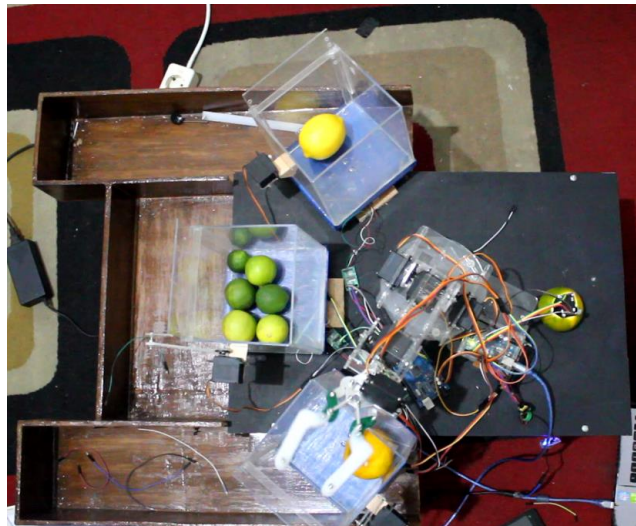


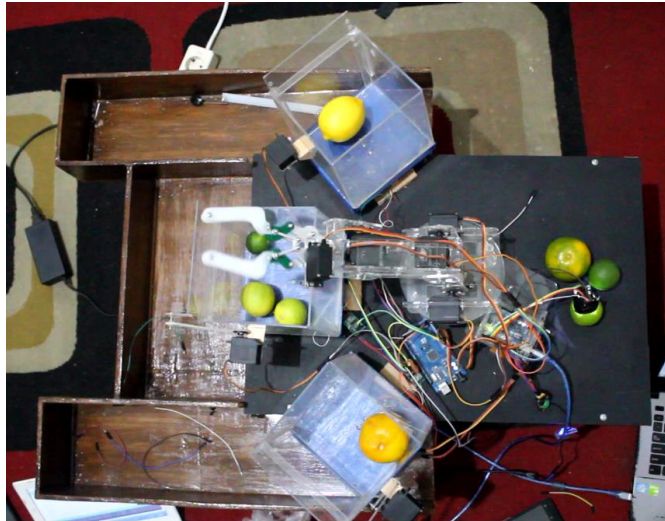
LAMPIRAN A



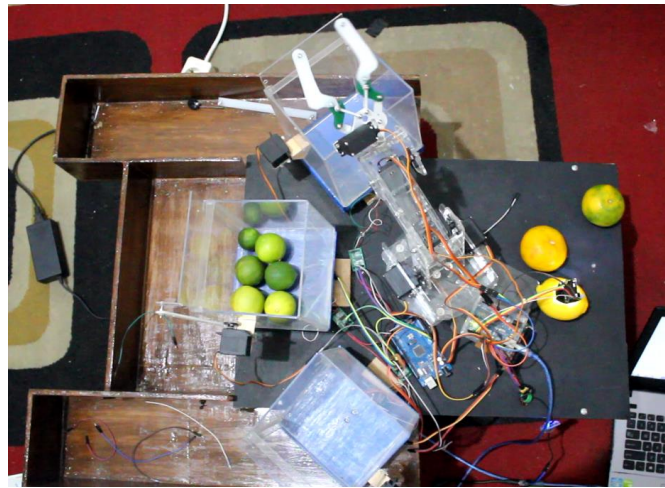
Gambar Alat Keseluruhan Tampak Depan



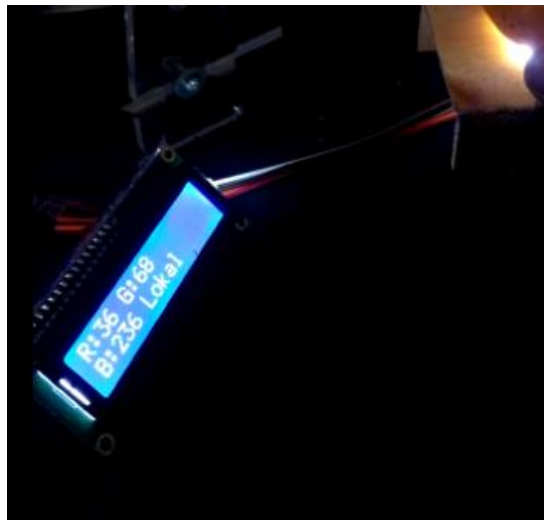
Gambar *Arm Robot* Pada Posisi Di Kotak 1 Objek Jeruk Lokal



Gambar *Arm Robot* Pada Posisi Di Kotak 2 Objek Jeruk Nipis

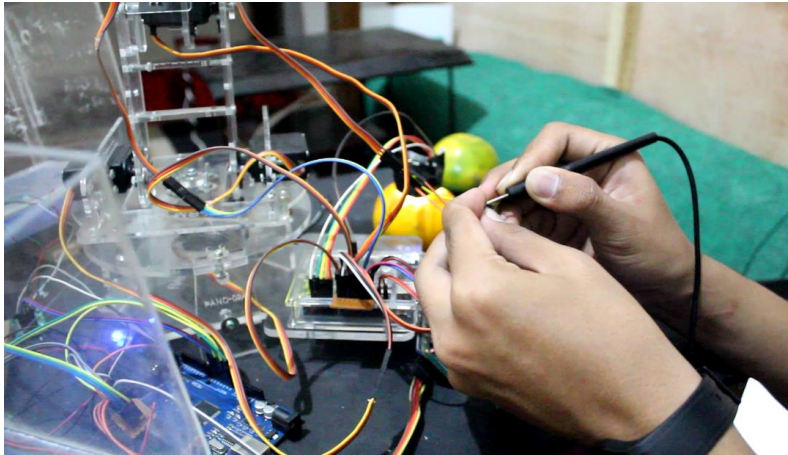


Gambar *Arm Robot* Pada Posisi Di Kotak 3 Objek Jeruk Lemon



Gambar Tampilan pada LCD

LAMPIRAN B



Gambar Saat Proses Pengukuran



Gambar Proses Pengukuran Tegangan Motor Servo



Gambar Proses Pengukuran Tegangan Motor Servo



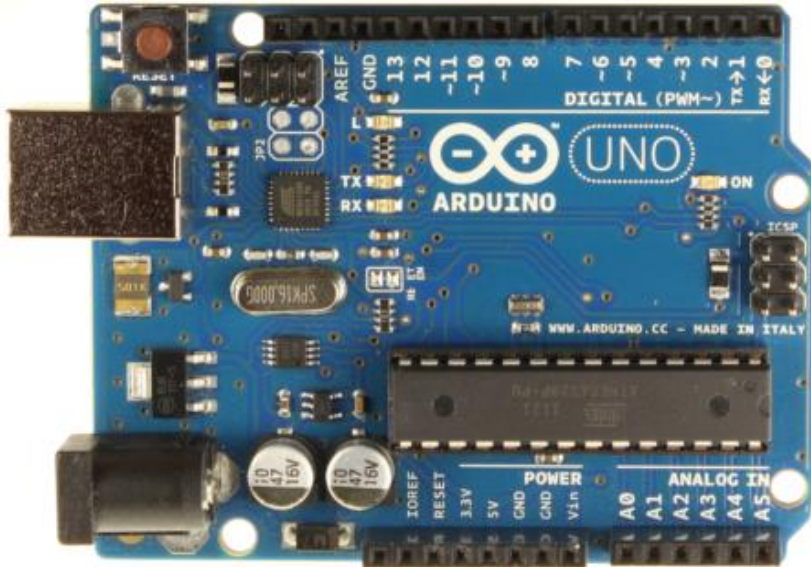
Gambar Proses Pengukuran Arus Motor Servo



Gambar Proses Pengukuran Arus Motor Servo

AIAA OC Rocketry (Revision 3 April 27, 2014 - <http://aiaaocrocketry.org>)

ARDUINO UNO Revision 3 BOARD



The Arduino Uno is one of the most common and widely used Arduino processor boards. There are a wide variety of shields (plug in boards adding functionality). It is relatively inexpensive (about \$25 - \$35). The latest version as of this writing (3/2014) is Revision 3 (r3):

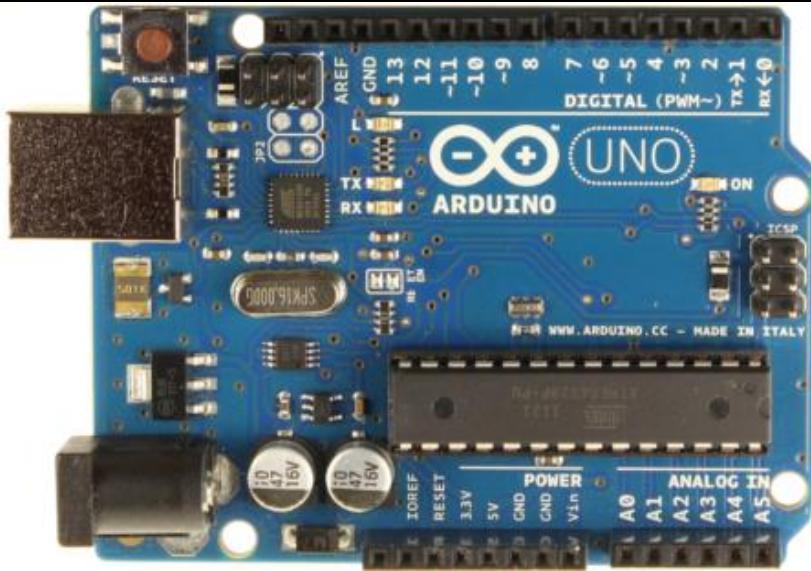
- Revision 2 added a pull-down resistor to the 8U2 HWB line, making it easier to put into DFU (Device Firmware Update) mode
- Revision 3 added
 - SDA and SCL pins are now brought out to the header near the AREF pin (upper left on picture). SDA and SCL are for the I2C interface
 - IOREF pin (middle lower on picture that allows shields to adapt to the voltage provided
 - Another pin not connected reserved for future use

The board can be powered from the USB connector (usually up to 500ma for all electronics including shield), or from the 2.1mm barrel jack using a separate power supply when you cannot connect the board to the PC's USB port.

Links:

- Arduino web site: <http://www.arduino.cc/>
- Arduino Uno overview and image source: <http://arduino.cc/en/Main/arduinoBoardUno#.UxNpBk2YZuG>
- DFU Mode (Device Firmware update) explanation: <http://arduino.cc/en/Hacking/DFUProgramming8U2#.UxNqXE2YZuE>
- Arduino Uno schematic: http://arduino.cc/en/uploads/Main/Arduino_Uno_Rev3-schematic.pdf
- Arduino Uno Eagle PCB Files: http://arduino.cc/en/uploads/Main/arduino_Uno_Rev3-02-TH.zip
- Eagle PCB design software (use License = "Run as Freeware"): <https://www.cadsoftusa.com/download-eagle/>
- Hardware Index – past and present boards: <http://arduino.cc/en/Main/Boards#.UxNq9U2YZuE>
- Specifications comparison chart: <http://arduino.cc/en/Products.Compare#.UxOJGk2YZuF>
- Board comparison chart: <http://arduino.cc/en/Products.Compare#.UxN6oE2YZuE>
- Sources
 - MP3Car: <http://store.mp3car.com/SearchResults.asp?Search=arduino>
 - Sparkfun: <https://www.sparkfun.com/>
 - Adafruit: <http://www.adafruit.com/category/17>
 - Amazon: http://www.amazon.com/s/ref=nb_sb_noss_1?url=search-alias%3Daps&field-keywords=Arduino
 - Pololu: <http://www.pololu.com/search?query=Arduino>

ARDUINO UNO Revision 3 Specifications

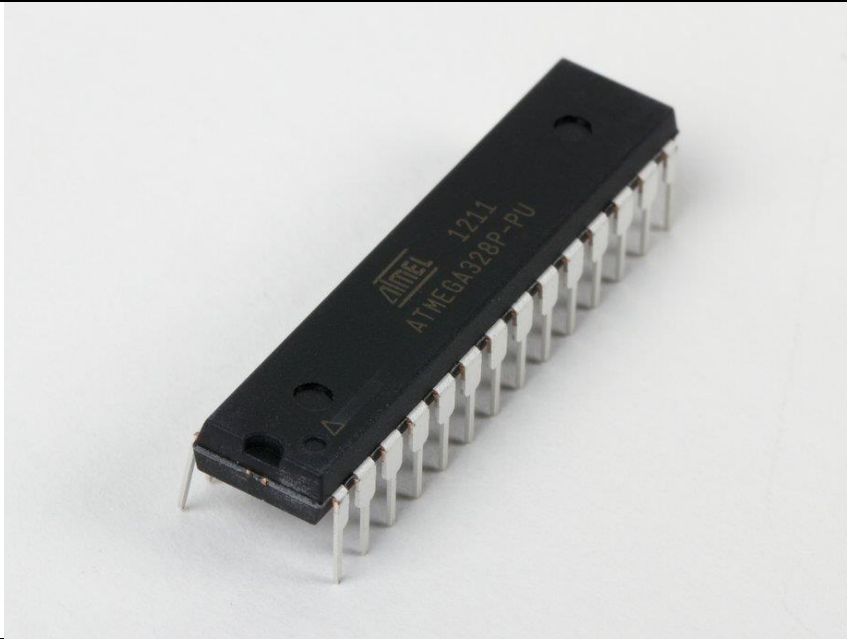


- Microcontroller: ATmega328
- Operating Voltage: 5V
- Uno Board Recommended Input Voltage: 7 – 12 V
- Uno Board Input Voltage Limits: 6 – 20 V
- Digital I/O Pins: 14 total – 6 of which can be PWM
- Analog Input Pins: 6
- Maximum DC Current per I/O pin at 5VDC: 40ma
- Maximum DC Current per I/O pin at 3.3 VDC: 50ma
- Flash Memory: 32KB (0.5KB used by bootloader)
- SRAM Memory: 2KB
- EEPROM: 1KB
- Clock Speed: 16 MHz

Links:

- Arduino specifications and image page: <http://arduino.cc/en/Main/arduinoBoardUno#UxOOLk2YZuH>

ARDUINO UNO Revision 3 Processor Peripherals (Atmel ATmega 328)

