Digital PID:
Interfacing the uC PIC18F and Matlab

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InteGrad EESC

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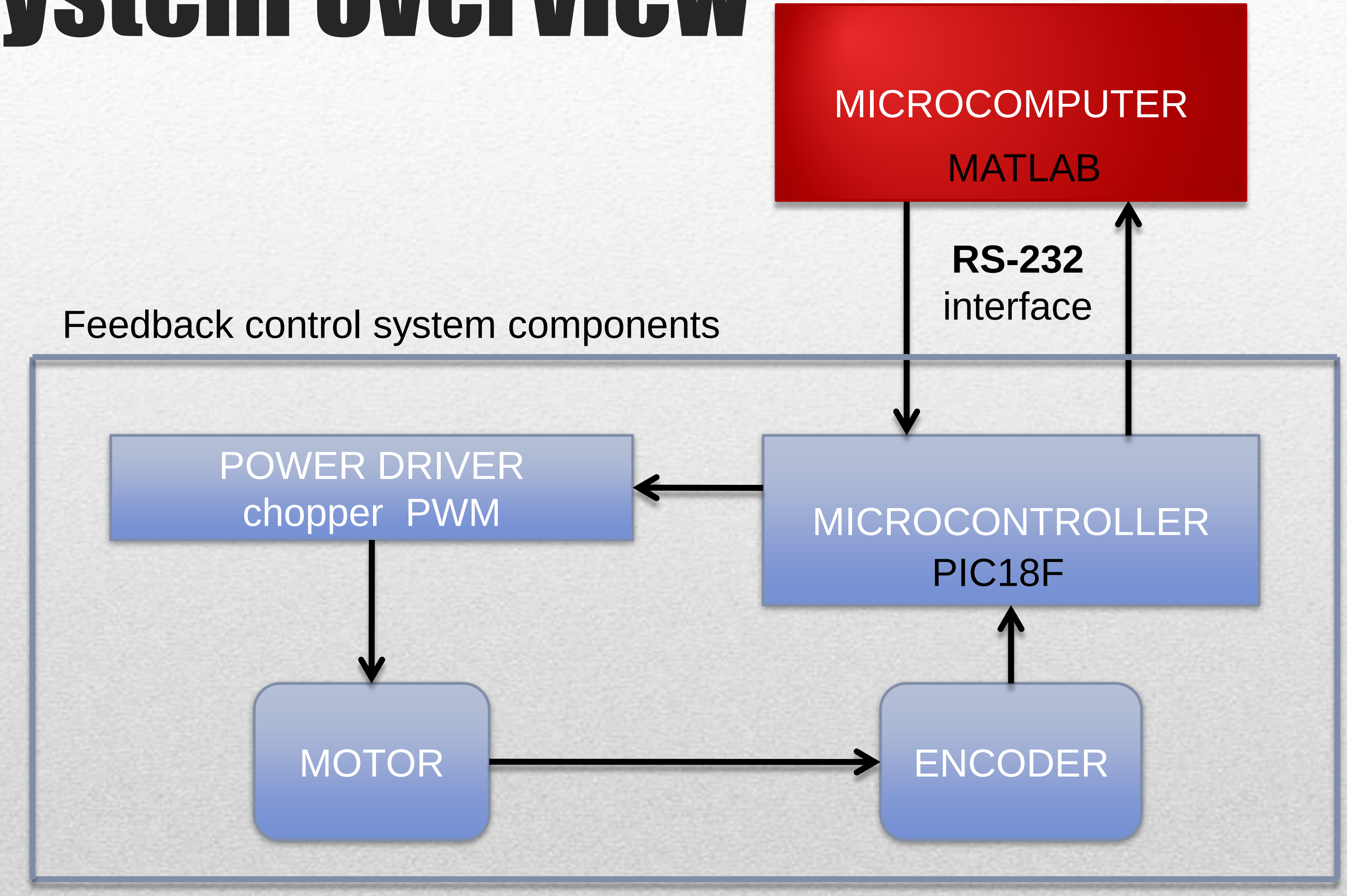
System overview



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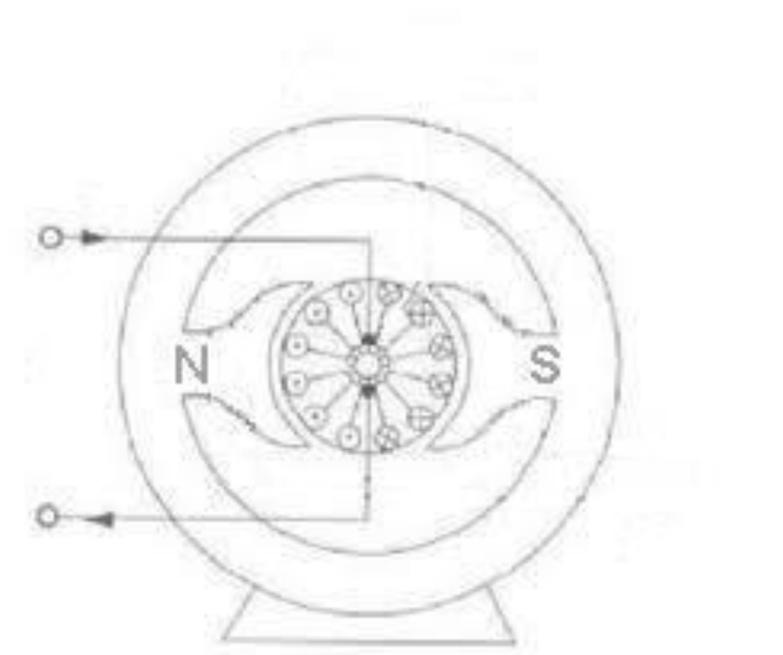
Plant Characteristics

