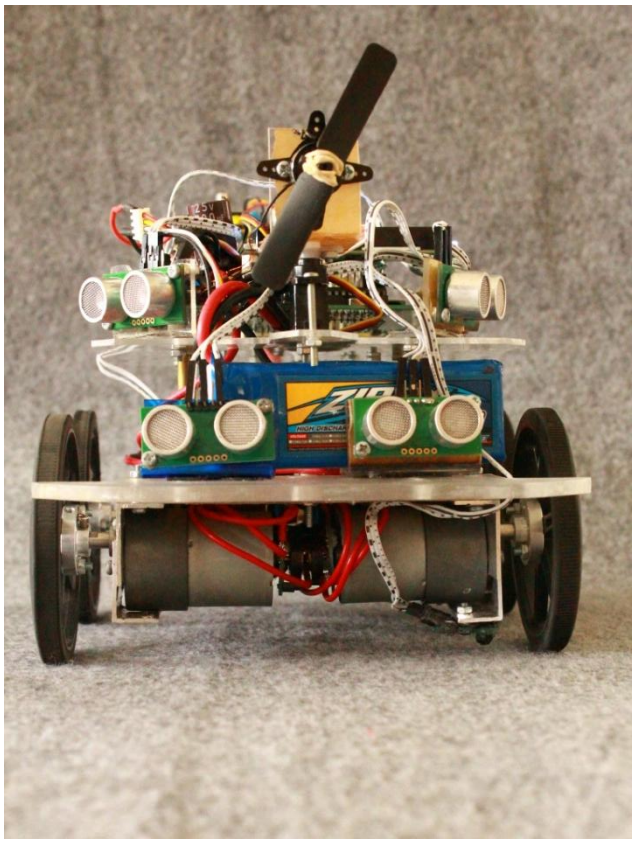
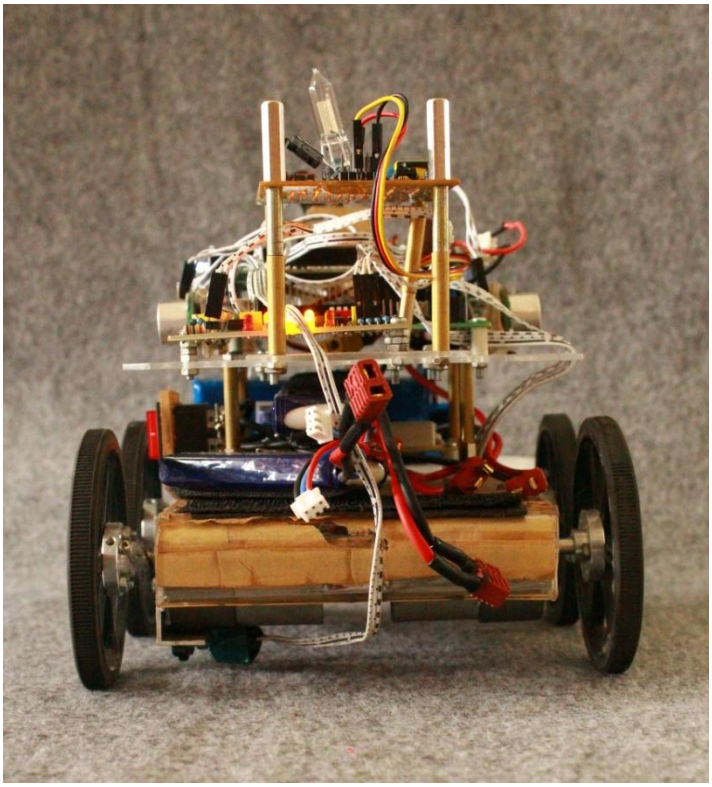
LAMPIRAN A
FOTO ROBOT BERODA

