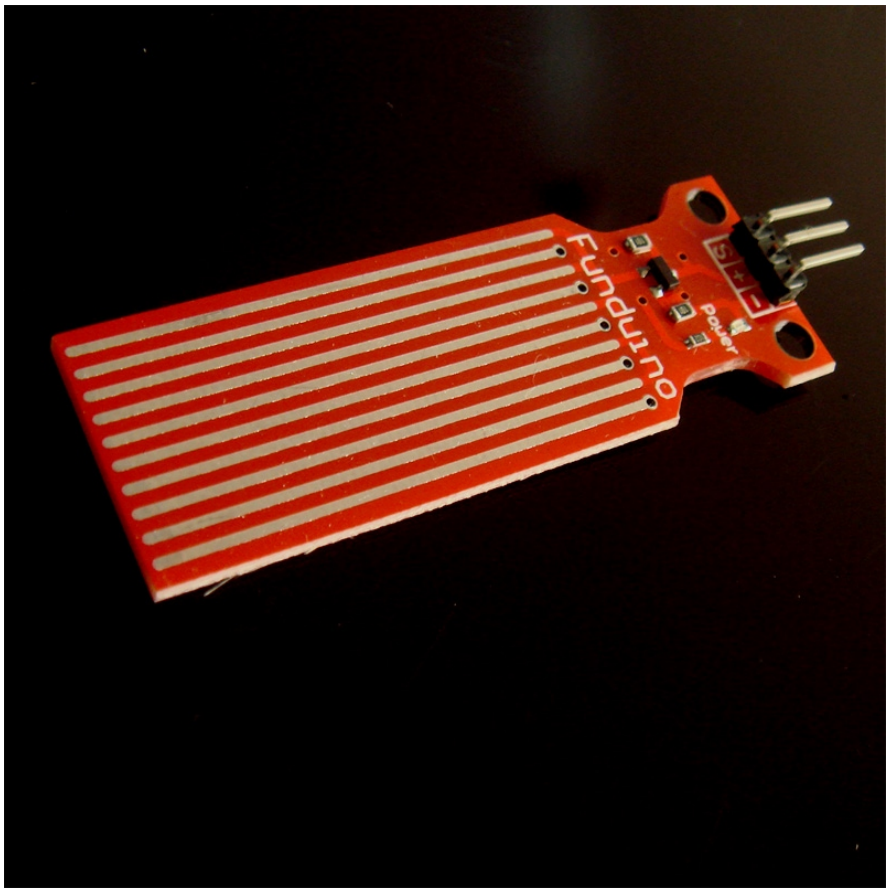
Water Sensor Module User's Manual



I. Notice

（1）did not carefully read the instructions before you do not give the driver board is powered ! Avoid faulty wiring caused permanent damage to the drive plate .

（2）Please carefully check pin function , attention condensed identifier , correct wiring ! Do not reverse the power cord , resulting in
Electronic devices burned.

2. the product introduction

2013 latest Water Sensor is a Easy to use, compact and lightweight , high cost of water , droplets identification and detection sensors. This sensor is working The principle is to measure the size of the trace amount of water droplets through the line with a series of parallel wires exposed . And domestic and foreign Products compared not only small , powerful, and cleverly designed with the following features : First, the amount of water to simulate Conversion ; Second, plasticity , based on the sensor output analog values ; Third, low power consumption , high sensitivity ; Fourth, can Directly connected to a microprocessor or other logic circuitry , and the controller board for a variety of , for example : ArduinoController , STC microcontroller , AVR microcontroller and so on.