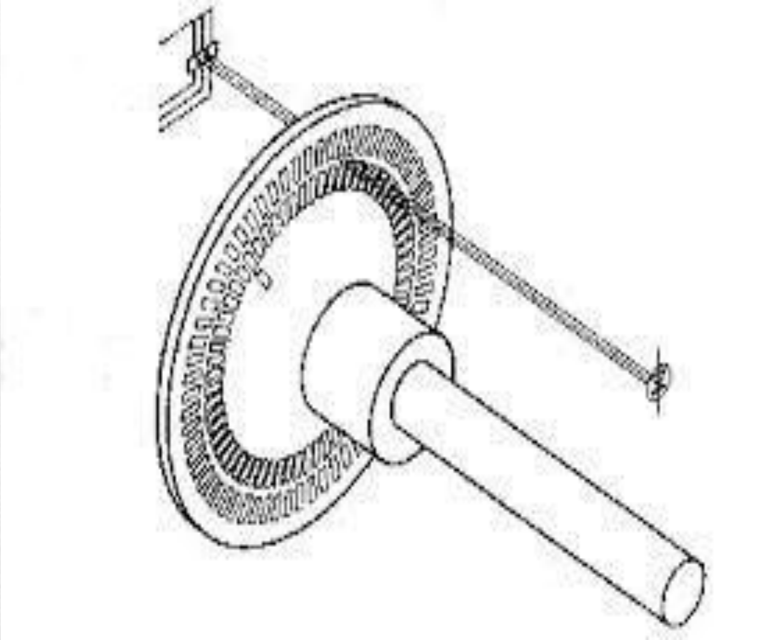
DC Motor

- ❑Permanent Magnet
- ❑Voltage 12V

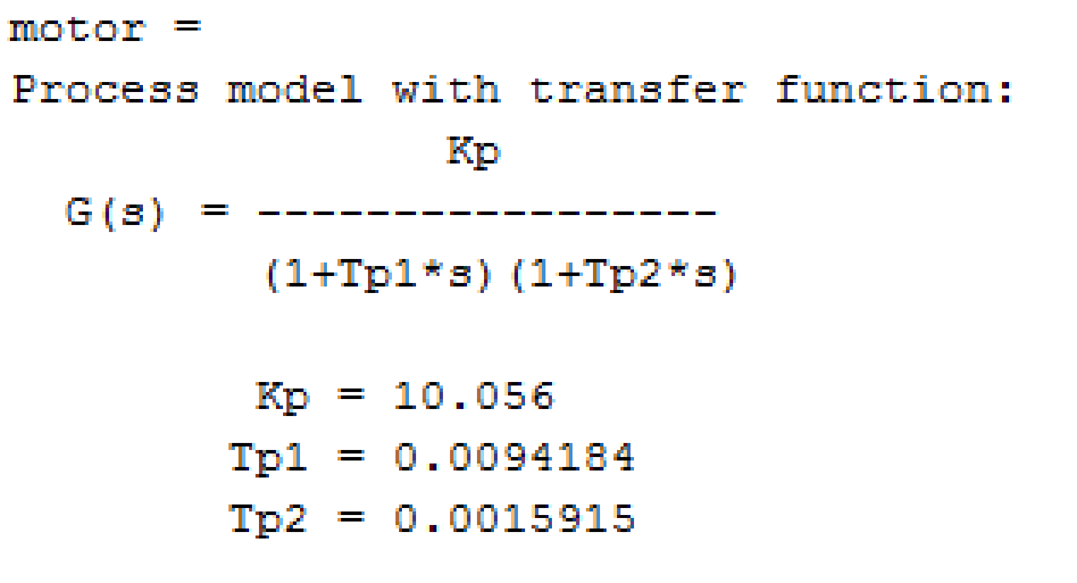
Encoder

- ❑Resolution 1024



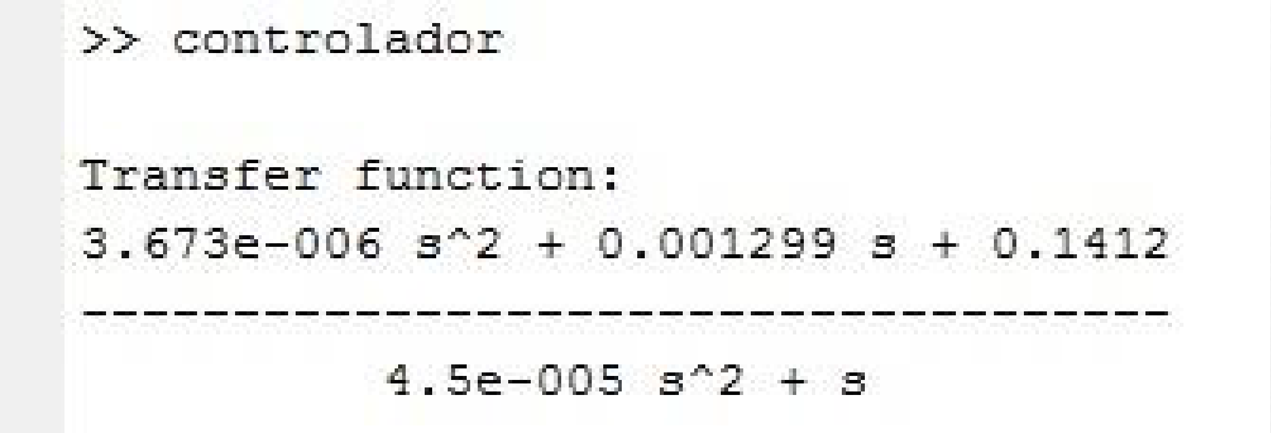


Motor Transfer Function



