

## LAMPIRAN - LAMPIRAN

```
#include <STM32F4ADC.h>
STM32ADC inADC(ADC1);

int count, car, car1, car2;
int mod_final;
int vact, iact, err, err_v, iref;

double itg, lastitg, pi, mod, Bmod, P, I;
double vref, itg_v, lastitg_v, pi_v, P_v, I_v;

uint8_t analog_pins[] = {PA0, PA1, PA4};

/* CONTROL */
float kp_v = 0.001;
float ki_v = 0.1;
float kp = 0.001;
float ki = 0.1;

void setup()
{
  Serial.begin(9600);
  for (uint8_t x = 0; x < sizeof(analog_pins); x++)
    pinMode(analog_pins[x], INPUT_ANALOG);

  Timer5.init();
  Timer5.pause();
  Timer5.setMasterMode(TIMER_MASTER_MODE_UPDATE);
  Timer5.setPeriod(10000);
  Timer5.setMode(TIMER_CH2, TIMER_OUTPUT_COMPARE);
  Timer5.setCompare(TIMER_CH2, 1);
  Timer5.attachInterrupt(TIMER_CH2, INT1);
  Timer5.refresh();
  Timer5.resume();

  Timer3.init(); //PWM timer
  Timer3.setPeriod(20);
  Timer3.refresh();

  Timer4.init();
  Timer4.setPeriod(20);
  Timer4.refresh();
  Timer4.setCount(1689);
```

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Timer3.resume();
Timer4.resume();

pinMode(PB0, PWM);
pinMode(PB6, PWM);
pinMode(PB7, PWM);
pinMode(PB8, PWM);

inADC.setSamplingTime(ADC_SMPR_3);
inADC.enableDMA();
vref = 0;
}

void loop()
{
while (1)
{
sensor();
Control();
}
}

void INT1()
{
vref=2875;
if (vref > 4000)
{
vref = 4000;
}
if (vref < 0)
{
vref = 0;
}
Serial.print(vref);
Serial.print(" ");
Serial.println(vact);
Serial.print(" ");
Serial.print(iref);
Serial.print(" ");
Serial.println(iact);
}
}

void sensor()
{
vact = map(analogRead(PA0), 0, 4095, 0, 4000); //v actual
iact = map(analogRead(PA1), 0, 4095, -2000, 2000); //act arus

```

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//vref = map(analogRead(PA4), 0, 4095, 0, 4000); //v ref
}

void Control()
{
  //refv = 4000;
  err_v = vref - vact;
  P_v = kp_v * err_v;
  itg_v = lastitg_v + err_v * 0.0001;
  I_v = ki_v * itg_v;
  pi_v = P_v + I_v;

  if (pi_v > -2000 && pi_v < 2000) //current anti windup
  {
    lastitg_v = itg_v;
  }

  iref = pi_v ;
  err = iref - iact;
  P = kp * err;
  itg = lastitg + err * 0.0001;
  I = ki * itg;
  pi = P + I;

  mod = pi;
  if (mod < -2500) //limiter
    mod = -2500;
  if (mod > -2500 && mod < 3360) //mod anti windup
  {
    lastitg = itg;
  }
  pwmWrite(PB6, mod); //S1
  pwmWrite(PB0, mod); //S2
}

```

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