3, the specification parameters

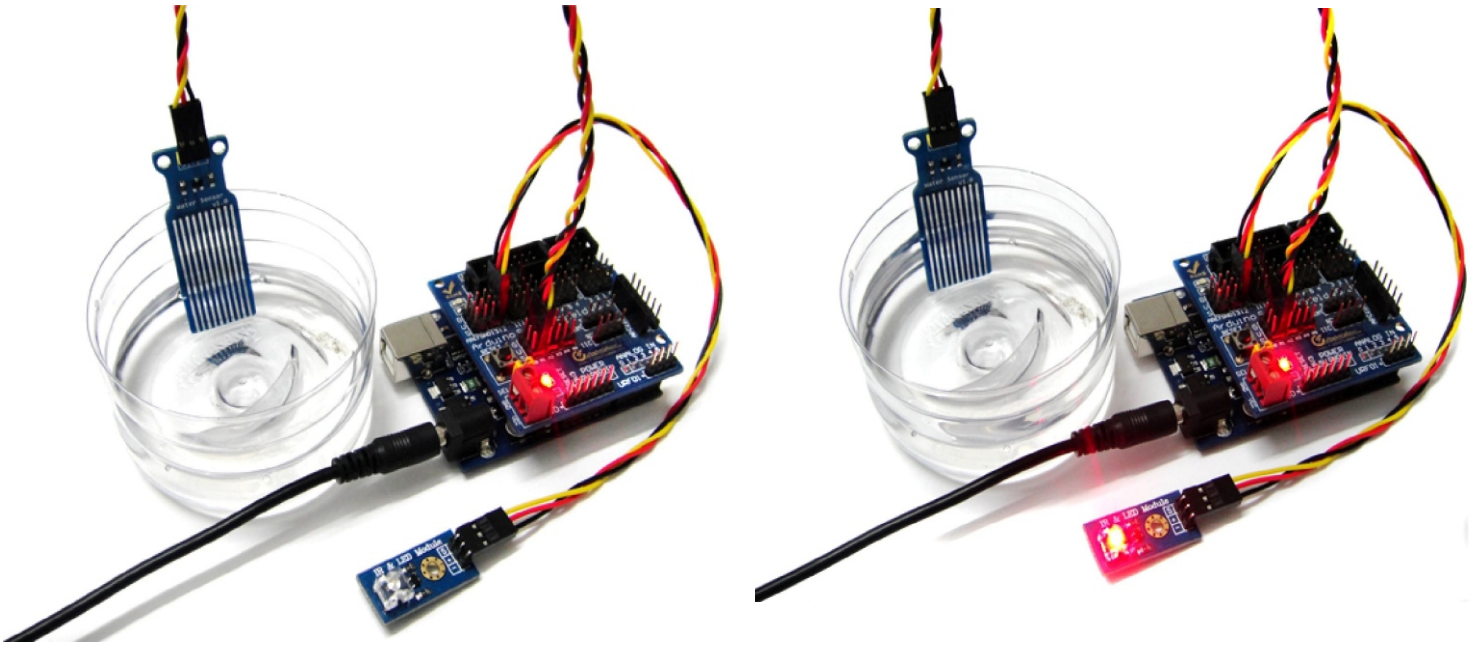
1 Product Name: water level sensor
2 Item :. K-0135
3 Operating voltage :. DC5V
4 Working current : less than 20mA
5 Sensor Type : Analog
6 detection area :. 40mm x16mm
7 Production process :. FR4 double-sided HASL
8 mounting hole size : 3.0mm
9 user-friendly design : half-moon -slip handle depression
10 Working temperature :. 10 ℃ -30 ℃
11 Operating Humidity : 10% ~ 90 % non -condensing
12 Weight :. 3g
13 Product Dimensions : 65mm x 20mm x 8mm

4., the test Water Sensor Module
We use the Arduino controller to be tested , need to use hardware devices as follows :
1, Arduino controller × 1
2, Arduino sensor expansion board × 1
3, Water Sensor Module × 1
4, 3P sensor cable × 2
5, IR & LED Modue (red) × 1
6, USB data communication cable × 1
Water Sensor DuPont line will be connected to the Arduino sensor expansion board interface
A1. The use of sensors
The red line will be connected to the Arduino piranha light sensor expansion board D8. After completing the hardware connection , the code is compiled
After downloading the Arduino inside .