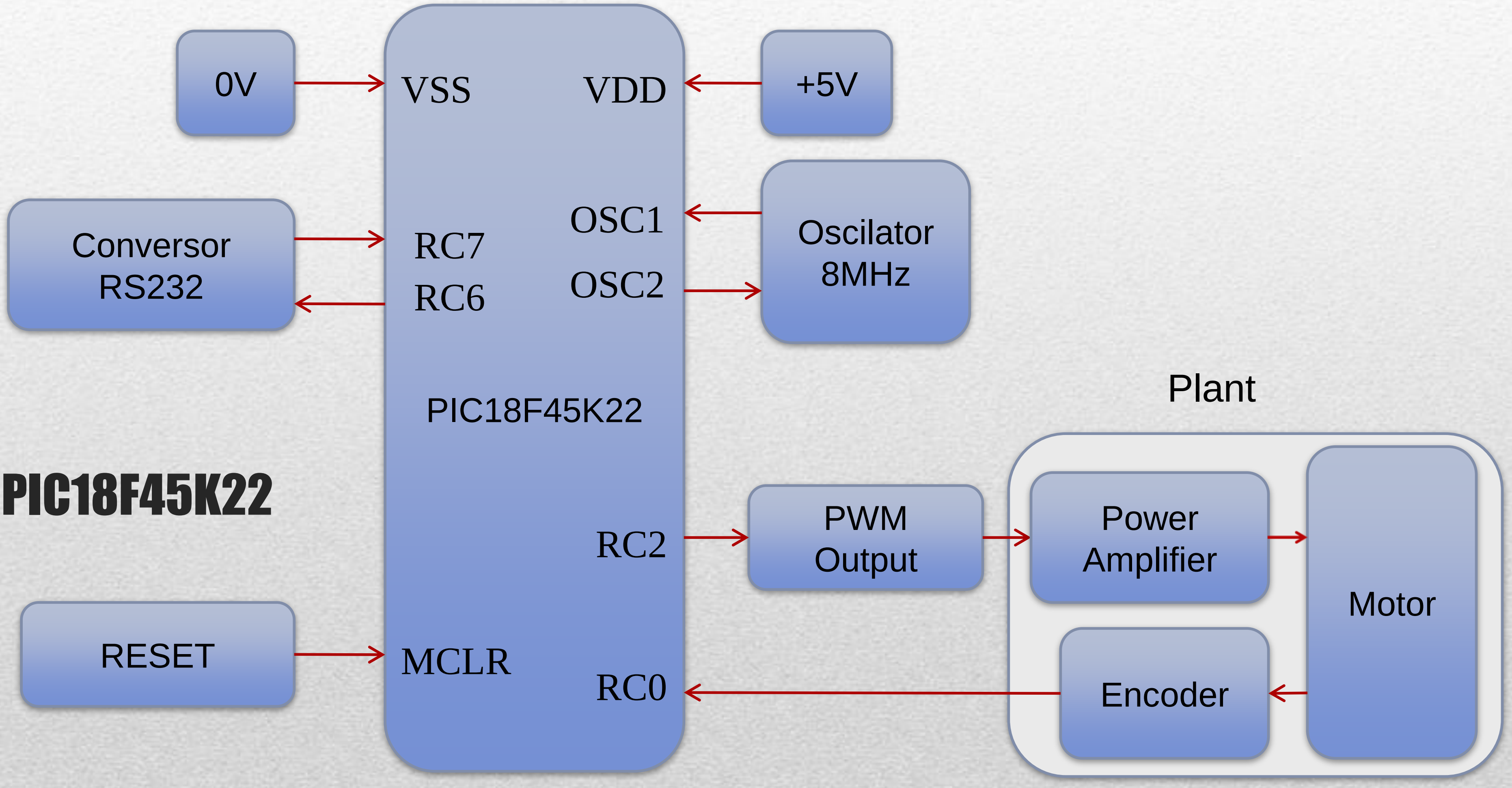
```
motor =
Process model with transfer function:
                 Kp
  G(s) = ------------------
          (1+Tp1*s)(1+Tp2*s)

          Kp = 10.056
         Tp1 = 0.0094184
         Tp2 = 0.0015915
```