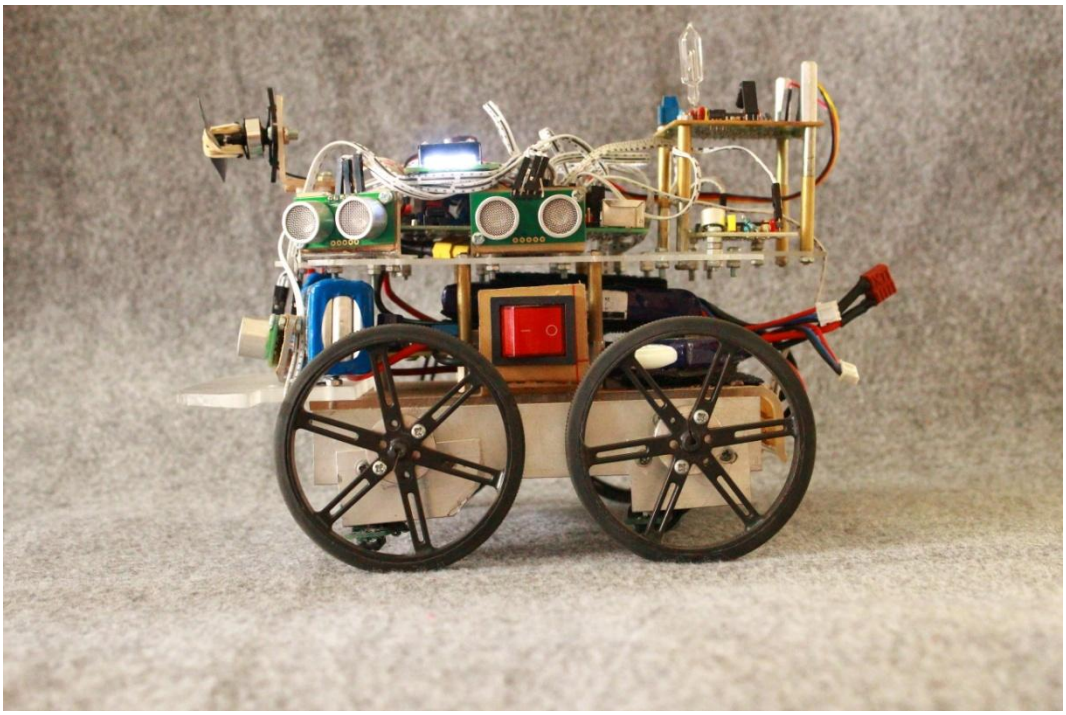
TAMPAK DEPAN



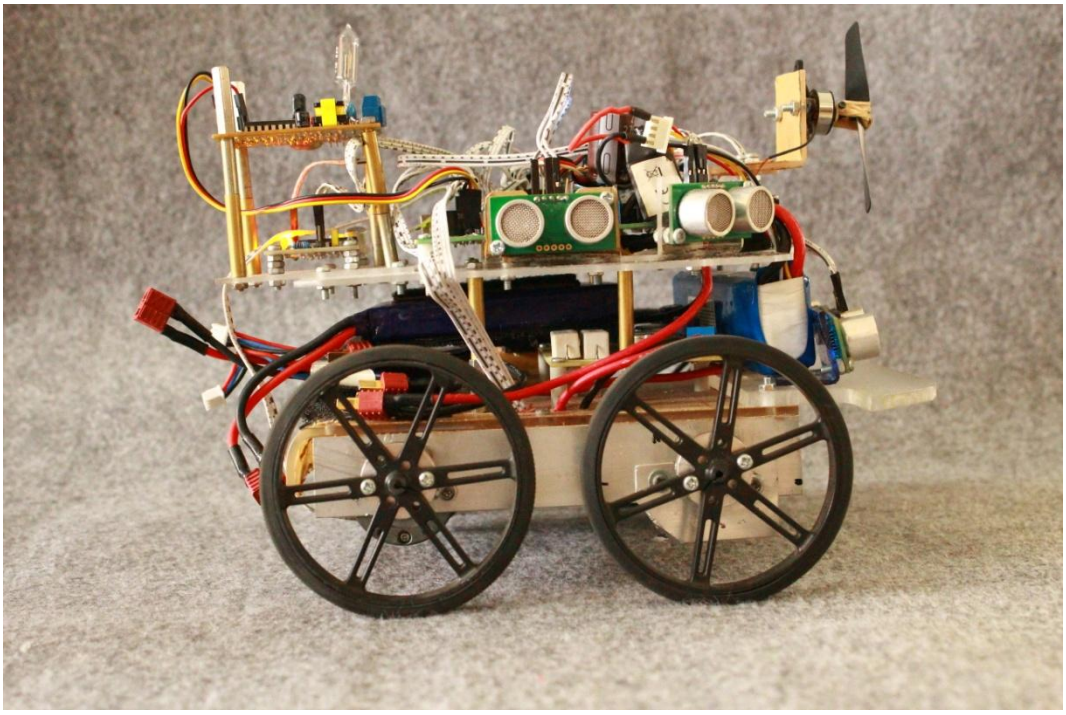
TAMPAK BELAKANG



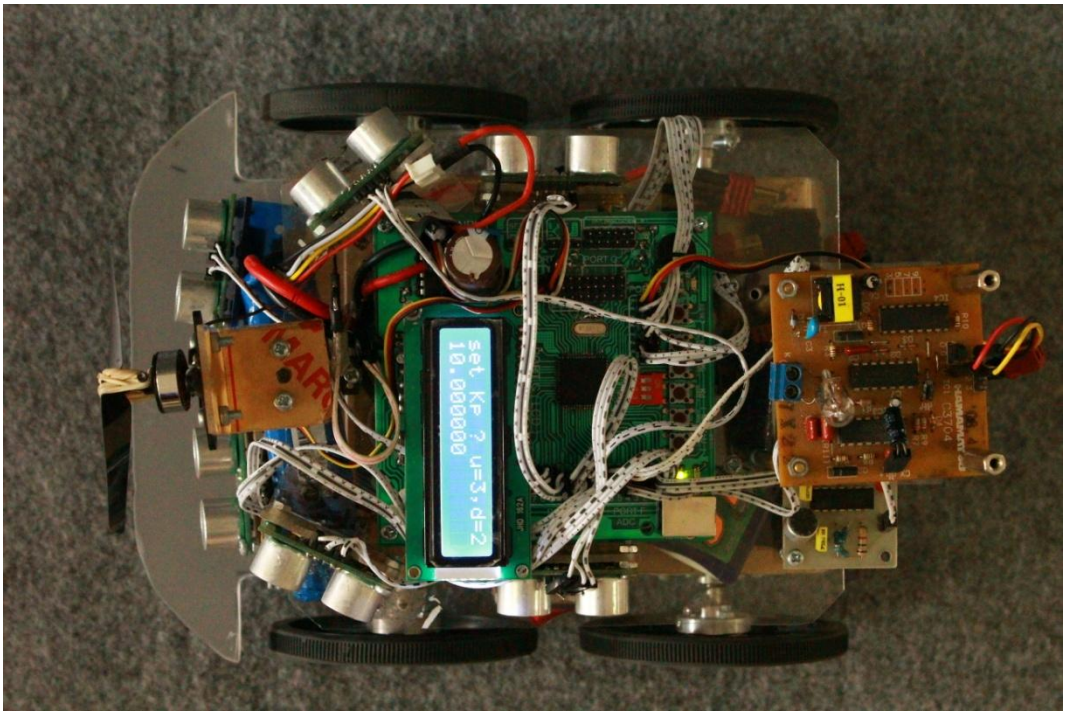
TAMPAK SAMPING KIRI



TAMPAK SAMPING KANAN



TAMPAK ATAS



LAMPIRAN B

PROGRAM PID PADA ROBOT BERODA

PROGRAM UTAMA

```
/*****************************************************
This program was produced by the
CodeWizardAVR V1.25.3 Standard
Automatic Program Generator
© Copyright 1998-2007 Pavel Haiduc, HP InfoTech s.r.l.
http://www.hpinfotech.com

Project :
Version :
Date    : 1/5/2012
Author  : ROCKY ANTHONI
Company :
Comments:


Chip type           : ATmega128
Program type        : Application
Clock frequency     : 11.059200 MHz
Memory model        : Small
External SRAM size  : 0
Data Stack size     : 1024
*****************************************************/

#include <mega128.h>
#include <delay.h>
#include <stdio.h>
#include <math.h>



#define RXB8 1
#define TXB8 0
#define UPE 2
#define OVR 3
#define FE 4
#define UDRE 5
#define RXC 7

#define FRAMING_ERROR (1<<FE)
#define PARITY_ERROR (1<<UPE)
#define DATA_OVERRUN (1<<OVR)
#define DATA_REGISTER_EMPTY (1<<UDRE)
#define RX_COMPLETE (1<<RXC)

// USART0 Transmitter buffer
#define TX_BUFFER_SIZE0 8
char tx_buffer0[TX_BUFFER_SIZE0];

#if TX_BUFFER_SIZE0<256
unsigned char tx_wr_index0,tx_rd_index0,tx_counter0;
#else
unsigned int tx_wr_index0,tx_rd_index0,tx_counter0;
#endif

// USART0 Transmitter interrupt service routine
interrupt [USART0_TXC] void usart0_tx_isr(void)
{
if (tx_counter0)
   {
   --tx_counter0;
```

```
   UDR0=tx_buffer0[tx_rd_index0];
   if (++tx_rd_index0 == TX_BUFFER_SIZE0) tx_rd_index0=0;
   };
}

#ifndef _DEBUG_TERMINAL_IO_
// Write a character to the USART0 Transmitter buffer
#define _ALTERNATE_PUTCHAR_
#pragma used+
void putchar(char c)
{
while (tx_counter0 == TX_BUFFER_SIZE0);
#asm("cli")
if (tx_counter0 || ((UCSR0A & DATA_REGISTER_EMPTY)==0))
   {
   tx_buffer0[tx_wr_index0]=c;
   if (++tx_wr_index0 == TX_BUFFER_SIZE0) tx_wr_index0=0;
   ++tx_counter0;
   }
else
   UDR0=c;
#asm("sei")
}
#pragma used-
#endif


// #define RXB8 1
// #define TXB8 0
// #define UPE 2
// #define OVR 3
// #define FE 4
// #define UDRE 5
// #define RXC 7
//
// #define FRAMING_ERROR (1<<FE)
// #define PARITY_ERROR (1<<UPE)
// #define DATA_OVERRUN (1<<OVR)
// #define DATA_REGISTER_EMPTY (1<<UDRE)
// #define RX_COMPLETE (1<<RXC)
//
// // USART0 Transmitter buffer
// #define TX_BUFFER_SIZE0 8
// char tx_buffer0[TX_BUFFER_SIZE0];
//
// #if TX_BUFFER_SIZE0<256
// unsigned char tx_wr_index0,tx_rd_index0,tx_counter0;
// #else
// unsigned int tx_wr_index0,tx_rd_index0,tx_counter0;
// #endif
//
// // USART0 Transmitter interrupt service routine
// interrupt [USART0_TXC] void usart0_tx_isr(void)
// {
// if (tx_counter0)
//    {
//    --tx_counter0;
//    UDR0=tx_buffer0[tx_rd_index0];
//    if (++tx_rd_index0 == TX_BUFFER_SIZE0) tx_rd_index0=0;
//    };
// }
//
// #ifndef _DEBUG_TERMINAL_IO_
// // Write a character to the USART0 Transmitter buffer
```

```
// #define _ALTERNATE_PUTCHAR_
// #pragma used+
// void putchar(char c)
// {
// while (tx_counter0 == TX_BUFFER_SIZE0);
// #asm("cli")
// if (tx_counter0 || ((UCSR0A & DATA_REGISTER_EMPTY)==0))
//    {
//    tx_buffer0[tx_wr_index0]=c;
//    if (++tx_wr_index0 == TX_BUFFER_SIZE0) tx_wr_index0=0;
//    ++tx_counter0;
//    }
// else
//    UDR0=c;
// #asm("sei")
// }
// #pragma used-
// #endif


// I2C Bus functions
#asm
   .equ __i2c_port=0x12 ;PORTD
   .equ __sda_bit=1
   .equ __scl_bit=0
#endasm
#include <i2c.h>

// Alphanumeric LCD Module functions
#asm
   .equ __lcd_port=0x15 ;PORTC
#endasm
#include <lcd.h>

#define RXB8 1
#define TXB8 0
#define UPE 2
#define OVR 3
#define FE 4
#define UDRE 5
#define RXC 7

#define FRAMING_ERROR (1<<FE)
#define PARITY_ERROR (1<<UPE)
#define DATA_OVERRUN (1<<OVR)
#define DATA_REGISTER_EMPTY (1<<UDRE)
#define RX_COMPLETE (1<<RXC)



#define ADC_VREF_TYPE 0x00

// Read the AD conversion result
unsigned int read_adc(unsigned char adc_input)
{
ADMUX=adc_input | (ADC_VREF_TYPE & 0xff);
// Start the AD conversion
ADCSRA|=0x40;
// Wait for the AD conversion to complete
while ((ADCSRA & 0x10)==0);
ADCSRA|=0x10;
return ADCW;
}
```

```
// Get a character from the USART1 Receiver
#pragma used+
char getchar1(void)
{
char status,data;
while (1)
     {
     while (((status=UCSR1A) & RX_COMPLETE)==0);
     data=UDR1;
     if ((status & (FRAMING_ERROR | PARITY_ERROR | DATA_OVERRUN))==0)
       return data;
     };
}
#pragma used-

// Write a character to the USART1 Transmitter
#pragma used+
void putchar1(char c)
{
while ((UCSR1A & DATA_REGISTER_EMPTY)==0);
UDR1=c;
}
#pragma used-

// Declare your global variables here



unsigned char matlab,x,y;
unsigned char text[32];
unsigned char varKipas,varUlang,varServo1,varServo2,varServo3,a,detect,apiPadam;
unsigned char counter,findHome,apiDead,i,juringTengah, juringPinggir, varJuring;
unsigned char Ts,menu,setOK,setKp,setKi,setKd;
eeprom float kp,kd,ki;
float proporsional,dataLeftPWM[5],dataRightPWM[5],dataSinyalControl[5];
float integral,derivative,processVariable,error,setPointSensorKiri,setPointPWM,rate,rateInt,lastError;
float
sinyalControl,leftPWM,prosesLeftPWM,rightPWM,dataTerakhir,prosesSinyalControl,prosesRightPWM;
unsigned int nilaiSrf08Kiri, range2;
unsigned int srfKanan, srfKiri;
unsigned char cariRuang4, counterRuang4, varRuang4, varHomeRuang4, nilaiCounterRuang4,varLoop;
unsigned char  count, count2, count3, counterLagiCui, counterCariHomeDariRuang4;
unsigned char posisi, varPosisiDepan, varPosisiKanan, varPos;

void soundAktive()
{
ulang:
if(PINA.3 == 0){
      goto lanjut;
      }
if(PINF.5==1 & PINF.6==0 & PINF.7==0){
if(PINA.3 == 0){
      goto lanjut;
      }
            while(PINF.5==1 & PINF.6==0 & PINF.7==0){delay_us(2);
if(PINA.3 == 0){
      goto lanjut;
      }}
}
else{

if(PINA.3 == 0){
      goto lanjut;
      }goto ulang;
```

```
}
if(PINF.5==0 & PINF.6==1 & PINF.7==0){
if(PINA.3 == 0){
	goto lanjut;
	}
		while(PINF.5==0 & PINF.6==1 & PINF.7==0) {
if(PINA.3 == 0){
	goto lanjut;
	}delay_us(2);}
if(PINF.5==1 & PINF.6==1 & PINF.7==0){
if(PINA.3 == 0){
	goto lanjut;
	}
	while(PINF.5==1 & PINF.6==1 & PINF.7==0) {
if(PINA.3 == 0){
	goto lanjut;
	}delay_us(2);}
//		if(PINF.5==0 & PINF.6==0 & PINF.7==1)
//		{
//		while(PINF.5==0 & PINF.6==0 & PINF.7==1) {delay_us(2);}

if(PINA.3 == 0){
	goto lanjut;
	}goto lanjut;
//		}
//		else
//		{
//		goto ulang;
//		}
	}
	else
	{

if(PINA.3 == 0){
	goto lanjut;
	}goto ulang;
	}
}
else
{

if(PINA.3 == 0){
	goto lanjut;
	}goto ulang;
}
lanjut:
}

void startranging(unsigned char address)
{
i2c_start();
i2c_write(address);
i2c_write(0x00);
i2c_write(0x51);
i2c_stop();
delay_ms(70);
}

void setAddress(unsigned char old, unsigned char new)
{
i2c_start();
i2c_write(old);
i2c_write(0x00);
i2c_write(0xA0);
```

```
i2c_stop();
delay_ms(70);
i2c_start();
i2c_write(old);
i2c_write(0x00);
i2c_write(0xAA);
i2c_stop();
delay_ms(70);
i2c_start();
i2c_write(old);
i2c_write(0x00);
i2c_write(0xA5);
i2c_stop();
delay_ms(70);
i2c_start();
i2c_write(old);
i2c_write(0x00);
i2c_write(new);
i2c_stop();
delay_ms(70);
}

unsigned int getRange(unsigned char address)
{
unsigned int data, data1, data2;

i2c_start();
i2c_write(address);
i2c_write(0x02);
i2c_start();
i2c_write(address|1);
data1 = i2c_read(0);
i2c_stop();

data1 = data1 << 8;

i2c_start();
i2c_write(address);
i2c_write(0x03);
i2c_start();
i2c_write(address|1);
data2 = i2c_read(0);
i2c_stop();

data = data1+data2;

return data;
}

unsigned int getSrf(unsigned char i)
{
      int jarak = 0, bacaJarak;
      switch(i)
      {
            case 0 :
                  {
                        PORTA.0 = 0;
                        DDRA.0 = 1;
                        PORTA.0 = 1;
                        delay_us(15);
                        PORTA.0 = 0;
                        DDRA.0 = 0;
                        delay_us(750);
                        while(PINA.0 == 0){delay_us(1);};
```

```
            while(PINA.0 == 1)
            {
                jarak++;
                delay_us(1);
                if(jarak>25000)   break;
            }
            delay_us(5);
        }
        break;
case 1 :
        {
            PORTA.1 = 0;
            DDRA.1 = 1;
            PORTA.1 = 1;
            delay_us(15);
            PORTA.1 = 0;
            DDRA.1 = 0;
            delay_us(750);
            while(PINA.1 == 0){delay_us(1);};
            while(PINA.1 == 1)
            {
                jarak++;
                delay_us(1);
                if(jarak>25000)  break;
            }
            delay_us(5);
        }
        break;
case 2 :
        {
            PORTA.2 = 0;
            DDRA.2 = 1;
            PORTA.2 = 1;
            delay_us(15);
            PORTA.2 = 0;
            DDRA.2 = 0;
            delay_us(750);
            while(PINA.2 == 0){delay_us(1);};
            while(PINA.2 == 1)
            {
                jarak++;
                delay_us(1);
                if(jarak>25000)  break;
            }
            delay_us(5);
        }
        break;
case 3 :
        {
            PORTB.0 = 0;
            DDRB.0 = 1;
            PORTB.0 = 1;
            delay_us(15);
            PORTB.0 = 0;
            DDRB.0 = 0;
            delay_us(750);
            while(PINB.0 == 0){delay_us(1);};
            while(PINB.0 == 1)
            {
                jarak++;
                delay_us(1);
                if(jarak>25000)  break;
            }
            delay_us(5);
```

```
        }
        break;
    case 4 :
        {
            PORTA.4 = 0;
            DDRA.4 = 1;
            PORTA.4 = 1;
            delay_us(15);
            PORTA.4 = 0;
            DDRA.4 = 0;
            delay_us(750);
            while(PINA.4 == 0){delay_us(1);};
            while(PINA.4 == 1)
            {
                jarak++;
                delay_us(1);
                if(jarak>25000)  break;
            }
            delay_us(5);
        }
        break;
    case 5 :
        {
            PORTA.5 = 0;
            DDRA.5 = 1;
            PORTA.5 = 1;
            delay_us(15);
            PORTA.5 = 0;
            DDRA.5 = 0;
            delay_us(750);
            while(PINA.5 == 0){delay_us(1);};
            while(PINA.5 == 1)
            {
                jarak++;
                delay_us(1);
                if(jarak>25000)  break;
            }
            delay_us(5);
        }
        break;
    case 6 :
        {
            PORTA.6 = 0;
            DDRA.6 = 1;
            PORTA.6 = 1;
            delay_us(15);
            PORTA.6 = 0;
            DDRA.6 = 0;
            delay_us(750);
            while(PINA.6 == 0){delay_us(1);};
            while(PINA.6 == 1)
            {
                jarak++;
                delay_us(1);
                if(jarak>25000)  break;
            }
            delay_us(5);
        }
        break;
    case 7 :
        {
            PORTA.7 = 0;
            DDRA.7 = 1;
            PORTA.7 = 1;
```

```
                    delay_us(15);
                    PORTA.7 = 0;
                    DDRA.7 = 0;
                    delay_us(750);
                    while(PINA.7 == 0){delay_us(1);};
                    while(PINA.7 == 1)
                    {
                        jarak++;
                        delay_us(1);
                        if(jarak>25000)  break;
                    }
                    delay_us(5);
                }
                break;
            default :
                {
                    return 0;
                }
    }
    bacaJarak = jarak/29.034;
    return bacaJarak;
}

void maju(char speedA, char speedB)
{
 OCR1A = speedA;
 OCR1B = speedB;
 PORTB.1 = 1;
 PORTB.2 = 0;
 PORTB.3 = 1;
 PORTB.4 = 0;
}
void berenti(char speedA, char speedB)
{
 OCR1A = speedA;
 OCR1B = speedB;
 PORTB.1 = 1;
 PORTB.2 = 1;
 PORTB.3 = 1;
 PORTB.4 = 1;
}

void belokKiri(char speedA, char speedB)      // ban kanan maju, kiri diem
{
 OCR1A = speedA;
 OCR1B = speedB;
 PORTB.1 = 1;
 PORTB.2 = 1;
 PORTB.3 = 1;
 PORTB.4 = 0;
}
void belokKanan(char speedA, char speedB)      // ban kiri maju, kanan diem
{
 OCR1A = speedA;
 OCR1B = speedB;
 PORTB.1 = 1;
 PORTB.2 = 0;
 PORTB.3 = 1;
 PORTB.4 = 1;
}
void kiri(char speedA, char speedB)          // ban kiri mundur, kanan diem
{
 OCR1A = speedA;
 OCR1B = speedB;
```

```
 PORTB.1 = 0;
 PORTB.2 = 1;
 PORTB.3 = 1;
 PORTB.4 = 1;
}
void kanan(char speedA, char speedB)         //ban kanan mundur, kiri diem
{
 OCR1A = speedA;
 OCR1B = speedB;
 PORTB.1 = 1;
 PORTB.2 = 1;
 PORTB.3 = 0;
 PORTB.4 = 1;
}
void bantingKiri(char speedA, char speedB)  //ban kiri mundur, kanan maju
{
 OCR1A = speedA;
 OCR1B = speedB;
 PORTB.1 = 0;
 PORTB.2 = 1;
 PORTB.3 = 1;
 PORTB.4 = 0;
}
void bantingKanan(char speedA, char speedB) //ban kanan mundur, kiri maju
{
 OCR1A = speedA;
 OCR1B = speedB;
 PORTB.1 = 1;
 PORTB.2 = 0;
 PORTB.3 = 0;
 PORTB.4 = 1;
}
void kipas(void){

      for( varServo1=0;varServo1<=10;varServo1++ ){
           PORTD.6=1;
           delay_us(1500);
           PORTD.6=0;
           delay_us(18500);
      }
      for( varKipas=0;varKipas<=50;varKipas++ ){
           PORTD.5=1;
           delay_us(1500);
           PORTD.5=0;
           delay_us(18500);
           }
      for( varServo1=0;varServo1<=10;varServo1++ ){
           PORTD.6=1;
           delay_us(1200);
           PORTD.6=0;
           delay_us(18800);
      }
      for( varKipas=0;varKipas<=50;varKipas++ ){
           PORTD.5=1;
           delay_us(2000);
           PORTD.5=0;
           delay_us(18000);
           }
      for( varServo1=0;varServo1<=10;varServo1++ ){
           PORTD.6=1;
           delay_us(1800);
           PORTD.6=0;
           delay_us(18200);
      }
```

```
        for( varKipas=0;varKipas<=50;varKipas++ ){
            PORTD.5=1;
            delay_us(2000);
            PORTD.5=0;
            delay_us(18000);
            }
        for( varServo1=0;varServo1<=10;varServo1++ ){
            PORTD.6=1;
            delay_us(1500);
            PORTD.6=0;
            delay_us(18500);
        }
        for( varServo1=0;varServo1<=10;varServo1++ ){
            PORTD.6=1;
            delay_us(1500);
            PORTD.6=0;
            delay_us(18500);
        }

}

unsigned int srf08Kiri() {
        startranging(0xE0);
        nilaiSrf08Kiri = getRange(0xE0);
        return nilaiSrf08Kiri;
        }

void countingHome(void){
        if(read_adc(0) >= 410){
                count2=1;
                }
        if(count2 == 1 && read_adc(0)<410 && apiPadam == 1){
                counterCariHomeDariRuang4 = counterCariHomeDariRuang4 + 1;
                count2 =0;
                }
 }
void counting(void){
        if(read_adc(0) >= 410){
                count=1;
                }
        if(count == 1 && read_adc(0)<410 && apiPadam == 0){
                counterRuang4 = counterRuang4 + 1;
                count =0;
                }
 }
void countingLagi(void){
        if(read_adc(0) >= 410){
                count3=1;
                }
        if(count3 == 1 && read_adc(0)<410 && apiPadam == 0){
                counterLagiCui = counterLagiCui + 1;
                count3 =0;
                }
 }

 void cariPosisiAwal(){
         while(1){
                cariPosisi:
                varPosisiDepan=getSrf(6);
                varPosisiKanan=getSrf(4);
                if(varPosisiDepan > 14){
                        if(varPosisiKanan > 8 && getSrf(1) > 10){
                                bantingKanan(120,120);
                                delay_ms(75);
```

```
                varPos=varPos+1;
                if(varPos>=19){
                    break;
                    }
                goto cariPosisi;
                }
            else{
                varPos=19;
                break;
                }
            goto cariPosisi;
            }

        else if( varPosisiDepan <=14){
            if(varPosisiKanan > 8 && getSrf(1) > 10){
                bantingKiri(120,120);
                delay_ms(75);
                varPos=varPos+1;
                if(varPos>=19){
                    break;
                    }
                goto cariPosisi;
                }
            else{
                varPos=19;
                break;
                }
            goto cariPosisi;
            }
        berenti(255,255);
        PORTD.4=1;
        delay_ms(20);
        PORTD.4=0;
        delay_ms(20);
        PORTD.4=1;
        delay_ms(20);
        PORTD.4=0;
        delay_ms(20);
        PORTD.4=1;
        delay_ms(20);
        PORTD.4=0;
        delay_ms(20);
        PORTD.4=1;
        delay_ms(20);
        PORTD.4=0;
        delay_ms(20);
        }
}


void wallKananMulus(void){

//=============================================================================
    if(PINB.7 == 1){                                    //   lagi gak ada api
            juringTengah=0;
            juringPinggir=0;                            //  reset juring tengah, klo juring tgh =1 muter
kiri trs

            if( getSrf(6) > 14) {                                   //14

                kp = 10;                                            //10
                kd = 15;                                            //15
                ki = 0.005;                                         // 0.025
                setPointPWM =110;
```

```
                    processVariable = getSrf(1);                    // proporsional program
                    setPointSensorKiri = 8;
                    error = setPointSensorKiri - processVariable;
                    proporsional = kp * error;                      //proporsional end
                    rate = error - lastError;                       //derivative program
                    rateInt = error + lastError;
                    Ts=1;                                           //Ts = time sampling
                    integral = Ts * (ki * rateInt);
                    derivative = (kd/Ts) * rate;                    //derivative
                    sinyalControl = proporsional + derivative + integral;       //sinyal control
                    rightPWM = setPointPWM + sinyalControl;
                    leftPWM = setPointPWM - sinyalControl;
                    if(rightPWM >= 255) {
                          rightPWM = 130;
                          }
                    if(leftPWM >= 255) {
                          leftPWM = 130;
                          }
                    if(rightPWM <= 0) {
                          rightPWM = 0;
                          }
                    if(leftPWM <= 0) {
                          leftPWM = 0;
                          }
                    leftPWM;
                    rightPWM;
                    if(leftPWM == 0 && rightPWM == 200){
                           bantingKiri(leftPWM,rightPWM);
                           lcd_clear();
                           lcd_gotoxy(0,0);
                           lcd_putsf("belok kiri");
                          }
                    if(rightPWM == 0 && leftPWM == 200){
                           bantingKanan(leftPWM,rightPWM);
                           lcd_clear();
                           lcd_gotoxy(0,0);
                           lcd_putsf("belok kanan");
                          }
                    if( (rightPWM <200 || leftPWM < 200)  && (rightPWM > 0 || leftPWM > 0) ){

                           if( (leftPWM < rightPWM) && (leftPWM < 40)){
                                belokKiri(leftPWM,rightPWM);
                                }
                           if( (leftPWM > rightPWM) && (rightPWM < 40) ){
                                belokKanan(leftPWM,rightPWM);
                                }
                           else{
                                maju(leftPWM,rightPWM);
                               }
                           lcd_clear();
                           lcd_gotoxy(0,0);
                           sprintf(text,"S.K=%3d ",processVariable);
                           lcd_puts(text);
                           lcd_gotoxy(0,1);
                           sprintf(text,"r=%3d l=%3d",rightPWM,leftPWM);
                           lcd_puts(text);
                           }//end  if( (rightPWM<170||leftPWM<170)&& (rightPWM>0||leftPWM>0) ){

//*************************************COUNTER  ***************************************
                    counting();
                    if( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 0 ){
                          if( (read_adc(0) > 140 && read_adc(0) < 300) &&  (read_adc(1) > 70 &&
read_adc(1) < 300) ){          // CEK WARNA ABU
                                srfKiri=getSrf(2);
```

```
                srfKanan=getSrf(4);
                if( srfKiri < 20 && srfKiri > 1 && srfKanan < 10 && srfKanan > 1){

                        PORTD.4 = 1;
                        varRuang4=1;
                        lcd_clear();
                        lcd_gotoxy(0,1);
                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                        lcd_puts(text);
                        delay_ms(50);
                        }
                else {
                    lcd_clear();
                    lcd_gotoxy(0,1);
                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                    lcd_puts(text);
                    PORTD.4 = 0;
                    goto start;
                    }
                }
            else {
                goto start;
                }
            }
        else {
            goto start;
            }
        if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 1){

            if( (read_adc(0) > 140 && read_adc(0) < 300) &&  (read_adc(1) > 70 &&
read_adc(1) < 300) ){

                srfKiri=getSrf(2);
                srfKanan=getSrf(4);
                if( srfKiri < 20 && srfKiri > 1 && srfKanan < 10 && srfKanan > 1){
                        PORTD.4 = 0;
                        varRuang4=2;
                        lcd_clear();
                        lcd_gotoxy(0,1);
                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                        lcd_puts(text);
                        delay_ms(50);
                        }
                else {
                        lcd_clear();
                        lcd_gotoxy(0,1);
                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                        lcd_puts(text);
                        PORTD.4 = 0;
                        varRuang4=0;
                        goto start;
                        }
                }
            else  {
                    lcd_clear();
                    lcd_gotoxy(0,1);
                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                    lcd_puts(text);
                    PORTD.4 = 0;
                    varRuang4=0;
                    goto start;
                   }
            }
        else {
```

```
                varRuang4=0;
                goto start;
                }
            if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 2){

                if( (read_adc(0) > 140 && read_adc(0) < 300) &&  (read_adc(1) > 70 &&
read_adc(1) < 300) ){

                    srfKiri=getSrf(2);
                    srfKanan=getSrf(4);
                    if( srfKiri < 20 && srfKiri > 1 && srfKanan < 10 && srfKanan > 1){
                            PORTD.4 = 0;
                            varRuang4=3;
                            lcd_clear();
                            lcd_gotoxy(0,1);
                            sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                            lcd_puts(text);
                            delay_ms(40);
                            }
                    else {
                        lcd_clear();
                        lcd_gotoxy(0,1);
                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                        lcd_puts(text);
                        PORTD.4 = 0;
                        varRuang4=0;
                        goto start;
                        }
                    }
                else  {
                    lcd_clear();
                    lcd_gotoxy(0,1);
                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                    lcd_puts(text);
                    PORTD.4 = 0;
                    varRuang4=0;
                    goto start;
                   }
                }
            else {
                varRuang4=0;
                goto start;
                }
            if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 3){

                if( (read_adc(0) > 140 && read_adc(0) < 300) &&  (read_adc(1) > 70 &&
read_adc(1) < 300) ){

                    srfKiri=getSrf(2);
                    srfKanan=getSrf(4);
                    if( srfKiri < 20 && srfKiri > 1 && srfKanan < 10 && srfKanan > 1){
                            PORTD.4 = 0;
                            varRuang4=4;
                            lcd_clear();
                            lcd_gotoxy(0,1);
                            sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                            lcd_puts(text);
                            delay_ms(30);
                            }
                    else {
                        lcd_clear();
                        lcd_gotoxy(0,1);
                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                        lcd_puts(text);
```

```
                                        PORTD.4 = 0;
                                        varRuang4=0;
                                        goto start;
                                        }
                                }
                            else  {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varRuang4=0;
                                        goto start;
                                       }
                            }
                        else {
                            varRuang4=0;
                            goto start;
                            }
                        if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 4){

                             if( (read_adc(0) > 140 && read_adc(0) < 300) &&  (read_adc(1) > 70 &&
read_adc(1) < 300) ){
                                srfKiri=getSrf(2);
                                srfKanan=getSrf(4);
                                if( srfKiri < 20 && srfKiri > 1 && srfKanan < 10 && srfKanan > 1){
                                            PORTD.4 = 0;
                                            varRuang4=5;
                                            lcd_clear();
                                            lcd_gotoxy(0,1);
                                            sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                            lcd_puts(text);
                                            delay_ms(15);
                                            }
                                else {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varRuang4=0;
                                        goto start;
                                        }
                                }
                            else  {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varRuang4=0;
                                        goto start;
                                       }
                            }
                        else {
                            varRuang4=0;
                            goto start;
                            }
                        if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 5){

                             if( (read_adc(0) > 140 && read_adc(0) < 300) &&  (read_adc(1) > 70 &&
read_adc(1) < 300) ){
                                srfKiri=getSrf(2);
                                srfKanan=getSrf(4);
```

```
                                    if( srfKiri < 20 && srfKiri > 1 && srfKanan < 10 && srfKanan > 1){
                                                PORTD.4 = 0;
                                                varRuang4=6;
                                                //wallKiri();
                                                lcd_clear();
                                                lcd_gotoxy(0,1);
                                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                                lcd_puts(text);
                                                }
                                    else {
                                                lcd_clear();
                                                lcd_gotoxy(0,1);
                                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                                lcd_puts(text);
                                                PORTD.4 = 0;
                                                varRuang4=0;
                                                goto start;
                                                }
                                    }
                                else  {
                                            lcd_clear();
                                            lcd_gotoxy(0,1);
                                            sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                            lcd_puts(text);
                                            PORTD.4 = 0;
                                            varRuang4=0;
                                            goto start;
                                           }
                                }
                        else {
                             varRuang4=0;
                             goto start;
                             }

//************************************END COUNTER  ***************************
start:
                        if( apiPadam == 1 && read_adc(0) < 345 && getSrf(1) > 12){  // CEK WARNA !!   abu
terbesar
                             findHome = 1;
                             apiPadam = 0;
                             delay_ms(200);
                             }
                        if( findHome == 1 && read_adc(0) < 130){                        // CEK WARNA !!
item
                             findHome = 2;
                             apiPadam = 0;
                             delay_ms(200);
                             }
                        if(varJuring == 2 && read_adc(0) > 140 && read_adc(0) < 300 && findHome == 2){
// CEK WARNA !!    abu terkecil dan terbesar

                             findHome = 3;
                             apiPadam = 0;
                             delay_ms(200);
                            }
                        if(varJuring == 2 && read_adc(0) < 140 && findHome == 3){              // CEK
WARNA !!      item terbesar

                             findHome = 4;
                             apiPadam = 0;
                             delay_ms(200);
                            }
                        if( (read_adc(2) > 61 && read_adc(0) > 380) && findHome == 4 && read_adc(1) > 300
&& varJuring == 2){     // CEK WARNA !! putih
```

```
                        berenti(255,255);
                        for( i=0;i<=10;i++ ){
                              lcd_clear();
                              lcd_gotoxy(0,0);
                              lcd_putsf("HOME!!");
                              berenti(255,255);
                              delay_ms(200);
                              lcd_clear();
                              lcd_putsf(" HOME!!");
                              berenti(255,255);
                              delay_ms(200);
                              lcd_clear();
                              lcd_putsf("  HOME!!");
                              berenti(255,255);
                              delay_ms(200);
                              lcd_clear();
                              lcd_putsf("   HOME!!");
                              delay_ms(200);
                              lcd_clear();
                              lcd_gotoxy(0,0);
                              lcd_putsf("  HOME!!");
                              delay_ms(200);
                              berenti(255,255);
                              lcd_clear();
                              lcd_putsf(" HOME!!");
                              delay_ms(200);
                              berenti(255,255);
                              lcd_clear();
                              lcd_putsf("HOME!!");
                              delay_ms(200);
                              berenti(255,255);
                             }
                        delay_ms(10000);
                        }
                     if( read_adc(0) > 380 && findHome == 2 && read_adc(1) > 300 && varJuring == 1){
// CEK WARNA !! putih

                        berenti(255,255);
                        for( i=0;i<=10;i++ ){
                              lcd_clear();
                              lcd_gotoxy(0,0);
                              lcd_putsf("HOME!!");
                              berenti(255,255);
                              delay_ms(200);
                              lcd_clear();
                              lcd_putsf(" HOME!!");
                              berenti(255,255);
                              delay_ms(200);
                              lcd_clear();
                              lcd_putsf("  HOME!!");
                              berenti(255,255);
                              delay_ms(200);
                              lcd_clear();
                              lcd_putsf("   HOME!!");
                              delay_ms(200);
                              lcd_clear();
                              lcd_gotoxy(0,0);
                              lcd_putsf("  HOME!!");
                              delay_ms(200);
                              berenti(255,255);
                              lcd_clear();
                              lcd_putsf(" HOME!!");
                              delay_ms(200);
```

```
                        berenti(255,255);
                        lcd_clear();
                        lcd_putsf("HOME!!");
                        delay_ms(200);
