LAMPIRAN A
RANCANGAN SKEMATIK
LAMPIRAN B
PROGRAM PADA PENGONTROL MIKRO
AT MEGA 16
/********************************************************************************
This program was produced by the
CodeWizardAVR V2.04.4a Advanced
Automatic Program Generator
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Project : 
Version : 
Date : 10/15/2011
Author : NeVaDa
Company : gto
Comments:

Chip type : ATmega16
Program type : Application
AVR Core Clock frequency: 11.059200 MHz
Memory model : Small
External RAM size : 0
Data Stack size : 256
********************************************************************************/

#include <mega16.h>
#include <delay.h>

#asm
  .equ __lcd_port=0x15 ;PORTC
#endasm
#include <lcd.h>
int i;

void servo1tengah() //tengah
{
  for(i=0;i<100;i++)
  {
    PORTB.7=1;
    delay_us(1100);
    PORTB.7=0;
    delay_us(18900);
  }
}
void servo1belok()
{
for(i=0;i<100;i++)
{
PORTB.7=1;
delay_us(750);
PORTB.7=0;
delay_us(19350);
}
}

void servo2belok()
{
for(i=0;i<100;i++)
{
PORTB.6=1;
delay_us(750);
PORTB.6=0;
delay_us(19250);
}
}

void servo2tengah()
{
for(i=0;i<100;i++)
{
PORTB.6=1;
delay_us(1100);
PORTB.6=0;
delay_us(18900);
}
}

void servo3tutup()
{
for(i=0;i<100;i++)
{
PORTB.5=1;
delay_us(1070);
PORTB.5=0;
delay_us(19930);
}
}
void servo3buka()
{
    for(i=0;i<100;i++)
    {
        PORTB.5=1;
        delay_us(600);
        PORTB.5=0;
        delay_us(19400);
    }
}

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=T State2=T State1=T
    State0=T
    PORTA=0xff;
    DDRA=0x00;

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

    // 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=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
PORTD=0xff;
DDRD=0x00;

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

// Timer/Counter 1 initialization
// Clock source: System Clock
// Clock value: Timer1 Stopped
// Mode: Normal top=FFFFh
// OC1A output: Discon.
// OC1B output: Discon.
// Noise Canceler: Off
// Input Capture on Falling Edge
// Timer1 Overflow Interrupt: Off
// Input Capture Interrupt: Off
// Compare A Match Interrupt: Off
// Compare B Match Interrupt: Off
TCCR1A=0x00;
TCCR1B=0x00;
TCNT1H=0x00;
TCNT1L=0x00;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;

// Timer/Counter 2 initialization
// Clock source: System Clock
// Clock value: Timer2 Stopped
// Mode: Normal top=FFh
// OC2 output: Disconnected
ASSR=0x00;
TCCR2=0x00;
TCNT2=0x00;
OCR2=0x00;
// External Interrupt(s) initialization
// INT0: Off
// INT1: Off
// INT2: Off
MCUCR=0x00;
MCUCSR=0x00;

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

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

// LCD module initialization
lcd_init(16);

while (1)
{

    if (PINA.3==0)
    {
        delay_ms (1000);
        if(PINA.1==0)  //A.1 sensor logam, 0 deteksi
        {
            lcd_clear();
            lcd_gotoxy (0,0);
            lcd_putsf(" SAMPAH LOGAM");
            servo2tengah();
            servo1belok();
            servo3buka();
            servo3tutup();
        }

        if(PINA.1==1 && PINA.2==1)
        {
            lcd_clear();
            lcd_gotoxy (0,0);
            lcd_putsf(" SAMPAH PLASTIK");
            servo1tengah();
            servo2tengah();
        }
    }
}
servo3buka();
servo3tutup();
}

if(PINA.2==0 & PINA.1==1)
{
    lcd_clear();
lcd_gotoxy (0,0);
lcd_putsf(" SAMPAH KERTAS");
servo1tengah();
servo2belok();

    servo3buka();
servo3tutup();
}

else
{
    lcd_clear();
lcd_gotoxy (0,0);

    lcd_putsf(" menunggu sampah");
servo3tutup();
}

};
}
LAMPIRAN C
DATASHEET
DATASHEET Sensor proximity kapasitif CR30-15DN

CR Series Electric Capacitive Type

Electric capacitive type proximity sensor

- **Features**
  - Sensing of iron, metal, plastic, water, stone, wood etc.
  - Long life cycle and high reliability
  - Integrated surge protection circuit
  - Integrated reverse polarity protection circuit (DC type)
  - Easy to adjust the sensing distance with sensitivity adjuster
  - LED status indication
  - Easy to control of level and position