Arduino experimental code .

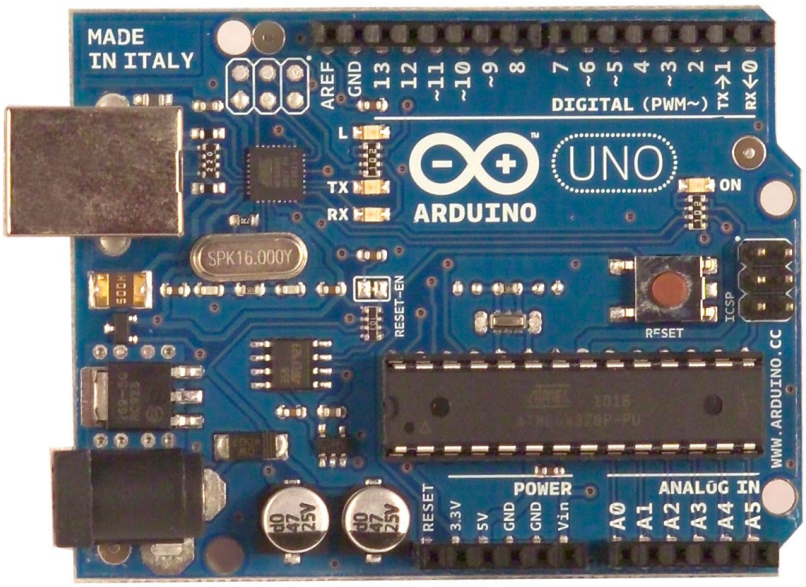
```
int analogPin = 1; / / level sensor connected to an analog port
int led = 12; / / Piranha LED connected to digital port 12
int val = 0; / / define a variable val initial value of 0
int data = 0; / / define a variable data initial value of 0
void setup ()
{
pinMode (led, OUTPUT); / / define led to an output pin
Serial.begin (9600); / / set the baud rate to 9600
}

void loop ()
{
val = analogRead (analogPin); / / read the analog value to the variable val
if (val> 700) {/ / determine whether more than 700 variables val
digitalWrite (led, HIGH); when / / variable val is greater than 700 , Piranha LED lights
}
else {
digitalWrite (led, LOW); when / / variable val is less than 700 , the lamp goes out piranha
}
data = val; / / variable is assigned to the variable data val
Serial.println (data); / / Serial print variable data
delay (100);
}
```

After these steps are completed, we test the low water level, see experimental phenomena :



The water level does not reach the warning value , piranhas lamp is not lit
Water level reaches and exceeds the alert value , piranha lights , initiate alarm.

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 Arduno, 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.

