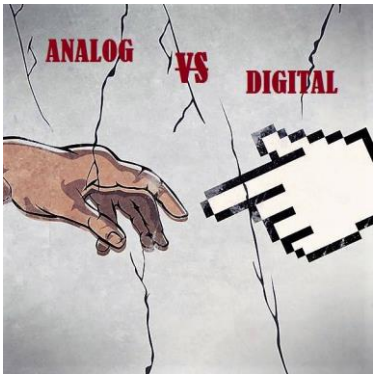
Mikropočítačové systémy MIPS

Prednáška 7: DAC

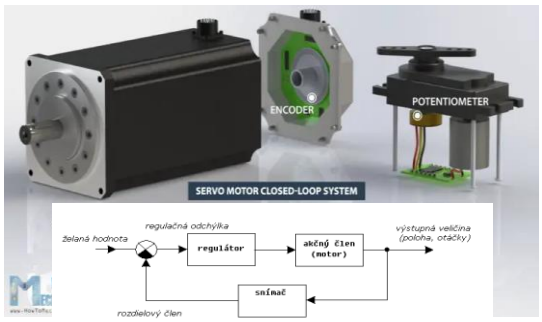
1



2

Servo

a) polohové



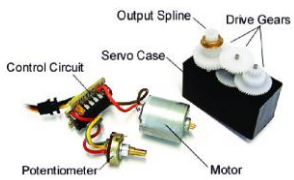
b) rýchlostné

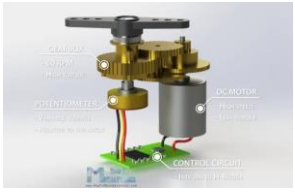
3

RC Servomotorčeky

4

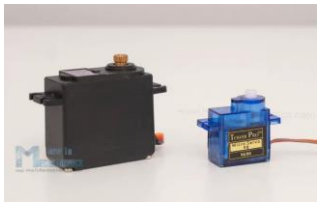
Servomotorčeky





5

Servomotorčeky



SG90 Micro Servo technical specifications:

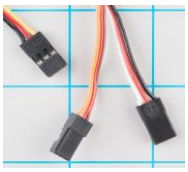
Stall Torque	1.2kg·cm @4.8V, 1.6kg·cm @6V,
Operating Voltage	3.5 – 6V
No Load Current	100mA
Stall Current	650mA
Max Speed	60 degrees in 0.12s
Weight	9g

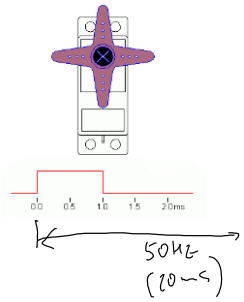
MG996R Servo technical specifications:

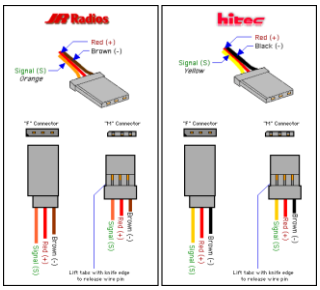
Stall Torque	11kg.cm @4.8v, 13kg.cm @6V
Operating Voltage	4.8 – 7.2V
No Load Current	220mA @4.8V, 250mA @6V
Stall Current	650mA
Max Speed	60 degrees in 0.20s
Weight	55g

6

Servomotorčeky







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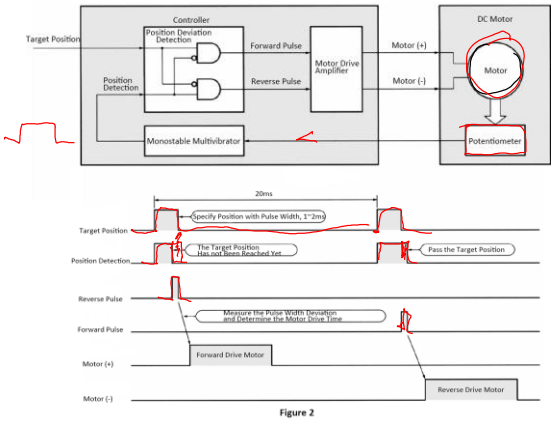
Servomotorčeky