Controler Transfer Function



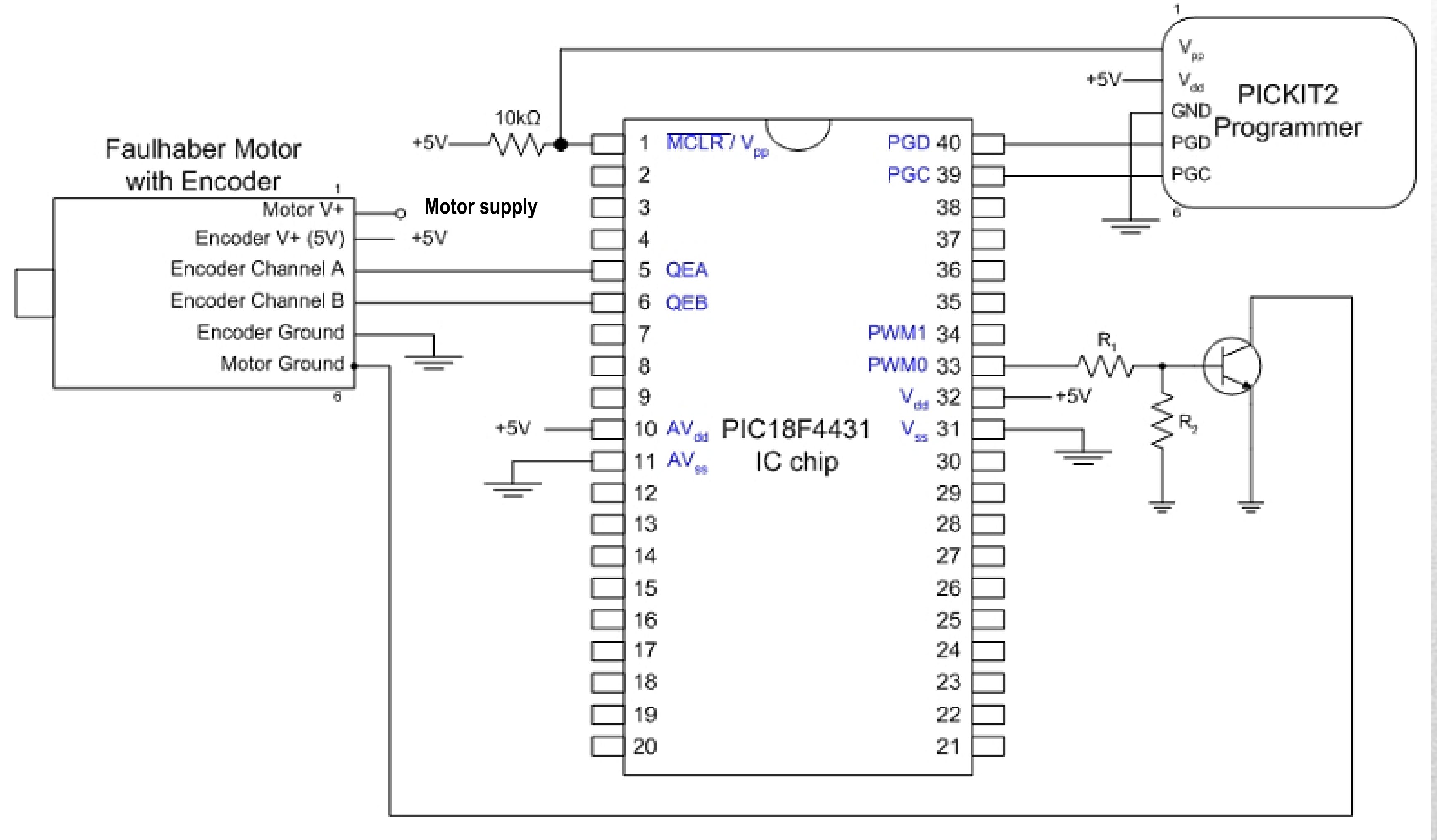
```
>> controlador

Transfer function:
3.673e-006 s^2 + 0.001299 s + 0.1412
------------------------------------
          4.5e-005 s^2 + s
```