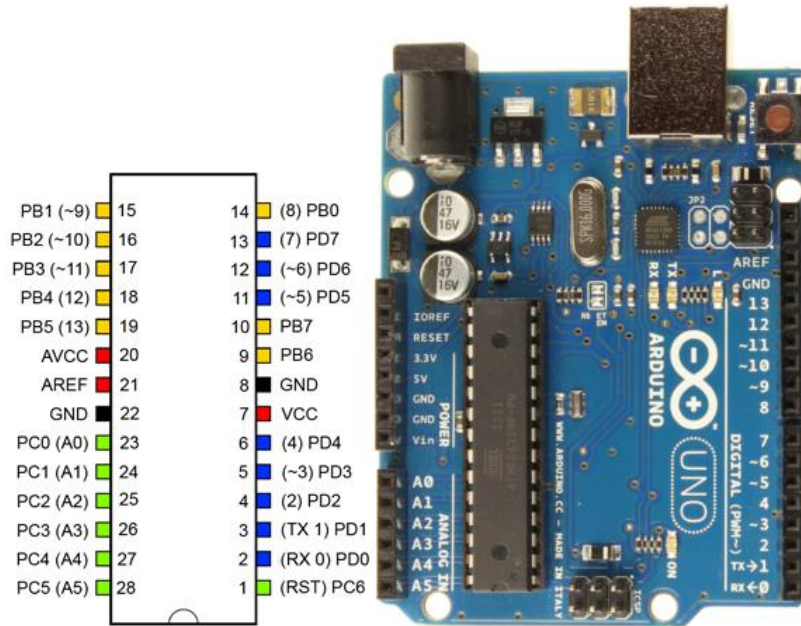


- Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
- One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
- Real Time Counter with Separate Oscillator
- Six PWM channels
- Six channel 10 bit ADC including temperature measurement
- Programmable Serial USART
- Master/Slave SPI Serial Interface
- Byte-oriented 2 wire Serial Interface (Philips I2C compatible)
- Programmable Watchdog Timer with Separate On-chip Oscillator
- On-chip Analog Comparator

Links:

- Source of above diagram: <http://tekkpinoy.com/wp-content/uploads/2013/10/1.jpg>
- AT Mega 328 datasheet: <http://www.atmel.com/Images/doc8161.pdf>

ARDUINO UNO Revision 3 and ATmega328 processor



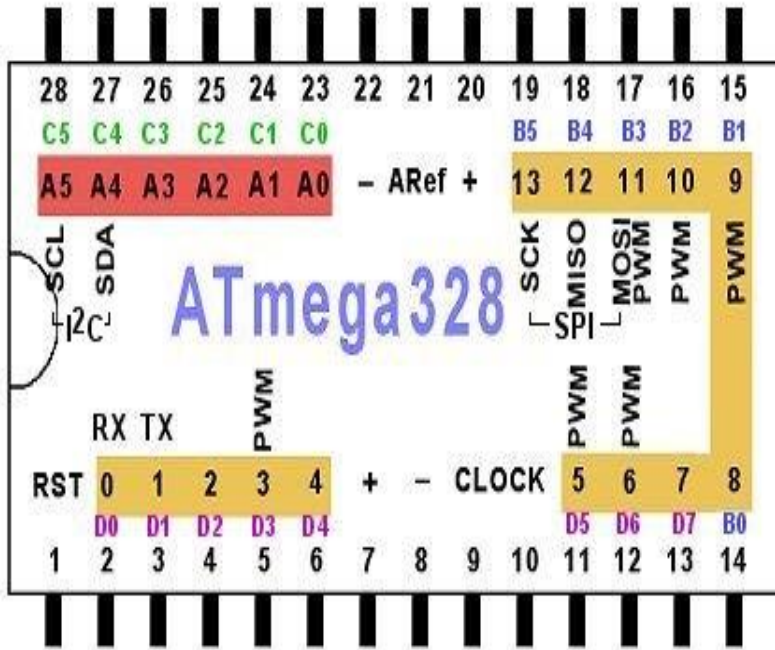
The Arduino board makes it very easy to use the ATmega328 processor by providing easy access to most of the pins via the headers, In addition, it provides:

- 5 VDC regulated power from the 6 – 20 VDC input jack
- 3.3 VDC regulated power available for other electronics
- The crystal oscillator
- A reset switch
- USB access to the serial port
- Headers for connection and for shields

Links:

- Arduino specifications and image page: <http://arduino.cc/en/Main/arduinoBoardUno#UxOOLk2YZuH>
- ATmega328 processor image modified from image found at: <http://www.protostack.com/microcontrollers/atmega328-pu-atmel-8-bit-32k-avr-microcontroller>

ARDUINO UNO Revision 3 Processor Pinout (Atmel ATmega 328) – Commonly Used



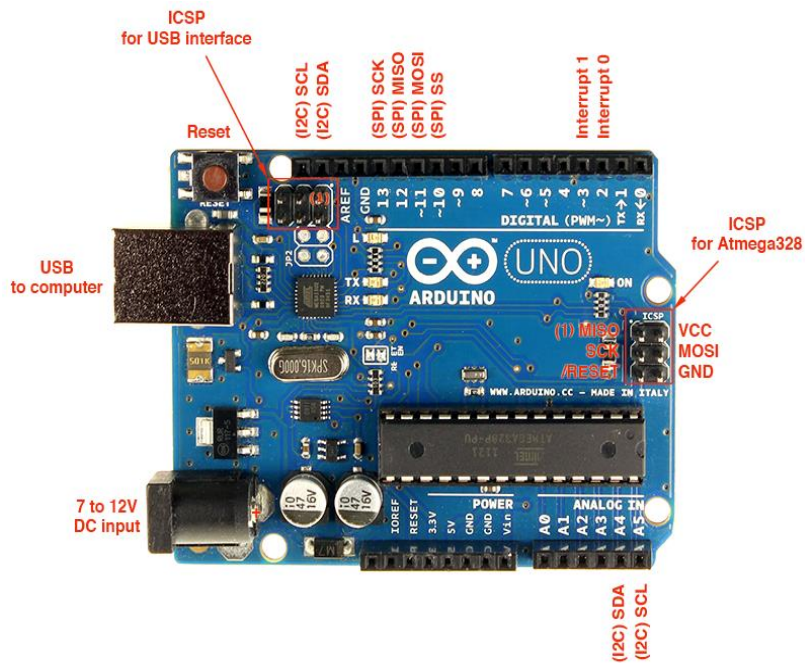
Pin Definition

- PORT B (PB0 – PB7) is an 8 bit bidirectional I/O port with internal pull-ups. Processor pins 14 – 17 bring PB0 to PB5 out
 - PB0 – PB5 are also interrupts 0-5 respectively
 - PB1 can also be used as a PWM output
 - PB2 can also be SPI Bus Master Slave Select (*SS) or PWM output
 - PB3 can also be or SPI Bus Master Out/Slave In (MOSI) or PWM output
 - PB4 can also be SPI Bus Master In/Slave Out (MISO)
 - PB5 can also be SPI Bus Master Clock Input (SCK)
 - PB6 and PB7 are brought out on Processor pins 9 and 10 for the crystal clock oscillator
- PORT C (PC0 – PC5) is a 7 bit bidirectional I/O port with internal pull-up resistors. Processor pins 23 – 28 bring PC0 to PC5 out.
 - PC0 – PC5 are also interrupts 8-13 respectively
 - PC0 – PC5 can also be used as A/D inputs
 - PC4 and PC5 can also be used as SDA and SCL for I2C
 - PC6 is brought out on processor pin 1 as reset
- PORT D (D0 – D7) is an 8 bit bidirectional I/O port with internal pull-ups. Processor pins 2 – 6 and 11 – 13 bring all pins out
 - PD0 can also be USART Input (RXD)
 - PD1 can also be USART Output (TXD)
 - PD3 can also be used as a PWM output
 - PD5 can also be used as a PWM output
 - PD6 can also be used as a PWM output

Links:

- Source of above diagram: <http://www.hobbytronics.co.uk/arduino-atmega328-pinout>
- AT Mega 328 datasheet: <http://www.atmel.com/Images/doc8161.pdf>

ARDUINO UNO Revision 3 Pinout (Uno PCB) – Commonly Used Features are printed on Silkscreen



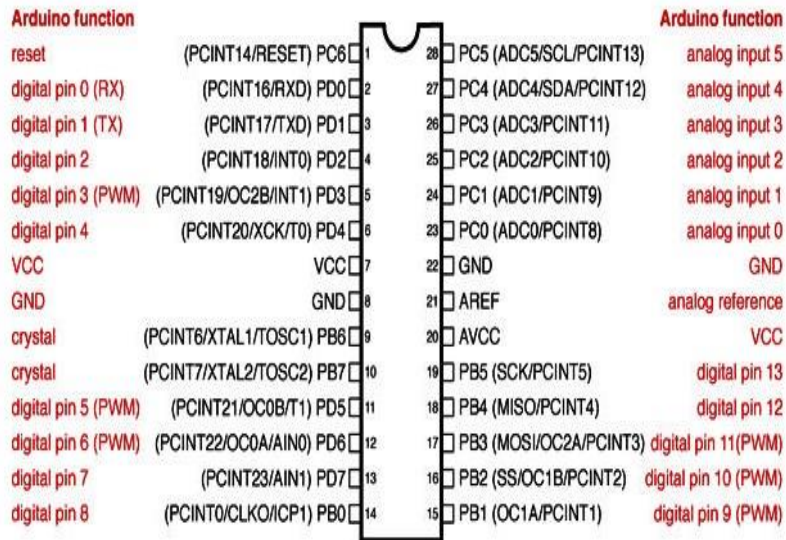
The Arduino Uno pinout is printed in the silkscreen on the top of the part. While this pinout is a good start, it does not explain the complete story – but it does give a good beginning. At first you use mainly the pins in the female headers at the edge of the board (top and bottom in the photo), plus USB and maybe power

- Tx and Rx are serial UART pins used for RS-232 and USB communications
- I2C is another serial communications method using a bidirectional data line (SDA) and a clock line (SCL)
- SPI is another serial communications method using one line for the master to transmit (MOSI – Master Out Slave In), another for the master to receive (MISO), and a third as a clock (SCK)
- A/D in Analogue to Digital this input converts an analogue voltage in to a digital representation
- PWM (Pulse Width Modulator) is used to create a square wave with a specific duty cycle (high time vs low time)
- ICSP is the In Circuit Serial Programming – another way to program the processor
- Vcc is the voltage supplied to the processor (+5VDC regulated from the higher input voltage)
- 3.3VDC is a regulated voltage (from the higher input voltage) for peripherals needing that voltage – 50ma maximum
- IOREF provides a voltage reference so shields can select the proper power source
- AREF is a reference INPUT voltage used by the A/Ds
- GND is the ground reference
- RESET resets the processor (and some peripherals)

Links:

- Source of above diagram: <http://www.adafruit.com/blog/2012/05/25/handy-arduino-r3-pinout-diagram/>
- Description of pin usage: <http://www.gammon.com.au/forum/?id=11473>
- Arduino Uno Pin Mapping: <http://arduino.cc/en/Hacking/PinMapping168#.UxOJik2YZuE>
- Description of Arduino Serial: <http://arduino.cc/en/reference/serial#.UxOMKk2YZuE>
- Description of the Arduino SPI functions and library: <http://arduino.cc/en/Reference/SPI#.UxOPLk2YZuE>
- Description of Arduino A/D: <http://arduino.cc/en/Tutorial/AnalogInputPins#.UxOM7k2YZuE>
- Description of Arduino PWM: <http://arduino.cc/en/Tutorial/PWM#.UxOLz02YZuE>
- Tutorial on ISP: <http://arduino.cc/en/Tutorial/ArduinoISP#.UxOUSk2YZuE>
- Tutorial on the AREF pin: <http://tronixstuff.com/2013/12/12/arduino-tutorials-chapter-22-aref-pin/>

ARDUINO UNO Revision 3 Processor Pinout (Atmel ATmega 328) – Other functions



Digital Pins 11, 12 & 13 are used by the ICSP header for MISO, MOSI, SCK connections (Atmega168 pins 17, 18 & 19). Avoid low-impedance loads on these pins when using the ICSP header.

Pin Definition

- PORT B pins, in addition to digital I/O have other uses
 - PB0 can also be the divided system clock output (CLKO) or Timer/Counter 1 Input Capture (ICP1)
 - PB1 can also be Timer/Counter1 Output Compare Match A (OC1A) out
 - PB2 can also be Timer/Counter1 Output Compare Match B (OC1B)
 - PB3 can also be Timer/Counter2 Output Compare Match A out(OC2A)
- Port D pins, in addition to digital I/O have other uses
 - PD3 is also Timer/Counter2 Output Compare Match B Output (OC2B)
 - PD4 is also Timer/Counter0 External Counter Input (T0) or USART External Clock Input/Output (XCK)
 - PD5 is also Timer/Counter0 Output Compare Match B Output (OC0B) and Timer/Counter 1 External Counter Input
 - PD6 can also be Analog Comparator Positive In (AIN0)
 - PD7 can also be Analog Comparator Negative In (AIN1)

Links:

- Source of above diagram: http://nearbus.net/wiki/index.php?title=Atmega_328_Pinout
- AT Mega 328 datasheet: <http://www.atmel.com/Images/doc8161.pdf>

NOTE: A single diagram showing all features of the Arduino Uno and the Atmel ATmega328 processor is shown in Appendix A

APPENDIX A

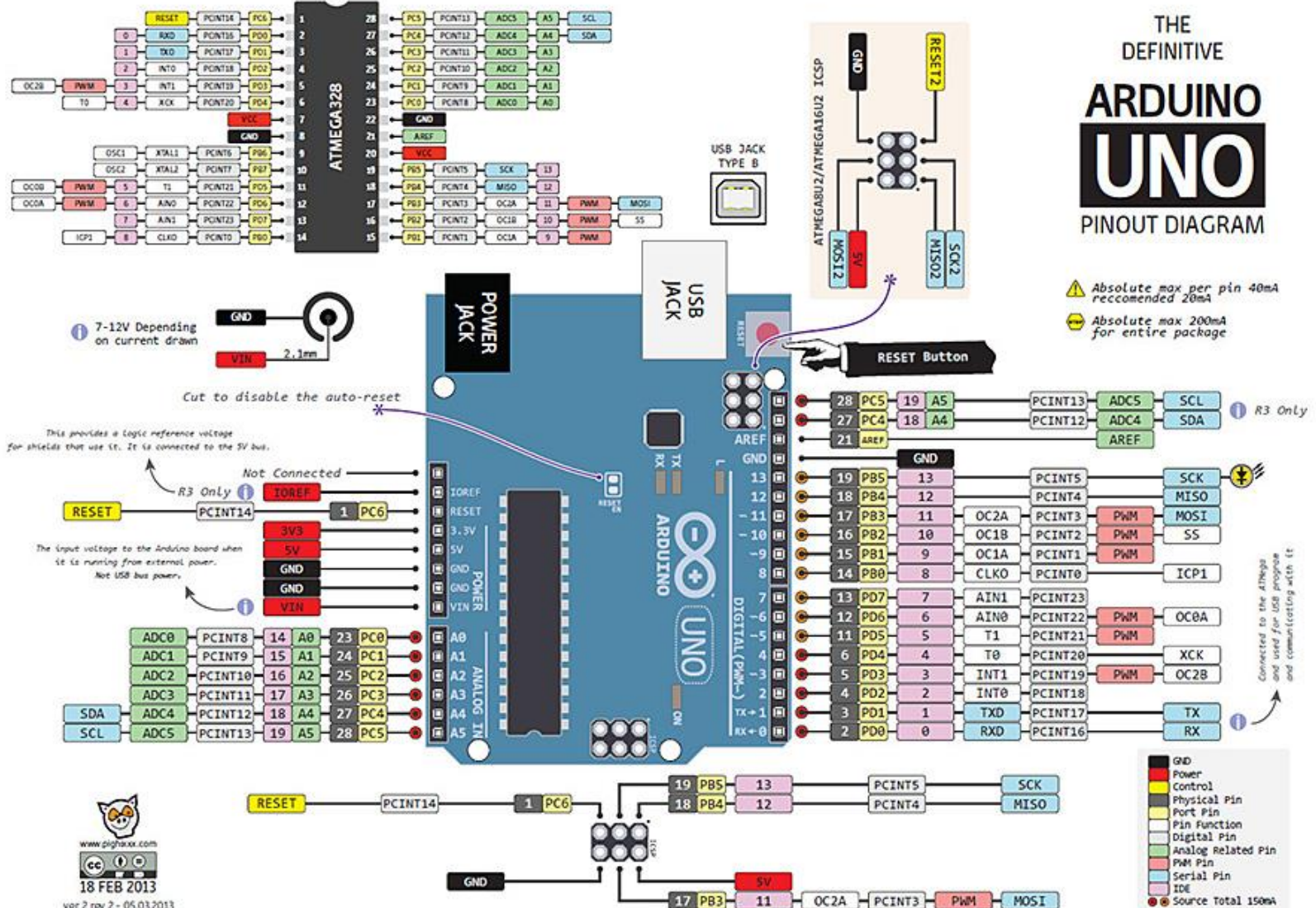


Diagram from: <http://arduino-info.wikispaces.com/file/view/ArduinoUNO-900.jpg/421496636/ArduinoUNO-900.jpg>

