LAMPIRAN-LAMPIRAN

1. Kode Program Sistem

```
#include <STM32F4ADC.h>
#define set PD5 //saklar set
#define vrefup PD3 //saklar + vref
#define vrefdown PD2 //saklar - vref

STM32ADC inADC(ADC1);
int iact,iload,ipv,vact,err,car,pot,iref;
int err_v;
double itg,lastitg,pi,mod,Bmod,P,I;
double vref= 2500, itg_v, lastitg_v, pi_v, P_v,I_v;
uint8_t analog_pins[] = {PA0, PA1, PA2, PA3, PA4, PA5, PA6};

//control
float kp_v=0.5;
float ki_v=20;
float kp_i=0.5;
float ki_i=80;

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

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

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

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

 Timer3.resume();
```

```
 Timer4.resume();

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

}


void ITR()
{
  if (digitalRead(set)==0)// set v reference
 {
  vref = map(analogRead(PA4),0,4095,0,4000);//v actual, for reference before voltage
drop
 }
 if(digitalRead(vrefup)==0)
 {
  vref++;
 }
  if(digitalRead(vrefdown)==0)
 {
  vref--;
 }
 if(vref>3900)
 {vref=3900;}
 if(vref<0)
 {vref=0;}
 Serial.print(vref);
 Serial.print("  ");
 Serial.print(iact);
 Serial.print("  ");
 Serial.println(mod);
}

void loop() {
  while(1){
  sensor(); //sensor read
  bidirect(); //control process
   }

}

void sensor(){
 iact = map(analogRead(PA1),0,4095,-2000,2000); //i actual
 vact = map(analogRead(PA4),0,4095,0,4000); //v actual
}
void bidirect(){
```

```
  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_i*err;
  itg = lastitg+err*0.0001;
  I=ki_i*itg;
  pi=P+I;

  mod = pi;
  if(mod<-2500)  //limiter
  mod= -2500;
  if(mod>-2500 && mod<3360)//mod anti windup
  {
  lastitg=itg;
  }
  Bmod = -mod; //boost mod

  pwmWrite(PB6,mod); //S1
  pwmWrite(PB7,Bmod); //S2
  pwmWrite(PB8,Bmod); //S3
  pwmWrite(PB0,mod); //S4
}
```

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