                        berenti(255,255);
                       }
                    delay_ms(10000);
                    }
                if(detect==2){
                    detect=0;
                    }
                lastError = error;                          // error sebelumnya
                }                                           //end   if(getSrf(0)>15){
            else if(getSrf(6) <= 14){
                    if( getSrf(2) > 30 && getSrf(4) > 30){
                      //if(getSrf(4) > 40){
                            bantingKanan (150,150);
                      //        }
                       }
                    else {
                        bantingKiri(190,190);
                        }
                }                                           //end   else if(getSrf(0) <= 14){

            }
        else{                                               //lagi ada api

            if( (read_adc(1) > 350 ) && detect == 0){       // CEK WARNA !! nilai putih terkecil, nemu api,
tpi kena garis putih pintu masuk dulu

                    lcd_clear();
                    lcd_gotoxy(0,0);
                    lcd_putsf("ada API !!!");
                    maju(255,255);
                    detect=1;
                }                                           // end nemu api, tpi kena garis putih pintu masuk
dulu
            else if( read_adc(1) < 200 && detect ==1 ){     // CEK WARNA !!  abu terbesar
                    detect=2;
                }


            else if(  (read_adc(2) > 71 && detect == 2) && juringPinggir == 0){     // CEK WARNA !!
putih terkecil, dapat juring lingkaran putih (putih>500)

                        apiPadam=1;
                        berenti(255,255);
                        kipas();
                        berenti(255,255);
                        juringPinggir=1;
                        varJuring=1;
                    }
            else if (juringPinggir == 1 && varJuring == 1){
                    bantingKanan(255,255);
                    delay_ms(75);
                    berenti(255,255);
                    kipas();
                    berenti(255,255);
                    apiPadam=1;
                    }
            else if( (read_adc(1) > 300 && detect == 2 ) && juringTengah == 0){     // CEK WARNA putih
terkecil !! dapat juring lingkaran putih di tengah (putih>800)

                    if( juringTengah == 1 ){                // blm mati tuw juring di tengah nya coi
```

```
                bantingKiri(255,255);
                delay_ms(50);
                berenti(255,255);
                kipas();
                berenti(255,255);
                apiPadam=1;
                }
            else {
                apiPadam=1;
                berenti(255,255);
                kipas();
                berenti(255,255);
                juringTengah=1;
                varJuring=2;
                }
            }

else if (juringTengah == 1 && varJuring == 2){
            bantingKiri(255,255);
            delay_ms(75);
            berenti(255,255);
            kipas();
            berenti(255,255);
            apiPadam=1;
            }
else {                      //  else klo blm dapat juring, jalan trs nyari juring putih+klo ada api
    if( getSrf(6) > 14) {                                   //14
            kp = 10;                                        //10
            kd = 15;                                        //15
            ki = 0.005;                                     //0.025
            setPointPWM =50;
            processVariable = getSrf(1);                    //proporsional program
            setPointSensorKiri = 8;
            error = setPointSensorKiri - processVariable;
            proporsional = kp * error;                      // proporsional end
            rate = error - lastError;                       //derivative program
            rateInt = error + lastError;
            Ts=1;                                           //Ts = time sampling
            integral = Ts * (ki * rateInt);
            derivative = (kd/Ts) * rate;                    //derivative
            sinyalControl = proporsional + derivative + integral;  //sinyal control , derivative end
            rightPWM = setPointPWM + sinyalControl;
            leftPWM = setPointPWM - sinyalControl;
            if(rightPWM >= 255) {
                rightPWM = 150;
                }
            if(leftPWM >= 255) {
                leftPWM = 150;
                }
            if(rightPWM <= 0) {
                rightPWM = 0;
                }
            if(leftPWM <= 0) {
                leftPWM = 0;
                }
            leftPWM;
            rightPWM;
            if(leftPWM == 0 && rightPWM == 200){
                bantingKiri(leftPWM,rightPWM);
                lcd_clear();
                lcd_gotoxy(0,0);
                lcd_putsf("belok kiri");
                }
            if(rightPWM == 0 && leftPWM == 200){
```

```
                        bantingKanan(leftPWM,rightPWM);
                        lcd_clear();
                        lcd_gotoxy(0,0);
                        lcd_putsf("belok kanan");
                       }
                    if( (rightPWM <200 || leftPWM < 200)  && (rightPWM > 0 || leftPWM > 0) ){

                        if( (leftPWM < rightPWM) && (leftPWM < 10)){
                            belokKiri(leftPWM,rightPWM);
                            }
                        if( (leftPWM > rightPWM) && (rightPWM < 10) ){
                            belokKanan(leftPWM,rightPWM);
                            }
                        else{
                            maju(leftPWM,rightPWM);
                           }
                        lcd_clear();
                        lcd_gotoxy(0,0);
                        sprintf(text,"S.K=%3d ",processVariable);
                        lcd_puts(text);
                        lcd_gotoxy(0,1);
                        sprintf(text,"r=%3d l=%3d",rightPWM,leftPWM);
                        lcd_puts(text);
                        }  //end   if( (rightPWM<170||leftPWM<170)&&(rightPWM>0||leftPWM>0) ){

                    lastError = error;                              // error sebelumnya
                    }
                else if(getSrf(6) <= 14){
                    if( getSrf(2) > 40 && getSrf(4) > 40){
                        //  if(getSrf(4) > 40){
                            bantingKanan (150,150);
                        //        }
                        }
                    else {
                        bantingKiri(190,190);
                        }
                    }
                }   //  end klo dari else klo blm dapat juring, jln trs nyari juring putih+klo ada api
            }      //   end klo lagi ada api

//=============================================================================
}



void wallKiri(void){
      while(1){
          if(PINB.7 == 1){                                          // ================   lagi gak
ada api
              juringTengah=0;
              juringPinggir=0;
              varRuang4=6;
              if( getSrf(0) > 14 ) {                                    //14
                  kp = 10;                                      //10
                  kd = 15;                                          //15
                  ki = 0.001667;                                        //0.0167
                  setPointPWM = 100;
                  error = setPointSensorKiri - processVariable;
                  processVariable = getSrf(2);
                  setPointSensorKiri = 8;
                  rate = error - lastError;                             //================== derivative
program
                  rateInt = error + lastError;
                  Ts=1;
```

```
                proporsional = kp * error;                              //================== proporsional
end                                             //===============>>>> Ts = time sampling
                integral = Ts * (ki * rateInt);
                derivative = (kd/Ts) * rate;                            //===============>>>> derivative
                sinyalControl = proporsional + derivative + integral;           //==================
sinyal control , derivative end
                rightPWM = setPointPWM - sinyalControl;
                leftPWM = setPointPWM + sinyalControl;
                if(rightPWM >= 255) {
                    rightPWM = 130;
                    }
                if(leftPWM >= 255) {
                    leftPWM = 130;
                    }
                if(rightPWM <= 0) {
                    rightPWM = 0;
                    }
                if(leftPWM <= 0) {
                    leftPWM = 0;
                    }
                leftPWM;
                rightPWM;
                if(leftPWM == 0 && rightPWM == 200){
                     bantingKiri(leftPWM,rightPWM);
                     lcd_clear();
                     lcd_gotoxy(0,0);
                     lcd_putsf("belok kiri");
                    }
                if(rightPWM == 0 && leftPWM == 200){
                     bantingKanan(leftPWM,rightPWM);
                     lcd_clear();
                     lcd_gotoxy(0,0);
                     lcd_putsf("belok kanan");
                    }
                if( (rightPWM <200 || leftPWM < 200)  && (rightPWM > 0 || leftPWM > 0) ){
                      if( (leftPWM > rightPWM) && (rightPWM < 40) ){
                          belokKanan(leftPWM,rightPWM);
                          }
                      else if( (leftPWM < rightPWM) && (leftPWM < 40)){
                          belokKiri(leftPWM,rightPWM);
                          }
                      else{
                          maju(leftPWM,rightPWM);
                         }
                      lcd_clear();
                      lcd_gotoxy(0,0);
                      sprintf(text,"S.K=%3d S.D=%3d ",processVariable,getSrf(0));
                      lcd_puts(text);
                      lcd_gotoxy(0,1);
                      sprintf(text,"r=%3d l=%3d",rightPWM,leftPWM);
                      lcd_puts(text);
                      }                                         //end   if( (rightPWM <170 || leftPWM < 170)  &&
(rightPWM > 0 || leftPWM > 0) ){

                if( varRuang4 != 6 && apiPadam == 1 && read_adc(0) < 350 && processVariable > 15){
//CEK WARNA!!  abu terbesar   jgn lupa varRuang4!!!
                     findHome = 1;
                     apiPadam = 0;
                     delay_ms(200);
                     }
                if( findHome == 1 && read_adc(0) < 130){                        //CEK WARNA!! item
terbesar
                     findHome = 2;
                     apiPadam = 0;
```

```
                        delay_ms(200);
                        }

                if(varJuring == 2 && read_adc(0) > 150 && read_adc(0) < 350 && findHome == 2){
//CEK WARNA!! abu terkecil dan terbesar
                        findHome = 3;
                        apiPadam = 0;
                        delay_ms(200);
                       }
                if(varJuring == 2 && read_adc(0) < 150 && findHome == 3){          //CEK WARNA!!
abu terkecil
                        findHome = 4;
                        apiPadam = 0;
                        delay_ms(200);
                       }
                if( varRuang4 == 6 &&  apiPadam == 1){
                        countingHome();
                        if( counterCariHomeDariRuang4 >= 1 && varHomeRuang4 == 0 ){
                              if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                                    srfKiri=getSrf(2);
                                    srfKanan=getSrf(4);
                                    if( srfKiri < 20 && srfKiri > 1 && srfKanan < 20 && srfKanan > 1){
                                                PORTD.4 = 1;
                                                varHomeRuang4=1;
                                                lcd_clear();
                                                lcd_gotoxy(0,1);
                                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                                lcd_puts(text);
                                                delay_ms(10);
                                                }
                                    else {
                                          lcd_clear();
                                          lcd_gotoxy(0,1);
                                          sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                          lcd_puts(text);
                                          PORTD.4 = 0;
                                          goto startKiri;
                                          }
                                    }
                                else {

                                    goto startKiri;
                                    }
                                }
                        else {
                              goto startKiri;
                              }
                        if ( counterCariHomeDariRuang4 >= 1 && varHomeRuang4 == 1){
                               if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                                    srfKiri=getSrf(2);
                                    srfKanan=getSrf(4);
                                    if( srfKiri < 20 && srfKiri > 1 && srfKanan < 20 && srfKanan > 1){
                                                PORTD.4 = 1;
                                                varHomeRuang4=2;
                                                lcd_clear();
                                                lcd_gotoxy(0,1);
                                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                                lcd_puts(text);
                                                delay_ms(10);
                                                }
                                    else {
                                                lcd_clear();
```

```
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varHomeRuang4=0;
                                        goto startKiri;
                                        }
                                }
                            else  {
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    PORTD.4 = 0;
                                    varHomeRuang4=0;
                                    goto startKiri;
                                   }
                            }
                        else {
                            varHomeRuang4=0;
                            goto startKiri;
                            }
                        if ( counterCariHomeDariRuang4 >= 1 && varHomeRuang4 == 2){
                                if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                                    srfKiri=getSrf(2);
                                    srfKanan=getSrf(4);
                                    if( srfKiri < 20 && srfKiri > 1 && srfKanan < 20 && srfKanan > 1){
                                                PORTD.4 = 1;
                                                varHomeRuang4=3;
                                                lcd_clear();
                                                lcd_gotoxy(0,1);
                                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                                lcd_puts(text);
                                                delay_ms(15);
                                                }
                                    else {
                                                lcd_clear();
                                                lcd_gotoxy(0,1);
                                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                                lcd_puts(text);
                                                PORTD.4 = 0;
                                                varHomeRuang4=0;
                                                goto startKiri;
                                                }
                                    }
                                else  {
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    PORTD.4 = 0;
                                    varHomeRuang4=0;
                                    goto startKiri;
                                   }
                                }
                        else {
                            varHomeRuang4=0;
                            goto startKiri;
                            }
                        if ( counterCariHomeDariRuang4 >= 1 && varHomeRuang4 == 3){
                                if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                                    srfKiri=getSrf(2);
```

```
                                srfKanan=getSrf(4);
                                if( srfKiri < 20 && srfKiri > 1 && srfKanan < 20 && srfKanan > 1){
                                        PORTD.4 = 0;
                                        varHomeRuang4=4;
                                        while(1){
                                            wallKananMulus();
                                            }
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        }
                                else {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varHomeRuang4=0;
                                        goto startKiri;
                                        }
                                }
                            else  {
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    PORTD.4 = 0;
                                    varHomeRuang4=0;
                                    goto startKiri;
                                   }
                            }
                        else {
                            varHomeRuang4=0;
                            goto startKiri;
                            }
                        }

                    if( varRuang4 == 6 &&  apiPadam == 0){
                        countingLagi();
                        if( counterLagiCui >= 1 && varHomeRuang4 == 0 ){
                             if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                                srfKiri=getSrf(2);
                                srfKanan=getSrf(4);
                                if( srfKiri < 20 && srfKiri > 1 && srfKanan < 20 && srfKanan > 1){
                                        PORTD.4 = 1;
                                        varHomeRuang4=1;
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        delay_ms(10);
                                        }
                                else {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        goto startKiri;
                                        }
                                }
                             else {
```

```
                        goto startKiri;
                        }
                    }
                else {
                    goto startKiri;
                    }
                if ( counterLagiCui >= 1 && varHomeRuang4 == 1){
                        if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                            srfKiri=getSrf(2);
                            srfKanan=getSrf(4);
                            if( srfKiri < 20 && srfKiri > 1 && srfKanan < 20 && srfKanan > 1){
                                    PORTD.4 = 1;
                                    varHomeRuang4=2;
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    delay_ms(10);
                                    }
                            else {
                                lcd_clear();
                                lcd_gotoxy(0,1);
                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                lcd_puts(text);
                                PORTD.4 = 0;
                                varHomeRuang4=0;
                                goto startKiri;
                                }
                            }
                        else  {
                                lcd_clear();
                                lcd_gotoxy(0,1);
                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                lcd_puts(text);
                                PORTD.4 = 0;
                                varHomeRuang4=0;
                                goto startKiri;
                               }
                        }
                else {
                    varHomeRuang4=0;
                    goto startKiri;
                    }
                if ( counterLagiCui >= 1 && varHomeRuang4 == 2){
                        if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                            srfKiri=getSrf(2);
                            srfKanan=getSrf(4);
                            if( srfKiri < 20 && srfKiri > 1 && srfKanan < 20 && srfKanan > 1){
                                    PORTD.4 = 1;
                                    varHomeRuang4=3;
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    delay_ms(15);
                                    }
                            else {
                                lcd_clear();
                                lcd_gotoxy(0,1);
                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                lcd_puts(text);
```

```
                                        PORTD.4 = 0;
                                        varHomeRuang4=0;
                                        goto startKiri;
                                        }
                                }
                            else  {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varHomeRuang4=0;
                                        goto startKiri;
                                       }
                            }
                        else {
                            varHomeRuang4=0;
                            goto startKiri;
                            }
                        if ( counterLagiCui >= 1 && varHomeRuang4 == 3){
                                if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                                    srfKiri=getSrf(2);
                                    srfKanan=getSrf(4);
                                    if( srfKiri < 20 && srfKiri > 1 && srfKanan < 20 && srfKanan > 1){
                                                PORTD.4 = 0;
                                                varHomeRuang4=4;
                                                while(1){
                                                    wallKananMulus();
                                                    }
                                                lcd_clear();
                                                lcd_gotoxy(0,1);
                                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                                lcd_puts(text);
                                                }
                                    else {
                                                lcd_clear();
                                                lcd_gotoxy(0,1);
                                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                                lcd_puts(text);
                                                PORTD.4 = 0;
                                                varHomeRuang4=0;
                                                goto startKiri;
                                                }
                                    }
                                else  {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varHomeRuang4=0;
                                        goto startKiri;
                                       }
                                }
                            else {
                                varHomeRuang4=0;
                                goto startKiri;
                                }
                            }

                    startKiri:
                    if( (read_adc(2) > 135 && read_adc(0) > 450) && findHome == 4 && read_adc(1) > 520
&& varJuring == 2){        //CEK WARNA!!  putih
```

```
                berenti(255,255);
                kipas();
                for( i=0;i<=10;i++ ){
                      lcd_clear();
                      lcd_gotoxy(0,0);
                      lcd_putsf("HOME!!");
                      berenti(255,255);
                      delay_ms(200);
                      lcd_clear();
                      lcd_putsf(" HOME!!");
                      berenti(255,255);
                      delay_ms(200);
                      lcd_clear();
                      lcd_putsf("  HOME!!");
                      berenti(255,255);
                      delay_ms(200);
                      lcd_clear();
                      lcd_putsf("   HOME!!");
                      delay_ms(200);
                      lcd_clear();
                      lcd_gotoxy(0,0);
                      lcd_putsf("  HOME!!");
                      delay_ms(200);
                      berenti(255,255);
                      lcd_clear();
                      lcd_putsf(" HOME!!");
                      delay_ms(200);
                      berenti(255,255);
                      lcd_clear();
                      lcd_putsf("HOME!!");
                      delay_ms(200);
                      berenti(255,255);
                     }
                delay_ms(10000);
                }

          if( read_adc(0) > 450 && findHome == 2 && read_adc(1) > 520 && varJuring == 1){
//CEK WARNA!!  putih

                berenti(255,255);
                kipas();
                for( i=0;i<=10;i++ ){
                      lcd_clear();
                      lcd_gotoxy(0,0);
                      lcd_putsf("HOME!!");
                      berenti(255,255);
                      delay_ms(200);
                      lcd_clear();
                      lcd_putsf(" HOME!!");
                      berenti(255,255);
                      delay_ms(200);
                      lcd_clear();
                      lcd_putsf("  HOME!!");
                      berenti(255,255);
                      delay_ms(200);
                      lcd_clear();
                      lcd_putsf("   HOME!!");
                      delay_ms(200);
                      lcd_clear();
                      lcd_gotoxy(0,0);
                      lcd_putsf("  HOME!!");
                      delay_ms(200);
                      berenti(255,255);
```

```
                        lcd_clear();
                        lcd_putsf(" HOME!!");
                        delay_ms(200);
                        berenti(255,255);
                        lcd_clear();
                        lcd_putsf("HOME!!");
                        delay_ms(200);
                        berenti(255,255);
                        }
                    delay_ms(10000);
                    }                                   // error sebelumnya
                lastError = error;
                }                                       //end   if(getSrf(0)>15){
          else if(getSrf(0) <= 14){
                    if( getSrf(2) > 40 && getSrf(4) > 40 && getSrf(6) < 9){
                        bantingKiri(150,150);
                        }
                    else {
                        bantingKanan(190,190);
                        }
                }                                                   //end   else if(getSrf(0) <= 14){
          }                                                         // end if lg gk ada api
    else{                                                           // lagi ada api

        if( read_adc(1) > 500 && detect == 0){                      //CEK WARNA!!  putih   // nemu api,
tpi kena garis putih pintu masuk dulu

                lcd_clear();
                lcd_gotoxy(0,0);
                lcd_putsf("ada API !!!");
                maju(255,255);
                detect=1;
          }                                                         // end nemu api, tpi kena garis putih
pintu masuk dulu
        else if( read_adc(1) < 300 && detect ==1 ){                 //CEK WARNA!!  abu terbesar
                detect=2;
          }
        else if(  (read_adc(0) > 550 && detect == 2) && juringPinggir == 0){        //CEK WARNA!!  putih
terkecil  adc 0, dapat juring lingkaran putih (putih>500)

                    apiPadam=1;
                    berenti(255,255);
                    kipas();
                    berenti(255,255);
                    juringPinggir=1;
                    varJuring=1;
                }
        else if (juringPinggir == 1 && varJuring == 1){
                bantingKiri(255,255);
                delay_ms(75);
                berenti(255,255);
                kipas();
                berenti(255,255);
                apiPadam=1;
                }
        else if( (read_adc(2) > 135 && detect == 2 ) && juringTengah==0){       //CEK WARNA!!  putih
terkecil    // ======================================== dapat juring lingkaran putih di tengah
(putih>800)

              if( juringTengah == 1 ){                              //  blm mati, juring di tengah
                    bantingKanan(255,255);
                    delay_ms(50);
                    berenti(255,255);
                    kipas();
```

```
            berenti(255,255);
            apiPadam=1;
            }
        else {
            apiPadam=1;
            berenti(255,255);
            kipas();
            berenti(255,255);
            juringTengah=1;
            varJuring=2;
            }
        }

else if (juringTengah == 1 && varJuring == 2){
        bantingKanan(255,255);
        delay_ms(75);
        berenti(255,255);
        kipas();
        berenti(255,255);
        apiPadam=1;
        }                       //  end klo dapat juring lingkaran putih (putih>800)

else {                          //  else klo blm dapat juring, jalan trs nyari juring putih+klo ada api
   if( getSrf(0) > 14) {
        kp = 10;                                    //10
        kd = 10;                                    //15
        ki = 0.025;
        setPointPWM = 50;
        processVariable = getSrf(2);                // proporsional program
        setPointSensorKiri = 8;
        error = setPointSensorKiri - processVariable;
        proporsional = kp * error;                  // proporsional end
        rate = error - lastError;                   // derivative program
        rateInt = error + lastError;
        Ts=1;                                       // Ts = time sampling
        integral = Ts * (ki * rateInt);
        derivative = (kd/Ts) * rate;                // derivative
        sinyalControl = proporsional + derivative + integral;       // sinyal control
        rightPWM = setPointPWM - sinyalControl;
        leftPWM = setPointPWM + sinyalControl;
        if(rightPWM >= 255) {
            rightPWM = 140;
            }
        if(leftPWM >= 255) {
            leftPWM = 140;
            }
        if(rightPWM <= 0) {
            rightPWM = 0;
            }
        if(leftPWM <= 0) {
            leftPWM = 0;
            }
        leftPWM;
        rightPWM;
        if(leftPWM == 0 && rightPWM == 200){
            bantingKiri(leftPWM,rightPWM);
            lcd_clear();
            lcd_gotoxy(0,0);
            lcd_putsf("belok kiri");
            }
        if(rightPWM == 0 && leftPWM == 200){
            bantingKanan(leftPWM,rightPWM);
            lcd_clear();
            lcd_gotoxy(0,0);
```

```
                    lcd_putsf("belok kanan");
                    }
                if( (rightPWM <200 || leftPWM < 200)  && (rightPWM > 0 || leftPWM > 0) ){
                    if( (leftPWM > rightPWM) && (rightPWM < 30) ){
                        belokKanan(leftPWM,rightPWM);
                        }
                    if( (leftPWM < rightPWM) && (leftPWM < 30)){
                        belokKiri(leftPWM,rightPWM);
                        }
                    else{
                        maju(leftPWM,rightPWM);
                        }
                    lcd_clear();
                    lcd_gotoxy(0,0);
                    sprintf(text,"S.K=%3d S.D=%3d ",processVariable,getSrf(0));
                    lcd_puts(text);
                    lcd_gotoxy(0,1);
                    sprintf(text,"r=%3d l=%3d",rightPWM,processVariable);
                    lcd_puts(text);
                    }   //end   if( (rightPWM <170 || leftPWM < 170)  && (rightPWM > 0 || leftPWM > 0) ){
                lastError = error;                          // error sebelumnya
                }                                           // end   if(getSrf(0)>15){
            else if(getSrf(0) <= 14){
                    if( getSrf(2) > 40 && getSrf(4) > 40  && getSrf(6) < 9){
                        bantingKiri(150,150);
                        }
                    else {
                        bantingKanan(190,190);
                        }
                }                   //end   else if(getSrf(0) <= 14){
            }                       // end klo dari else klo blm dapat juring, jln trs nyari juring putih+klo ada api
        }                           // end klo lagi ada api

    }
}                                   //end void wallKiri


void setKeypad(void){
    b:
    lcd_clear();
    lcd_gotoxy(0,0);
    sprintf(text,"set Kp ? u=3,d=2");
    lcd_puts(text);
    lcd_gotoxy(0,1);
    sprintf(text,"%f",kp);
    lcd_puts(text);
    delay_ms(200);
    if( kp != 0 ){
        kp=kp;
        }
    else if( ki != 0 ){
        ki=ki;
        }
    else if( kd != 0 ){
        kd=kd;
        }
    else{
        kp=0;
        ki=0;
        kd=0;
        }
    menu=0;
    setOK=0;
    setKd=0;
```

```
setKp=1;
setKi=0;
while(1){
    if(PINE.4 == 0 && menu == 0){
            lcd_clear();
            lcd_gotoxy(0,0);
            sprintf(text,"set Kd ? u=3,d=2");
            lcd_puts(text);
            lcd_gotoxy(0,1);
            sprintf(text,"%f",kd);
            lcd_puts(text);