APPENDIX B

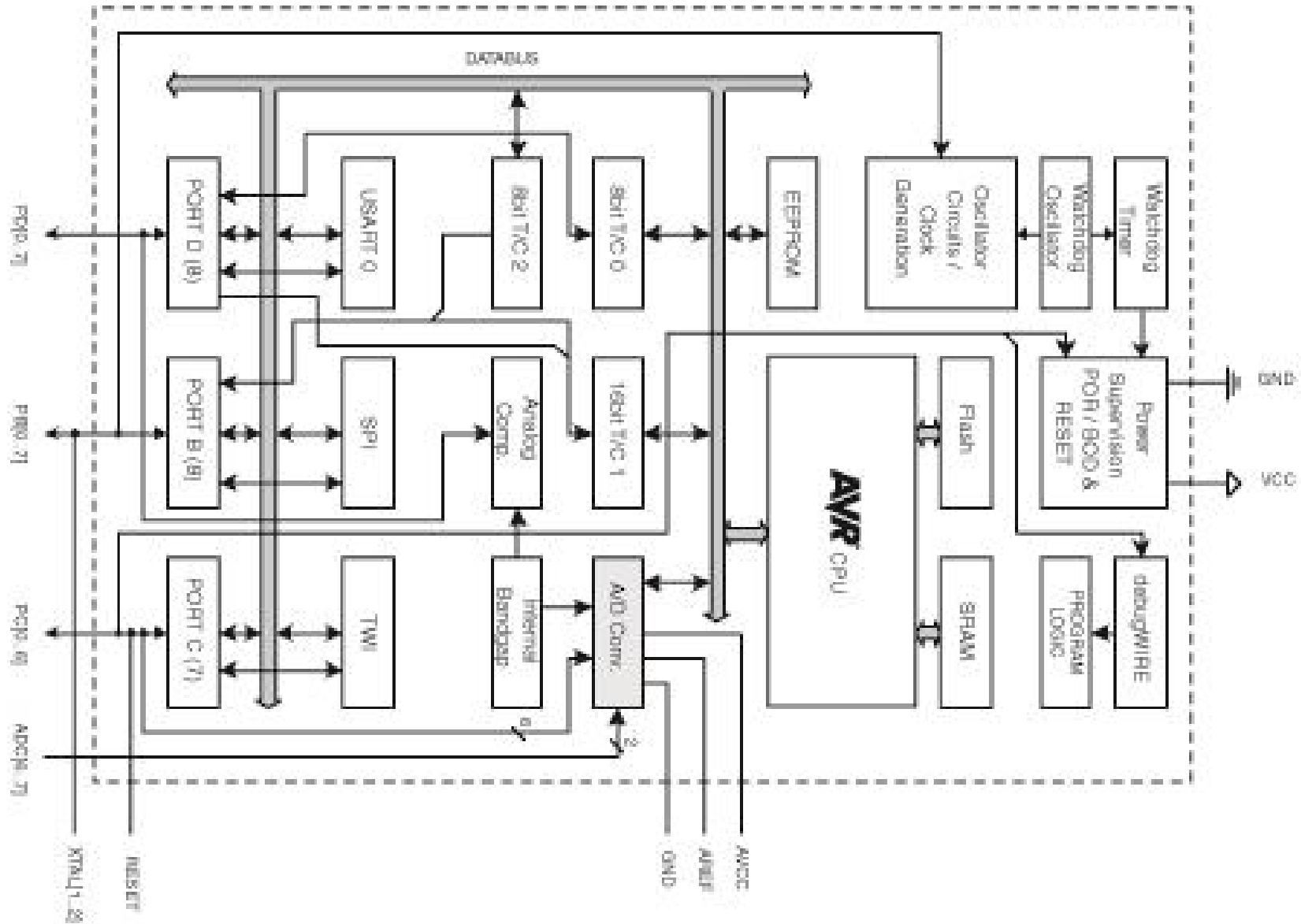
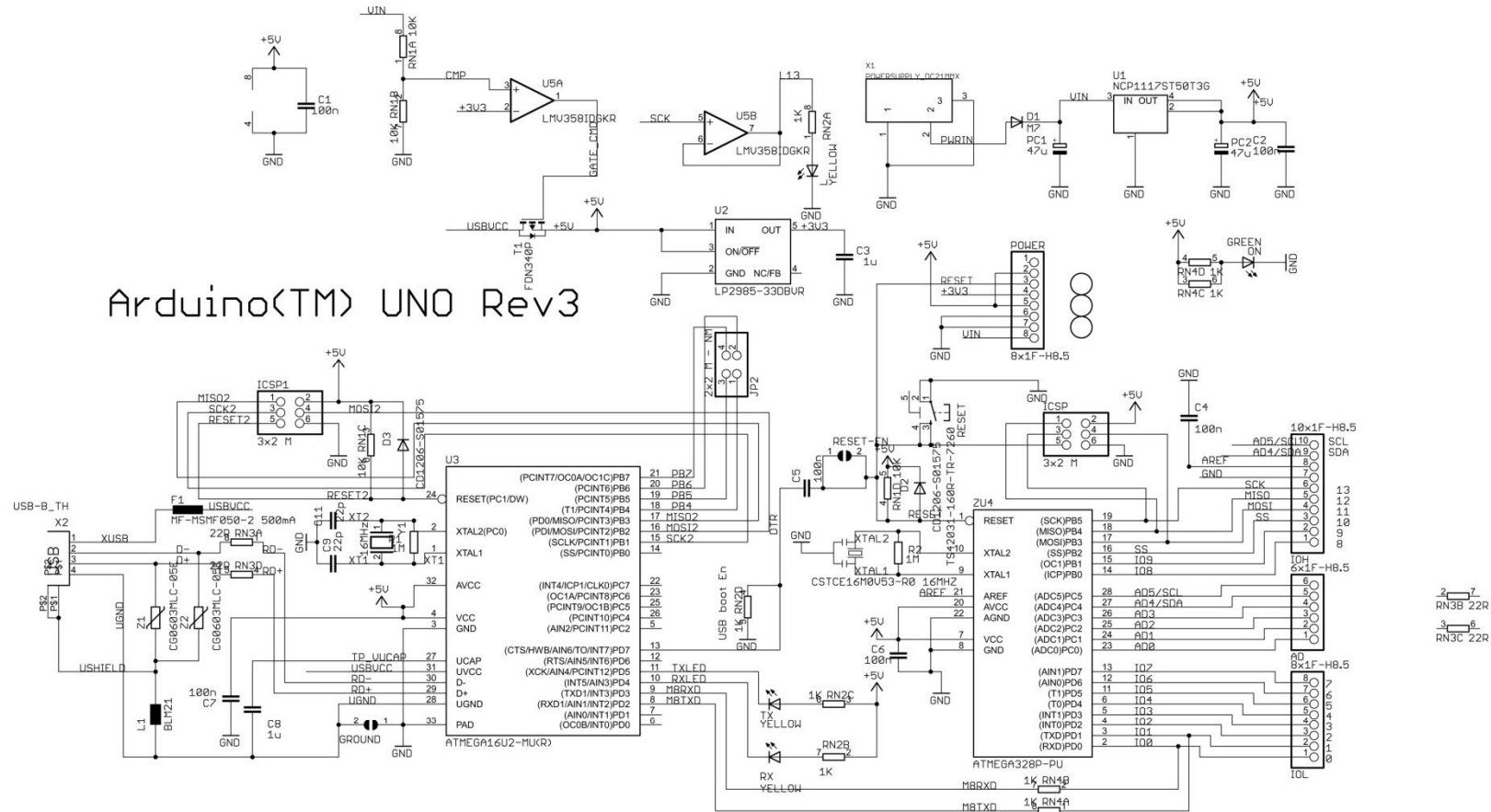


Diagram from document at: <http://www.atmel.com/Images/doc8161.pdf>

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APPENDIX C



Reference Designs ARE PROVIDED "AS IS" AND "WITH ALL FAULTS. Arduino DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING PRODUCTS, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Arduino may make changes to specifications and product descriptions at any time, without notice. The Customer must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Arduino reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them. The product information on the Web Site or Materials is subject to change without notice. Do not finalize a design with this information.

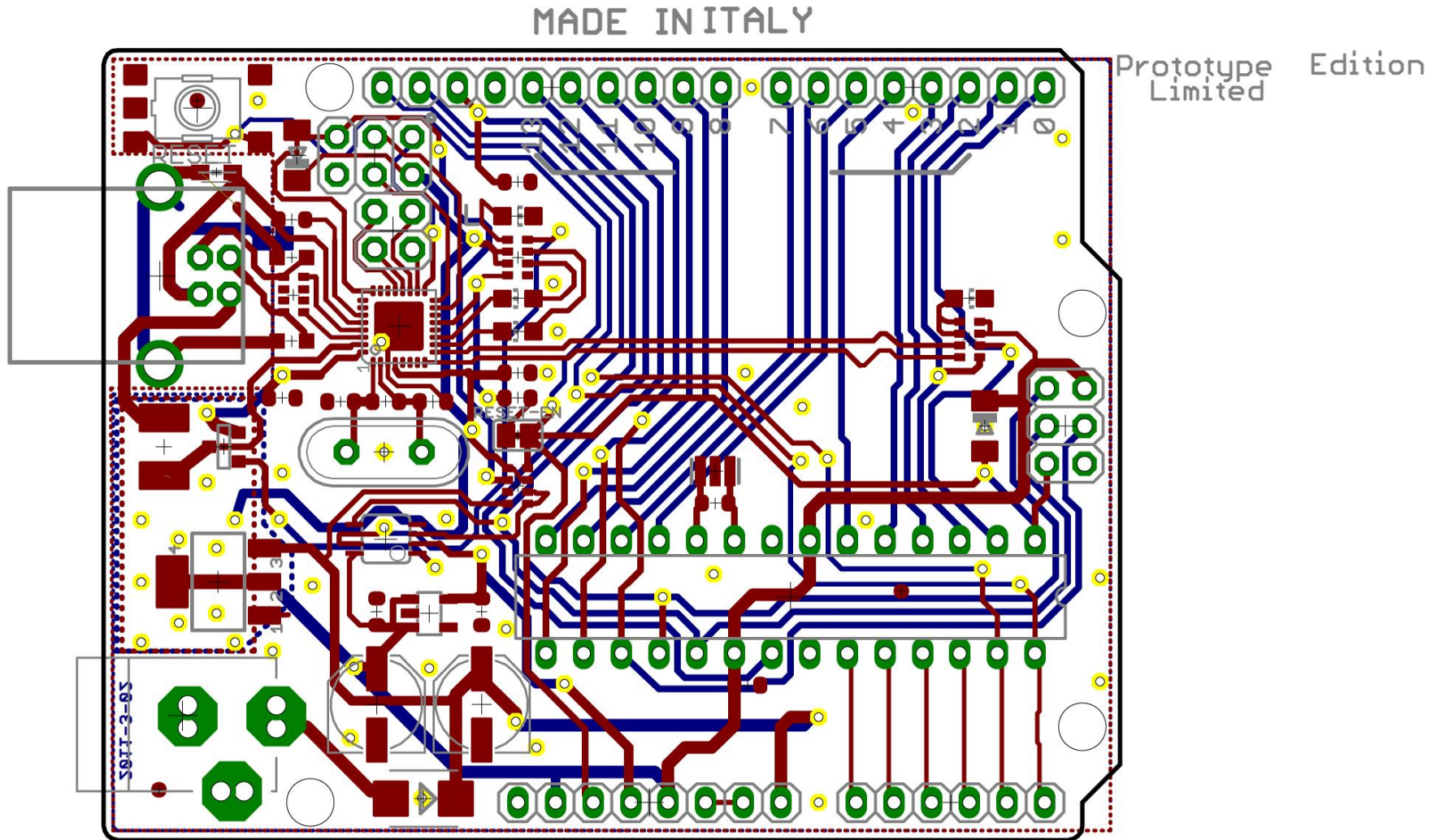
ARDUINO is a registered trademark.

Use of the ARDUINO name must be compliant with <http://www.arduino.cc/en/Main/Policy>

Diagram from document at: http://arduino.cc/en/uploads/Main/Arduino_Uno_Rev3-schematic.pdf

AIAA OC Rocketry (Revision 3 April 27, 2014 - <http://aiaaocrocketry.org>)

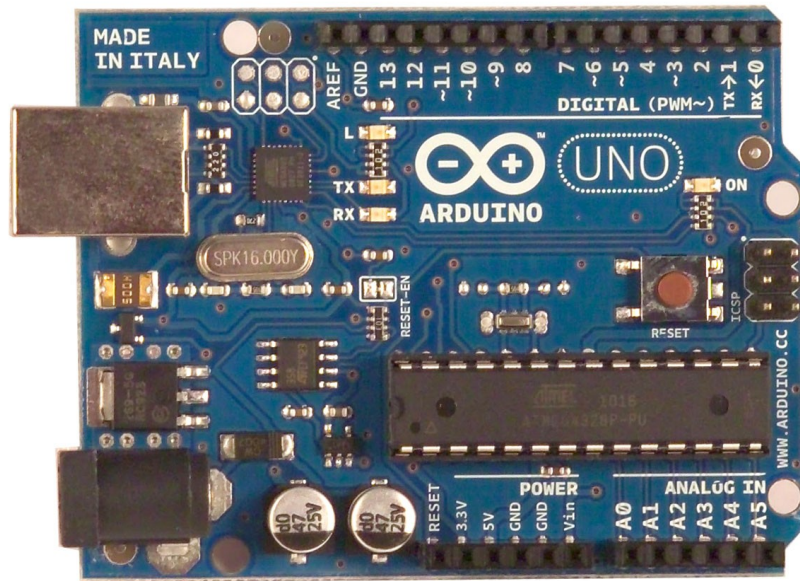
APPENDIX D



From arduino_Uno_Rev3-02-TH.zip file at <http://arduino.cc/en/Main/ArduinoBoardUno#.Uxk9qk2YYpA>

Eagle PCB software: Eagle PCB design software (use License = "Run as Freeware"): <https://www.cadsoftusa.com/download-eagle/>

Arduino UNO



Product Overview

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](#).