- **Type**
  - **DC 3-wire type**
    - Model: CR18-8DN
    - Model: CR18-8DP
    - Model: CR18-6DN
    - Model: CR18-6DN
    - Model: CR30-15DN
    - Model: CR30-15DP
    - Model: CR20-15DN
    - Model: CR20-15DP

- **AC 2-wire type**
  - Model: CR18-8AO
  - Model: CR18-8AC
  - Model: CR20-15AO
  - Model: CR20-15AC

- **Specifications**

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing distance</td>
<td>8mm ± 10%</td>
<td>8mm ± 10%</td>
<td>15mm ± 10%</td>
<td>15mm ± 10%</td>
<td>15mm ± 10%</td>
<td>15mm ± 10%</td>
<td>15mm ± 10%</td>
<td>15mm ± 10%</td>
</tr>
<tr>
<td>Materials</td>
<td>Max. 20% of sensing distance</td>
<td>Max. 20% of sensing distance</td>
<td>Max. 20% of sensing distance</td>
<td>Max. 20% of sensing distance</td>
<td>Max. 20% of sensing distance</td>
<td>Max. 20% of sensing distance</td>
<td>Max. 20% of sensing distance</td>
<td>Max. 20% of sensing distance</td>
</tr>
<tr>
<td>Standard setting range</td>
<td>0 to 50 ± 1mm (ideal)</td>
<td>0 to 50 ± 1mm (ideal)</td>
<td>0 to 50 ± 1mm (ideal)</td>
<td>0 to 50 ± 1mm (ideal)</td>
<td></td>
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</tr>
<tr>
<td>Setting distance</td>
<td>0 to 50 ± 1mm (ideal)</td>
<td>0 to 50 ± 1mm (ideal)</td>
<td>0 to 50 ± 1mm (ideal)</td>
<td>0 to 50 ± 1mm (ideal)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Power supply (Operating voltage)</td>
<td>12V DC ± 10% (100mA)</td>
<td>12V DC ± 10% (100mA)</td>
<td>100VAC ± 10% (100mA)</td>
<td>100VAC ± 10% (100mA)</td>
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<td></td>
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</tr>
<tr>
<td>Current consumption</td>
<td>Max. 10mA</td>
<td>Max. 10mA</td>
<td>Max. 10mA</td>
<td>Max. 10mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leakage current</td>
<td>Max. 10mA</td>
<td>Max. 10mA</td>
<td>Max. 10mA</td>
<td>Max. 10mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response frequency</td>
<td>50Hz</td>
<td>50Hz</td>
<td>50Hz</td>
<td>50Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual voltage</td>
<td>Max. 5V</td>
<td>Max. 5V</td>
<td>Max. 5V</td>
<td>Max. 5V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attenuation</td>
<td>± 10%</td>
<td>± 10%</td>
<td>± 10%</td>
<td>± 10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control output</td>
<td>Max. 200mA</td>
<td>Max. 200mA</td>
<td>Max. 200mA</td>
<td>Max. 200mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>Min. 3000MΩ (1000VDC, megger)</td>
<td>Min. 3000MΩ (1000VDC, megger)</td>
<td>Min. 3000MΩ (1000VDC, megger)</td>
<td>Min. 3000MΩ (1000VDC, megger)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating life</td>
<td>100000 cycles for 1 minute</td>
<td>100000 cycles for 1 minute</td>
<td>100000 cycles for 1 minute</td>
<td>100000 cycles for 1 minute</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration</td>
<td>1mm amplitude at frequency of 10 to 2000Hz, in each of X, Y, Z directions for 2 hours</td>
<td>1mm amplitude at frequency of 10 to 2000Hz, in each of X, Y, Z directions for 2 hours</td>
<td>1mm amplitude at frequency of 10 to 2000Hz, in each of X, Y, Z directions for 2 hours</td>
<td>1mm amplitude at frequency of 10 to 2000Hz, in each of X, Y, Z directions for 2 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock</td>
<td>3G (6000G) 3G (6000G)</td>
<td>3G (6000G) 3G (6000G)</td>
<td>3G (6000G) 3G (6000G)</td>
<td>3G (6000G) 3G (6000G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicator</td>
<td>Output operating indicator/Red LED</td>
<td>Output operating indicator/Red LED</td>
<td>Output operating indicator/Red LED</td>
<td>Output operating indicator/Red LED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0°C to 55°C (non-frosting)</td>
<td>0°C to 55°C (non-frosting)</td>
<td>0°C to 55°C (non-frosting)</td>
<td>0°C to 55°C (non-frosting)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-25°C to 70°C (non-frosting)</td>
<td>-25°C to 70°C (non-frosting)</td>
<td>-25°C to 70°C (non-frosting)</td>
<td>-25°C to 70°C (non-frosting)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>95% or less</td>
<td>95% or less</td>
<td>95% or less</td>
<td>95% or less</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection circuit</td>
<td>Surge protection circuit</td>
<td>Reverse polarity protection circuit</td>
<td>Overload &amp; Short protection circuit</td>
<td>Overload &amp; Short protection circuit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection</td>
<td>IP66 (IEC standard)</td>
<td>IP66 (IEC standard)</td>
<td>IP65 (IEC standard)</td>
<td>IP65 (IEC standard)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable</td>
<td>#1 x 0.25mm²</td>
<td>#1 x 0.25mm²</td>
<td>#1 x 0.25mm²</td>
<td>#1 x 0.25mm²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit weight</td>
<td>Approx. 72g</td>
<td>Approx. 72g</td>
<td>Approx. 69g</td>
<td>Approx. 69g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: The response frequency is the average value, The standard sensing target is used and the width is set as 2 times of the standard sensing target, 1/3 of the sensing distance for the distance.*
CR Series