            menu=2;
            setKd=1;
            setKp=0;
            setKi=0;
            delay_ms(200);
           }
    else if(PINE.4 == 0 && menu == 2){
            lcd_clear();
            lcd_gotoxy(0,0);
            sprintf(text,"set Ki? u=3,d=2");
            lcd_puts(text);
            lcd_gotoxy(0,1);
            sprintf(text,"%f",ki);
            lcd_puts(text);
            menu=3;
            setKd=0;
            setKp=0;
            setKi=1;
            delay_ms(200);
           }
    else if(PINE.4 == 0 && menu == 3 ){
            lcd_clear();
            lcd_gotoxy(0,0);
            sprintf(text,"YES=PORTE.3");
            lcd_puts(text);
            lcd_gotoxy(0,1);
            lcd_putsf("NO=PORTE.2");
            delay_ms(200);
            setOK=1;
            setKp=0;
            setKd=0;
            setKi=0;
           }

    else if(PINE.2 == 0 && setOK == 1 ){
            goto b;
           }
    else if(PINE.3 == 0 && setOK == 1 ){

            kp=kp;
            ki=ki;
            kd=kd;
            lcd_clear();
            lcd_gotoxy(0,0);
            sprintf(text," 3 ");
            lcd_puts(text);
            PORTD.4 = 1;
            delay_ms(200);
            PORTD.4 = 0;
            delay_ms(200);
            lcd_clear();
            lcd_gotoxy(0,0);
            sprintf(text," 2 ");
```

```
        lcd_puts(text);
        PORTD.4 = 1;
        delay_ms(200);
        PORTD.4 = 0;
        delay_ms(200);
        lcd_clear();
        lcd_gotoxy(0,0);
        sprintf(text," 1 ");
        lcd_puts(text);
        PORTD.4 = 1;
        delay_ms(200);
        PORTD.4 = 0;
        delay_ms(200);
        lcd_clear();
        lcd_gotoxy(0,0);
        sprintf(text," START ");
        lcd_puts(text);
        PORTD.4 = 1;
        delay_ms(200);
        PORTD.4 = 0;
        delay_ms(200);
        PORTD.4 = 1;
        delay_ms(150);
        PORTD.4 = 0;
        delay_ms(100);
        PORTD.4 = 1;
        delay_ms(150);
        PORTD.4 = 0;
        delay_ms(100);
        PORTD.4 = 1;
        delay_ms(100);
        PORTD.4 = 0;
        delay_ms(50);
        break;
       }

else if(PINE.3 == 0 && setKp == 1){
        lcd_clear();
        lcd_gotoxy(0,0);
        sprintf(text,"set Kp ? u=3,d=2");
        lcd_puts(text);
        lcd_gotoxy(0,1);
        kp=kp+0.5;
        sprintf(text,"%f",kp);
        lcd_puts(text);
        delay_ms(200);
       }
else if(PINE.3 == 0 && setKi == 1){
        lcd_clear();
        lcd_gotoxy(0,0);
        sprintf(text,"set Ki ? u=3,d=2");
        lcd_puts(text);
        lcd_gotoxy(0,1);
        ki=ki+0.5;
        sprintf(text,"%f",ki);
        lcd_puts(text);
        delay_ms(200);
       }
else if(PINE.3 == 0 && setKd == 1){
        lcd_clear();
        lcd_gotoxy(0,0);
        sprintf(text,"set Kd ? u=3,d=2");
        lcd_puts(text);
        lcd_gotoxy(0,1);
```

```
                sprintf(text,"%f",kd);
                lcd_puts(text);
                kd=kd+0.5;
                delay_ms(200);
                }
        else if(PINE.2 == 0 && setKp == 1){
                lcd_clear();
                lcd_gotoxy(0,0);
                sprintf(text,"set Kp ? u=3,d=2");
                lcd_puts(text);
                lcd_gotoxy(0,1);
                kp=kp-0.5;
                sprintf(text,"%f",kp);
                lcd_puts(text);
                delay_ms(200);
                }
        else if(PINE.2 == 0 && setKi == 1){
                lcd_clear();
                lcd_gotoxy(0,0);
                sprintf(text,"set Ki ? u=3,d=2");
                lcd_puts(text);
                lcd_gotoxy(0,1);
                ki=ki-0.5;
                sprintf(text,"%f",ki);
                lcd_puts(text);
                delay_ms(200);
                }
        else if(PINE.2 == 0 && setKd == 1){
                lcd_clear();
                lcd_gotoxy(0,0);
                sprintf(text,"set Kd ? u=3,d=2");
                lcd_puts(text);
                lcd_gotoxy(0,1);
                kd=kd-0.5;
                sprintf(text,"%f",kd);
                lcd_puts(text);
                delay_ms(200);
                }
      }

}

void main(void)
{
// Declare your local variables here

// Input/Output Ports initialization
// Port A initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=P State2=T State1=T State0=T
PORTA=0x08;
DDRA=0x00;

// Port B initialization
// Func7=In Func6=Out Func5=Out Func4=In Func3=In Func2=In Func1=In Func0=In
// State7=T State6=0 State5=0 State4=T State3=T State2=T State1=T State0=T
PORTB=0x00;
DDRB=0x60;



// Port C initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=T State2=T State1=T State0=T
```

```
PORTC=0x00;
DDRC=0x00;

// Port D initialization
// Func7=In Func6=In Func5=Out Func4=Out Func3=In Func2=In Func1=In Func0=In
// State7=T State6=T State5=0 State4=0 State3=T State2=T State1=T State0=T
PORTD=0x00;
DDRD=0x30;

// Port E initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
// State7=T State6=T State5=T State4=P State3=P State2=P State1=P State0=P
PORTE=0x1F;
DDRE=0x00;


// Port F initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=T State2=T State1=T State0=T
PORTF=0x00;
DDRF=0x00;

// Port G initialization
// Func4=In Func3=In Func2=In Func1=In Func0=In
// State4=T State3=T State2=T State1=T State0=T
PORTG=0x00;
DDRG=0x00;

// Timer/Counter 0 initialization
// Clock source: System Clock
// Clock value: Timer 0 Stopped
// Mode: Normal top=FFh
// OC0 output: Disconnected
ASSR=0x00;
TCCR0=0x00;
TCNT0=0x00;
OCR0=0x00;

// Timer/Counter 1 initialization
// Clock source: System Clock
// Clock value: 11059.200 kHz
// Mode: Ph. correct PWM top=00FFh
// OC1A output: Non-Inv.
// OC1B output: Non-Inv.
// OC1C output: Discon.
// Noise Canceler: Off
// Input Capture on Falling Edge
// Timer 1 Overflow Interrupt: Off
// Input Capture Interrupt: Off
// Compare A Match Interrupt: Off
// Compare B Match Interrupt: Off
// Compare C Match Interrupt: Off
TCCR1A=0xA1;
TCCR1B=0x01;
TCNT1H=0x00;
TCNT1L=0x00;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;
OCR1CH=0x00;
OCR1CL=0x00;
```

```
// Timer/Counter 2 initialization
// Clock source: System Clock
// Clock value: Timer 2 Stopped
// Mode: Normal top=FFh
// OC2 output: Disconnected
TCCR2=0x00;
TCNT2=0x00;
OCR2=0x00;


// Timer/Counter 3 initialization
// Clock source: System Clock
// Clock value: Timer 3 Stopped
// Mode: Normal top=FFFFh
// Noise Canceler: Off
// Input Capture on Falling Edge
// OC3A output: Discon.
// OC3B output: Discon.
// OC3C output: Discon.
// Timer 3 Overflow Interrupt: Off
// Input Capture Interrupt: Off
// Compare A Match Interrupt: Off
// Compare B Match Interrupt: Off
// Compare C Match Interrupt: Off
TCCR3A=0x00;
TCCR3B=0x00;
TCNT3H=0x00;
TCNT3L=0x00;
ICR3H=0x00;
ICR3L=0x00;
OCR3AH=0x00;
OCR3AL=0x00;
OCR3BH=0x00;
OCR3BL=0x00;
OCR3CH=0x00;
OCR3CL=0x00;

// External Interrupt(s) initialization
// INT0: Off
// INT1: Off
// INT2: Off
// INT3: Off
// INT4: Off
// INT5: Off
// INT6: Off
// INT7: Off
EICRA=0x00;
EICRB=0x00;
EIMSK=0x00;

// Timer(s)/Counter(s) Interrupt(s) initialization
TIMSK=0x00;
ETIMSK=0x00;

 // USART0 initialization
// Communication Parameters: 8 Data, 1 Stop, No Parity
// USART0 Receiver: On
// USART0 Transmitter: On
// USART0 Mode: Asynchronous
// USART0 Baud rate: 9600
UCSR0A=0x00;
UCSR0B=0x58;
```

```
UCSR0C=0x06;
UBRR0H=0x00;
UBRR0L=0x47;

// // USART0 initialization
// // Communication Parameters: 8 Data, 1 Stop, No Parity
// // USART0 Receiver: On
// // USART0 Transmitter: On
// // USART0 Mode: Asynchronous
// // USART0 Baud rate: 9600
// UCSR0A=0x00;
// UCSR0B=0x58;
// UCSR0C=0x06;
// UBRR0H=0x00;
// UBRR0L=0x47;

// USART1 initialization
// Communication Parameters: 8 Data, 1 Stop, No Parity
// USART1 Receiver: On
// USART1 Transmitter: On
// USART1 Mode: Asynchronous
// USART1 Baud rate: 9600
UCSR1A=0x00;
UCSR1B=0x18;
UCSR1C=0x06;
UBRR1H=0x00;
UBRR1L=0x47;


// Analog Comparator initialization
// Analog Comparator: Off
// Analog Comparator Input Capture by Timer/Counter 1: Off
ACSR=0x80;
SFIOR=0x00;

// ADC initialization
// ADC Clock frequency: 691.200 kHz
// ADC Voltage Reference: AREF pin
ADMUX=ADC_VREF_TYPE & 0xff;
ADCSRA=0x84;

// I2C Bus initialization
i2c_init();

// LCD module initialization
lcd_init(16);




//================================================================================
//setKeypad();
//==============================VARIABLE==========================================
x=0;
matlab=1;
detect=0;
apiPadam=0;
counter=0;
findHome=0;
juringTengah=0;
juringPinggir=0;
varJuring=0;
```

```
cariRuang4=0;
varRuang4=0;
nilaiCounterRuang4=0;
counterRuang4=0;
count=0;
count2=0;
varHomeRuang4=0;
varPos=0;

//============================SOUND ACTIVATION=======================
//============================SET ADDRESS I2C SRF08====================
//setAddress(0xE4,0xE0);
      menu=0;
      while(1){
      if(PINE.4==0 && menu==0){
                        while(1){
                              lcd_clear();
                              lcd_gotoxy(0,0);
                              sprintf(text,"%d %d %d ", read_adc(0), read_adc(1), read_adc(2));
                              lcd_puts(text);
                              lcd_gotoxy(0,1);
                              sprintf(text,"%3d %3d %d",getSrf(2),getSrf(4),PINB.7);         //  srf4 tuw kanan
                              lcd_puts(text);
                              menu=1;
                              delay_ms(150);
                              if(PINE.3==0 && menu==1){break;}
                        }
                }delay_ms(150);
      if(PINE.4==0 && menu==1){
                         while(1){
                              lcd_clear();
                              lcd_gotoxy(0,0);
                              sprintf(text,"%3d %3d %3d %3d ", getSrf(1),getSrf(2),getSrf(4),getSrf(0));
                              lcd_puts(text);
                              lcd_gotoxy(0,1);
                              sprintf(text,"%3d  ",getSrf(6),);
                              lcd_puts(text);
                              menu=2;
                              delay_ms(150);
                              if(PINE.3==0 && menu==2){break;}
                        }
                }delay_ms(150);
      if(PINE.4==0 && menu==2){
                         while(1){
                               counting();
                               countingLagi();
                               countingHome();
                              lcd_clear();
                              lcd_gotoxy(0,0);
                              sprintf(text," %3d %3d %3d ",
counterCariHomeDariRuang4,counterRuang4,counterLagiCui);
                              lcd_puts(text);
                              lcd_gotoxy(0,1);
                              sprintf(text,"%3d %3d ",getSrf(4),getSrf(2));
                              lcd_puts(text);
                              menu=3;
                              delay_ms(200);
                              if(PINE.3==0 && menu==3){break;}
                               }
                        }delay_ms(150);
       if(PINE.4==0 && menu==3){break;}delay_ms(150);
       }
PORTD.4=1;delay_ms(100);
PORTD.4=0;delay_ms(100);
```

```
PORTD.4=1;delay_ms(100);
PORTD.4=0;delay_ms(100);
PORTD.4=1;delay_ms(100);
PORTD.4=0;delay_ms(100);
soundAktive();
cariPosisiAwal();
while (1)  {
      if(PINB.7 == 1){                              //   lagi gak ada api
            juringTengah=0;
            juringPinggir=0;                        //  reset juring tengah, klo juring tgh =1 muter kiri trs

            if( getSrf(6) > 14) {                                 //14
                  kp = 10;                                        //10
                  kd = 15;                                        //15
                  ki = 0.005;                                     //0.025
                  setPointPWM =110;
                  processVariable = getSrf(1);                    // proporsional program
                  setPointSensorKiri = 8;
                  error = setPointSensorKiri - processVariable;
                  proporsional = kp * error;                      // proporsional end
                  rate = error - lastError;                       // derivative program
                  rateInt = error + lastError;
                  Ts=1;                                          // Ts = time sampling
                  integral = Ts * (ki * rateInt);
                  derivative = (kd/Ts) * rate;                   //  derivative
                  sinyalControl = proporsional + derivative + integral;          // sinyal control
                  rightPWM = setPointPWM + sinyalControl;
                  leftPWM = setPointPWM - sinyalControl;
                  if(rightPWM >= 255) {
                        rightPWM = 130;
                        }
                  if(leftPWM >= 255) {
                        leftPWM = 130;
                        }
                  if(rightPWM <= 0) {
                        rightPWM = 0;
                        }
                  if(leftPWM <= 0) {
                        leftPWM = 0;
                        }
                  leftPWM;
                  rightPWM;
                  if(leftPWM == 0 && rightPWM == 200){
                        bantingKiri(leftPWM,rightPWM);
                        lcd_clear();
                        lcd_gotoxy(0,0);
                        lcd_putsf("belok kiri");
                        }
                  if(rightPWM == 0 && leftPWM == 200){
                        bantingKanan(leftPWM,rightPWM);
                        lcd_clear();
                        lcd_gotoxy(0,0);
                        lcd_putsf("belok kanan");
                        }
                  if( (rightPWM <200 || leftPWM < 200)  && (rightPWM > 0 || leftPWM > 0) ){

                        if( (leftPWM < rightPWM) && (leftPWM < 40)){
                              belokKiri(leftPWM,rightPWM);
                              }
                        if( (leftPWM > rightPWM) && (rightPWM < 40) ){
                              belokKanan(leftPWM,rightPWM);
                              }
                        else{
                              maju(leftPWM,rightPWM);
```

```
                    }
                lcd_clear();
                lcd_gotoxy(0,0);
                sprintf(text,"S.K=%3d ",processVariable);
                lcd_puts(text);
                lcd_gotoxy(0,1);
                sprintf(text,"r=%3d l=%3d",rightPWM,leftPWM);
                lcd_puts(text);
                }                                   //end   if( (rightPWM <170 || leftPWM < 170)
&& (rightPWM > 0 || leftPWM > 0) ){

//**********************************KIRIM KE MATLAB*****************************
            x=x+1;
//************PWM KIRI ******
//              if(x==1){
//                  dataLeftPWM[0]=leftPWM;
//                  dataTerakhir=dataLeftPWM[0];
//                  }
//              if(x==2){
//                  dataLeftPWM[1]=dataLeftPWM[0]+leftPWM;
//                  dataTerakhir=dataLeftPWM[1];
//                  }
//              if(x==3){
//                  dataLeftPWM[2]=dataLeftPWM[1]+leftPWM;
//                  dataTerakhir=dataLeftPWM[2]/2;
//                  }
//              if(x==4){
//                  dataLeftPWM[3]=dataLeftPWM[2]+leftPWM;
//                  prosesLeftPWM =dataLeftPWM[3] / 3;
//                  dataTerakhir=prosesLeftPWM;
//                  printf("%f",prosesLeftPWM);
//                  putchar(0x0A);
//                  x=1;
//                  }
//***********SINYAL KONTROL*****
//
//              if(x==1){
//                  dataSinyalControl[0]=sinyalControl;
//                  }
//                          else if(x==2){
//                  dataSinyalControl[1]=dataSinyalControl[0]+sinyalControl;
//
//                  }
//              else if(x==3){
//                  dataSinyalControl[2]=dataSinyalControl[1]+sinyalControl;
//                  prosesSinyalControl =dataSinyalControl[2] / 3;
//                  printf("%f",prosesSinyalControl);
//                  putchar(0x0A);
//
//                  x=0;
//                  }

//***********ERROR*****************
             if(x==1){
                dataError[0]=error;
                }
            else if(x==2){
                dataError[1]=dataError[0]+error;

                }
             else if(x==3){
                dataError[2]=dataError[1]+error;
                prosesSinyalControl =dataError[2] / 3;
                printf("%f",prosesSinyalControl);
```

```
                    putchar(0x0A);
                    x=0;
                   }

//*************************************************************************************************
//***********PROSES VARIABEL*****
//
//                  if(x==1){
//                       dataPV[0]=processVariable;
//                       }
//                              else if(x==2){
//                       dataPV[1]=dataPV[0]+processVariable;
//
//                       }
//                  else if(x==3){
//                       dataPV[2]=dataPV[1]+processVariable;
//                       prosesSinyalControl =dataPV[2] / 3;
//                       printf("%f",prosesSinyalControl);
//                       putchar(0x0A);
//                       x=0;
//                       }

//*************************************************************************************************
////////////////////  COUNTER  ////////////////////////
                    counting();
                    if( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 0 ){
                         if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){          // CEK WARNA ABU

                              srfKiri=getSrf(2);
                              srfKanan=getSrf(4);
                              if( srfKiri < 20 && srfKiri > 1 && srfKanan < 13 && srfKanan > 1){

                                        PORTD.4 = 1;
                                        varRuang4=1;
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        delay_ms(10);
                                        }
                              else {
                                   lcd_clear();
                                   lcd_gotoxy(0,1);
                                   sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                   lcd_puts(text);
                                   PORTD.4 = 0;
                                   goto start;
                                   }
                              }
                         else {
                              goto start;
                              }
                         }
                    else {
                         goto start;
                         }
                    if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 1){

                          if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                              srfKiri=getSrf(2);
                              srfKanan=getSrf(4);
                              if( srfKiri < 20 && srfKiri > 1 && srfKanan < 13 && srfKanan > 1){
```

```
                                        PORTD.4 = 0;
                                        varRuang4=2;
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        delay_ms(10);
                                        }
                                else {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varRuang4=0;
                                        goto start;
                                        }
                                }
                        else  {
                                lcd_clear();
                                lcd_gotoxy(0,1);
                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                lcd_puts(text);
                                PORTD.4 = 0;
                                varRuang4=0;
                                goto start;
                               }
                        }
                else {
                     varRuang4=0;
                     goto start;
                     }
                if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 2){

                    if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                                srfKiri=getSrf(2);
                                srfKanan=getSrf(4);
                                if( srfKiri < 20 && srfKiri > 1 && srfKanan < 13 && srfKanan > 1){
                                        PORTD.4 = 0;
                                        varRuang4=3;
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        delay_ms(10);
                                        }
                                else {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varRuang4=0;
                                        goto start;
                                        }
                                }
                        else  {
                                lcd_clear();
                                lcd_gotoxy(0,1);
                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                lcd_puts(text);
                                PORTD.4 = 0;
                                varRuang4=0;
```

```
                                goto start;
                                }
                        }
                else {
                    varRuang4=0;
                    goto start;
                    }
                if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 3){

                    if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                            srfKiri=getSrf(2);
                            srfKanan=getSrf(4);
                            if( srfKiri < 20 && srfKiri > 1 && srfKanan < 13 && srfKanan > 1){
                                    PORTD.4 = 0;
                                    varRuang4=4;
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    delay_ms(10);
                                    }
                            else {
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    PORTD.4 = 0;
                                    varRuang4=0;
                                    goto start;
                                    }
                            }
                        else  {
                                lcd_clear();
                                lcd_gotoxy(0,1);
                                sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                lcd_puts(text);
                                PORTD.4 = 0;
                                varRuang4=0;
                                goto start;
                                }
                        }
                else {
                    varRuang4=0;
                    goto start;
                    }
                if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 4){

                    if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                            srfKiri=getSrf(2);
                            srfKanan=getSrf(4);
                            if( srfKiri < 20 && srfKiri > 1 && srfKanan < 13 && srfKanan > 1){
                                    PORTD.4 = 0;
                                    varRuang4=5;
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    delay_ms(15);
                                    }
                            else {
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
```

```
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varRuang4=0;
                                        goto start;
                                        }
                                }
                            else  {
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    PORTD.4 = 0;
                                    varRuang4=0;
                                    goto start;
                                   }
                            }
                        else {
                            varRuang4=0;
                            goto start;
                            }
                        if ( counterRuang4 >= 4 && apiPadam == 0 && varRuang4 == 5){

                            if( (read_adc(0) > 140 && read_adc(0) < 550) &&  (read_adc(1) > 70 &&
read_adc(1) < 600) ){
                                srfKiri=getSrf(2);
                                srfKanan=getSrf(4);
                                if( srfKiri < 20 && srfKiri > 1 && srfKanan < 13 && srfKanan > 1){
                                        PORTD.4 = 0;
                                        varRuang4=6;
                                        //wallKiri();
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        }
                                else {
                                        lcd_clear();
                                        lcd_gotoxy(0,1);
                                        sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                        lcd_puts(text);
                                        PORTD.4 = 0;
                                        varRuang4=0;
                                        goto start;
                                        }
                                }
                            else  {
                                    lcd_clear();
                                    lcd_gotoxy(0,1);
                                    sprintf(text,"%3d %3d ",srfKiri,srfKanan);
                                    lcd_puts(text);
                                    PORTD.4 = 0;
                                    varRuang4=0;
                                    goto start;
                                   }
                            }
                        else {
                            varRuang4=0;
                            goto start;
                            }

//////////////////////END COUNTER ////////////////////
                        start:
```

```
                    if( apiPadam == 1 && read_adc(0) < 500 && getSrf(1) > 12){ // CEK WARNA!!abu
terbesar
                        findHome = 1;
                        apiPadam = 0;
                        delay_ms(200);
                        }
                    if( findHome == 1 && read_adc(0) < 200){                    // CEK WARNA, item
                        findHome = 2;
                        apiPadam = 0;
                        delay_ms(200);
                        }
                    if(varJuring == 2 && read_adc(0) > 140 && read_adc(0) < 600 && findHome == 2){
// CEK WARNA !!   abu terkecil dan terbesar

                        findHome = 3;
                        apiPadam = 0;
                        delay_ms(200);
                       }
                    if(varJuring == 2 && read_adc(0) < 140 && findHome == 3){  // CEK WARNA !!
item terbesar

                        findHome = 4;
                        apiPadam = 0;
                        delay_ms(200);
                       }
                    if( (read_adc(2) > 135 && read_adc(0) > 380) && findHome == 4 && read_adc(1) >
350 && varJuring == 2){     // CEK WARNA !! putih

                        berenti(255,255);
                        for( i=0;i<=10;i++ ){
                            lcd_clear();
                            lcd_gotoxy(0,0);
                            lcd_putsf("HOME!!");
                            berenti(255,255);
                            delay_ms(200);
                            lcd_clear();
                            lcd_putsf(" HOME!!");
                            berenti(255,255);
                            delay_ms(200);
                            lcd_clear();
                            lcd_putsf("  HOME!!");
                            berenti(255,255);
                            delay_ms(200);
                            lcd_clear();
                            lcd_putsf("   HOME!!");
                            delay_ms(200);
                            lcd_clear();
                            lcd_gotoxy(0,0);
                            lcd_putsf("  HOME!!");
                            delay_ms(200);
                            berenti(255,255);
                            lcd_clear();
                            lcd_putsf(" HOME!!");
                            delay_ms(200);
                            berenti(255,255);
                            lcd_clear();
                            lcd_putsf("HOME!!");
                            delay_ms(200);
                            berenti(255,255);
                           }
                        delay_ms(10000);
                        }
  ////////////////////////////////////////////////////////////////
```

```
                    if( read_adc(0) > 380 && findHome == 2 && read_adc(1) > 350 && varJuring == 1){
// CEK WARNA !!        putih

                        berenti(255,255);
                        for( i=0;i<=10;i++ ){
                            lcd_clear();
                            lcd_gotoxy(0,0);
                            lcd_putsf("HOME!!");
                            berenti(255,255);
                            delay_ms(200);
                            lcd_clear();
                            lcd_putsf(" HOME!!");
                            berenti(255,255);
                            delay_ms(200);
                            lcd_clear();
                            lcd_putsf("  HOME!!");
                            berenti(255,255);
                            delay_ms(200);
                            lcd_clear();
                            lcd_putsf("   HOME!!");
                            delay_ms(200);
                            lcd_clear();
                            lcd_gotoxy(0,0);
                            lcd_putsf("  HOME!!");
                            delay_ms(200);
                            berenti(255,255);
                            lcd_clear();
                            lcd_putsf(" HOME!!");
                            delay_ms(200);
                            berenti(255,255);
                            lcd_clear();
                            lcd_putsf("HOME!!");
                            delay_ms(200);
                            berenti(255,255);
                           }
                        delay_ms(10000);
                        }
                    if(detect==2){
                        detect=0;
                        }
                    lastError = error;                          // error sebelumnya
                    }                                           //  end   if(getSrf(0)>15){
                else if(getSrf(6) <= 14){
                        if( getSrf(2) > 30 && getSrf(4) > 30){
                            //if(getSrf(4) > 40){
                                bantingKanan (150,150);
                            //        }
                             }
                        else {
                            bantingKiri(190,190);
                             }
                    }                                           //end   else if(getSrf(0) <= 14){

                }
        else{                                                   // lagi ada api

            if( (read_adc(1) > 500 ) && detect == 0){           // CEK WARNA !! nilai putih terkecil, nemu
api, tpi kena garis putih pintu masuk dulu

                    lcd_clear();
                    lcd_gotoxy(0,0);
                    lcd_putsf("ada API !!!");
                    maju(255,255);
                    detect=1;
```

```
            }                                                   // end nemu api, tpi kena garis putih pintu masuk
dulu

        else if( read_adc(1) < 400 && detect ==1 ){     // CEK WARNA !!  abu terbesar
                detect=2;
            }


        else if(  (read_adc(2) > 130 && detect == 2) && juringPinggir == 0){     // CEK WARNA !!
putih terkecil, dapat juring lingkaran putih (putih>500)
                    apiPadam=1;
                    berenti(255,255);
                    kipas();
                    berenti(255,255);
                    juringPinggir=1;
                    varJuring=1;
                }
        else if (juringPinggir == 1 && varJuring == 1){
                bantingKanan(255,255);
                delay_ms(75);
                berenti(255,255);
                kipas();
                berenti(255,255);
                apiPadam=1;
                }
        else if( (read_adc(1) > 500 && detect == 2 ) && juringTengah == 0){     // CEK WARNA putih
terkecil, dapat juring lingkaran putih di tengah (putih>800)

                if( juringTengah == 1 ){                // blm mati tuw juring di tengah
                    bantingKiri(255,255);
                    delay_ms(50);
                    berenti(255,255);
                    kipas();
                    berenti(255,255);
                    apiPadam=1;
                    }
                else {
                    apiPadam=1;
                    berenti(255,255);
                    kipas();
                    berenti(255,255);
                    juringTengah=1;
                    varJuring=2;
                    }
                }

        else if (juringTengah == 1 && varJuring == 2){
                bantingKiri(255,255);
                delay_ms(75);
                berenti(255,255);
                kipas();
                berenti(255,255);
                apiPadam=1;
                }
        else {                      // else klo blm dapat juring, jalan trs nyari juring putih+klo ada api

            if( getSrf(6) > 14) {                               //14
                kp = 10;                                        //10
                kd = 15;                                        //15
                ki = 0.005;                                     //0.025
                setPointPWM =50;
                processVariable = getSrf(1);                    // proporsional program
                setPointSensorKiri = 8;
                error = setPointSensorKiri - processVariable;
```