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Programming Environment, Basic Tutorials

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Environmental Policies
half sqm of green via Impatto Zero®

Page 7



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Technical Specification

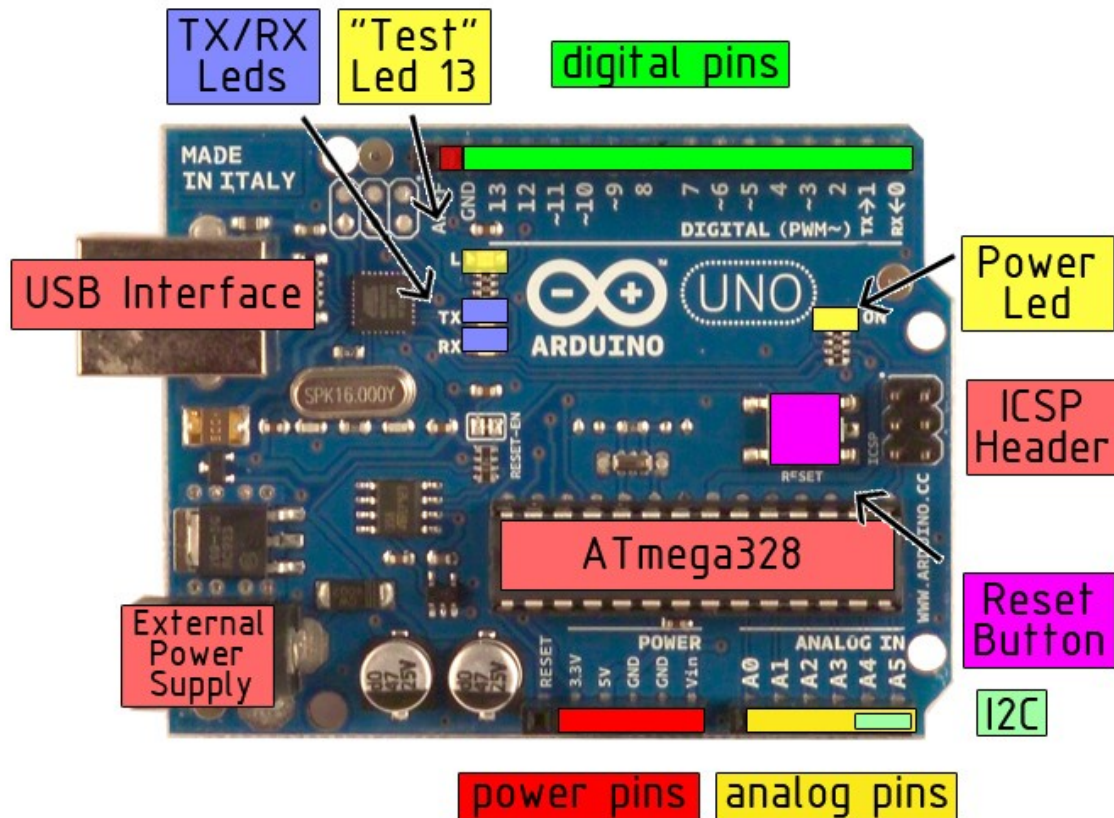


EAGLE files: [arduino-duemilanove-uno-design.zip](#) Schematic: [arduino-uno-schematic.pdf](#)

Summary

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB of which 0.5 KB used by bootloader
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

the board



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Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.

Memory

The Atmega328 has 32 KB of flash memory for storing code (of which 0,5 KB is used for the bootloader); It has also 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the [EEPROM library](#)).

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using [pinMode\(\)](#), [digitalWrite\(\)](#), and [digitalRead\(\)](#) functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip .
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the [attachInterrupt\(\)](#) function for details.
- **PWM: 3, 5, 6, 9, 10, and 11.** Provide 8-bit PWM output with the [analogWrite\(\)](#) function.
- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- **LED: 13.** There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.



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The Uno has 6 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the [analogReference\(\)](#) function. Additionally, some pins have specialized functionality:

- **I²C: 4 (SDA) and 5 (SCL).** Support I²C (TWI) communication using the [Wire library](#).

There are a couple of other pins on the board:

- **AREF.** Reference voltage for the analog inputs. Used with [analogReference\(\)](#).
- **Reset.** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

See also the [mapping between Arduino pins and Atmega328 ports](#).

Communication

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega8U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '8U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an *.inf file is required..

The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A [SoftwareSerial library](#) allows for serial communication on any of the Uno's digital pins.

The ATmega328 also support I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the [documentation](#) for details. To use the SPI communication, please see the ATmega328 datasheet.

Programming

The Arduino Uno can be programmed with the Arduino software ([download](#)). Select "Arduino Uno w/ ATmega328" from the **Tools > Board** menu (according to the microcontroller on your board). For details, see the [reference](#) and [tutorials](#).

The ATmega328 on the Arduino Uno comes preburned with a [bootloader](#) that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol ([reference](#), [C header files](#)).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see [these instructions](#) for details.

The ATmega8U2 firmware source code is available . The ATmega8U2 is loaded with a DFU bootloader, which can be activated by connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2. You can then use [Atmel's FLIP software](#) (Windows) or the [DFU programmer](#) (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU bootloader).



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Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

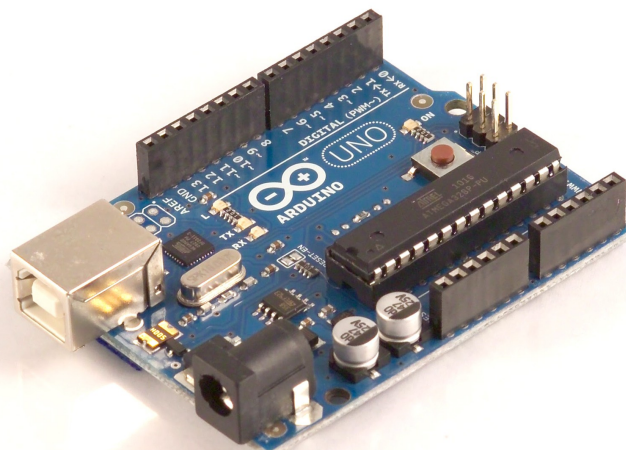
The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see [this forum thread](#) for details.

USB Overcurrent Protection

The Arduino Uno has a resettable polyfuse that protects your computer's USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

Physical Characteristics

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Three screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100 mil spacing of the other pins.



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How to use Arduino



Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the [Arduino programming language](#) (based on [Wiring](#)) and the Arduino development environment (based on [Processing](#)). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, MaxMSP).

Arduino is a cross-platform program. You'll have to follow different instructions for your personal OS. Check on the [Arduino site](http://arduino.cc/en/Guide/HomePage) for the latest instructions. <http://arduino.cc/en/Guide/HomePage>

Linux Install

Windows Install

Mac Install

Once you have downloaded/unzipped the arduino IDE, you can Plug the Arduino to your PC via USB cable.

Blink led

Now you're actually ready to "burn" your first program on the arduino board. To select "blink led", the physical translation of the well known programming "hello world", select

**File>Sketchbook>
Arduino-0017>Examples>
Digital>Blink**

Once you have your sketch you'll see something very close to the screenshot on the right.

In **Tools>Board** select

Now you have to go to **Tools>SerialPort** and select the right serial port, the one arduino is attached to.

```
Blink | Arduino 0017
File Edit Sketch Tools Help
Blink $
int ledPin = 13; // LED connected to digital pin 13

// The setup() method runs once, when the sketch starts

void setup() {
  // initialize the digital pin as an output:
  pinMode(ledPin, OUTPUT);
}

// the loop() method runs over and over again,
// as long as the Arduino has power

void loop()
{
  digitalWrite(ledPin, HIGH); // set the LED on
  delay(1000); // wait for a second
  digitalWrite(ledPin, LOW); // set the LED off
  delay(1000); // wait for a second
}
```



Done compiling.

Press Compile button
(to check for errors)



Upload



TX RX Flashing



Blinking Led!

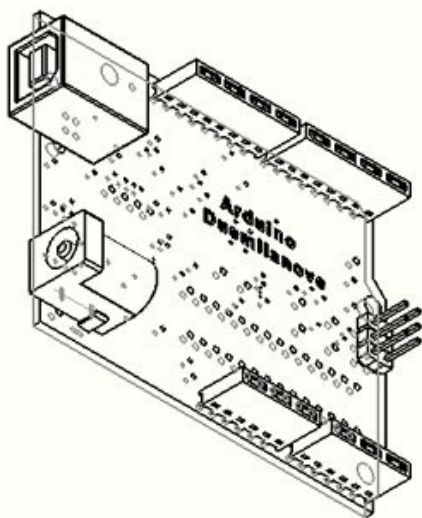
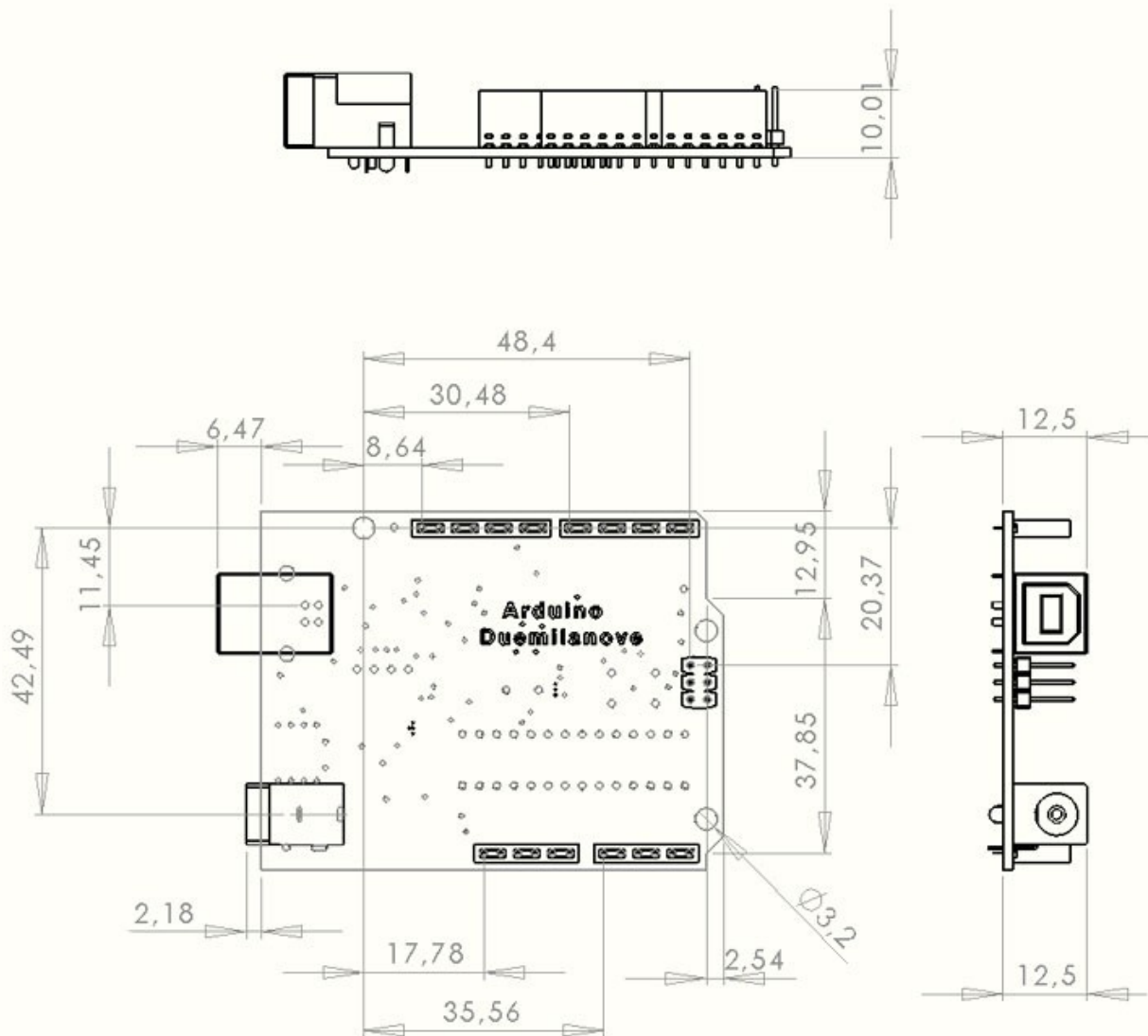


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Dimensioned Drawing



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Terms & Conditions



1. Warranties

1.1 The producer warrants that its products will conform to the Specifications. This warranty lasts for one (1) years from the date of the sale. The producer shall not be liable for any defects that are caused by neglect, misuse or mistreatment by the Customer, including improper installation or testing, or for any products that have been altered or modified in any way by a Customer. Moreover, The producer shall not be liable for any defects that result from Customer's design, specifications or instructions for such products. Testing and other quality control techniques are used to the extent the producer deems necessary.

1.2 If any products fail to conform to the warranty set forth above, the producer's sole liability shall be to replace such products. The producer's liability shall be limited to products that are determined by the producer not to conform to such warranty. If the producer elects to replace such products, the producer shall have a reasonable time to replacements. Replaced products shall be warranted for a new full warranty period.

1.3 EXCEPT AS SET FORTH ABOVE, PRODUCTS ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." THE PRODUCER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING PRODUCTS, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE

1.4 Customer agrees that prior to using any systems that include the producer products, Customer will test such systems and the functionality of the products as used in such systems. The producer may provide technical, applications or design advice, quality characterization, reliability data or other services. Customer acknowledges and agrees that providing these services shall not expand or otherwise alter the producer's warranties, as set forth above, and no additional obligations or liabilities shall arise from the producer providing such services.

1.5 The Arduino™ products are not authorized for use in safety-critical applications where a failure of the product would reasonably be expected to cause severe personal injury or death. Safety-Critical Applications include, without limitation, life support devices and systems, equipment or systems for the operation of nuclear facilities and weapons systems. Arduino™ products are neither designed nor intended for use in military or aerospace applications or environments and for automotive applications or environment. Customer acknowledges and agrees that any such use of Arduino™ products which is solely at the Customer's risk, and that Customer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

1.6 Customer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products and any use of Arduino™ products in Customer's applications, notwithstanding any applications-related information or support that may be provided by the producer.

2. Indemnification

The Customer acknowledges and agrees to defend, indemnify and hold harmless the producer from and against any and all third-party losses, damages, liabilities and expenses it incurs to the extent directly caused by: (i) an actual breach by a Customer of the representation and warranties made under this terms and conditions or (ii) the gross negligence or willful misconduct by the Customer.

3. Consequential Damages Waiver

In no event the producer shall be liable to the Customer or any third parties for any special, collateral, indirect, punitive, incidental, consequential or exemplary damages in connection with or arising out of the products provided hereunder, regardless of whether the producer has been advised of the possibility of such damages. This section will survive the termination of the warranty period.

4. Changes to specifications

The producer may make changes to specifications and product descriptions at any time, without notice. The Customer must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." The producer reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them. The product information on the Web Site or Materials is subject to change without notice. Do not finalize a design with this information.