Dimensions

- CR18-8D
- CR18-8C
- CR30-15D
- CR30-15C

(Unit: mm)

Control output diagram

DC 3-wire type

NPN output type

PNP output type

AC 2-wire type

Connections

DC 3-wire type

Connections

AC 2-wire type

*The load can be connected to either wire.*
**Electric Capacitive Type**

### Sensitivity adjustment

Please turn potentiometer VR to set sensitivity as below procedure.
1. Without a sensing object, turn the potentiometer VR to the right and stop at the proximity sensor is (ON/OFF).
2. Put the object in right sensing position, turn the potentiometer VR to the left and stop at the proximity sensor is (OFF/ON).

- Stop at OFF position
- Stop at OFF position

3. If the difference of the number of potentiometer VR rotation between the ON(OFF) point and the OFF(ON) point is more than 1.5 turns, the sensing operation will be stable.

- It is stable when it is over 1.5 turns

4. If it is set in sensitivity adjustment position of potentiometer VR at center between 1 and 2, sensitivity setting will be completed.

- Adjustment completed

- OFF position
- ON position

- OFF position
- ON position

- OFF position
- ON position

*When there is distance fluctuation between proximity sensor and the target, please adjust 2 at the farthest distance from this unit.
Tuning potentiometer VR toward clockwise, it will be max and turning toward counter clockwise, it will be min. The number of adjustment should be 15±3 revolution and if it is turned to the right or left excessively, it will not stop, but it fills without breakdown.

* 1 is for Normal Close type.

### Grounding

The sensing distance will be changed by grounding status of capacitive proximity sensor and the target (50×50×1mm[Teflon]). Please check the material when installing it on panel.

- **CR18 Type**
  - Ground condition (Switch b)
  - Operating distance (mm)
  - ON
  - OFF

<table>
<thead>
<tr>
<th>Condition (Switch b)</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating distance (mm)</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

- **CR30 Type**
  - Ground condition (Switch a)
  - Operating distance (mm)
  - ON
  - OFF

<table>
<thead>
<tr>
<th>Condition (Switch a)</th>
<th>ON</th>
<th>OFF</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating distance (mm)</td>
<td>15</td>
<td>18</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
**CR Series**

**Mutual-interference & Influence by surrounding metals**

When several proximity sensors are mounted close to one another, a malfunction of the sensor may be caused due to mutual interference. Therefore, be sure to provide a minimum distance between the two sensors as below chart indicates.

<table>
<thead>
<tr>
<th>Model</th>
<th>CR18</th>
<th>CR30</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>48</td>
<td>90</td>
</tr>
<tr>
<td>B</td>
<td>54</td>
<td>90</td>
</tr>
</tbody>
</table>

(Units: mm)

When sensors are mounted on metallic panel, you must prevent the sensors from being affected by any metallic object except target. Therefore, be sure to provide a minimum distance as below chart indicates.