Hardware



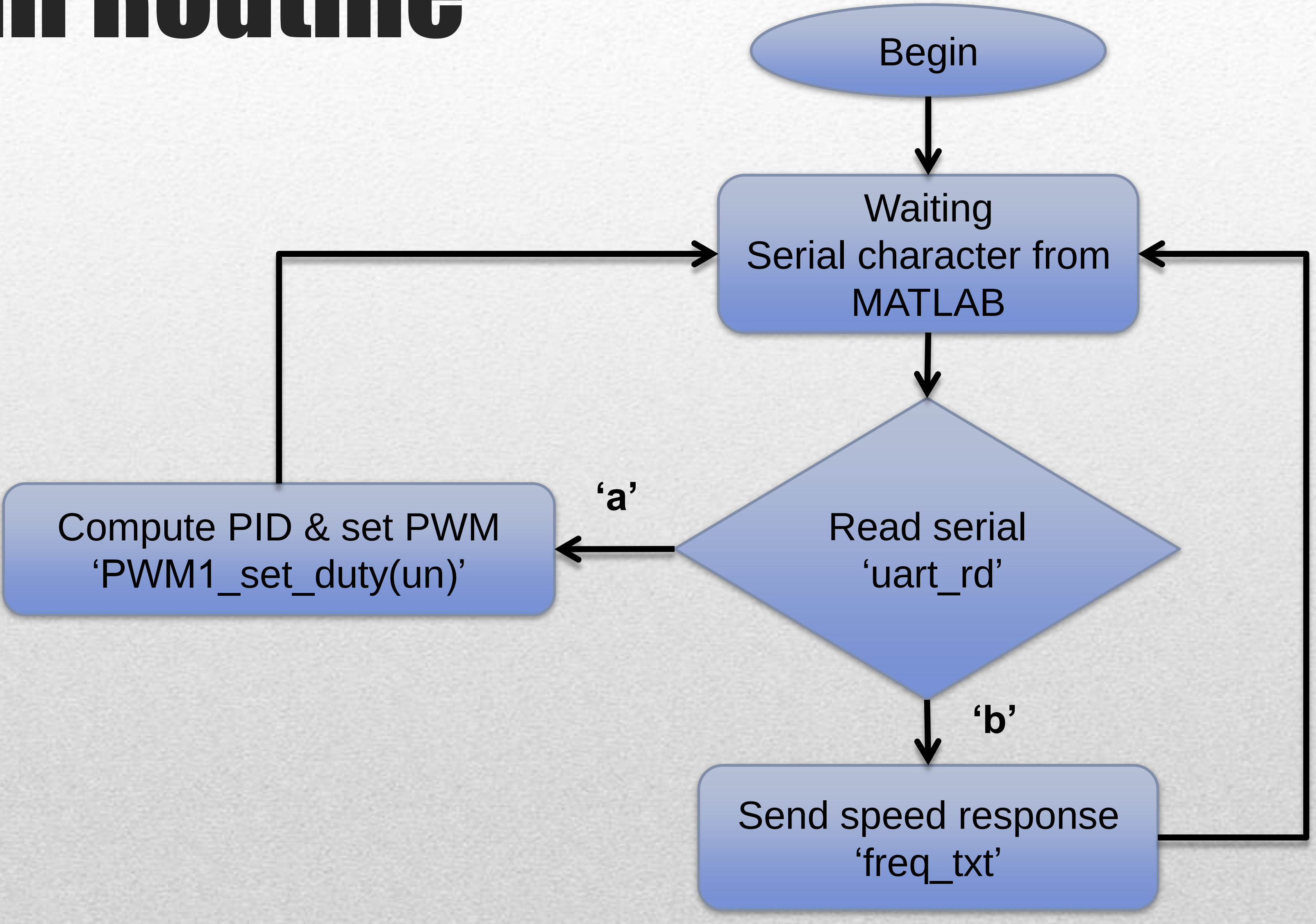
Kit PIC18F45K22

Specific QEI Hardware



Circuit Diagram

Main Routine


Begin

Waiting
Serial character from MATLAB

Read serial
'uart_rd'

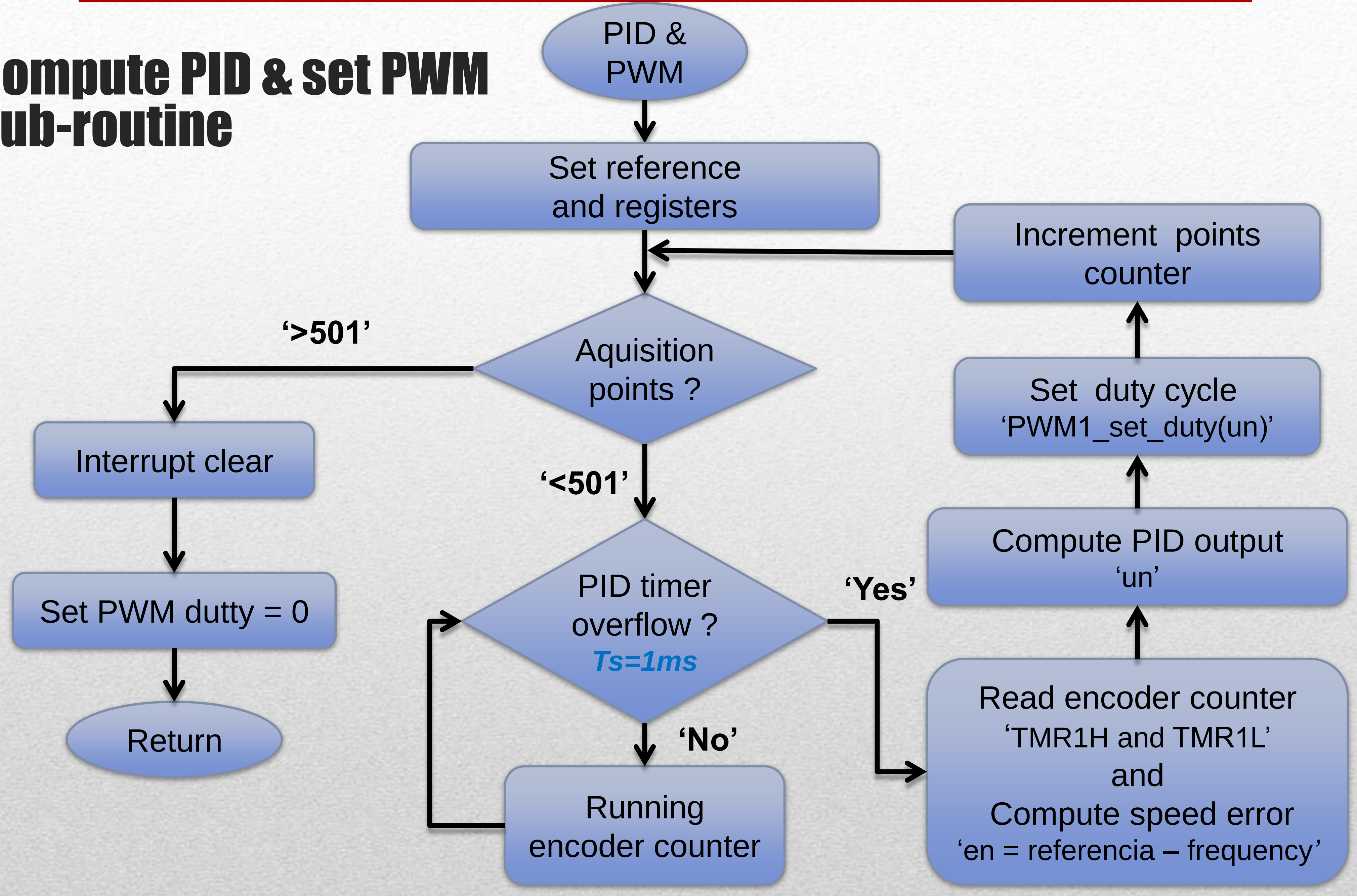
'a'