Environmental Policies



The producer of Arduino™ has joined the Impatto Zero® policy of LifeGate.it. For each Arduino board produced is created / looked after half squared Km of Costa Rica's forest's.



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RADIONICS



- 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

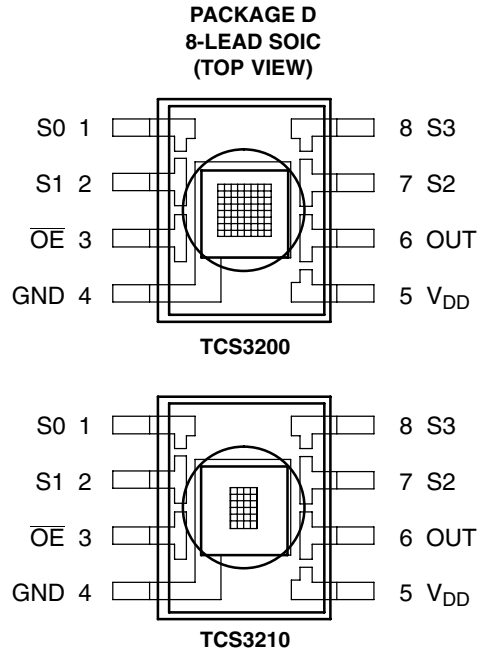
The TCS3200 and TCS3210 programmable color light-to-frequency converters that combine configurable silicon photodiodes and a current-to-frequency converter on a single monolithic CMOS integrated circuit. The output is a square wave (50% duty cycle) with frequency directly proportional to light intensity (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 (\overline{OE}) places the output in the high-impedance state for multiple-unit sharing of a microcontroller input line.

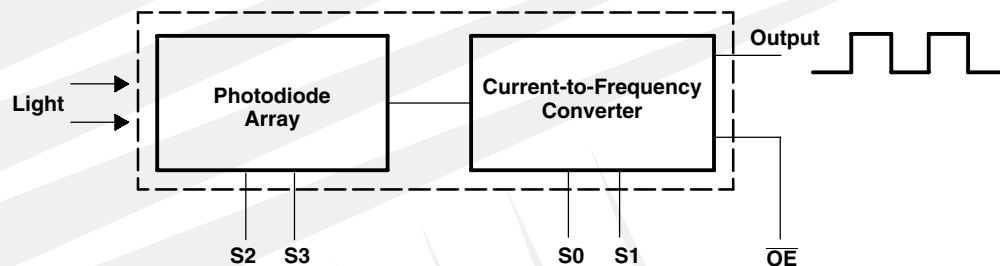
In the TCS3200, the light-to-frequency converter reads an 8 x 8 array of photodiodes. Sixteen photodiodes have blue filters, 16 photodiodes have green filters, 16 photodiodes have red filters, and 16 photodiodes are clear with no filters.

In the TCS3210, the light-to-frequency converter reads a 4 x 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 x 110 μm in size and are on 134- μm centers.



Functional Block Diagram



TCS3200, TCS3210 PROGRAMMABLE COLOR LIGHT-TO-FREQUENCY CONVERTER

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Terminal Functions

TERMINAL NAME	NO.	I/O	DESCRIPTION
GND	4		Power supply ground. All voltages are referenced to GND.
\overline{OE}	3	I	Enable for f_o (active low).
OUT	6	O	Output frequency (f_o).
S0, S1	1, 2	I	Output frequency scaling selection inputs.
S2, S3	7, 8	I	Photodiode type selection inputs.
V_{DD}	5		Supply voltage

Table 1. Selectable Options

S0	S1	OUTPUT FREQUENCY SCALING (f_o)
L	L	Power down
L	H	2%
H	L	20%
H	H	100%

S2	S3	PHOTODIODE TYPE
L	L	Red
L	H	Blue
H	L	Clear (no filter)
H	H	Green

Available Options

DEVICE	T_A	PACKAGE – LEADS	PACKAGE DESIGNATOR	ORDERING NUMBER
TCS3200	–40°C to 85°C	SOIC–8	D	TCS3200D
TCS3210	–40°C to 85°C	SOIC–8	D	TCS3210D

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

Supply voltage, V_{DD} (see Note 1)	6 V
Input voltage range, all inputs, V_I	–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 2)	–40°C to 85°C
Solder conditions in accordance with JEDEC J–STD–020A, maximum temperature (see Note 3) ...	260°C

† 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

		MIN	NOM	MAX	UNIT
Supply voltage, V_{DD}		2.7	5	5.5	V
High-level input voltage, V_{IH}	$V_{DD} = 2.7$ V to 5.5 V	2		V_{DD}	V
Low-level input voltage, V_{IL}	$V_{DD} = 2.7$ V to 5.5 V	0		0.8	V
Operating free-air temperature range, T_A		–40		70	°C

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	$I_{OH} = -2$ mA	4	4.5		V
V_{OL}	Low-level output voltage	$I_{OL} = 2$ mA		0.25	0.40	V
I_{IH}	High-level input current				5	μA
I_{IL}	Low-level input current				5	μA
I_{DD}	Supply current	Power-on mode		1.4	2	mA
		Power-down mode			0.1	μA
	Full-scale frequency (See Note 4)	$S_0 = H, S_1 = H$	500	600		kHz
		$S_0 = H, S_1 = L$	100	120		kHz
		$S_0 = L, S_1 = H$	10	12		kHz
	Temperature coefficient of responsivity	$\lambda \leq 700$ nm, $-25^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$		±200		ppm/°C
k_{SVS}	Supply voltage sensitivity	$V_{DD} = 5$ V ±10%		±0.5		%/V

NOTE 4: Full-scale frequency is the maximum operating frequency of the device without saturation.

TCS3200, TCS3210 PROGRAMMABLE COLOR LIGHT-TO-FREQUENCY CONVERTER

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Operating Characteristics at $V_{DD} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, $S_0 = \text{H}$, $S_1 = \text{H}$ (unless otherwise noted)
(See Notes 5, 6, 7, and 8). Values for TCS3200 (TCS3210) are below.

PARAMETER	TEST CONDITIONS	CLEAR PHOTODIODE S2 = H, S3 = L			BLUE PHOTODIODE S2 = L, S3 = H			GREEN PHOTODIODE S2 = H, S3 = H			RED PHOTODIODE S2 = L, S3 = L			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
f_O Output frequency (Note 9)	$E_e = 47.2\ \mu\text{W}/\text{cm}^2$, $\lambda_p = 470\ \text{nm}$	12.5 (4.7)	15.6 (5.85)	18.7 (7)	61%	84%	22%	43%	0%	6%	kHz			
	$E_e = 40.4\ \mu\text{W}/\text{cm}^2$, $\lambda_p = 524\ \text{nm}$	12.5 (4.7)	15.6 (5.85)	18.7 (7)	8%	28%	57%	80%	9%	27%				
	$E_e = 34.6\ \mu\text{W}/\text{cm}^2$, $\lambda_p = 640\ \text{nm}$	13.1 (4.9)	16.4 (6.15)	19.7 (7.4)	5%	21%	0%	12%	84%	105%				
R_e Irradiance responsivity (Note 10)	$\lambda_p = 470\ \text{nm}$	331 (124)			61%	84%	22%	43%	0%	6%	Hz/ ($\mu\text{W}/\text{cm}^2$)			
	$\lambda_p = 524\ \text{nm}$	386 (145)			8%	28%	57%	80%	9%	27%				
	$\lambda_p = 640\ \text{nm}$	474 (178)			5%	21%	0%	12%	84%	105%				
Saturation irradiance (Note 11)	$\lambda_p = 470\ \text{nm}$	1813 (4839)			--	--	--	--	--	--	$\mu\text{W}/\text{cm}^2$			
	$\lambda_p = 524\ \text{nm}$	1554 (4138)			--	--	--	--	--	--				
	$\lambda_p = 640\ \text{nm}$	1266 (3371)			--	--	--	--	--	--				
f_D Dark frequency	$E_e = 0$	2	10	2	10	2	10	2	10	Hz				
Nonlinearity (Note 12)	$f_O = 0$ to 5 kHz	± 0.1			± 0.1			± 0.1			% F.S.			
	$f_O = 0$ to 50 kHz	± 0.2			± 0.2			± 0.2						
	$f_O = 0$ to 500 kHz	± 0.5			± 0.5			± 0.5						
Recovery from power down		100			100			100			μs			
Response time to output enable ($\overline{\text{OE}}$)		100			100			100			ns			

- NOTES: 5. Optical measurements are made using small-angle incident radiation from a light-emitting diode (LED) optical source.
6. The 470 nm input irradiance is supplied by an InGaN light-emitting diode with the following characteristics: peak wavelength $\lambda_p = 470\ \text{nm}$, spectral halfwidth $\Delta\lambda_{1/2} = 35\ \text{nm}$, and luminous efficacy = 75 lm/W.
7. The 524 nm input irradiance is supplied by an InGaN light-emitting diode with the following characteristics: peak wavelength $\lambda_p = 524\ \text{nm}$, spectral halfwidth $\Delta\lambda_{1/2} = 47\ \text{nm}$, and luminous efficacy = 520 lm/W.
8. The 640 nm input irradiance is supplied by a AlInGaP light-emitting diode with the following characteristics: peak wavelength $\lambda_p = 640\ \text{nm}$, spectral halfwidth $\Delta\lambda_{1/2} = 17\ \text{nm}$, and luminous efficacy = 155 lm/W.
9. Output frequency Blue, Green, Red percentage represents the ratio of the respective color to the Clear channel absolute value.
10. Irradiance responsivity R_e is characterized over the range from zero to 5 kHz.
11. Saturation irradiance = (full-scale frequency)/(irradiance responsivity) for the Clear reference channel.
12. Nonlinearity is defined as the deviation of f_O from a straight line between zero and full scale, expressed as a percent of full scale.

TYPICAL CHARACTERISTICS

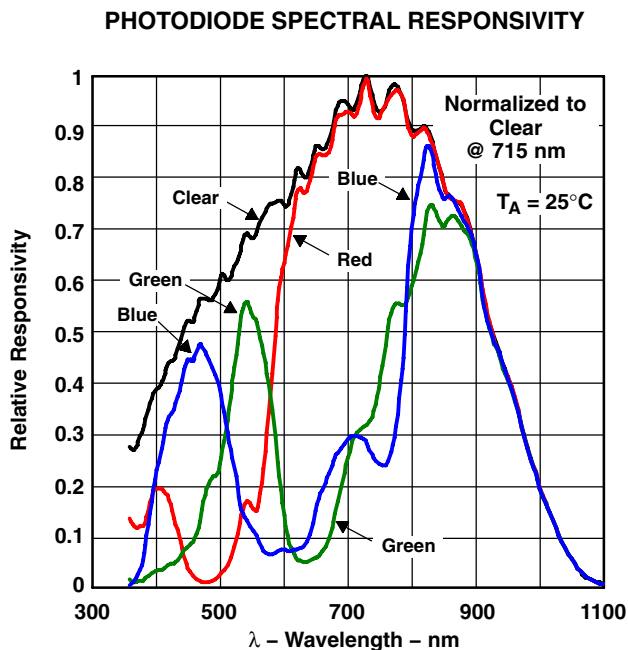


Figure 1

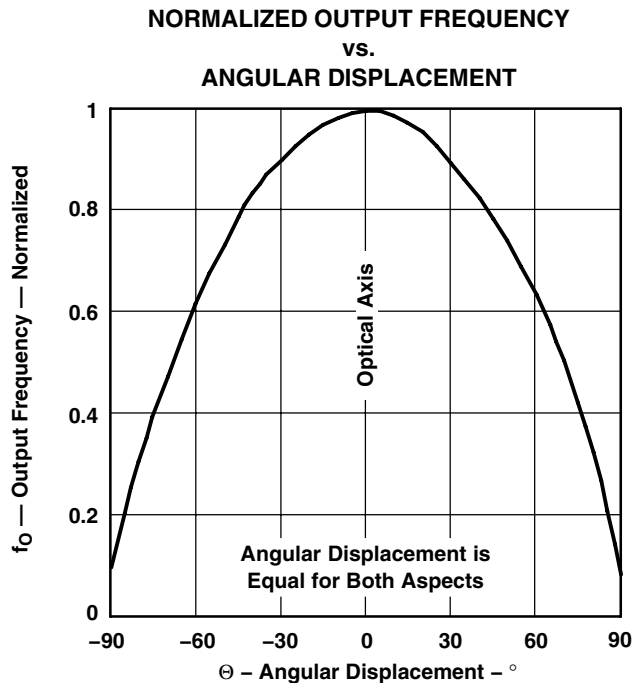


Figure 2

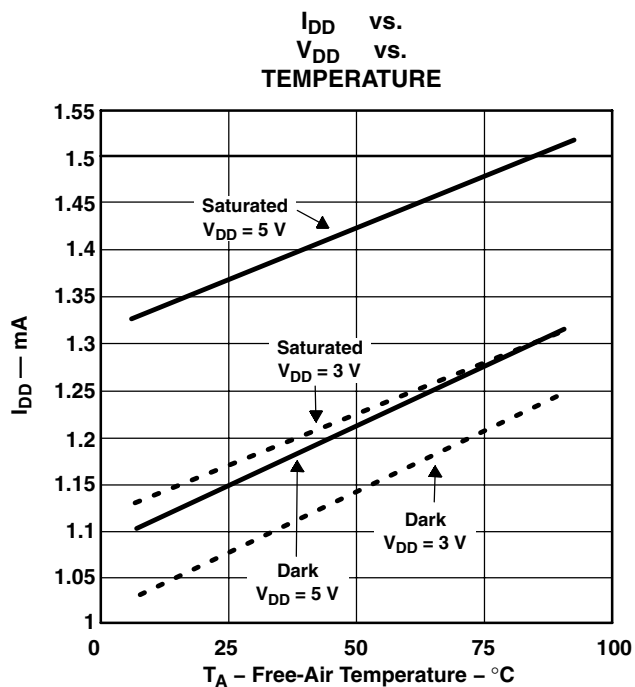


Figure 3

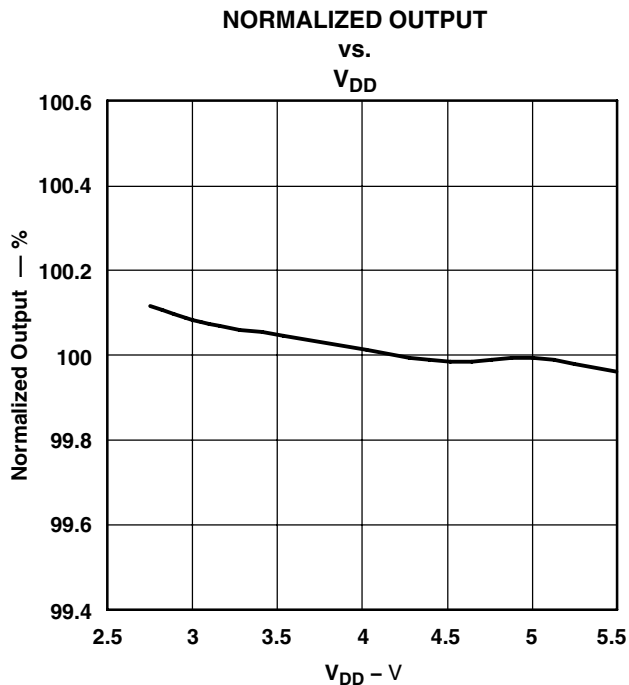


Figure 4

TYPICAL CHARACTERISTICS

PHOTODIODE RESPONSIVITY TEMPERATURE COEFFICIENT
vs.
WAVELENGTH OF INCIDENT LIGHT

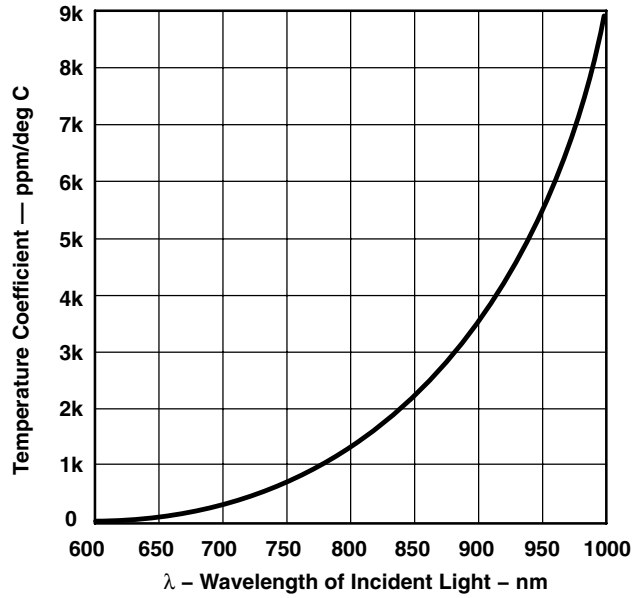


Figure 5

APPLICATION INFORMATION

Power supply considerations

Power-supply lines must be decoupled by a 0.01- μ F to 0.1- μ F capacitor with short leads mounted close to the device package.