<table>
<thead>
<tr>
<th>Model</th>
<th>CR18</th>
<th>CR30</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>g</td>
<td>54</td>
<td>50</td>
</tr>
<tr>
<td>m</td>
<td>24</td>
<td>45</td>
</tr>
<tr>
<td>n</td>
<td>54</td>
<td>90</td>
</tr>
</tbody>
</table>

(Units: mm)

**Materials**

- Materials of sensing targets
  - Sensing distance may be different by electrical characteristics: of sensing target (conductivity, non-dielectric constant) and status of water absorption, size etc.
- Effect by high frequency electrical field
  - It may cause malfunction by machinery which generate high frequency of electrical field such as a washing machine etc.
- Surrounding environment
  - There is water or oil on surface of sensing part, it may cause malfunction.
  - If the bottle for sensing of level is coated by oil etc., it may cause malfunction.
  - Especially, 10mm type has high sensitivity for induced objects, please be careful of water drops.
- Oil
  - Do not let the oil or oil liquid is flowed into the sensor, the case is made by plastic.
DATASHEET Sensor proximity induktif PSN 40-20DN

PS/PSN Series

Rectangular type proximity sensor

Features

- Shortens the time of maintenance by changing the body
- Improves noise resistance by adopting dedicated 2C (DC 3-wire type)
- Built-in protection circuit of reverse power polarity (DC)
- Built-in surge protection circuit (DC/AC) except for PS18 type
- Long life span, high reliability with simple operation
- Available to check the status of operation by LED indicator
- Waterproof structure by IP67 (IEC standard)
- Wide range of applications for replacement of micro switch, limit switch

Specifications

DC 3-wire type

| Model       | PSN1-01DN | PSN1-02DN | PSN1-03DN | PSN1-04DN | PSN1-05DN | PSN1-06DN | PSN1-07DN | PSN1-08DN | PSN1-09DN | PSN1-10DN | PSN1-11DN | PSN1-12DN | PSN1-13DN | PSN1-14DN | PSN1-15DN | PSN1-16DN | PSN1-17DN | PSN1-18DN | PSN1-19DN | PSN1-20DN |
|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Sensing range | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm | 10mm ± 5mm |
| Current consumption | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA | Max. 1mA |

Response frequency (1)

- 500Hz, 750Hz, 250Hz, 60Hz, 45Hz, 20Hz, 6Hz, 5Hz

Voltage

- Max. 1.5V

Affect by Temp.

- ±10% Max for sensing distance at 45%VDC within temperature range of 30°C ± 5°C

Control output

- Max. 0.5A

Inductive coil resistance

- Min. 500Ω (at 50VDC)

Glossary

- 1000VAC 50/60Hz for induction

- 1mm amplitude of frequency at 10 times in each of X, Y, Z directions for 3 hours

- Sheet: 500μm (500μ) in X, Y, Z direction for 3 times

- Inductor: Operation indicator (Red LED)

- Ambient temperature: +5°C to +40°C (at non-fusing station)

- Storage temperature: +5°C to +40°C (at non-fusing station)

- Humidity: 25% to 85%RH

Protection circuit

- Surge protection circuit, Reverse polarity protection

- Surge & short circuit protection

- Overload & short circuit protection

- IP67 (IEC standard)

Unit weight

- Approx. 6g (Approx. 7g)

- Approx. 7g

- Approx. 11g

- Approx. 10g (Approx. 8g)

Approx. weight

- 0.4 to 0.5g

- 0.5 to 0.7g

- 1.1g

- 1.0g (Approx. 8.5g)

(*1) The response frequency is the average value. The standard sensing target is used and the width is set as 3 times of the standard sensing target, 1/2 of the sensing distance for the distance.
# Rectangular Type