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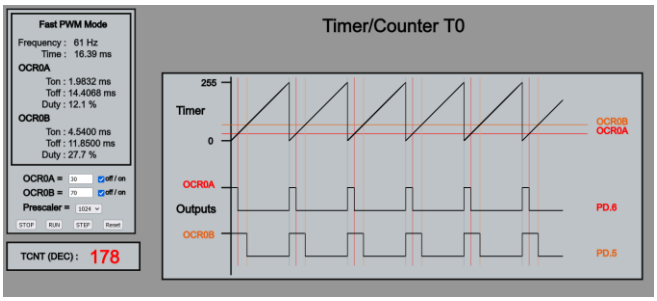

https://senzor.robotika.sk/mmp/anim/TimerCounter_T0/TimerCounter.html

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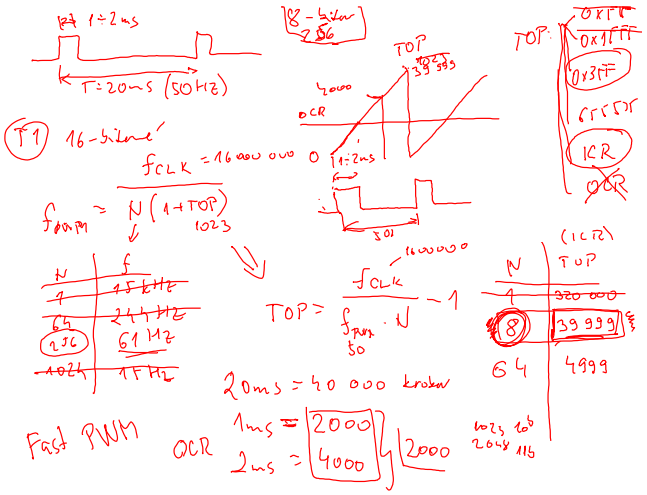

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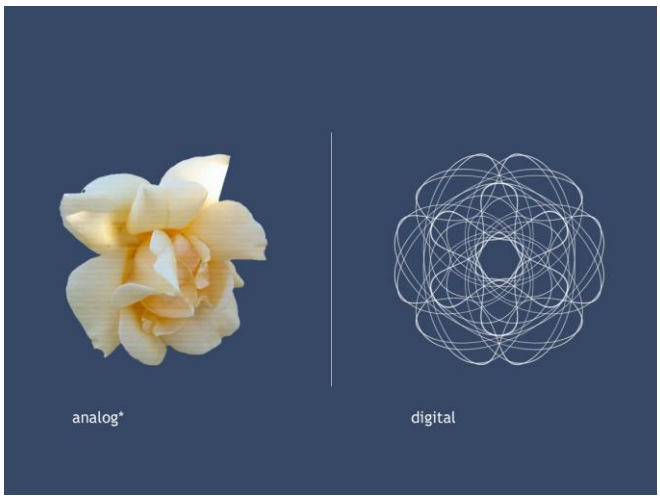

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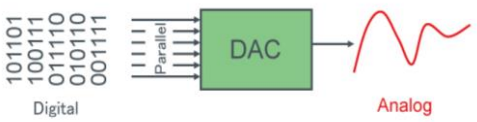
D/A prevodník



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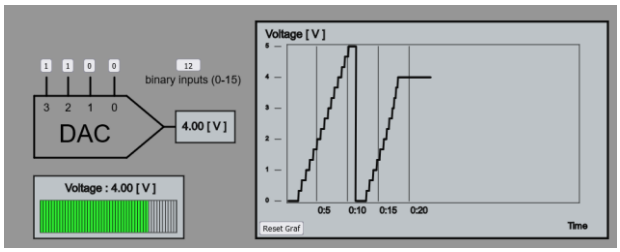
D/A prevodník