Compute PID & set PWM
'PWM1_set_duty(un)'

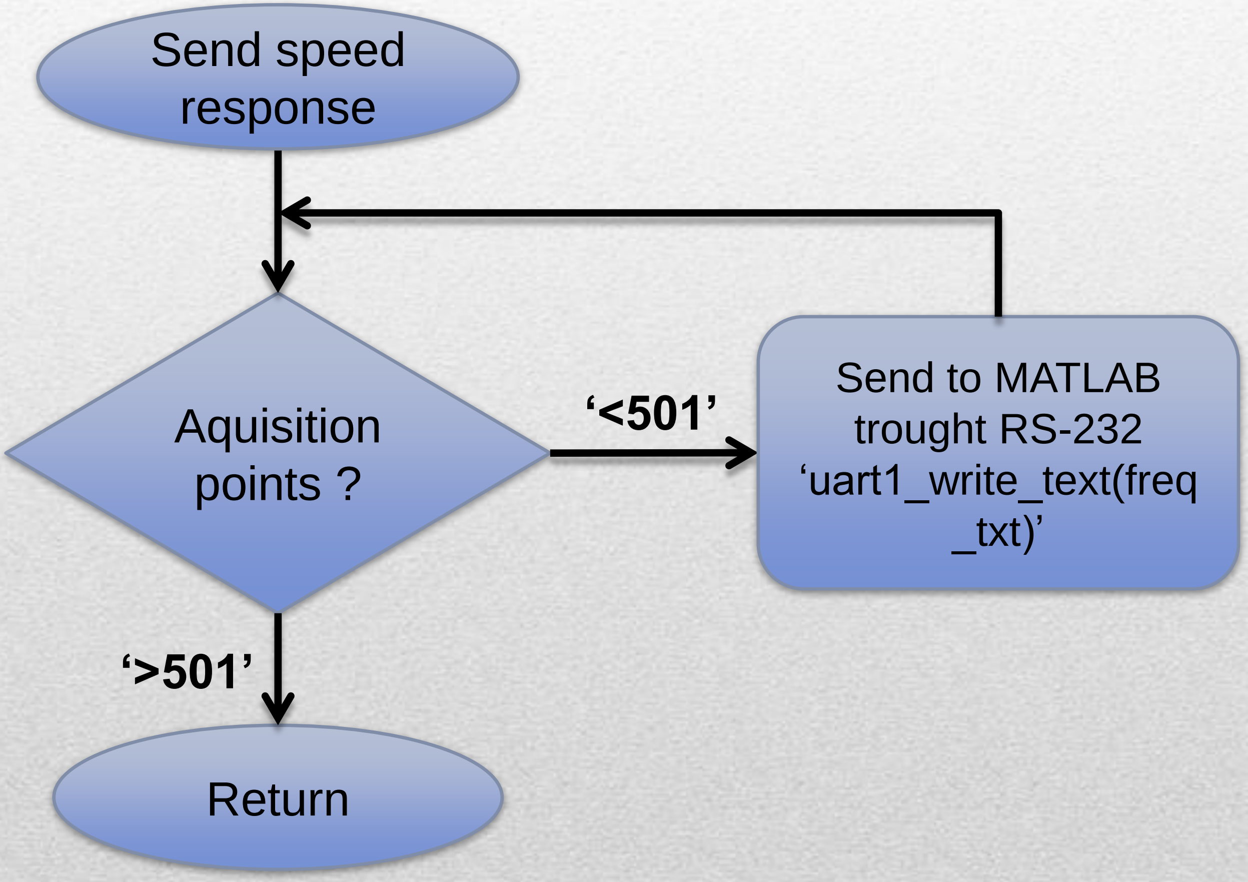
'b'