## Specifications

### DC 3-wire type

<table>
<thead>
<tr>
<th>Model</th>
<th>PNT17-SSC</th>
<th>PNT17-SSU</th>
<th>PNT17-SSCU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaging distance</td>
<td>5mm ±1%</td>
<td>5mm ±1%</td>
<td>5mm ±1%</td>
</tr>
<tr>
<td>Materials</td>
<td>Must</td>
<td>Must</td>
<td>Must</td>
</tr>
<tr>
<td>Standard sensing target</td>
<td>1600 (±10%) mm [flat]</td>
<td>1600 (±10%) mm [flat]</td>
<td>1600 (±10%) mm [flat]</td>
</tr>
<tr>
<td>Setting distance</td>
<td>2 - 3mm</td>
<td>2 - 3mm</td>
<td>2 - 3mm</td>
</tr>
<tr>
<td>Release voltage (Operating voltage)</td>
<td>220VAC</td>
<td>220VAC</td>
<td>220VAC</td>
</tr>
<tr>
<td>Leakage current</td>
<td>Max. 1mA</td>
<td>Max. 1mA</td>
<td>Max. 1mA</td>
</tr>
<tr>
<td>Response frequency(1)</td>
<td>500Hz</td>
<td>500Hz</td>
<td>500Hz</td>
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<tr>
<td>Technical voltage</td>
<td>110VAC</td>
<td>110VAC</td>
<td>110VAC</td>
</tr>
<tr>
<td>Affected by temp.</td>
<td>85°C (Max. for sensing distance at 220°C within temperature range of +35 - +70°C)</td>
<td>85°C (Max. for sensing distance at 220°C within temperature range of +35 - +70°C)</td>
<td>85°C (Max. for sensing distance at 220°C within temperature range of +35 - +70°C)</td>
</tr>
<tr>
<td>Control output</td>
<td>3, 25mA</td>
<td>3, 25mA</td>
<td>3, 25mA</td>
</tr>
<tr>
<td>Protection resistance</td>
<td>Min. 3GΩ</td>
<td>Min. 3GΩ</td>
<td>Min. 3GΩ</td>
</tr>
<tr>
<td>Discrimination</td>
<td>1500VAC / 250VDC for 1 second</td>
<td>1500VAC / 250VDC for 1 second</td>
<td>1500VAC / 250VDC for 1 second</td>
</tr>
<tr>
<td>Vibration</td>
<td>15mm at frequency of 15 - 500Hz in each of X, Y, Z directions for 3 hours</td>
<td>15mm at frequency of 15 - 500Hz in each of X, Y, Z directions for 3 hours</td>
<td>15mm at frequency of 15 - 500Hz in each of X, Y, Z directions for 3 hours</td>
</tr>
<tr>
<td>Shock</td>
<td>8000g (±5%) in X, Y, Z directions for 3 times</td>
<td>8000g (±5%) in X, Y, Z directions for 3 times</td>
<td>8000g (±5%) in X, Y, Z directions for 3 times</td>
</tr>
<tr>
<td>Indicator</td>
<td>Operation indicator (Red LED)</td>
<td>Operation indicator (Red LED)</td>
<td>Operation indicator (Red LED)</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-30°C - +70°C (for non-freezing status)</td>
<td>-30°C - +70°C (for non-freezing status)</td>
<td>-30°C - +70°C (for non-freezing status)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-20°C - +80°C (for non-freezing status)</td>
<td>-20°C - +80°C (for non-freezing status)</td>
<td>-20°C - +80°C (for non-freezing status)</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>25 - 95%RH</td>
<td>25 - 95%RH</td>
<td>25 - 95%RH</td>
</tr>
<tr>
<td>Protection circuit</td>
<td>Surge protection circuit</td>
<td>Surge protection circuit</td>
<td>Surge protection circuit</td>
</tr>
<tr>
<td>Approval</td>
<td>C (CE)</td>
<td>C (CE)</td>
<td>C (CE)</td>
</tr>
<tr>
<td>Unit weight</td>
<td>Approx. 0.4kg</td>
<td>Approx. 0.4kg</td>
<td>Approx. 0.4kg</td>
</tr>
</tbody>
</table>

(1) The response frequency is the average value. The standard sensing target is used and the width is set as 5 times of the standard sensing target. 1/5 of the sensing distance for the distance.