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

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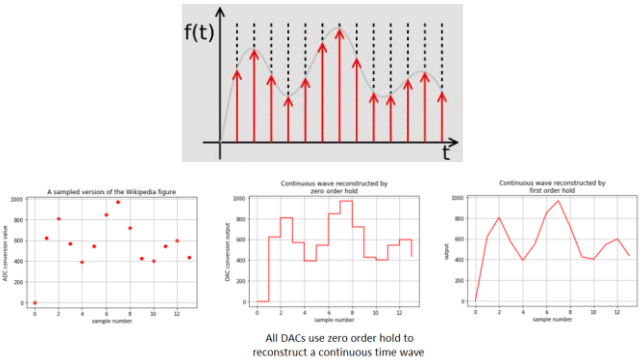
Impulzový výstup



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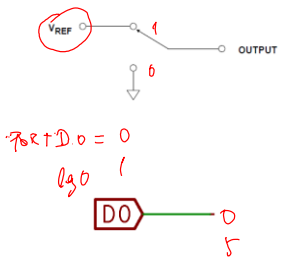
1-bitový D/A prevodník



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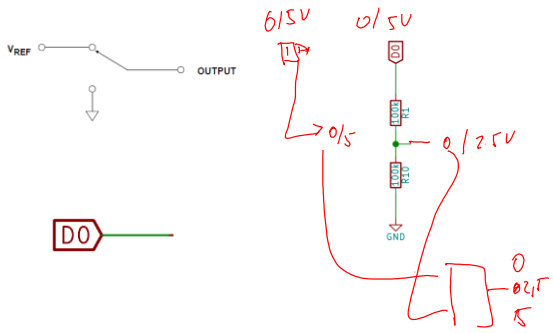
1-bitový D/A prevodník



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3-bitový D/A prevodník

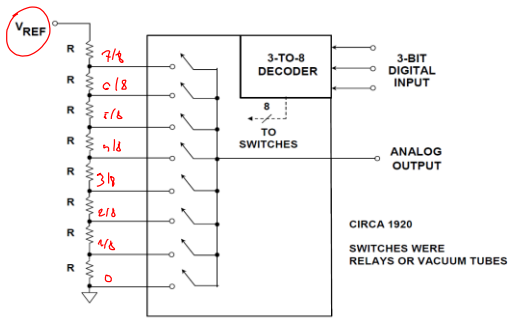

Figure 2: Simplest Voltage-Output Thermometer DAC: The Kelvin Divider ("String DAC")

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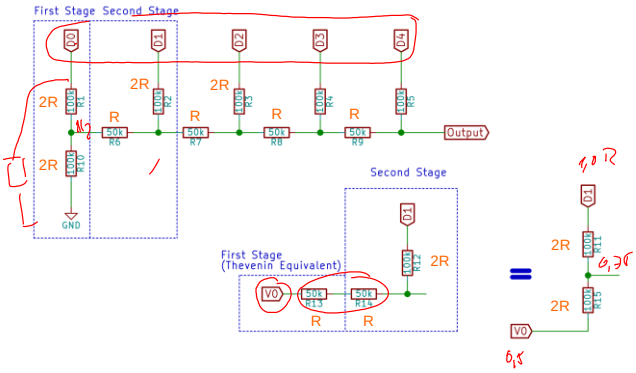
D/A prevodník typu R-2R



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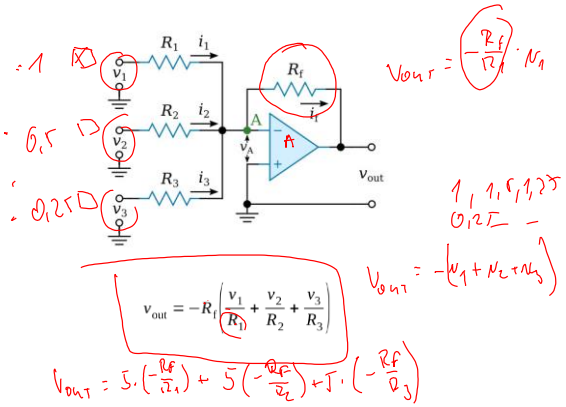
Sumátor (invertujúci)



$$v_{out} = -R_f\left(\frac{v_1}{R_1} + \frac{v_2}{R_2} + \frac{v_3}{R_3}\right)$$

