LAMPIRAN

Datasheet Sensor Warna TCS3200

---

**TCS3200, TCS3210**

**COLOR LIGHT-TO-FREQUENCY PROGRAMMABLE CONVERTER**

- High-Resolution Conversion of Light Intensity to Frequency
- Programmable Color and Full-Scale Output Frequency
- Communicates Directly With a Microcontroller
- Single-Supply Operation (2.7 V to 5.5 V)
- Power Down Feature
- Nonlinearity Error Typically 0.2% at 50 kHz
- Stable 200 ppm/°C Temperature Coefficient
- Low-Profile Lead (Pb) Free and RoHS Compliant Surface-Mount Package

**Description**

The TCS3200 and TCS3210 programmable color light-to-frequency converters that combine configurable silicon photodiodes and a current-to-frequency converter on a single monolithic CMOS integrated circuit. The output is a square wave (50% duty cycle) with frequency directly proportional to light intensity (irradiance).

The full-scale output frequency can be scaled by one of three preset values via two control input pins. Digital inputs and digital output allow direct interface to a microcontroller or other logic circuitry. Output enable (OE) places the output in the high-impedance state for multiple-unit sharing of a microcontroller input line.

In the TCS3200, the light-to-frequency converter reads an 8 × 8 array of photodiodes. Sixteen photodiodes have blue filters, 16 photodiodes have green filters, 16 photodiodes have red filters, and 16 photodiodes are clear with no filters.

In the TCS3210, the light-to-frequency converter reads a 4 × 6 array of photodiodes. Six photodiodes have blue filters, 6 photodiodes have green filters, 6 photodiodes have red filters, and 6 photodiodes are clear with no filters.

The four types (colors) of photodiodes are interdigitated to minimize the effect of non-uniformity of incident irradiance. All photodiodes of the same color are connected in parallel. Pins S2 and S3 are used to select which group of photodiodes (red, green, blue, clear) are active. Photodiodes are 110 µm × 110 µm in size and are on 134-µm centers.

**Functional Block Diagram**

[Diagram showing the functional block of the TCS3200 and TCS3210 sensors]
TCS3200, TCS3210 PROGRAMMABLE COLOR LIGHT-TO-FREQUENCY CONVERTER

Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted)¹

- Supply voltage, \( V_{DD} \) (see Note 1) \( \leq 6 \) V
- Input voltage range, all inputs, \( V_I \) \( \leq 0.3 \) V to \( V_{DD} + 0.3 \) V
- Operating free-air temperature range, \( T_A \) (see Note 2) \(-40°C \) to \( 85°C \)
- Storage temperature range (see Note 3) \(-40°C \) to \( 85°C \)
- Solder conditions in accordance with JEDEC J-STD-020A, maximum temperature \( 260°C \)

¹ Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES:
1. All voltage values are with respect to GND.
2. Long-term storage or operation above 70°C could cause package yellowing that will lower the sensitivity to wavelengths < 500nm.
3. The device may be hand-soldered provided that heat is applied only to the solder pad and no contact is made between the tip of the solder iron and the device lead. The maximum time heat should be applied to the device is 5 seconds.

Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MIN</th>
<th>NOM</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage, ( V_{DD} )</td>
<td>2.7</td>
<td>5</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>High-level input voltage, ( V_{IH} )</td>
<td>( V_{DD} = 2.7 ) V to 5.5 V</td>
<td>( V_{DD} )</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Low-level input voltage, ( V_{IL} )</td>
<td>0</td>
<td>0.8</td>
<td>0.8</td>
<td>V</td>
</tr>
<tr>
<td>Operating free-air temperature range, ( T_A )</td>
<td>(-40°C ) to 70°C</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Electrical Characteristics at \( T_A = 25°C \), \( V_{DD} = 5 \) V (unless otherwise noted)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{CH} ) High-level output voltage</td>
<td>( I_{OL} = -2 ) mA</td>
<td>4</td>
<td>4.5</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>( V_{CL} ) Low-level output voltage</td>
<td>( I_{OL} = 2 ) mA</td>
<td>0.25</td>
<td>0.40</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>( I_{IH} ) High-level input current</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>( I_{IL} ) Low-level input current</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>( I_{DD} ) Supply current</td>
<td>Power-on modes</td>
<td>1.4</td>
<td>2</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>Power-down modes</td>
<td>0.1</td>
<td></td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>Full-scale frequency (See Note 4)</td>
<td>( 30 ) kHz</td>
<td>500</td>
<td>600</td>
<td></td>
<td>kHz</td>
</tr>
<tr>
<td>Temperature coefficient of responsivity</td>
<td>( 70°C )</td>
<td>200</td>
<td></td>
<td></td>
<td>ppm/K</td>
</tr>
</tbody>
</table>

NOTE 4: Full-scale frequency is the maximum operating frequency of the device without saturation.
The Arduino Uno is a microcontroller board based on the ATMega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.
<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller</td>
<td>ATmega328</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>5V</td>
</tr>
<tr>
<td>Input Voltage (recommended)</td>
<td>7-12V</td>
</tr>
<tr>
<td>Input Voltage (limits)</td>
<td>6-20V</td>
</tr>
<tr>
<td>Digital I/O Pins</td>
<td>14 (of which 6 provide PWM output)</td>
</tr>
<tr>
<td>Analog Input Pins</td>
<td>6</td>
</tr>
<tr>
<td>DC Current per I/O Pin</td>
<td>40 mA</td>
</tr>
<tr>
<td>DC Current for 3.3V Pin</td>
<td>50 mA</td>
</tr>
<tr>
<td>Flash Memory</td>
<td>32 KB of which 0.5 KB used by bootloader</td>
</tr>
<tr>
<td>SRAM</td>
<td>2 KB</td>
</tr>
<tr>
<td>EEPROM</td>
<td>1 KB</td>
</tr>
<tr>
<td>Clock Speed</td>
<td>16 MHz</td>
</tr>
</tbody>
</table>

**The Board**

- **TX/RX Leds**: Transmitter and Receiver Leds
- **Test Led 13**: Internal test LED
- **Digital Pins**: Input and output pins for digital signals
- **USB Interface**: Connection for power and data
- **Power Led**: Indicator for power status
- **ICSP Header**: In-Circuit Serial Programming header
- **Reset Button**: Initiates reset
- **External Power Supply**: For external power source
- **I2C**: Inter-Integrated Circuit bus
- **power pins analog pins**: Connectors for power and analog signals
Datasheet Motor Servo MG995

MG995 High Speed
Metal Gear Dual Ball Bearing Servo

The unit comes complete with 30cm wire and 3 pin 'S' type female header connector that fits most receivers, including Futaba, JR, GWS, Cirrus, Blue Bird, Blue Arrow, Corona, Berg, Spektrum and Hitec.

This high-speed standard servo can rotate approximately 120 degrees (60 in each direction). You can use any servo code, hardware or library to control these servos, so it's great for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. The MG995 Metal Gear Servo also comes with a selection of arms and hardware to get you set up nice and fast!

Specifications

- Weight: 55 g
- Dimension: 40.7 x 19.7 x 42.9 mm approx.
- Stall torque: 8.5 kgf-cm (4.8 V), 10 kgf-cm (6 V)
- Operating speed: 0.2 s/60° (4.8 V), 0.16 s/60° (6 V)
- Operating voltage: 4.8 V a 7.2 V
- Dead band width: 5 μs
- Stable and shock proof double ball bearing design
- Temperature range: 0 °C – 55 °C
PWM = Orange (▲▼)
Vcc = Red (+)
Ground = Brown (-)