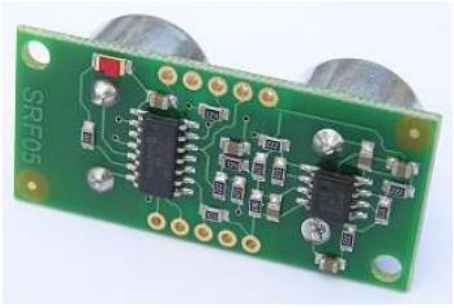
```
                    proporsional = kp * error;                          // proporsional end
                    rate = error - lastError;                           // derivative program
                    rateInt = error + lastError;
                    Ts=1;                                               // Ts = time sampling
                    integral = Ts * (ki * rateInt);
                    derivative = (kd/Ts) * rate;                                // derivative
                    sinyalControl = proporsional + derivative + integral;  // sinyal control
                    rightPWM = setPointPWM + sinyalControl;
                    leftPWM = setPointPWM - sinyalControl;
                    if(rightPWM >= 255) {
                          rightPWM = 150;
                          }
                    if(leftPWM >= 255) {
                          leftPWM = 150;
                          }
                    if(rightPWM <= 0) {
                          rightPWM = 0;
                          }
                    if(leftPWM <= 0) {
                          leftPWM = 0;
                          }
                    leftPWM;
                    rightPWM;
                    if(leftPWM == 0 && rightPWM == 200){
                           bantingKiri(leftPWM,rightPWM);
                           lcd_clear();
                           lcd_gotoxy(0,0);
                           lcd_putsf("belok kiri");
                          }
                    if(rightPWM == 0 && leftPWM == 200){
                           bantingKanan(leftPWM,rightPWM);
                           lcd_clear();
                           lcd_gotoxy(0,0);
                           lcd_putsf("belok kanan");
                          }
                    if( (rightPWM <200 || leftPWM < 200)  && (rightPWM > 0 || leftPWM > 0) ){

                           if( (leftPWM < rightPWM) && (leftPWM < 10)){
                                belokKiri(leftPWM,rightPWM);
                                }
                           if( (leftPWM > rightPWM) && (rightPWM < 10) ){
                                belokKanan(leftPWM,rightPWM);
                                }
                           else{
                                maju(leftPWM,rightPWM);
                               }
                           lcd_clear();
                           lcd_gotoxy(0,0);
                           sprintf(text,"S.K=%3d ",processVariable);
                           lcd_puts(text);
                           lcd_gotoxy(0,1);
                           sprintf(text,"r=%3d l=%3d",rightPWM,leftPWM);
                           lcd_puts(text);
                           }                                            //end   if( (rightPWM <170 || leftPWM < 170)
&& (rightPWM > 0 || leftPWM > 0) ){

                    lastError = error;                                  //error sebelumnya
                              }
              else if(getSrf(6) <= 14){
                    if( getSrf(2) > 40 && getSrf(4) > 40){
                              bantingKanan (150,150);
                          }
                    else {
                          bantingKiri(190,190);
```

```
                        }
                    }
                }                                   // end klo dari else klo blm dapat juring, jln trs
nyari juring putih+klo ada api
                }                                   // end klo lagi ada api

//=============================================================================
    };                          //end while(1)

}
```