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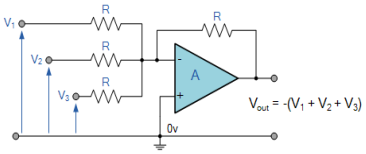
Sumátor (invertujúci)



$$v_{out} = -R_f\left(\frac{v_1}{R_1} + \frac{v_2}{R_2} + \frac{v_3}{R_3}\right)$$

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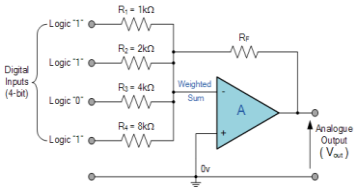
Sumátor (invertujúci)

$R_f = 0{,}5\,k\Omega$
$R_1 = 2\,R_f$
$R_2 = 4\,R_f$
$R_3 = 8\,R_f$
$R_4 = 16\,R_f$



$$v_{out} = -R_f\left(\frac{v_1}{R_1} + \frac{v_2}{R_2} + \frac{v_3}{R_3}\right)$$

$$V_{out} = -\left(\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3 + \frac{R_f}{R_4}V_4\right)$$

$$V_{out} = -\left(\frac{1}{2}V_1 + \frac{1}{4}V_2 + \frac{1}{8}V_3 + \frac{1}{16}V_4\right)$$

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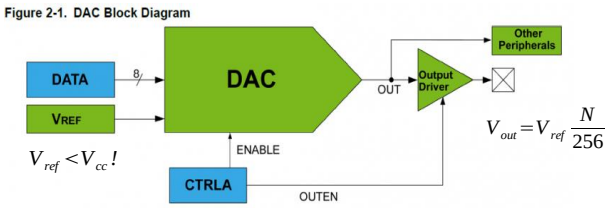
D/A prevodník



$V_{ref} < V_{cc}!$

$$V_{out} = V_{ref}\frac{N}{256}$$

Bloková schéma D/A prevodníka v procesore ATtiny214.

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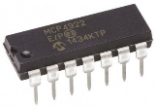
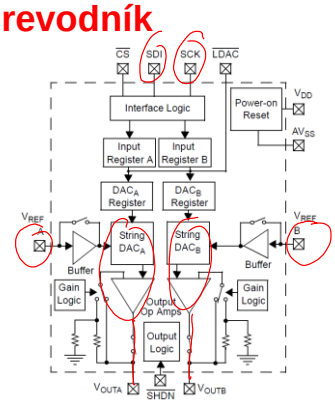
D/A prevodník





MCP4921 - dvojitý 12-bitový A/D prevodník na zbernicu SPI.

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PWM ako D/A prevodník

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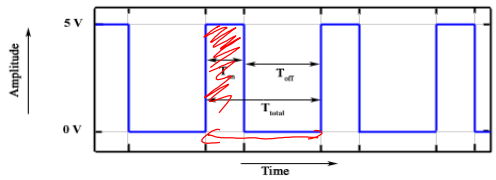
Charakteristiky PWM signálu



$$T_{total} = T_{on} + T_{off}$$

$$D = \frac{T_{on}}{T_{total}} = \frac{T_{on}}{T_{on} + T_{off}}$$

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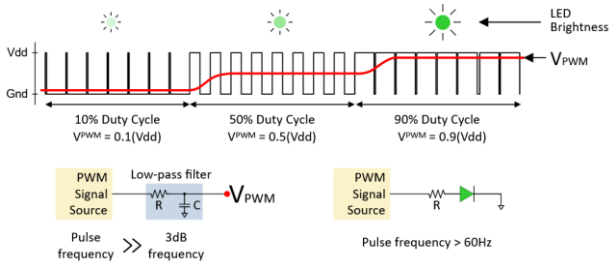
PWM signál ako D/A prevodník