### AC 2-wire type

<table>
<thead>
<tr>
<th>Model</th>
<th>PNT28-SSC</th>
<th>PNT28-SSU</th>
<th>PNT28-SSCU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaging distance</td>
<td>5mm ±1%</td>
<td>5mm ±1%</td>
<td>5mm ±1%</td>
</tr>
<tr>
<td>Materials</td>
<td>Must</td>
<td>Must</td>
<td>Must</td>
</tr>
<tr>
<td>Standard sensing target</td>
<td>1600 (±10%) mm [flat]</td>
<td>1600 (±10%) mm [flat]</td>
<td>1600 (±10%) mm [flat]</td>
</tr>
<tr>
<td>Setting distance</td>
<td>2 - 3mm</td>
<td>2 - 3mm</td>
<td>2 - 3mm</td>
</tr>
<tr>
<td>Release voltage (Operating voltage)</td>
<td>220VAC</td>
<td>220VAC</td>
<td>220VAC</td>
</tr>
<tr>
<td>Leakage current</td>
<td>Max. 1mA</td>
<td>Max. 1mA</td>
<td>Max. 1mA</td>
</tr>
<tr>
<td>Response frequency(1)</td>
<td>500Hz</td>
<td>500Hz</td>
<td>500Hz</td>
</tr>
<tr>
<td>Technical voltage</td>
<td>110VAC</td>
<td>110VAC</td>
<td>110VAC</td>
</tr>
<tr>
<td>Affected by temp.</td>
<td>85°C (Max. for sensing distance at 220°C within temperature range of +35 - +70°C)</td>
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</tr>
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<td>Operation indicator (Red LED)</td>
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<tr>
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<td>-20°C - +80°C (for non-freezing status)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-30°C - +80°C (for non-freezing status)</td>
<td>-30°C - +80°C (for non-freezing status)</td>
<td>-30°C - +80°C (for non-freezing status)</td>
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<td>25 - 95%RH</td>
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<tr>
<td>Approval</td>
<td>C (CE)</td>
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<td>C (CE)</td>
</tr>
<tr>
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<td>Approx. 0.4kg</td>
</tr>
</tbody>
</table>

(1) The response frequency is the average value. The standard sensing target is used and the width is set as 5 times of the standard sensing target. 1/5 of the sensing distance for the distance.

---

A-16
Rectangular Type

Control output diagram

ODC 3-wire type

Connections

ODC 3-wire type

ODC 2-wire type

OAC 2-wire type

Connections

ODC 2-wire type

OAC 2-wire type

A-18
PS/PSN Series

Proper Usage

1. Differential frequency
   - PSN17-2DN-F
   - PSN17-3DN-F
   - PSN27-2DN-F
   - PSN27-3DN-F

   When installing several proximity sensors closely, it may cause malfunction due to mutual interference. Therefore, please use differential frequency for the application.

2. Connection of the power supply
   - AC POWER
   - Load

   When using DC 2-wire type, a load must be connected before applying power. Otherwise, components can be damaged.

3. In case of the load current is small

   a) AC 2-wire type

   ![Diagram]

   It may cause return failure of load by residual voltage.

   1) If the load current is under 1mA, please make sure the residual voltage is less than the return voltage of the lead by connecting a bleeder resistor in parallel with the load as shown in the diagram.

   \[ V_r = \frac{I}{R} \]

   \[ P_r = \frac{V_r^2}{R} \]

   [V_r: Action current of load, R: Bleeder resistance, P_r: Permissible power]

   Please make the current on proximity sensor smaller than the return current of load by connecting a bleeder resistor in parallel.

   \[ V_s = \frac{V_a}{N} \]

   \[ P_s = \frac{V_s^2}{R} \]

   [V_s: Power supply, V_a: Min. action current of proximity sensor, N: Number of bleeder resistance unit]

   b) DC 2-wire type

   ![Diagram]

   It may cause return failure of load by residual voltage.

   Conditions:
   - \( A \\leq 10 \) for PSN17
   - \( A \\leq 20 \) for PSN27
   - \( A \\leq 30 \) for PSN1-BD
   - \( A \\leq 50 \) for PSN2-BD

   \[ L = \frac{L_{min}}{N} \]

   [L: Length, L_{min}: Minimum length unit]

   \[ N = \frac{L_{max}}{L_{min}} \]

   [N: Number of sensors]

Mutual-Interference & Influence by surrounding metals

When several proximity sensors are mounted closely, malfunction of sensor may be caused due to mutual interference. Therefore, be sure to provide a minimum distance between the two sensors, as below.

![Diagram]

<table>
<thead>
<tr>
<th>Sensor</th>
<th>PSN17</th>
<th>PSN27</th>
<th>PSN1-BD</th>
<th>PSN2-BD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>24</td>
<td>26</td>
<td>48</td>
<td>80</td>
</tr>
<tr>
<td>Width</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Height</td>
<td>8</td>
<td>12</td>
<td>15</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensor</th>
<th>PSN17</th>
<th>PSN27</th>
<th>PSN1-BD</th>
<th>PSN2-BD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>30</td>
<td>38</td>
<td>40</td>
<td>55</td>
</tr>
<tr>
<td>Width</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Height</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

J-33

A-19
DATASHEET PHOTODIODA

Features
• Peak sensitivity wavelength matching with infrared LED (λ= 950nm)
• 4.8mm x 5.5mm side view package
• Black colored visible light cut-off lens