Input interface

A low-impedance electrical connection between the device \overline{OE} pin and the device GND pin is required for improved noise immunity. All input pins must be either driven by a logic signal or connected to VDD or GND — they should not be left unconnected (floating).

Output interface

The output of the device is designed to drive a standard TTL or CMOS logic input over short distances. If lines greater than 12 inches are used on the output, a buffer or line driver is recommended.

A high state on Output Enable (OE) places the output in a high-impedance state for multiple-unit sharing of a microcontroller input line.

Power down

Powering down the sensor using S0/S1 (L/L) will cause the output to be held in a high-impedance state. This is similar to the behavior of the output enable pin, however powering down the sensor saves significantly more power than disabling the sensor with the output enable pin.

Photodiode type (color) selection

The type of photodiode (blue, green, red, or clear) used by the device is controlled by two logic inputs, S2 and S3 (see Table 1).

Output frequency scaling

Output-frequency scaling is controlled by two logic inputs, S0 and S1. The internal light-to-frequency converter generates a fixed-pulsewidth pulse train. Scaling is accomplished by internally connecting the pulse-train output of the converter to a series of frequency dividers. Divided outputs are 50%-duty cycle square waves with relative frequency values of 100%, 20%, and 2%. Because division of the output frequency is accomplished by counting pulses of the principal internal frequency, the final-output period represents an average of the multiple periods of the principle frequency.

The output-scaling counter registers are cleared upon the next pulse of the principal frequency after any transition of the S0, S1, S2, S3, and \overline{OE} lines. The output goes high upon the next subsequent pulse of the principal frequency, beginning a new valid period. This minimizes the time delay between a change on the input lines and the resulting new output period. The response time to an input programming change or to an irradiance step change is one period of new frequency plus 1 μ s. The scaled output changes both the full-scale frequency and the dark frequency by the selected scale factor.

The frequency-scaling function allows the output range to be optimized for a variety of measurement techniques. The scaled-down outputs may be used where only a slower frequency counter is available, such as low-cost microcontroller, or where period measurement techniques are used.

APPLICATION INFORMATION

Measuring the frequency

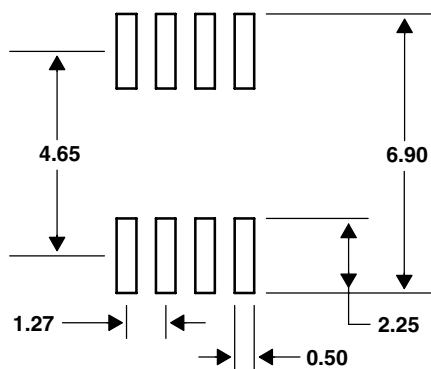
The choice of interface and measurement technique depends on the desired resolution and data acquisition rate. For maximum data-acquisition rate, period-measurement techniques are used.

Output data can be collected at a rate of twice the output frequency or one data point every microsecond for full-scale output. Period measurement requires the use of a fast reference clock with available resolution directly related to reference clock rate. Output scaling can be used to increase the resolution for a given clock rate or to maximize resolution as the light input changes. Period measurement is used to measure rapidly varying light levels or to make a very fast measurement of a constant light source.

Maximum resolution and accuracy may be obtained using frequency-measurement, pulse-accumulation, or integration techniques. Frequency measurements provide the added benefit of averaging out random- or high-frequency variations (jitter) resulting from noise in the light signal. Resolution is limited mainly by available counter registers and allowable measurement time. Frequency measurement is well suited for slowly varying or constant light levels and for reading average light levels over short periods of time. Integration (the accumulation of pulses over a very long period of time) can be used to measure exposure, the amount of light present in an area over a given time period.

PCB Pad Layout

Suggested PCB pad layout guidelines for the D package are shown in Figure 6.



- NOTES: A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.

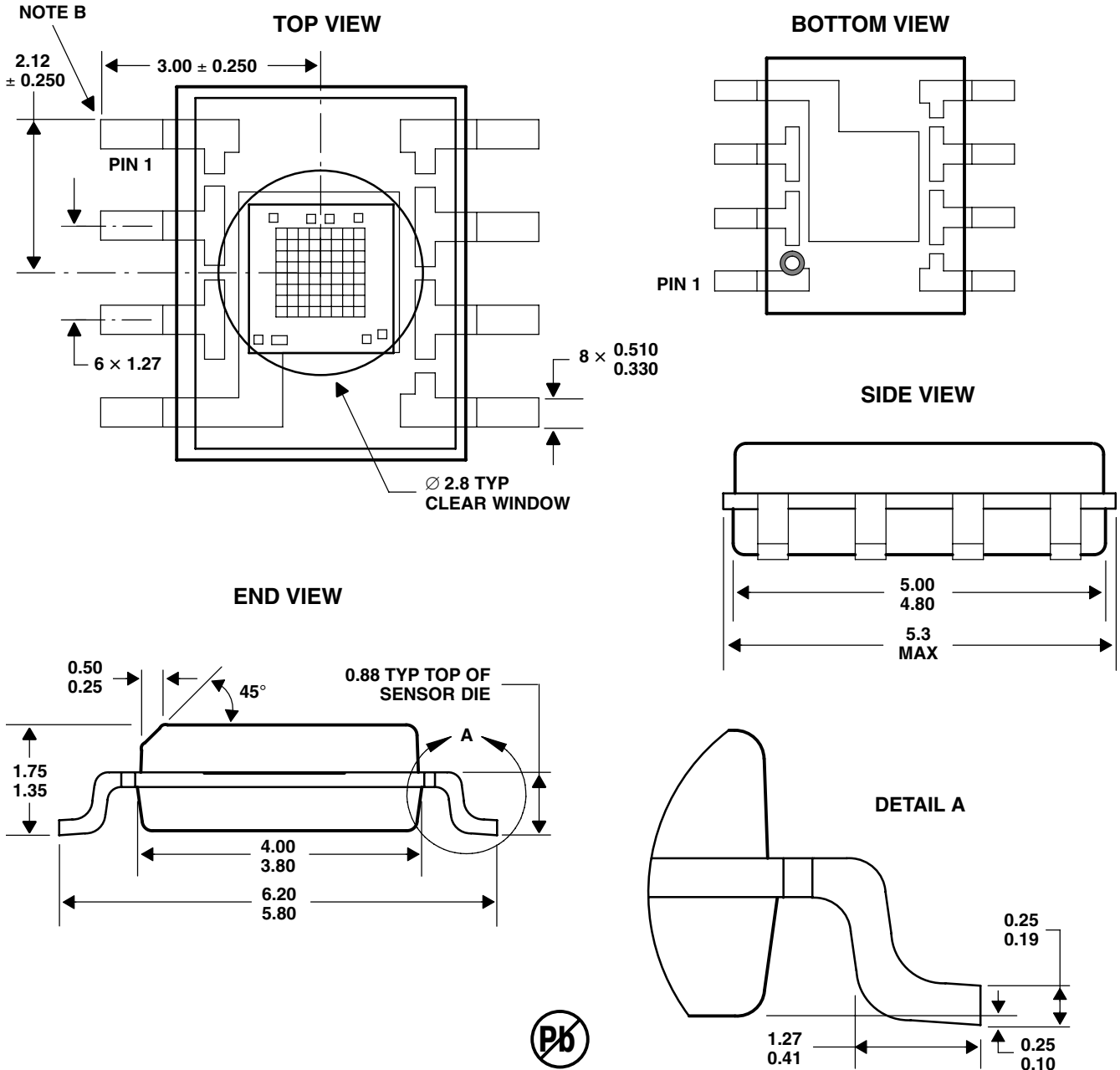
Figure 6. Suggested D Package PCB Layout

MECHANICAL INFORMATION

This SOIC package consists of an integrated circuit mounted on a lead frame and encapsulated with an electrically nonconductive clear plastic compound. The TCS3200 has an 8 × 8 array of photodiodes with a total size of 1 mm by 1 mm. The photodiodes are 110 μm × 110 μm in size and are positioned on 134 μm centers.

PACKAGE D

PLASTIC SMALL-OUTLINE



- NOTES: A. All linear dimensions are in millimeters.
 B. The center of the 1-mm by 1-mm photo-active area is referenced to the upper left corner tip of the lead frame (Pin 1).
 C. Package is molded with an electrically nonconductive clear plastic compound having an index of refraction of 1.55.
 D. This drawing is subject to change without notice.

Figure 7. Package D — TCS3200 Plastic Small Outline IC Packaging Configuration

TCS3200, TCS3210
PROGRAMMABLE
COLOR LIGHT-TO-FREQUENCY CONVERTER

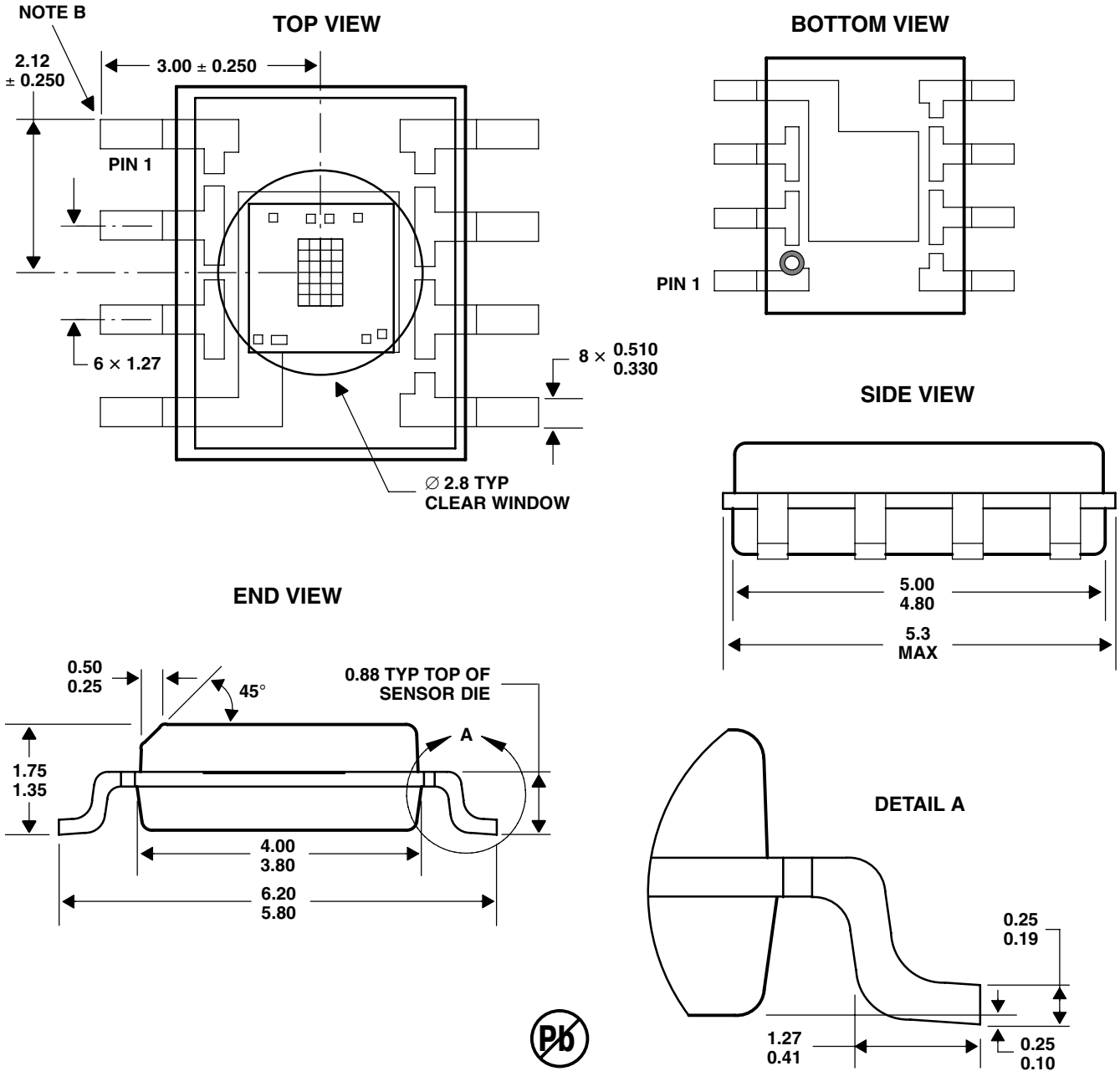
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MECHANICAL INFORMATION

This SOIC package consists of an integrated circuit mounted on a lead frame and encapsulated with an electrically nonconductive clear plastic compound. The TCS3210 has a 4 × 6 array of photodiodes with a total size of 0.54 mm by 0.8 mm. The photodiodes are 110 μm × 110 μm in size and are positioned on 134 μm centers.

PACKAGE D

PLASTIC SMALL-OUTLINE

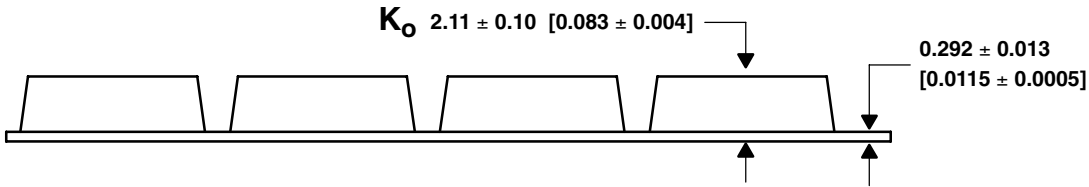


- NOTES: A. All linear dimensions are in millimeters.
 B. The center of the 0.54-mm by 0.8-mm photo-active area is referenced to the upper left corner tip of the lead frame (Pin 1).
 C. Package is molded with an electrically nonconductive clear plastic compound having an index of refraction of 1.55.
 D. This drawing is subject to change without notice.