$$V_{out} = DV_{in} = \frac{T_{on}}{T_{total}} V_{in}$$

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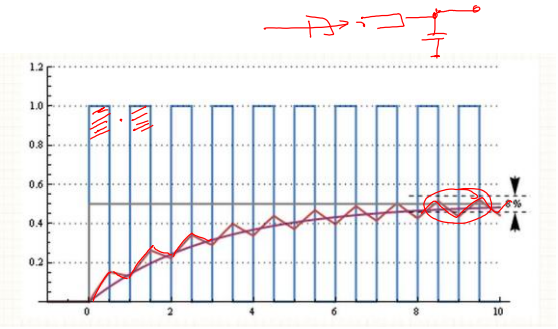
Charakteristiky PWM signálu



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SW PWM

```
#include <avr/io.h>
#include <util/delay.h>

/* Pripojenie periferii k vyvojovej doske Arduino: */

#define LED2 PD7   // externa LED dioda

#define LED2_ON  (PORTD |= (1<<LED2))
#define LED2_OFF (PORTD &= ~(1<<LED2))

int main(void)
{
  /*  SETUP   */

    DDRD = (1<<LED2);       // PORTD: LED2 na PD7  je output

  /*   LOOP   */

    unsigned char duty = 250;

    while(1)
    {
     // nase vlastne pocitadlo pocita stale dokola, rychlost dana delay
      for (int time=0;time<255;time++)
      {
        if (time > duty)
          LED2_ON;
        else
          LED2_OFF;
        delay_us(10);
      }

    } /* end of while */

    return(0);
}
```

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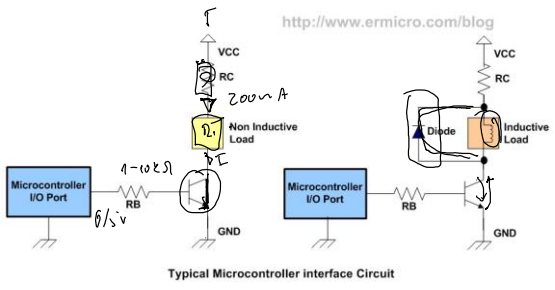
PWM interface



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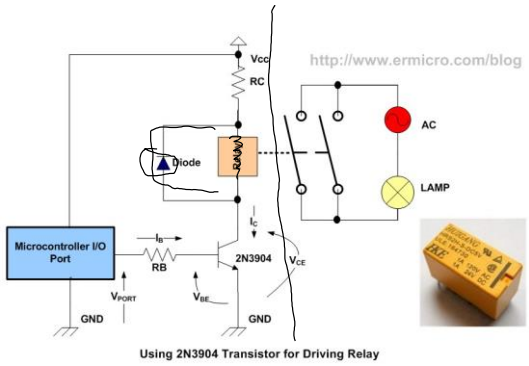
PWM interface



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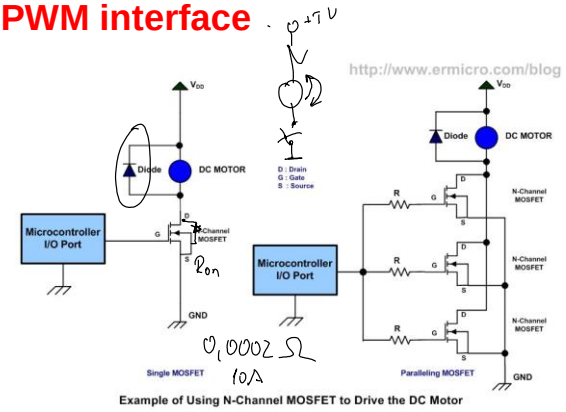
PWM interface