LAMPIRAN C
DATASHEET

SRF05 - Ultra-Sonic Ranger

Technical Specification

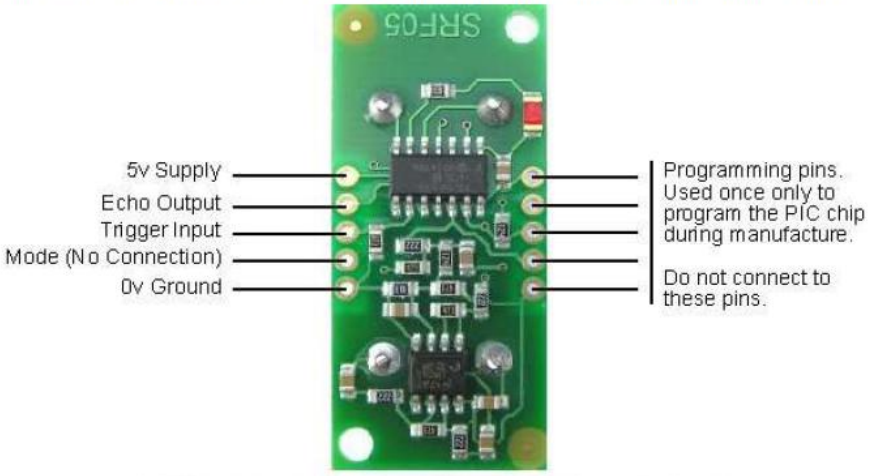


Introduction

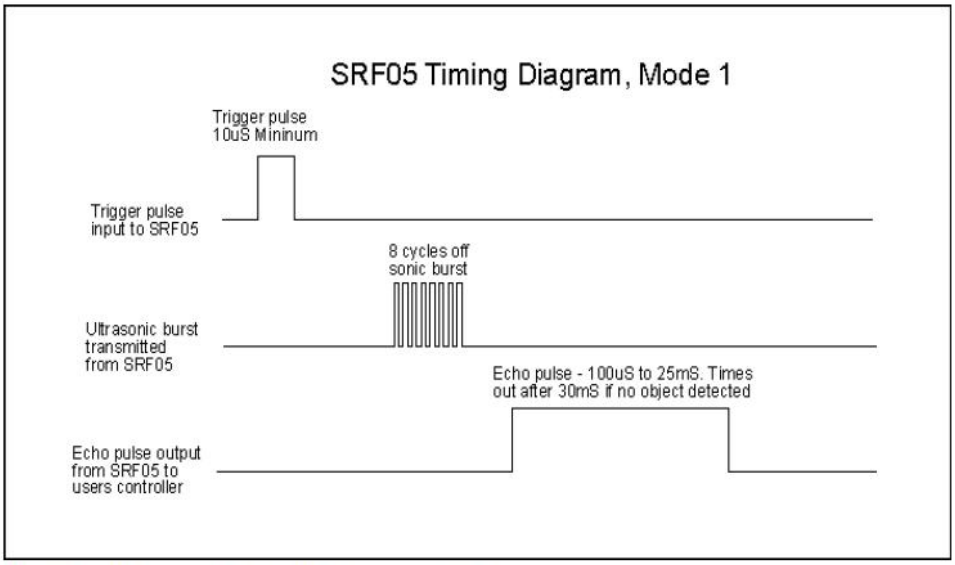
The SRF05 is an evolutionary step from the SRF04, and has been designed to increase flexibility, increase range, and to reduce costs still further. As such, the SRF05 is fully compatible with the SRF04. Range is increased from 3 meters to 4 meters. A new operating mode (tying the mode pin to ground) allows the SRF05 to use a single pin for both trigger and echo, thereby saving valuable pins on your controller. When the mode pin is left unconnected, the SRF05 operates with separate trigger and echo pins, like the SRF04. The SRF05 includes a small delay before the echo pulse to give slower controllers such as the Basic Stamp and Picaxe time to execute their pulse in commands.

Mode 1 - SRF04 compatible - Separate Trigger and Echo

This mode uses separate trigger and echo pins, and is the simplest mode to use. All code examples for the SRF04 will work for the SRF05 in this mode. To use this mode, just leave the mode pin unconnected - the SRF05 has an internal pull up resistor on this pin.