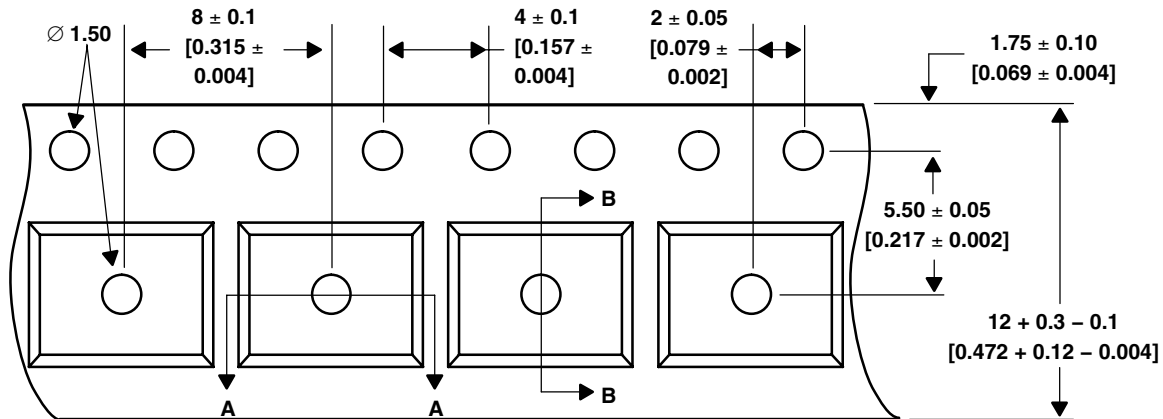
Figure 8. Package D — TCS3210 Plastic Small Outline IC Packaging Configuration

MECHANICAL INFORMATION

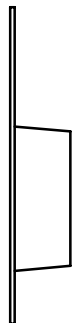
SIDE VIEW



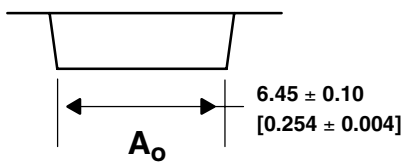
TOP VIEW



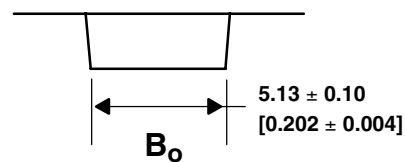
END VIEW



DETAIL A



DETAIL B



- NOTES: A. All linear dimensions are in millimeters [inches].
B. The dimensions on this drawing are for illustrative purposes only. Dimensions of an actual carrier may vary slightly.
C. Symbols on drawing A_o , B_o , and K_o are defined in ANSI EIA Standard 481-B 2001.
D. Each reel is 178 millimeters in diameter and contains 1000 parts.
E. TAOS packaging tape and reel conform to the requirements of EIA Standard 481-B.
F. This drawing is subject to change without notice.

Figure 9. Package D Carrier Tape

**TCS3200, TCS3210
PROGRAMMABLE
COLOR LIGHT-TO-FREQUENCY CONVERTER**

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MANUFACTURING INFORMATION

The Plastic Small Outline IC package (D) has been tested and has demonstrated an ability to be reflow soldered to a PCB substrate.

The solder reflow profile describes the expected maximum heat exposure of components during the solder reflow process of product on a PCB. Temperature is measured on top of component. The component should be limited to a maximum of three passes through this solder reflow profile.

Table 2. TCS3200, TCS3210 Solder Reflow Profile

PARAMETER	REFERENCE	TCS32x0
Average temperature gradient in preheating		2.5°C/sec
Soak time	t_{soak}	2 to 3 minutes
Time above 217°C	t_1	Max 60 sec
Time above 230°C	t_2	Max 50 sec
Time above $T_{peak} - 10^\circ\text{C}$	t_3	Max 10 sec
Peak temperature in reflow	T_{peak}	260° C (-0°C/+5°C)
Temperature gradient in cooling		Max -5°C/sec

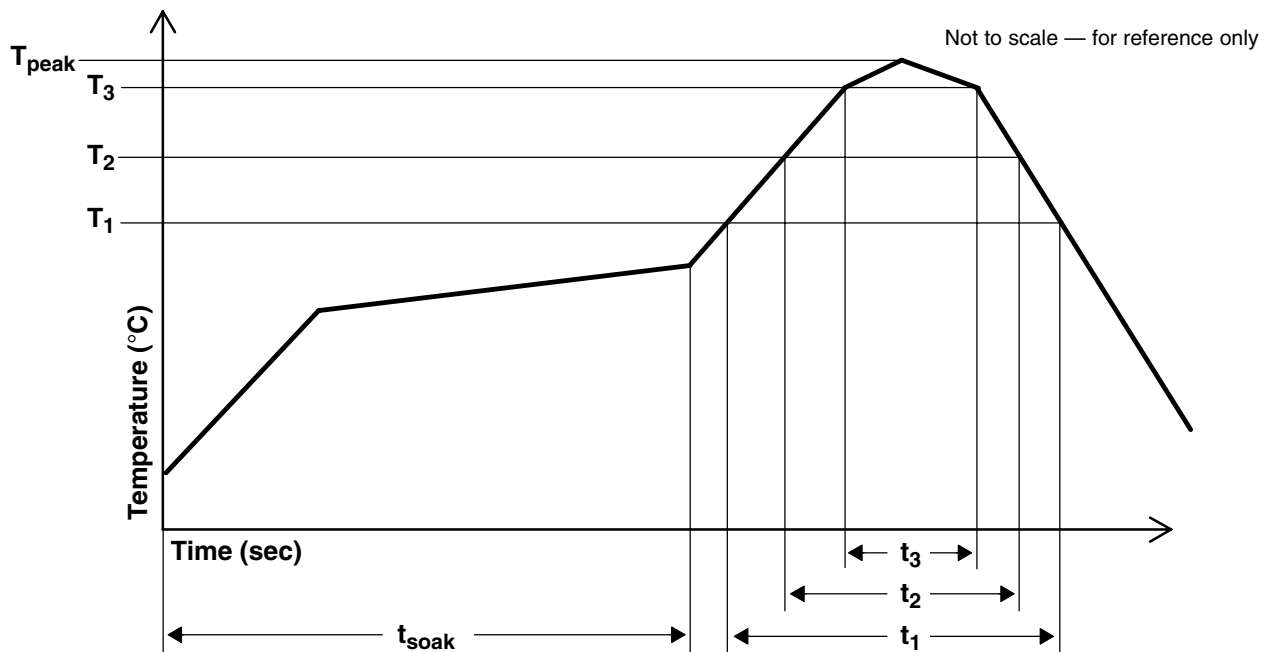


Figure 10. TCS3200, TCS3210 Solder Reflow Profile Graph

Moisture Sensitivity

Optical characteristics of the device can be adversely affected during the soldering process by the release and vaporization of moisture that has been previously absorbed into the package molding compound. To prevent these adverse conditions, all devices shipped in carrier tape have been pre-baked and shipped in a sealed moisture-barrier bag. No further action is necessary if these devices are processed through solder reflow within 24 hours of the seal being broken on the moisture-barrier bag.

However, for all devices shipped in tubes or if the seal on the moisture barrier bag has been broken for 24 hours or longer, it is recommended that the following procedures be used to ensure the package molding compound contains the smallest amount of absorbed moisture possible.

For devices shipped in tubes:

1. Remove devices from tubes
2. Bake devices for 4 hours, at 90°C
3. After cooling, load devices back into tubes
4. Perform solder reflow within 24 hours after bake

Bake only a quantity of devices that can be processed through solder reflow in 24 hours. Devices can be re-baked for 4 hours, at 90°C for a cumulative total of 12 hours (3 bakes for 4 hours at 90°C).

For devices shipped in carrier tape:

1. Bake devices for 4 hours, at 90°C in the tape
2. Perform solder reflow within 24 hours after bake

Bake only a quantity of devices that can be processed through solder reflow in 24 hours. Devices can be re-baked for 4 hours in tape, at 90°C for a cumulative total of 12 hours (3 bakes for 4 hours at 90°C).

TCS3200, TCS3210 PROGRAMMABLE COLOR LIGHT-TO-FREQUENCY CONVERTER

TAOS099 – JULY 2009

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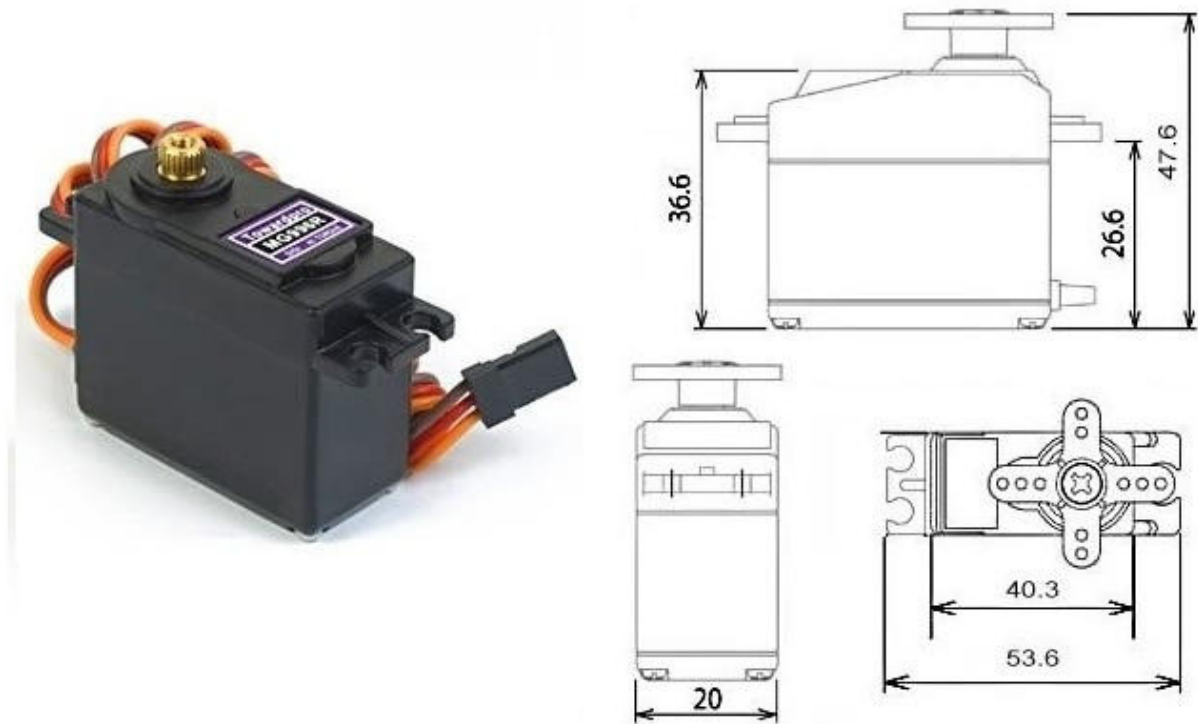
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MG996R High Torque Metal Gear Dual Ball Bearing Servo



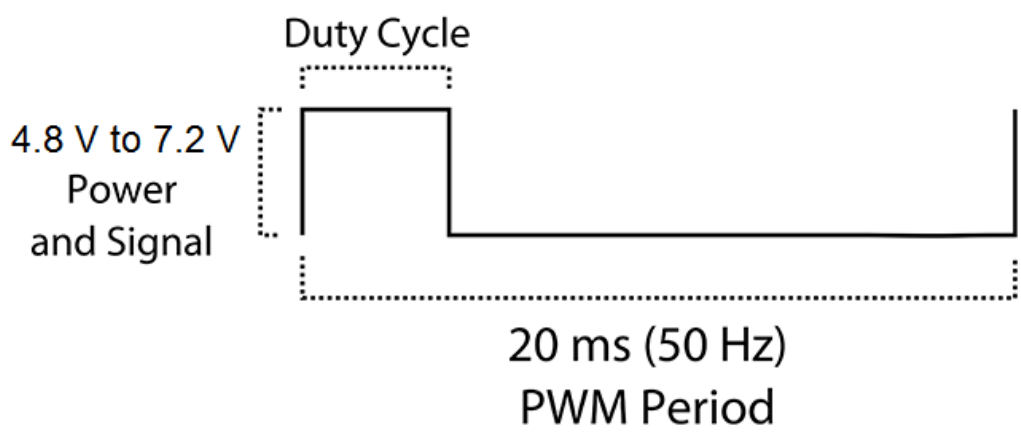
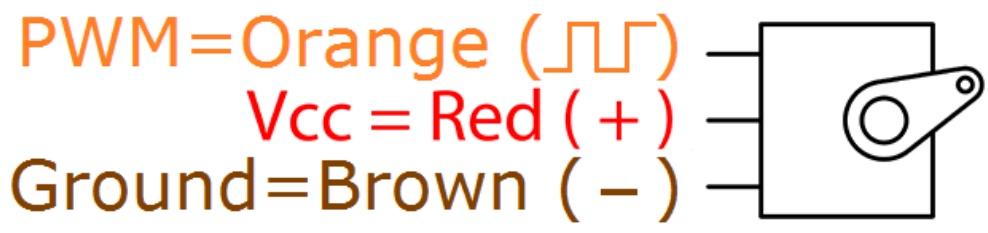
This High-Torque MG996R Digital Servo features metal gearing resulting in extra high 10kg stalling torque in a tiny package. The MG996R is essentially an upgraded version of the famous MG995 servo, and features upgraded shock-proofing and a redesigned PCB and IC control system that make it much more accurate than its predecessor. The gearing and motor have also been upgraded to improve dead bandwith and centering. 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-torque 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 MG996R 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: 9.4 kgf·cm (4.8 V), 11 kgf·cm (6 V)
- Operating speed: 0.17 s/60° (4.8 V), 0.14 s/60° (6 V)