Index

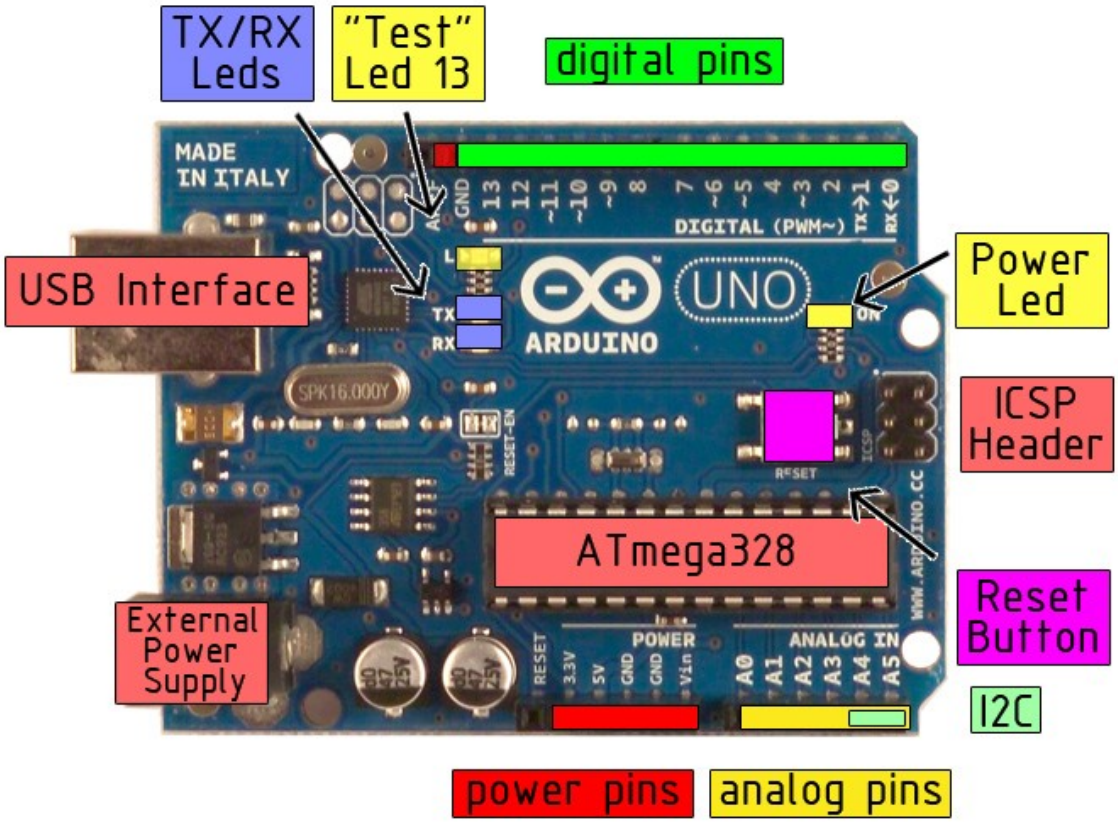
Technical Specification

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



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. TThese 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.

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).

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.

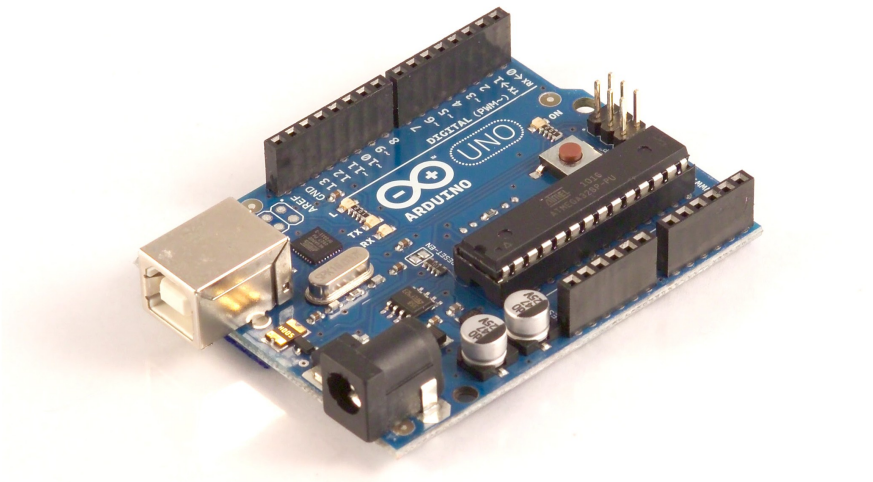
The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see this forum thread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



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-platoform program. You'll have to follow different instructions for your personal OS. Check on the Arduino site 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