Application
• Infrared remote controllers for TVs, VCRs, Audio equipment etc

Outline Dimensions

P/N Connections
1. Anode
2. Cathode
Absolute maximum ratings

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Voltage</td>
<td>V_{R}</td>
<td>-40</td>
<td>V</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>P_{D}</td>
<td>170</td>
<td>mW</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>T_{op}</td>
<td>-20 70</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>T_{st}</td>
<td>-25 85</td>
<td></td>
</tr>
<tr>
<td>* Soldering Temperature</td>
<td>T_{sd}</td>
<td>260 for 5 seconds</td>
<td></td>
</tr>
</tbody>
</table>

*1. Keep the distance more than 2.0mm from PCB to the bottom of Photo Diode package

Electrical Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Short Circuit Current</strong></td>
<td>I_{SC}</td>
<td>E_{in}=9mW/1</td>
<td>-40</td>
<td>-</td>
<td>-</td>
<td>uA</td>
</tr>
<tr>
<td>Dark Current</td>
<td>I_{D}</td>
<td>V_{in}=10V</td>
<td>-</td>
<td>-</td>
<td>-50</td>
<td>nA</td>
</tr>
<tr>
<td>Capacitance</td>
<td>C_{0}</td>
<td>V_{in}=10V, f=1MHz</td>
<td>-</td>
<td>-</td>
<td>-10</td>
<td>pF</td>
</tr>
<tr>
<td>Spectral Sensitivity</td>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
<td>840~1,050</td>
<td>nm</td>
</tr>
<tr>
<td>Peak Sensitivity Wavelength</td>
<td>p</td>
<td></td>
<td>-</td>
<td>-</td>
<td>940</td>
<td>nm</td>
</tr>
<tr>
<td>Half angle</td>
<td>θ_{1/2}</td>
<td></td>
<td>-</td>
<td>-</td>
<td>46</td>
<td>deg</td>
</tr>
</tbody>
</table>

*1. E_{in}: Irradiance by infrared LED light source(λ_{0}=940nm)
Characteristic Diagrams

Fig. 1 $I_{SC} - E_s$

Fig. 2 $I_D - T_a$

Fig. 3 $C_r - V_r$

Fig. 4 $I_o - V_x$

Fig. 5 Spectrum Sensitivity

Fig. 5-I Radiation Diagram
DATASHEET MOTOR SERVO

Parallax Standard Servo (#900-00005)
The Parallax Standard Servo is ideal for robotics and basic movement projects.

Features
- Holds any position between 0 and 180 degrees
- 43.1 oz-in torque at 6 V
- Accepts four mounting screws
- Easy to interface with any Parallax microcontroller
- High precision gear made of the POM (polyacetal) resin makes the operation smooth causing no backlash.
- Manufactured for Parallax exclusively by Futaba

Technical Specifications
- Power requirements: 4 to 6 VDC* (see Power Requirement Notes below)
- Maximum current draw: 140 +/- 50 mA at 6 VDC when operating in no load conditions
- 15 mA when in static state
- Communication: Pulse-width modulation
- Dimensions approx. 2.2 x 0.8 x 1.6 in (5.68 x 1.9 x 40.6 cm) excluding servo horn
- Operating temperature range: 14 to 122°F (-10 to 50°C)
- Weight: 1.55 oz (44 g)

*Power Requirement Notes
Futaba specifies 4-6 VDC for this servo. However, we find that this servo is tolerant of a 9 V battery for short periods of time when there is no load, as used in some activities in the Stamps in Class series of tutorials. (Slight jittering may be observed when batteries are fresh; this does not cause damage). Do not use this servo with an unregulated wall-mount supply, or a regulated wall mount supply exceeding 6 VDC.

Servo current draw can spike while under load. Be sure that your application's power supply and voltage regulator is prepared to supply adequate current for all servos used. Do not try to power this servo directly from a BASIC Stamp module’s Vdd or Vin pins; do not connect the servo’s Vcc line directly to the BASIC Stamp module’s Vcc pin.
Quick-Start Circuit

Vdd = microcontroller voltage supply
Vservo = 4 to 6 VDC, regulated or battery (See Error! Reference source not found., page Error! Bookmark not defined.)
I/O = PWM TTL or CMOS output signal, 3.3 to 5 V, not to exceed Vservo + 0.2 V