- Operating voltage: 4.8 V a 7.2 V
- Running Current 500 mA – 900 mA (6V)
- Stall Current 2.5 A (6V)
- Dead band width: 5 μ s
- Stable and shock proof double ball bearing design
- Temperature range: 0 $^{\circ}$ C – 55 $^{\circ}$ C



```
// R. APRIASAN PAMUNGKAS
// POLITEKNIK NEGERI SRIWIJAYA
// TEKNIK ELEKTRO 2013
// ARM ROBOT 4 DOF PENYORTIR BUAH OTOMATIS

#include <Servo.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

#define I2C_ADDR 0x3F // <<- Add your address here.
#define Rs_pin 0
#define Rw_pin 1
#define En_pin 2
#define BACKLIGHT_PIN 3
#define D4_pin 4
#define D5_pin 5
#define D6_pin 6
#define D7_pin 7

LiquidCrystal_I2C lcd(I2C_ADDR,En_pin,Rw_pin,Rs_pin,D4_pin,D5_pin,D6_pin,D7_pin);

#define S0 3
#define S1 4
#define S2 5
#define S3 6
#define sensorOut 2

int frequency = 0;
int red = 0;
int green = 0;
int blue = 0;

#define jumlah_servo 6
```



```
int servoPins[] = {8, 9, 10, 11, 12, 13};  
Servo servos[jumlah_servo];  
int servomax[] = {180, 180, 180, 180, 180, 180};  
int servomin[] = {10, 10, 10, 10, 10, 10};  
int servostart[] = {90, 90, 90, 90, 90, 90};  
int servo1=90,servo2=90,servo3=90,servo4=90,servo5=90;  
String inputString = "";
```

```
void initServos() {  
  int i;  
  for (i=0; i<jumlah_servo; i++)  
  {  
    servos[i].attach(servoPins[i]); // servo setup  
    servos[i].write(servostart[i]);  
  }  
}
```

```
void setup() {  
  Wire.begin();  
  
  pinMode(S0, OUTPUT);  
  pinMode(S1, OUTPUT);  
  pinMode(S2, OUTPUT);  
  pinMode(S3, OUTPUT);  
  pinMode(sensorOut, INPUT);  
  
  // Setting frequency-scaling to 20%  
  digitalWrite(S0,HIGH);  
  digitalWrite(S1,LOW);
```

```

initServos();
Serial.begin(9600);

// setservo(10, 90, 90, 90, 90, 60);
lcd.begin (16,2); // <<-- our LCD is a 16x2, change for your LCD if needed
// LCD Backlight ON
lcd.setBacklightPin(BACKLIGHT_PIN,POSITIVE);
lcd.setBacklight(HIGH);

lcd.home (); // go home on LCD
lcd.setCursor (0,0);
lcd.print("Alat Sortir Buah");
lcd.setCursor (0,1);
lcd.print("Poltek Sriwijaya");
delay(1000);
}

void loop() {
  color();
  lcd.clear();
  lcd.setCursor (0,0);
  lcd.print("R:");lcd.print(red);lcd.print(" G:");lcd.print(green);
  lcd.setCursor (0,1);
  lcd.print("B:");lcd.print(blue);
  // delay(1000);
  if (red >0 && red <10){
  // Serial.println("Jeruk Lemon");
  lcd.print(" Lemon");
  Serial.println("1,");
  ambil3();
  delay(500);

```

```

    kotak3();
    Serial.println("2,");
}
else if (red >120 && red <153){
// Serial.println("Jeruk Nipis");
    lcd.print(" Nipis");
    Serial.println("1,");
    ambil2();
    delay(500);
    kotak2();
    Serial.println("2,");
}
else if (red >32 && red <61 ){
// Serial.println("Jeruk Lokal");
    lcd.print(" Lokal");
    Serial.println("1,");
    ambil1();
    delay(500);
    kotak1();
    Serial.println("2,");
}
// set servo(servo1, servo2, servo2, servo3, servo4, servo5);
}

void color(){
    // Setting red filtered photodiodes to be read
    digitalWrite(S2,LOW);
    digitalWrite(S3,LOW);
    // Reading the output frequency
    frequency = pulseIn(sensorOut, LOW);
    //Remaping the value of the frequency to the RGB Model of 0 to 255
    red = map(frequency, 20,90,0,255);

```

```

// Printing the value on the serial monitor
// Serial.print("R= "); //printing name
// Serial.print(abs(red)); //printing RED color frequency
// Serial.print(" ");
delay(100);
// Setting Green filtered photodiodes to be read
digitalWrite(S2,HIGH);
digitalWrite(S3,HIGH);
// Reading the output frequency
frequency = pulseIn(sensorOut, LOW);
//Remaping the value of the frequency to the RGB Model of 0 to 255
green = map(frequency, 15,30,255,0);
// Printing the value on the serial monitor
// Serial.print("G= "); //printing name
// Serial.print(abs(green)); //printing RED color frequency
// Serial.print(" ");
delay(100);
// Setting Blue filtered photodiodes to be read
digitalWrite(S2,LOW);
digitalWrite(S3,HIGH);
// Reading the output frequency
frequency = pulseIn(sensorOut, LOW);
//Remaping the value of the frequency to the RGB Model of 0 to 255
blue = map(frequency, 25,90,255,0);
// Printing the value on the serial monitor
// Serial.print("B= "); //printing name
// Serial.print(abs(blue)); //printing RED color frequency
// Serial.println(" ");
delay(100);
}
void serialEvent() {

```

```
while (Serial.available()) {  
  char inChar = (char)Serial.read();  
  inputString += inChar;  
  if (inChar == '\n') {  
    if(inputString.substring(0,1)=="a"){  
      servo1 =inputString.substring(1).toInt();  
    }  
    else if(inputString.substring(0,1)=="b"){  
      servo2 =inputString.substring(1).toInt();  
    }  
    else if(inputString.substring(0,1)=="c"){  
      servo3 =inputString.substring(1).toInt();  
    }  
    else if(inputString.substring(0,1)=="d"){  
      servo4 =inputString.substring(1).toInt();  
    }  
    else if(inputString.substring(0,1)=="e"){  
      servo5 =inputString.substring(1).toInt();  
    }  
    else if(inputString.substring(0,1)=="5"){  
      ambil1();  
    }  
    else if(inputString.substring(0,1)=="4"){  
      main_pos();  
    }  
    else if(inputString.substring(0,1)=="3"){  
      kotak3();  
    }  
    else if(inputString.substring(0,1)=="2"){  
      kotak2();  
    }  
  }  
}
```

```

else if(inputString.substring(0,1)=="1"){
    kotak1();
}
inputString="";
}
}
}

void motor_servo(int num, int deg) {
    deg = constrain(deg, servomin[num], servomax[num]);
    servos[num].write(deg);
}

void setservo(int deg1, int deg2, int deg3, int deg4, int deg5, int deg6) {
    int i;
    int deg[]= {deg1,deg2,deg3,deg4,deg5,deg6};

    for (i=0; i<6; i++)
    {
        deg[i] = constrain(deg[i], servomin[i], servomax[i]);
        servos[i].write(deg[i]);
    }
}

void main_pos(){
    setservo(10, 90, 90, 90, 90, 60);
}

void ambil1(){
    for(int i=0;i<70;i++){
        setservo(10, 90, 90, 90+i, 90, 60);
        delay(20);
    }
}

```

```
}  
for(int i=0;i<70;i++){  
    setservo(10, 90, 90, 160, 90-i, 60);  
    delay(20);  
}  
for(int i=0;i<50;i++){  
    setservo(10, 90, 90, 160, 20, 60+i);  
    delay(20);  
}  
for(int i=0;i<70;i++){  
    setservo(10, 90, 90, 160, 20+i, 90);  
    delay(20);  
}  
for(int i=0;i<70;i++){  
    setservo(10, 90, 90, 160-i, 90, 90);  
    delay(20);  
}  
}  
void ambil2(){  
    for(int i=0;i<70;i++){  
        setservo(10, 90, 90, 90+i, 90, 60);  
        delay(20);  
    }  
    for(int i=0;i<70;i++){  
        setservo(10, 90, 90, 160, 90-i, 60);  
        delay(20);  
    }  
    for(int i=0;i<60;i++){  
        setservo(10, 90, 90, 160, 20, 60+i);  
        delay(20);  
    }  
}
```

```
for(int i=0;i<70;i++){
  setservo(10, 90, 90, 160, 20+i, 120);
  delay(20);
}
for(int i=0;i<70;i++){
  setservo(10, 90, 90, 160-i, 90, 120);
  delay(20);
}
}
void ambil3(){
  for(int i=0;i<70;i++){
    setservo(10, 90, 90, 90+i, 90, 60);
    delay(20);
  }
  for(int i=0;i<70;i++){
    setservo(10, 90, 90, 160, 90-i, 60);
    delay(20);
  }
  for(int i=0;i<40;i++){
    setservo(10, 90, 90, 160, 20, 60+i);
    delay(20);
  }
  for(int i=0;i<70;i++){
    setservo(10, 90, 90, 160, 20+i, 90);
    delay(20);
  }
  for(int i=0;i<70;i++){
    setservo(10, 90, 90, 160-i, 90, 90);
    delay(20);
  }
}
```



```
void kotak3(){
  for(int i=0;i<50;i++){
    setservo(10+i, 90, 90, 90, 90, 90);
    delay(20);
  }
  for(int i=0;i<60;i++){
    setservo(60, 90, 90, 90+i, 90, 90);
    delay(10);
  }
  for(int i=0;i<10;i++){
    setservo(60, 90, 90, 150, 90-i, 60);
    delay(10);
  }
  for(int i=0;i<60;i++){
    setservo(60, 90, 90, 150-i, 90, 60);
    delay(10);
  }
  for(int i=0;i<50;i++){
    setservo(60-i, 90, 90, 90, 90, 60);
    delay(10);
  }
}
```

```
void kotak2(){
  for(int i=0;i<110;i++){
    setservo(10+i, 90, 90, 90, 90, 120);
    delay(20);
  }
  for(int i=0;i<60;i++){
    setservo(120, 90, 90, 90+i, 90, 120);
```

```
    delay(10);
}
for(int i=0;i<10;i++){
    setservo(120, 90, 90, 150, 90-i, 60);
    delay(10);
}
for(int i=0;i<60;i++){
    setservo(120, 90, 90, 150-i, 90, 60);
    delay(10);
}
for(int i=0;i<110;i++){
    setservo(120-i, 90, 90, 90, 90, 60);
    delay(10);
}
}
```

```
void kotak1(){
    for(int i=0;i<170;i++){
        setservo(10+i, 90, 90, 90, 90, 90);
        delay(20);
    }
    for(int i=0;i<60;i++){
        setservo(180, 90, 90, 90+i, 90, 90);
        delay(10);
    }
    for(int i=0;i<10;i++){
        setservo(180, 90, 90, 150, 90-i, 60);
        delay(10);
    }
    for(int i=0;i<60;i++){
        setservo(180, 90, 90, 150-i, 90, 60);
```

```
    delay(10);  
}  
for(int i=0;i<170;i++){  
    setservo(180-i, 90, 90, 90, 90, 60);  
    delay(10);  
}  
}
```



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Mahasiswa berikut,

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Judul Laporan Skripsi : Analisis Penerapan *Arm Robot 4 Degree Of Freedom (DOF)* Sebagai Alat Penyortir Buah Otomatis

Telah melaksanakan revisi terhadap Skripsi yang disidangkan pada hari Selasa tanggal 18 bulan Juli tahun 2017. Pelaksanaan revisi terhadap Skripsi tersebut telah disetujui oleh Dosen Penilai yang memberikan revisi :

No.	Komentar	Nama Dosen Penilai *)	Tanggal	Tanda Tangan
1.	Ace	Ir. Iskandar Lutfi, M.T. ** NIP. 19650129 199103 1 002	13/9 2017	
2.	Ace	Ir. Yordan Hasan, M.Kom.* NIP. 19591010 199003 1 004	24/8. 2017	
3.		Amperawan, S.T, M.T. NIP. 19670523 199303 1 002		
4.	Ace	Yeni Irdayanti, S.T., M.Kom.* NIP. 19761221 200212 2 001	23/8-2017	
5.	Ace Revisi	M. Taufik Roseno, S.T., M.Kom.* NIP. 197770323 200312 1 002	22/8 2017	
6.	Revised	Yurni Oktarina, S.T., M.T.* NIP. 19771016 200812 2 001	3/8 2017	

Palembang, Juli 2017
Mengetahui,
Dosen Pembimbing

Ir. Iskandar Lutfi, M.T.
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Catatan:

*) Dosen penilai yang memberikan revisi saat Sidang Skripsi.
**) Dosen penilai yang ditugaskan sebagai Ketua Penilai saat Sidang Skripsi.
Lembaran pelaksanaan revisi ini harus dilampirkan dalam Laporan Skripsi



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Ruang : 2
Dosen Penguji : Yurni Oktavia
Nama Mahasiswa : R. Aprizca P
NIM :
Jurusan/Program Studi :
Judul Laporan Akhir :

No	Uraian Revisi	Paraf
1.	Perbaiki cara penulisan nomor tabel	
2.	Tambahkan data RSB asli dg gambar dan bandanya	
3.	Tambahkan data pulsa servo legar (link: perancangan robot pengontrolan bantol berbasis mikrokontroler)	

Palembang,

Dosen Penguji,

(.....)





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NO	TANGGAL	URAIAN BIMBINGAN	PARAF PEMBIMBING
1.	9/1 2017	Pengajuan Pembuatan Judul Tugas Akhir (TA).	
2.	10/1 2017	Konsultasi Judul Proposal Tugas Akhir	
3.	16/1 2017	Konsultasi Proposal Tugas Akhir	
4.	18/1 2017	Proposal BAB I dan BAB II	
5.	19/1 2017	BAB I BAB II OK LANJUT BAB III, BAB IV	
6.	23/1 2017	Proposal TA, ACC	
7.	13/3 2017	Konsultasi Alat	
8.	5/5 2017	Pengajuan BAB I, BAB II, BAB III TA	

9.	3 / 7 2017	ACC BAB I, BAB II, BAB III	
10.	10 / 7 2017	Perbaiki BAB IV	
11.	12 / 7 2017	ACC BAB IV LANJUT BAB V	
12.	13 / 7 2017	Konsultasi Powerpoint ACC BAB V	
13.	17 / 7 2017	ACC UJIAN SKRIPSI !!!	

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NO	TANGGAL	URAIAN BIMBINGAN	PARAF PEMBIMBING
1.	4 / 1 2017	Pengajuan Judul Laporan Tugas Akhir	f.
2.	13 / 1 2017	Konsultasi Judul Proposal Tugas Akhir	f.
3.	18 / 1 2017	Konsultasi Proposal Tugas Akhir	f.
4.	19 / 1 2017	Perbaikan Proposal Tugas Akhir	f.
5.	22 / 3 2017	ACC PROPOSAL TA	f.
6.	12 / 4 2017	Konsultasi Alat	f.
7.	5 / 5 2017	Pengajuan TA BAB I dan BAB II	f.
8.	31 / 5 2017	BAB I ok! BAB II REVISI!	f.

9.	10-6-2017	BAB II OK. Lanjutkan BAB III	J.
10.	12 / 6 2017	Perbaiki BAB III	J.
11.	9 / 7 2017	ACC BAB III. Konsultasi pengambilan data / Uji Alat.	J.
12	10 / 7 2017	Revisi perbaikan Bab III, IV, V & ACC Ujian Skripsi	J.

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LEMBAR REKOMENDASI UJIAN SKRIPSI

Pembimbing Skripsi Memberikan Rekomendasi Kepada :

Nama : R. Apriasan Pamungkas

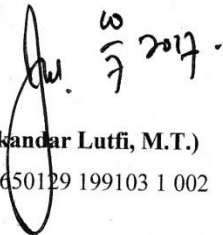
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Judul Tugas Akhir : Analisis Penerapan *Arm Robot 4 Degree Of Freedom (DOF)* Sebagai Alat Penyortir Buah Otomatis


Mahasiswa tersebut telah memenuhi persyaratan dan dapat mengikuti Ujian Skripsi pada Tahun Akademik 2016/2017

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