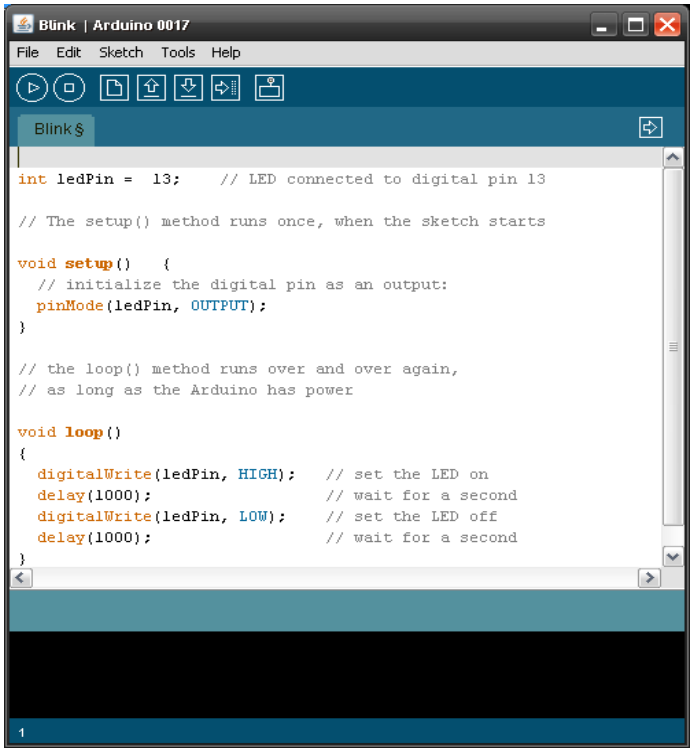
Now you're actually ready to "burn" your first program on the arduino board. To select "blink led", the physical translation of the well known programming "hello world", select

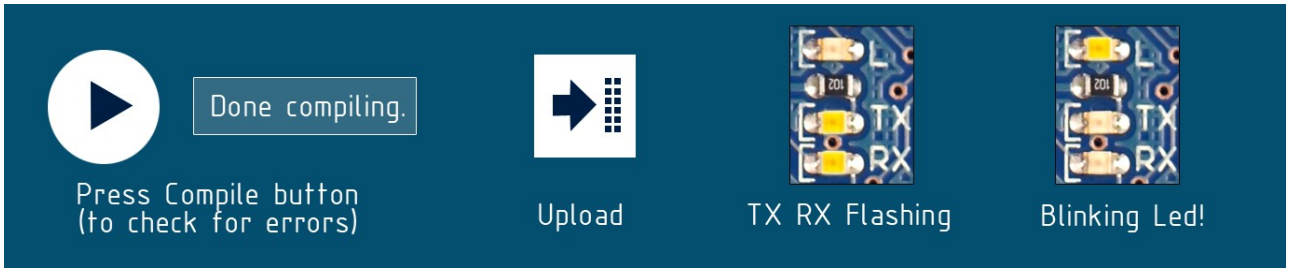
File>Sketchbook>
Arduino-0017>Examples>
Digital>Blink