Specifications

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (White)</td>
<td>Signal</td>
<td>Input: TTL or CMOS</td>
<td>3.3</td>
<td>5.0</td>
<td>Vservo + 0.2</td>
<td>V</td>
</tr>
<tr>
<td>2 (Red)</td>
<td>Vservo</td>
<td>Power Supply</td>
<td>4.0</td>
<td>5.0</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>3 (Black)</td>
<td>Vss</td>
<td>Ground</td>
<td></td>
<td>0</td>
<td>0</td>
<td>V</td>
</tr>
</tbody>
</table>

Power Precautions

- Do not use this servo with an unregulated wall-mount supply. Such power supplies may deliver variable voltage far above the stated voltage.
- Do not power this servo through the BASIC Stamp Module's Vdd pin.
- Servo current draw can spike while under peak load; be sure your application's regulator is prepared to supply adequate current for all servos used in combination.
- Some Stamps in Class tutorials, such as "What's a Microcontroller?" instruct the user to power these servos with a 9V battery when using a Homework Board; this does not cause damage.

Board of Education Jumper Connection

When connecting the servo to the Board of Education Rev C's servo header, be sure the jumper is set to Vdd as shown in the figure below. Failure to place the jumper at this setting can cause damage to your servo.
Communication Protocol

The Parallax Standard Servo is controlled through pulse width modulation, where the position of the servo shaft is dependent on the duration of the pulse. In order to hold its position, the servo needs to receive a pulse every 20 ms. Below is a sample timing diagram for the center position of the Parallax Standard Servo.

BASIC Stamp Programming Examples

BASIC Stamp 2 uses the PULSOUT command that sets the I/O pin to an output and sends a pulse of a specified duration.

PULSOUT Pin, Duration

The example shown below for a BASIC Stamp 2 causes a servo connected to BASIC Stamp I/O pin 1 to turn to and hold its center position for approximately 5 seconds.

```basic
* (56)STAMP BS2
* (8)BASIC 2.5

counter VAR Word
FOR counter = 1 TO 100
    PULSOUT 1, 750
    PAUSE 20
NEXT
```

For more examples with the BASIC Stamp 2, see "What's a Microcontroller?" Chapter 4, available for free download from the 90005 product page at www.parallax.com.

Different BASIC Stamp modules use different units for the PULSOUT command's Duration argument. When adapting BS2 code to another BASIC Stamp model, you may need to make adjustments. The table below lists the PULSOUT ranges for each BASIC Stamp microcontroller. See the BASIC Stamp Manual or BASIC Stamp Editor Help for more information.
<table>
<thead>
<tr>
<th>BASIC Stamp Module</th>
<th>1.3 ms</th>
<th>1.5 ms</th>
<th>1.7 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS1</td>
<td>100</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>BS2, BS2e, BS2pe</td>
<td>500</td>
<td>750</td>
<td>1000</td>
</tr>
<tr>
<td>BS2ex, BS2px, BS2p24/40</td>
<td>1250</td>
<td>1875</td>
<td>2500</td>
</tr>
</tbody>
</table>

You can figure out what the PULSOUT command’s *Duration* argument has to be when you know how long you want the pulse to last. Just divide the PULSOUT *Duration* units into the time you want the pulse to last:

\[
\text{Duration Argument} = \frac{\text{Pulse Duration (ms)}}{\text{PULSOUT Duration units (μs)}}
\]

**Propeller Application**

Using counter modules, you can easily center the servo by using the code below. For more information about counter modules and PWM with the Propeller, see Chapter 7 in the Propeller Education Kit Labs: Fundamentals text, which is included as a PDF in the Propeller Tool IDE Help.

```propeller
CenterServo.spin

; Config clock and PULSOUT
_clkmode = xtal1 + p116x
_xinfreq = 5_000_000

; Define constants
 İntsc[30..26] := $E80100
_INTsc[8..0] := 0
_find := 1
_dira[0] :=

; Set cycle and high times
_tC := (clkfreq/1_000_000) * 21_500
_tha := (clkfreq/1_000_000) * 1500
_t := ctt

; Main loop
repeat
  phs := +tha
  t := tC
  waitcnt(t) ; Wait for next cycle
end

; Repeat PWM signal
  Set up the pulse
  Calculate next cycle
  Wait for next cycle
```

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LAMPIRAN D
PHOTO OBJEK SAMPAH
LAMPIRAN E
GAMBAR REALISASI ALAT
Tampak depan

Tampak belakang
Tampak samping kiri

Tampak samping kanan
Tampilan output pada LCD