4.8 V to 7.2 V
Power and Signal

Duty Cycle

20 ms (50 Hz)
PWM Period
Program Lengan Robot Pemilah Barang Berdasarkan Warna

#include <Servo.h>

Servo motorServo1; //Base
Servo motorServo2; //SHoulder
Servo motorServo3; //ELbow
Servo motorServo4; //Wrist
Servo motorServo5; //Gripper

int s2 = 11;       //S2 Sensor Ke Pin 11 Arduino
int s3 = 12;       //S3 Sensor Ke Pin 12 Arduino
int outPin = 13;   //Output Sensor Ke Pin 13 Arduino

void setup() {
    pinMode(s2, OUTPUT);
    pinMode(s3, OUTPUT);
    pinMode(outPin, INPUT);
    Serial.begin(9600); //Menyalakan Port Serial Monitor
    motorServo1.attach(2);
    motorServo2.attach(3);
    motorServo3.attach(4);
    motorServo4.attach(5);
    motorServo5.attach(6);
}

void loop() {

}
//Posisi awal
motorServo1.write(90);
motorServo2.write(90);
motorServo3.write(90);
motorServo4.write(90);
motorServo5.write(0);
delay(2000);

//Menuju lokasi objek
motorServo4.write(4);
delay(1000);
motorServo1.write(180);
delay(1000);
motorServo2.write(73);
delay(1000);
motorServo3.write(140);
delay(1000);
motorServo5.write(160);
delay(1000);

//Identifikasi Warna
char color

switch(color) {
    case 'r':    //Warna Merah
        motorServo2.write(90);
delay(1000);
        motorServo3.write(140);
        break;
}


delay(1000);
motorServo1.write(0);
delay(1000);
motorServo4.write(40);
delay(2000);
motorServo5.write(0);
delay(1000);
    case 'g':    //Warna Hijau

motorServo2.write(90);
delay(1000);
motorServo3.write(140);
delay(1000);
motorServo1.write(15);
delay(1000);
motorServo4.write(40);
delay(2000);
motorServo5.write(0);
delay(1000);
    case 'b':    //Warna Biru

motorServo2.write(90);
delay(1000);
motorServo3.write(140);
delay(1000);
motorServo1.write(30);
delay(1000);
motorServo4.write(40);
delay(2000);
motorServo5.write(0);
delay(1000);
    case 'u':   //Warna Tidak Terdeteksi
        motorServo1.write(90);
motorServo2.write(90);
motorServo3.write(90);
motorServo4.write(90);
motorServo5.write(90);
delay(1000);
        delay(5000); //pause
    }
delay(5000);
return;
}
char get_color() {
    int R;
    int G;
    int B;
//Membaca Komponen Merah
digitalWrite(s2, LOW);
digitalWrite(s3, LOW);
R = pulseIn(outPin, LOW);

//Membaca Komponen Hijau
digitalWrite(s2, HIGH);
digitalWrite(s3, HIGH);
G = pulseIn(outPin, LOW);

//Membaca Komponen Biru
digitalWrite(s2, LOW);
digitalWrite(s3, HIGH);
B = pulseIn(outPin, LOW);

if((R>5) && (R<11) && (G>16) && (G<26) && (B>16) && (B<26))     //Warna Merah
{
    if (DEBUG) Serial.println("Warna Merah");
    color = 'r';
}
else if((R>28) && (R<38) && (G>19) && (G<25) && (B>16) && (B<25))       //Warna Biru
{
    if (DEBUG) Serial.println("Warna Biru");
    color = 'b';
}
else if((R>14) && (R<20) && (G>7) && (G<13) && (B>7) && (B<13))          //Warna Hijau
{

Serial.println("Warna Hijau");
color = 'g';
}
else
{
    Serial.print("R = ");
    Serial.print(R);
    Serial.print(" G = ");
    Serial.print(G);
    Serial.print(" B = ");
    Serial.println(B);
}
color = 'u'; //Tidak Terdeteksi
}