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

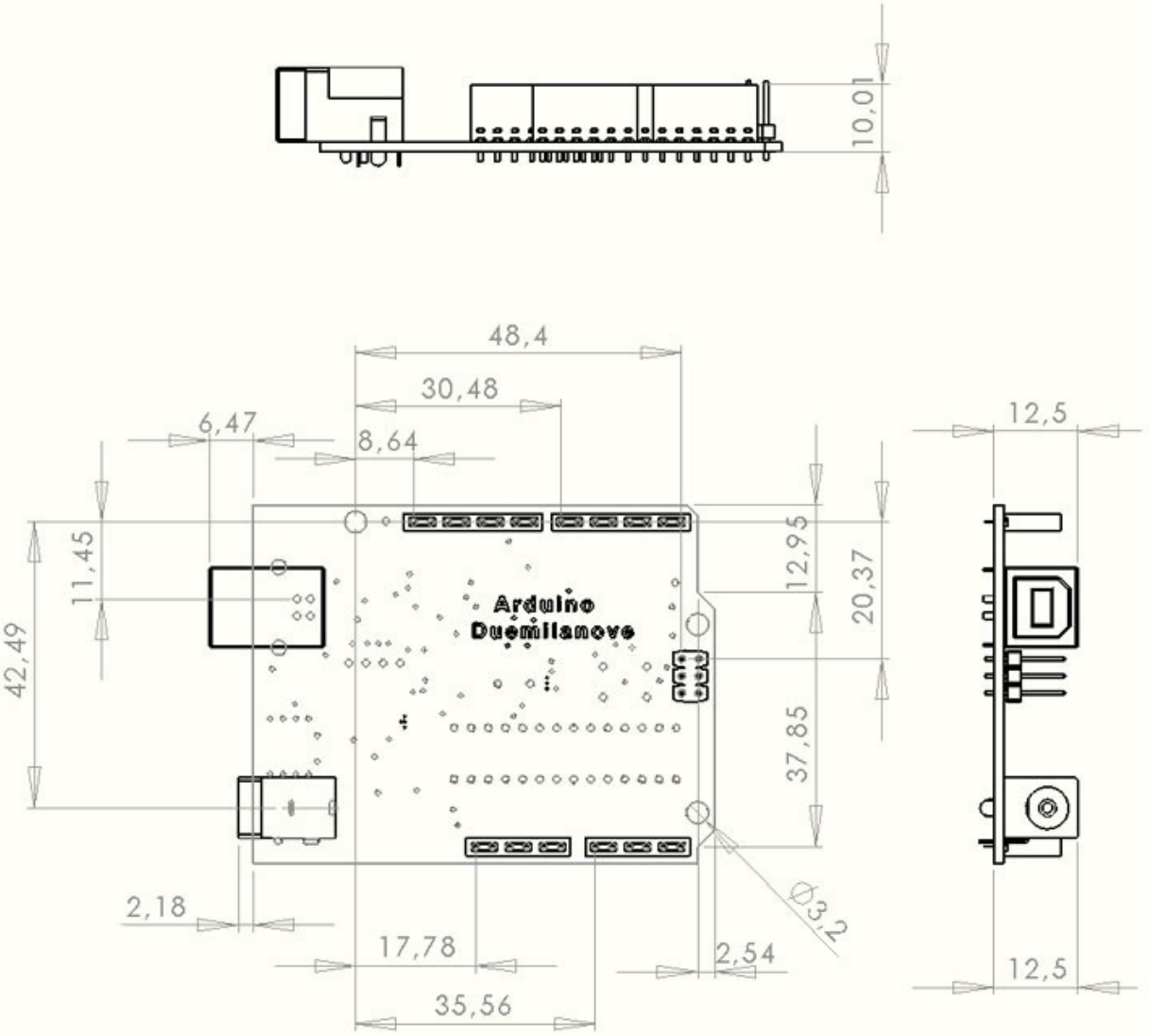
In **Tools>Board** select

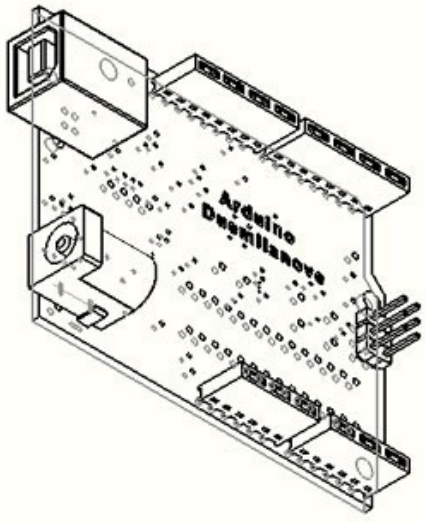
Now you have to go to
Tools>SerialPort
and select the right serial port, the one arduino is attached to.





Dimensioned Drawing





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.

Enviromental 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.

