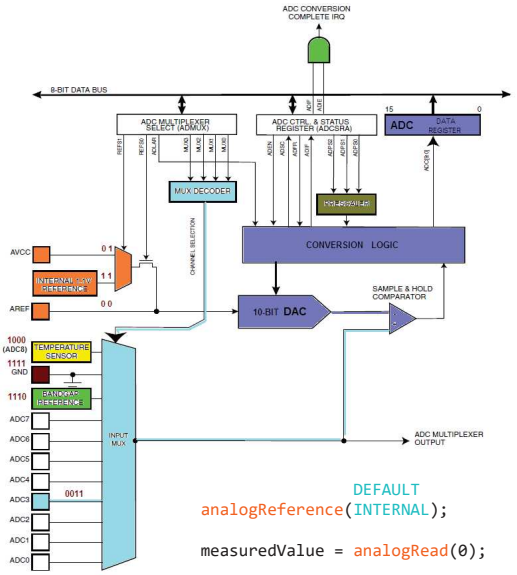


V_{DD} = PIN 16
V_{SS} = PIN 8
V_{EE} = PIN 7

ON Resistance	R_{on}	5.0 10 15	$\Delta V_{switch} \leq 500$ mV (Note 3) $V_{in} = V_{IL}$ or V_{IH} (Control), and V_{in} = 0 to V_{DD} (Switch)	– – –	800 400 220	– – –	250 120 80	1050 500 280	– – –	1200 520 300	Ω

Teraz už poznáme všetky základné bloky, ktoré sa nachádzajú v tom ADC ktorý je implementovaný v ATmega328P






```
DEFAULT
analogReference(INTERNAL);

measuredValue = analogRead(0);
```