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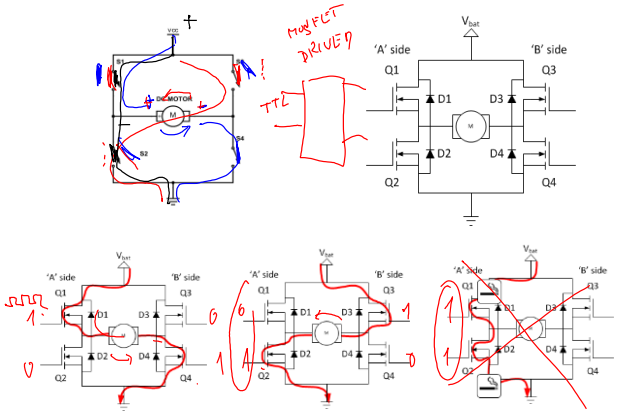
PWM interface: H-most



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Počítač – analógový / digitálny

analógový (spojitý) – číslicový, digitálny (diskrétny)

Source: http://morguefile.com/

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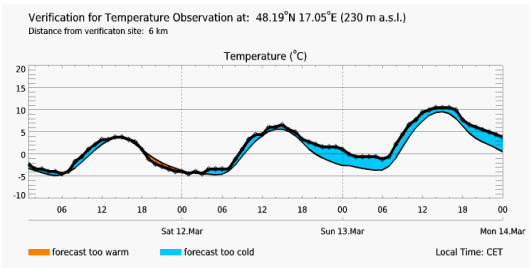
Analógový vs. Digitálny



VZORKOVANIE = SAMPLING

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

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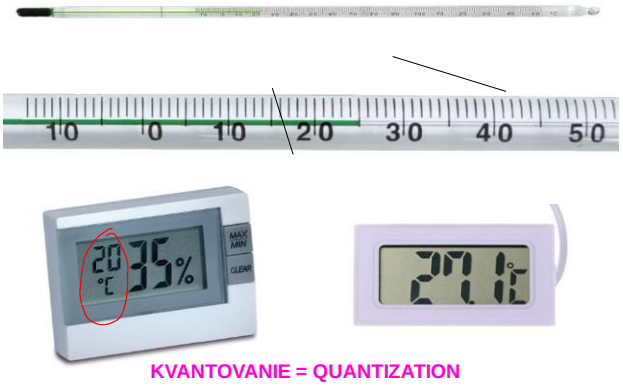
Analógový vs. Digitálny



KVANTOVANIE = QUANTIZATION

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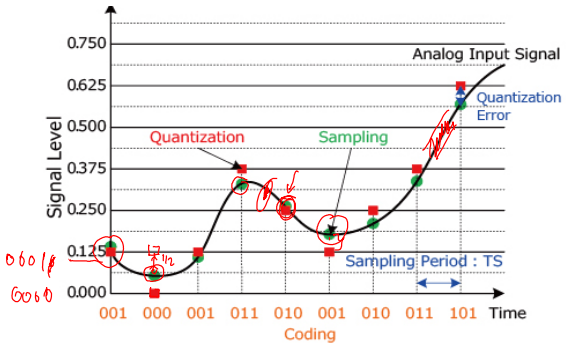
Analógový vs. Digitálny



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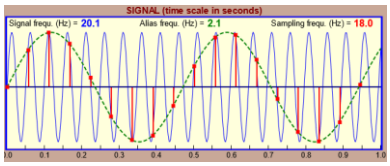
Vzorkovanie

Nyquist -- Shannon -- Kotelnikov

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

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

$$f_s > 2 f_{max}$$



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

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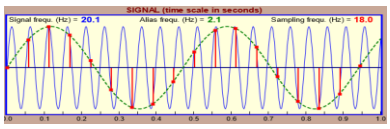
Vyskúšajte:

Aká bude zdanlivá frekvencia, ak signál s f = 10Hz budeme merať 8x za sekundu?



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

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