Send speed response
'freq_txt'

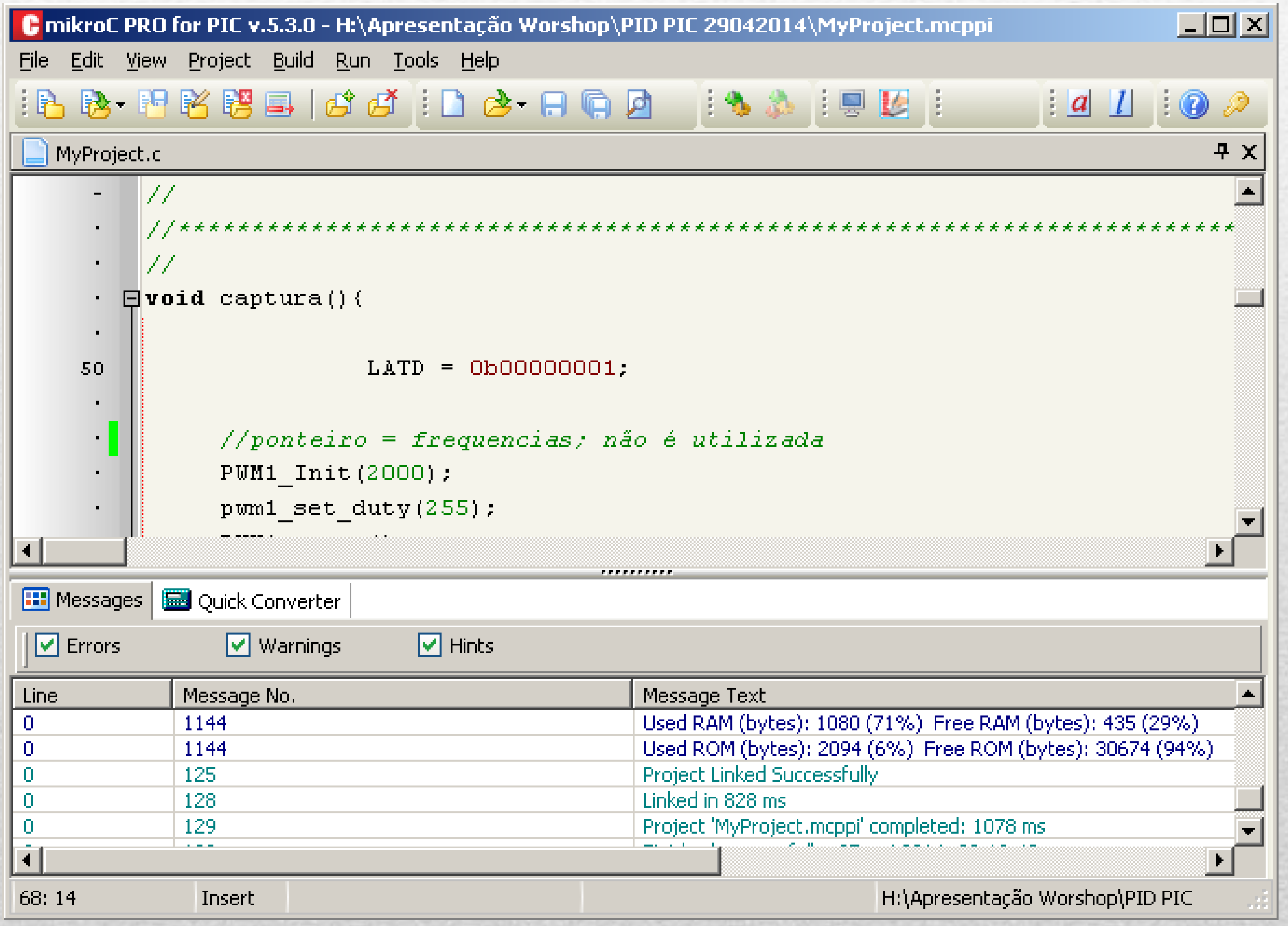
Compute PID & set PWM Sub-routine


PID & PWM
Set reference and registers
Increment points counter
'>501'
Aquisition points ?
Set duty cycle 'PWM1_set_duty(un)'
Interrupt clear
'<501'
Compute PID output 'un'
Set PWM dutty = 0
PID timer overflow ? *Ts=1ms*
'Yes'
Return
'No'
Running encoder counter
Read encoder counter 'TMR1H and TMR1L' and Compute speed error 'en = referencia – frequency'

Send Speed response Sub-routine



mikroC integrated development environment (IDE)


mikroC PRO for PIC v.5.3.0 - H:\Apresentação Worshop\PID PIC 29042014\MyProject.mcppi
File Edit View Project Build Run Tools Help
MyProject.c
Messages
Quick Converter
☑ Errors
☑ Warnings
☑ Hints
68: 14
Insert
H:\Apresentação Worshop\PID PIC