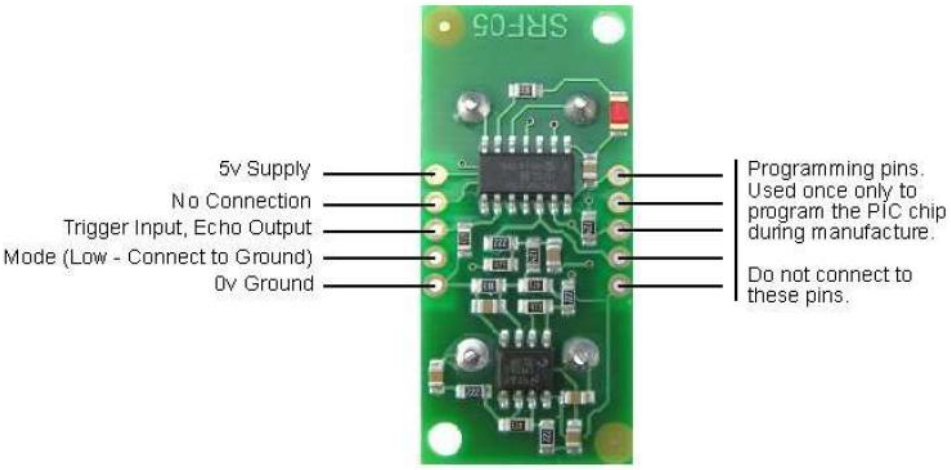


Connections for 2-pin Trigger/Echo Mode (SRF04 compatible)

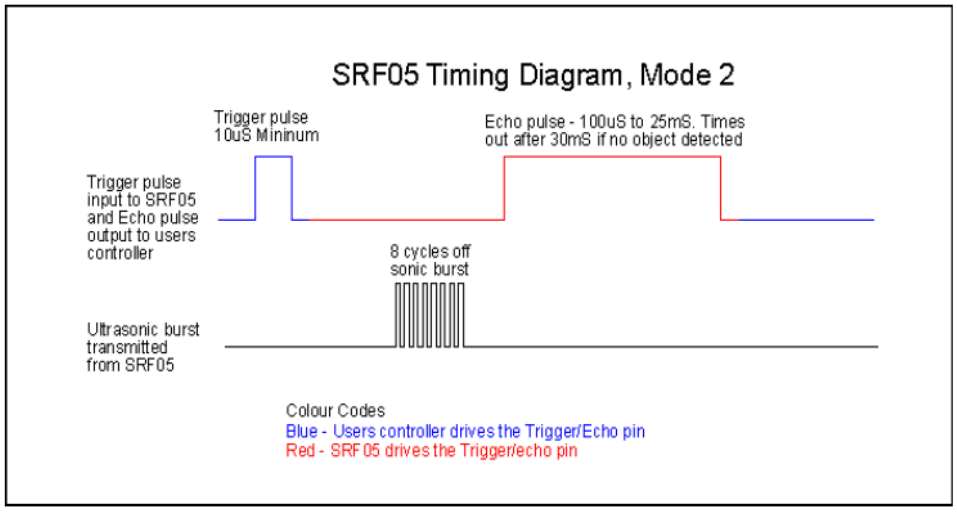


Mode 2 - Single pin for both Trigger and Echo

This mode uses a single pin for both Trigger and Echo signals, and is designed to save valuable pins on embedded controllers. To use this mode, connect the mode pin to the 0v Ground pin. The echo signal will appear on the same pin as the trigger signal. The SRF05 will not raise the echo line until 700uS after the end of the trigger signal. You have that long to turn the trigger pin around and make it an input and to have your pulse measuring code ready. The PULSIN command found on many popular controllers does this automatically.



Connections for single pin Trigger/Echo Mode



To use mode 2 with the Basic Stamp BS2, you simply use PULSOUT and PULSIN on the same pin, like this:

```
SRF05 PIN 15              ' use any pin for both trigger and echo
Range VAR Word            ' define the 16 bit range variable

SRF05 = 0                 ' start with pin low
PULSOUT SRF05, 5          ' issue 10uS trigger pulse (5 x 2uS)
PULSIN SRF05, 1, Range    ' measure echo time
Range = Range/29          ' convert to cm (divide by 74 for inches)
```

Calculating the Distance

The SRF05 Timing diagrams are shown above for each mode. You only need to supply a short 10uS pulse to the trigger input to start the ranging. The SRF05 will send out an 8 cycle burst of ultrasound at 40khz and raise its echo line high (or trigger line in mode 2). It then listens for an echo, and as soon as it detects one it lowers the echo line again. The echo line is therefore a pulse whose width is proportional to the distance to the object. By timing the pulse it is possible to calculate the range in inches/centimeters or anything else. If nothing is detected then the SRF05 will lower its echo line anyway after about 30mS.

The SRF04 provides an echo pulse proportional to distance. If the width of the pulse is measured in uS, then dividing by 58 will give you the distance in cm, or dividing by 148 will give the distance in inches. uS/58=cm or uS/148=inches.

The SRF05 can be triggered as fast as every 50mS, or 20 times each second. You should wait 50ms before the next trigger, even if the SRF05 detects a close object and the echo pulse is shorter. This is to ensure the ultrasonic "beep" has faded away and will not cause a false echo on the next ranging.

The other set of 5 pins

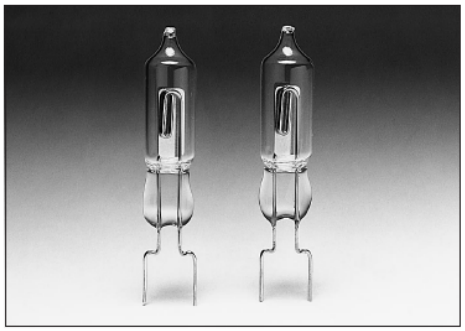
The 5 pins marked "programming pins" are used once only during manufacture to program the Flash memory on the PIC16F630 chip. The PIC16F630's programming pins are also used for other functions on the SRF05, so make sure you don't connect anything to these pins, or you will disrupt the modules operation.

HAMAMATSU

FLAME SENSOR
UV TRON® R2868

Quick Detection of Flame from Distance, Compact UV Sensor with High Sensitivity and Wide Directivity, Suitable for Flame Detectors and Fire Alarms.

Hamamatsu R2868 is a UV TRON ultraviolet detector that makes use of the photoelectric effect of metal and the gas multiplication effect. It has a narrow spectral sensitivity of 185 to 260 nm, being completely insensitive to visible light. Unlike semiconductor detectors, it does not require optical visible-cut filters, thus making it easy to use.
In spite of its small size, the R2868 has wide angular sensitivity (directivity) and can reliably and quickly detect weak ultraviolet radiations emitted from flame due to use of the metal plate cathode (eg. it can detect the flame of a cigarette lighter at a distance of more than 5 m.).
The R2868 is well suited for use in flame detectors and fire alarms, and also in detection of invisible discharge phenomena such as corona discharge of high-voltage transmission lines.



APPLICATIONS

- **Flame detectors for gas/oil lighters and matches**
- **Fire alarms**
- **Combustion monitors for burners**
- **Inspection of ultraviolet leakage**
- **Detection of discharge**
- **Ultraviolet switching**

GENERAL

Parameters	Rating	Units
Spectral Response	185 to 260	nm
Window Material	UV glass	—
Weight	Approx. 1.5	g
Dimensional Outline	See Fig. 3	—

MAXIMUM RATINGS

Parameters	Rating	Units
Supply Voltage	400	Vdc
Peak Current [1]	30	mA
Average Discharge Current [2]	1	mA
Operating Temperature	-20 to +60	°C

CHARACTERISTICS (at 25°C)

Parameters	Rating	Units
Discharge Starting Voltage (with UV radiation)	280	Vdc Max.
Recommended Operating Voltage	325±25	Vdc
Recommended Average Discharge Current	100	µA
Background [3]	10	cpm Max
Sensitivity [4]	5000	cpm Typ.

NOTES:
1) This is the maximum momentary current that can be handled if its full width at half maximum is less than 10 µs.
2) If the tube is operated near this or higher, the service life is noticeably reduced. Use the tube within the recommended current values.
3) Measured under room illuminations (approximately 500 lux) and recommended operating conditions. Note that these values may increase if the following environmental factors are present.
   1. Mercury lamps, sterilization lamps, or halogen lamps are located nearby.
   2. Direct or reflected sunlight is incident on the tube.
   3. Electrical sparks such as welding sparks are present.
   4. Radiation sources are present.
   5. High electric field (including static field) generates across the tube.
4) These are representative values for a wavelength of 200 nm and a light input of 10 pW/cm². In actual use, the sensitivity will vary with the wavelength of the ultraviolet radiation and the drive circuitry employed.

Figure 1: UV TRON's Spectral Response and Various Light Sources

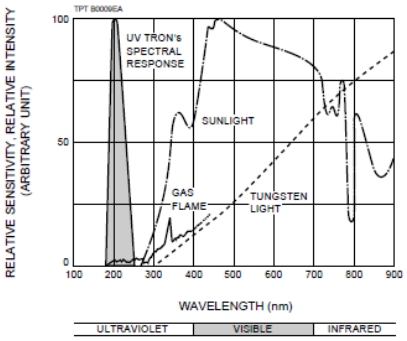


Figure 2: Angular Sensitivity (Directivity)

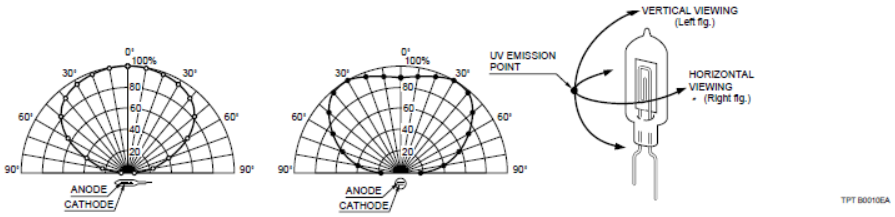


Figure 3: Dimensional Outline (Unit: mm)

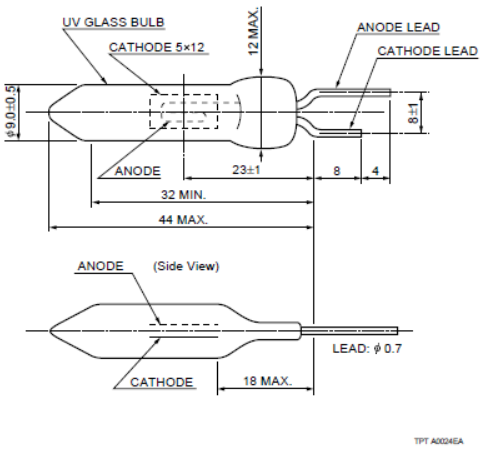
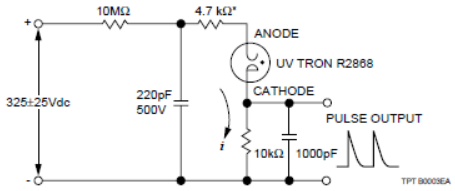
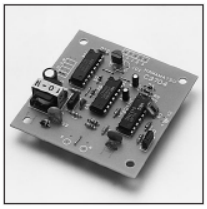


Figure 4: Recommended Operating Circuit



* Be sure to connect the 4.7 kΩ resistor within 2.5 cm from the anode lead end of UV TRON.

- UV TRON Driving Circuit C3704 series (Option)



Hamamatsu also provide the driving circuit C3704 series for R2868 operation.
C3704 series include a high voltage power supply and a signal processing circuit in printed circuit board, which allows to operate R2868 easily as a flame sensor with the low input voltage (DC 6 to 30 V) only.
For the details, please refer to the datasheet of C3704 series.

PRECAUTIONS FOR USE

- **Ultraviolet Radiation**

The UV TRON itself emits ultraviolet radiation in operation. When using two or more UV TRONs at the same time in close position, care should be taken so that they do not optically interfere with each other.

- **Vibration and Shock**

The UV TRON is designed in accordance with the standards of MIL-STD-202F (Method 204D/0.06 inch or 10g, 10- 500Hz, 15 minutes, 1 cycle) and MIL-STD-202F (Method 213B/100g, 11ms, Half-sine, 3 times). However, should a strong shock be sustained by the UV TRON (e.g. if dropped), the glass bulb may crack or the internal electrode may be deformed, resulting in deterioration of electrical characteristics. So extreme care should be taken in handling the tube.

- **Polarity**

Connect the UV TRON with correct polarity. Should it be connected with reverse polarity, operating errors may occur.

WARRANTY.

The UV TRON is covered by a warranty for a period of one year after delivery. The warranty is limited to replacement of any defective tube due to defects traceable to the manufacturer.

HAMAMATSU

HAMAMATSU PHOTONICS K.K., Electron Tube Center
314-5, Shimokanzo, Toyooka-village, Iwata-gun, Shizuoka-ken, 438-0193, Japan, Telephone: (81)539/62-5248, Fax: (81)539/62-2205,
U.S.A.: Hamamatsu Corporation: 360 Foothill Road, Bridgewater, N.J. 08807-0910, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-2658
France: Hamamatsu Photonics France S.A.R.L.: 8, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10
United Kingdom: Hamamatsu Photonics UK Limited: Lough Point, 2 Gladbeck Way, Windmill Hill, Enfield, Middlesex EN2 7JA, United Kingdom, Telephone: (44)181-367-3560, Fax: (44)181-367-6384
North Europe: Hamamatsu Photonics Norden AB: Färögatan 7, S-164-40 Kista, Sweden, Telephone: (46)8-703-29-50, Fax: (46)8-750-58-95
Italy: Hamamatsu Photonics Italia S.R.L.: Via Della Mola, 1/E, 20020 Arese, (Milano), Italy, Telephone: (39)2-935 81 733, Fax: (39)2-935 81 741

TPT 1008E01
MAR.1998 CR
Created in Japan

HAMAMATSU

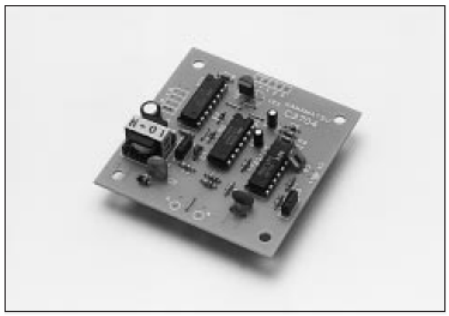
UV TRON® DRIVING CIRCUIT C3704 SERIES

Compact, Lightweight, Low Current Consumption, Low Cost Operates as High Sensitivity UV Sensor with UV TRON Suitable for Flame Detectors and Fire Alarms

Hamamatsu C3704 series UV TRON driving circuits are low current consuming, signal processing circuits for the UV TRON, well known as a high sensitivity ultraviolet detecting tube. The C3704 series can be operated as a UV sensor by connecting the UV TRON and applying DC low voltage, as they have both a high-voltage power supply and a signal processing circuit on the same printed circuit board.

Since background discharges of the UV TRON caused by natural excitation lights (such as a cosmic ray, scattered sunlight, etc.) can be cancelled in the signal processing circuit, the output signals from the C3704 series can be used without errors.

When the high sensitivity sensor "UV TRON R2868" (sold separately) is used, the flame from a cigarette lighter (flame length: 25mm) can be detected even from a distance of more than 5m.



APPLICATIONS

- **Flame detectors for gas and oil lighters**
- **Fire alarms**
- **Combustion monitors for burners**
- **Electric spark detector**
- **UV photoelectric counter**

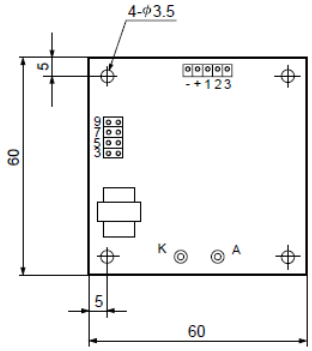
SPECIFICATIONS

Dimensional outline ..... Figure 1
Weight ..... Approx. 20g
Output signal ..... Open collector Output (50 V, 100 mA Max.)
10 ms width pulse output (Note : 1)
UV TRON supply voltage ..... DC 350 V (Note : 2)
Quenching time ..... Approx. 50 ms
Operating temperature ..... -10 to +50°C
(with no condensation)
Suitable UV TRON ..... Low voltage operation UV TRON
(such as R2868)

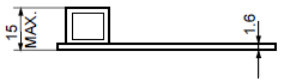
	C3704	C3704-02	C3704-03
Input Voltage	10 to 30 Vdc	5Vdc ± 5%	6 to 9 Vdc
Current consumption	3 mA Max.	300µA Max.	300µA Max.

Note 1: The output pulse width can be extended up to about 100s by adding a capacitor to the circuit board.
Note 2: Since the output impedance of this power supply is extremely high, an ordinary voltmeter cannot be used. Use a voltmeter that has an input impedance of more than 10 GΩ.

Figure 1: Dimensional Outline (Unit : mm)



<Top View>



<Side View>

TPT A0024EA

Figure 2: Schematic Diagram

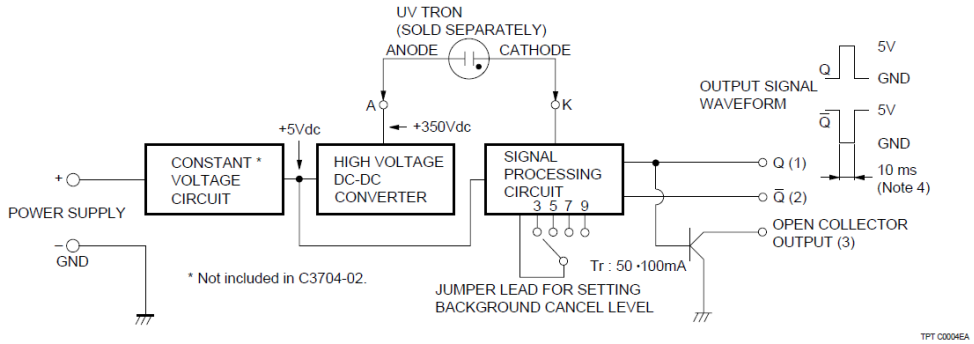
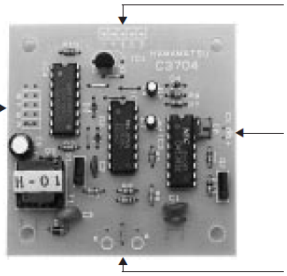


Figure 3: Method of Connection



POWER SUPPLY INPUT AND SIGNAL OUTPUT POINT
– : GND
+ : POWER SUPPLY INPUT
1 : SIGNAL OUTPUT Q
2 : SIGNAL OUTPUT Q̄ (Note 3)
3 : OPEN COLLECTOR OUTPUT

JUMPER LEAD FOR SETTING
BACKGROUND CANCEL LEVEL

Cx : POINT FOR ADDING A CAPACITOR TO
EXTEND OUTPUT PULSE WIDTH (Note 4)

This background cancel circuit outputs signal pulses of 10ms width only when 3 to 9 pulses enter the circuit with a time interval of 2 seconds or less from the UV TRON. Cancel level can be set in 4 steps (number of pulses: 3, 5, 7, 9) by this jumper lead. Connect to "3" for general use. When using where much natural excitation light is present, set the cancel level at a higher step (5, 7, 9).