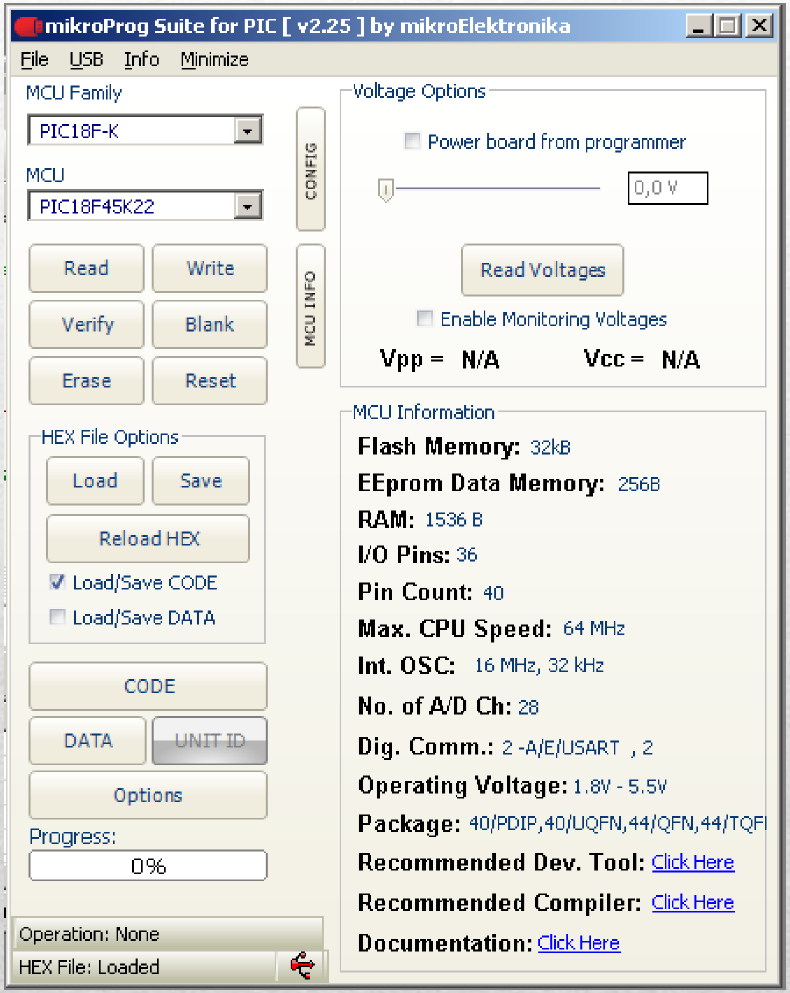
```
//
//***********************************************************************
//
void captura(){

               LATD = 0b00000001;

     //ponteiro = frequencias; não é utilizada
     PWM1_Init(2000);
     pwm1_set_duty(255);
```

Line	Message No.	Message Text
0	1144	Used RAM (bytes): 1080 (71%) Free RAM (bytes): 435 (29%)
0	1144	Used ROM (bytes): 2094 (6%) Free ROM (bytes): 30674 (94%)
0	125	Project Linked Successfully
0	128	Linked in 828 ms
0	129	Project 'MyProject.mcppi' completed: 1078 ms

Implementation of the Algorithm in the Microcontroller

```
 while(i<501){
…
frequency = frequency + (TMR1H * 256 + TMR1L);
 frequency = frequency*1000;
 frequencias[i] = frequency;
frequency  = (frequency/1024)*2*pi;
en = referencia - frequency;
 i++;

//Calculate the error by a difference equation

un = 0.007996*en - en1*0.01335 + en2*0.005612 + 0.1651*un1 + 0.8349*un2;     //0.001
en2 = en1;
en1 = en;              //controller output  : u(n-1) = un1  u(n-2) = un2
un2 = un1;             //erro  :              e(n-1) = en1  e(n-2) = en2
un1 = un;
un = un*255;
un = (int)un;
//seta pwm
 PWM1_set_duty(un);
}
```

Gravação



mikroProg Suite for PIC [v2.25] by mikroElektronika

MCU Family: PIC18F-K

MCU: PIC18F45K22

Voltage Options

□ Power board from programmer

0,0 V

□ Enable Monitoring Voltages

Vpp = N/A Vcc = N/A

HEX File Options

☑ Load/Save CODE

□ Load/Save DATA

Progress: 0%

Operation: None

HEX File: Loaded

MCU Information

Flash Memory: 32kB

EEprom Data Memory: 256B

RAM: 1536 B

I/O Pins: 36

Pin Count: 40

Max. CPU Speed: 64 MHz

Int. OSC: 16 MHz, 32 kHz

No. of A/D Ch: 28

Dig. Comm.: 2 -A/E/USART , 2

Operating Voltage: 1.8V - 5.5V

Package: 40/PDIP,40/UQFN,44/QFN,44/TQFI

Recommended Dev. Tool: Click Here

Recommended Compiler: Click Here

Documentation: Click Here

END

Thank you very much.