CONNECTING POINT OF UV TRON
A : Connecting Anode of UV TRON
K : Connecting Cathode of UV TRON

Note 3: No load can be driven by an output from points "1" and "2" because these signals are output from the only C-MOS IC directly. When a load such as a buzzer and a relay is connected to this circuit, it should be connected to the point open collector output. The transistor ratings of the open collector is 50V, 100mA. Be careful not to exceed the ratings.

Note 4: The output pulse width is set to 10ms at shipping. If the pulse width needs to be extended, add a capacitor to this point. (When using an electrolytic condenser, make sure the polarity is correct.)
e.g. CX = 1 µF: Pulse Width ≃ 1s, CX=10 µF : Pulse Width ≃ 10s

PRECAUTIONS FOR USE

- Since the operation impedance is extremely high, the UV TRON should be connected as close as possible to the circuit board within 5 cm.
- Take care to avoid external noise since a C-MOS IC is used in the circuit. It is recommended that the whole PC board be put in the shield box when it is used.
- To reduce current consumption, oscillating frequency is very low (approx. 20 Hz) in this DC-DC converter. Thus, the output impedance of the high voltage power supply is extremely high. If the surrounding humidity is high, electrical leakage on the PC board surface may lead to a drop in the supply voltage to the UV TRON. This voltage drop may result in lowered detection performance, so a moistureproof material (silicone compound, etc.) should be applied at the connecting point of the UV TRON, etc., if using the unit in a humid environment.

- A model equipped with a flame sensor (R2868) is also available.

HAMAMATSU

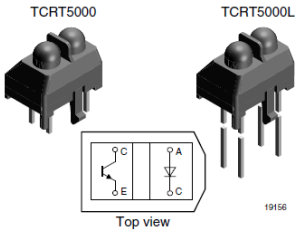
HAMAMATSU PHOTONICS K.K., Electron Tube Center
314-5, Shimokanzo, Toyooka-village, Iwata-gun, Shizuoka-ken, 438-0193, Japan, Telephone: (81)539/62-5248, Fax: (81)539/62-2205, Telex: 4225-186HAMAHQ
U.S.A.: Hamamatsu Corporation: 360 Foothill Road, Bridgewater, N.J. 08807-0910, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-2658
France: Hamamatsu Photonics France S.A.R.L.: 8, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10
United Kingdom: Hamamatsu Photonics UK Limited: Lough Point, 2 Gladbeck Way, Windmill Hill, Enfield, Middlesex EN2 7JA, United Kingdom, Telephone: (44)181-367-3560, Fax: (44)181-367-6384
North Europe: Hamamatsu Photonics Norden AB: Färögatan 7, S-164-40 Kista, Sweden, Telephone: (46)8-703-29-50, Fax: (46)8-750-58-95
Italy: Hamamatsu Photonics Italia S.R.L.: Via Della Moia, 1/E 20020 Arese, (Milano), Italy, Telephone: (39)2-935 81 733, Fax: (39)2-935 81 741

TPT1007E01
JUL.1997 CR
Created in Japan

Reflective Optical Sensor with Transistor Output

Description

The TCRT5000 and TCRT500L are reflective sensors which include an infrared emitter and phototransistor in a leaded package which blocks visible light. The package includes two mounting clips. TCRT5000L is the long lead version.



Features

- Package type: Leaded
- Detector type: Phototransistor
- Dimensions:
  L 10.2 mm x W 5.8 mm x H 7.0 mm
- Peak operating distance: 2.5 mm
- Operating range: 0.2 mm to 15 mm
- Typical output current under test: I_C = 1 mA
- Daylight blocking filter
- Emitter wavelength 950 nm
- Lead (Pb)-free soldering released
- Lead (Pb)-free component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC

Applications

- Position sensor for shaft encoder
- Detection of reflective material such as paper, IBM cards, magnetic tapes etc.
- Limit switch for mechanical motions in VCR
- General purpose - wherever the space is limited

Order Instructions

Part Number	Remarks	Minimum Order Quantity
TCRT5000	3.5 mm lead length	4500 pcs, 50 pcs/tube
TCRT5000L	15 mm lead length	2400 pcs, 48 pcs/tube

Absolute Maximum Ratings

T_{amb} = 25 °C, unless otherwise specified

Input (Emitter)

Parameter	Test condition	Symbol	Value	Unit
Reverse voltage		V_R	5	V
Forward current		I_F	60	mA
Forward surge current	$t_p \leq 10$ µs	I_{FSM}	3	A
Power dissipation	$T_{amb} \leq 25$ °C	P_V	100	mW
Junction temperature		T_j	100	°C

Output (Detector)

Parameter	Test condition	Symbol	Value	Unit
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	100	mA
Power dissipation	$T_{amb} \leq 55$ °C	P_V	100	mW
Junction temperature		T_j	100	°C

Sensor

Parameter	Test condition	Symbol	Value	Unit
Total power dissipation	$T_{amb} \leq 25$ °C	P_{tot}	200	mW
Operation temperature range		T_{amb}	- 25 to + 85	°C
Storage temperature range		T_{stg}	- 25 to + 100	°C
Soldering temperature	2 mm from case, t ≤ 10 s	T_{sd}	260	°C

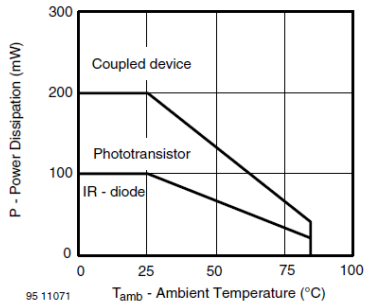


Figure 1. Power Dissipation Limit vs. Ambient Temperature

Electrical Characteristics

T_{amb} = 25 °C, unless otherwise specified

Input (Emitter)

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Forward voltage	I_F = 60 mA	V_F		1.25	1.5	V
Junction capacitance	V_R = 0 V, f = 1 MHz	C_j		17		pF
Radiant intensity	I_F = 60 mA, t_P = 20 ms	I_E			21	mW/sr
Peak wavelength	I_F = 100 mA	λ_P	940			nm
Virtual source diameter	Method: 63 % encircled energy	Ø		2.1		mm

Output (Detector)

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Collector emitter voltage	I_C = 1 mA	V_{CEO}	70			V
Emitter collector voltage	I_E = 100 µA	V_{ECO}	7			V
Collector dark current	V_{CE} = 20 V, I_F = 0, E = 0	I_{CEO}		10	200	nA

Sensor

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Collector current	V_{CE} = 5 V, I_F = 10 mA, D = 12 mm	I_C [1,2]	0.5	1	2.1	mA
Collector emitter saturation voltage	I_F = 10 mA, I_C = 0.1 mA, D = 12 mm	V_{CEsat} [1,2]			0.4	V

[1] See figure 3

[2] Test surface: Mirror (Mfr. Spindler a. Hoyer, Part No 340005)

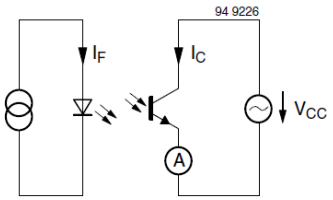


Figure 2. Test Circuit

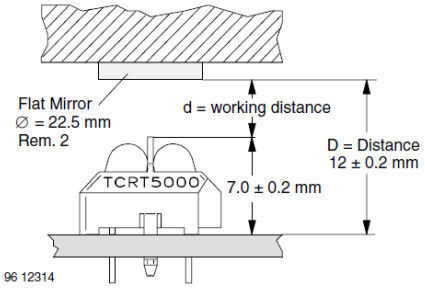


Figure 3. Test Circuit

Typical Characteristics

T_{amb} = 25 °C, unless otherwise specified

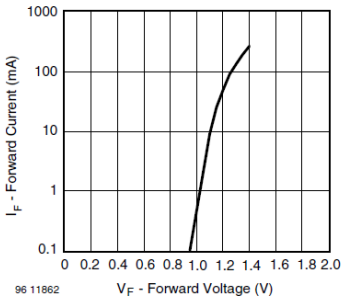


Figure 4. Forward Current vs. Forward Voltage

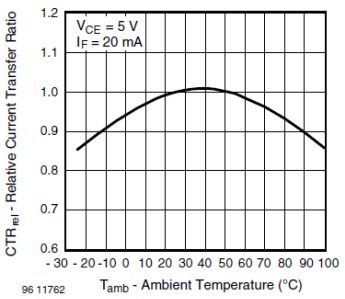


Figure 5. Relative Current Transfer Ratio vs. Ambient Temperature

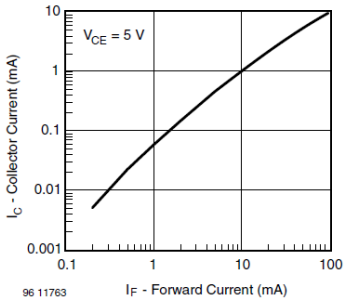


Figure 6. Collector Current vs. Forward Current

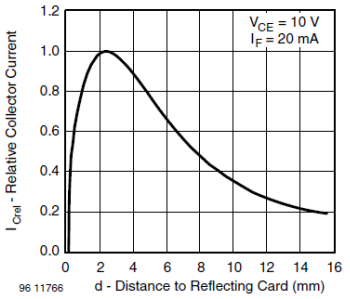


Figure 9. Relative Collector Current vs. Distance

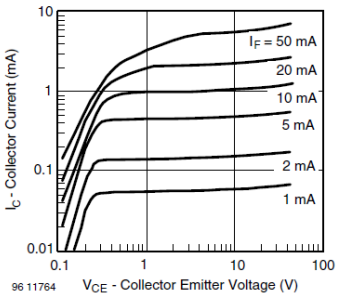


Figure 7. Collector Emitter Saturation Voltage vs. Collector Current

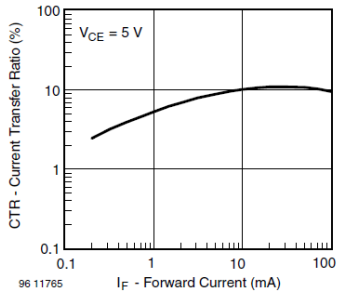
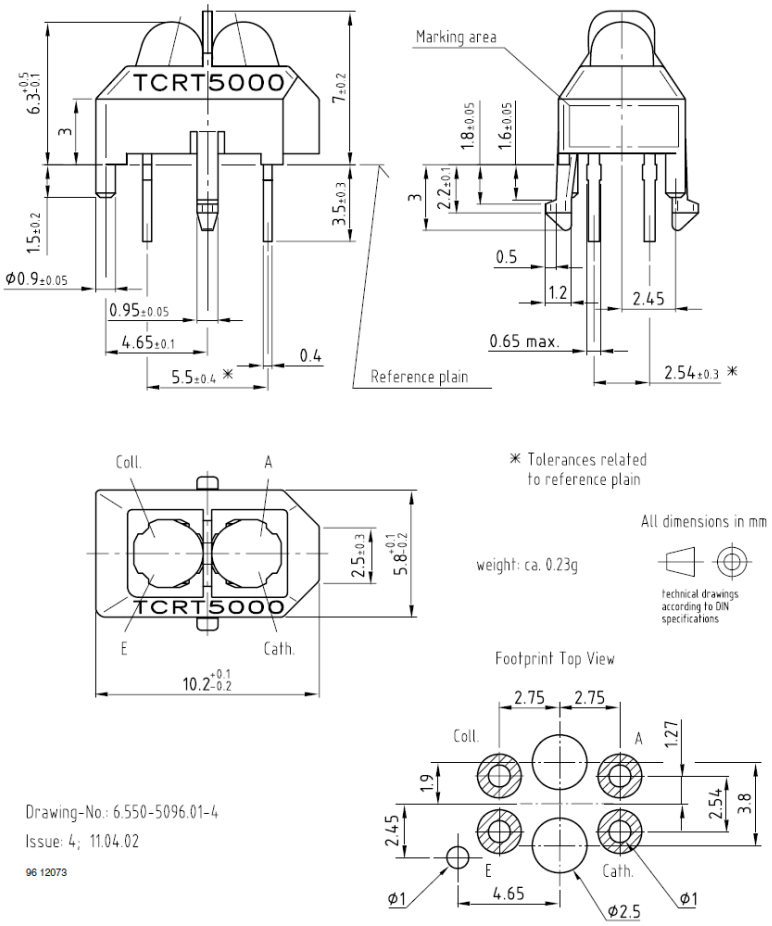
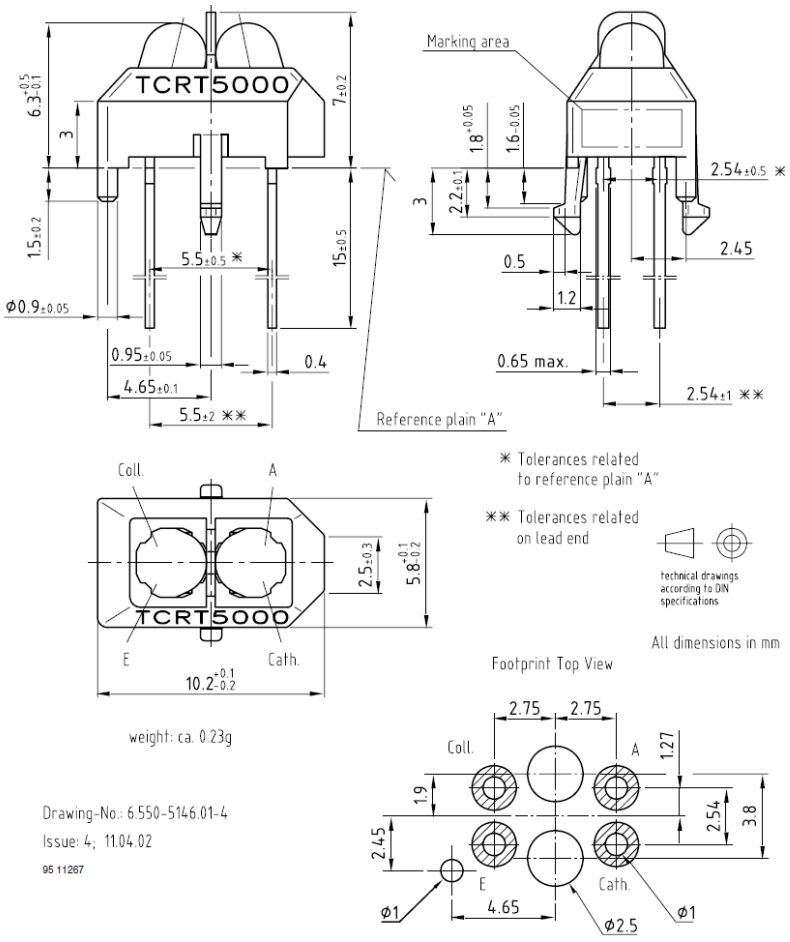


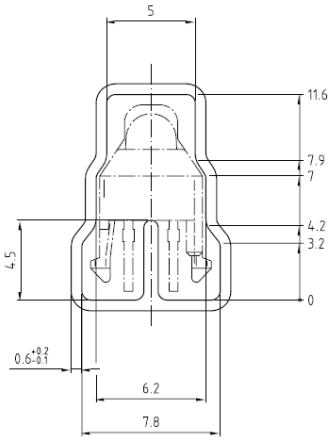
Figure 8. Current Transfer Ratio vs. Forward Current

Package Dimensions in mm




TCRT5000
Marking area
Reference plain "A"
✳ Tolerances related to reference plain "A"
✳✳ Tolerances related on lead end
technical drawings according to DIN specifications
All dimensions in mm
Coll.
A
E
Cath.
weight: ca. 0.23g
Drawing-No.: 6.550-5146.01-4
Issue: 4; 11.04.02
95 11267
Footprint Top View

TCRT5000, Tube Dimensions

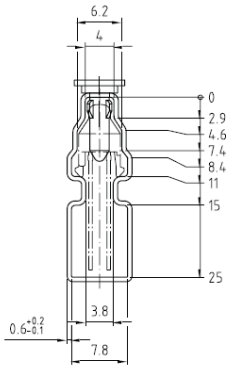


With rubber stopper
Tolerance: ±0.5mm
Length: 575±1mm

All dimensions in mm

Drawing-No.: 9.700-5139.01-4
Issue: 1; 10.05.00
20298

TCRT5000L, Tube Dimensions



With stopper pins
Tolerance: ±0.5mm
Length: 575±1mm

All dimensions in mm

Drawing-No.: 9.700-5178.01-4
Issue: 1; 25.02.00
20299