April 1999
Revised October 2005

LM7805 • LM7806 • LM7808 • LM7809 • LM7810 • LM7812 • LM7815 • LM7818 • LM7824 • LM7805A • LM7806A • LM7808A •LM7809A • LM7810A • LM7812A • LM7815A • LM7818A • LM7824A

3-Terminal 1A Positive Voltage Regulator (Preliminary)

General Description

The LM78XX series of three terminal positive regulators are available in the TO-220 package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

Features

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 12, 15, 18, 24
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

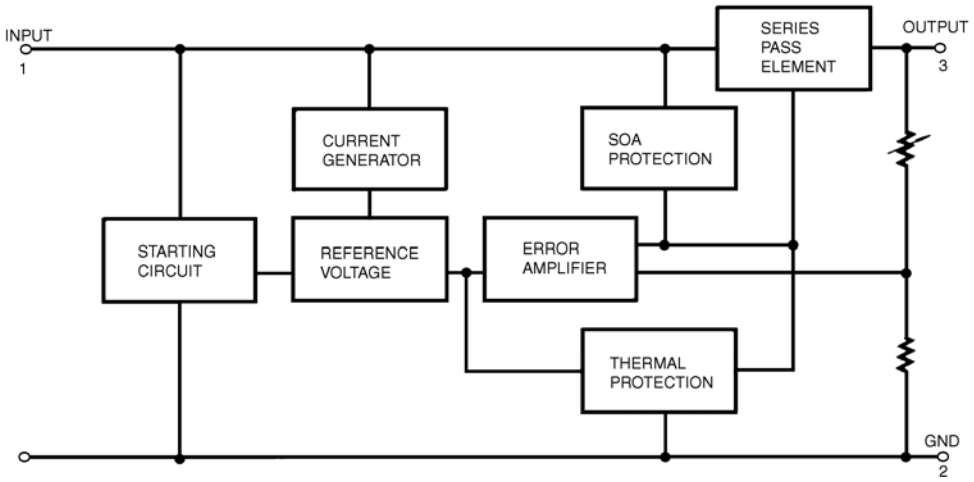
Ordering Code:

Product Number	Output Voltage Tolerance	Package	Operating Temperature
LM7805CT	±4%	TO-220	−40°C - +125°C
LM7806CT			
LM7808CT			
LM7809CT			
LM7810CT			
LM7812CT			
LM7815CT			
LM7818CT			
LM7824CT			
LM7805ACT	±2%		0°C - +125°C
LM7806ACT			
LM7808ACT			
LM7809ACT			
LM7810ACT			
LM7812ACT			
LM7815ACT			
LM7818ACT			
LM7824ACT			

LM7805 • LM7806 • LM7808 • LM7809 • LM7810 • LM7812 • LM7815 • LM7818 • LM7824 • LM7805A • LM7806A • LM7808A •LM7809A • LM7810A • LM7812A • LM7815A • LM7818A • LM7824A 3-Terminal 1A Positive Voltage Regulator (Preliminary)

TO-220

Internal Block Diagram



Absolute Maximum Ratings(Note 1)

Parameter	Symbol	Value	Unit
Input Voltage (for V_O = 5V to 18V)	V_I	35	V
(for V_O = 24V)	V_I	40	V
Thermal Resistance Junction-Cases (TO-220)	$R_{\theta JC}$	5	°C/W
Thermal Resistance Junction-Air (TO-220)	$R_{\theta JA}$	65	°C/W
Operating Temperature Range	T_{OPR}	0 ~ +125	°C
LM78xx		−40 ~ +125	°C
LM78xxA		0 ~ +125	°C
Storage Temperature Range	T_{STG}	−65 ~ +150	°C

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The datasheet specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation outside datasheet specifications.

Electrical Characteristics (LM7805)

(Refer to the test circuits. −40°C < T_J < 125°C, I_O = 500mA, V_I = 10V, C_I = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		4.8	5.0	5.2	V
		5mA ≤ I_O ≤ 1A, P_O ≤ 15W, V_I = 7V to 20V		4.75	5.0	5.25	
Line Regulation	Regline	T_J = +25°C	V_O = 7V to 25V	–	4.0	100	mV
(Note 2)			V_I = 8V to 12V	–	1.6	50.0	
Load Regulation	Regload	T_J = +25°C	I_O = 5mA to 1.5mA	–	9.0	100	mV
			I_O = 250mA to 750mA	–	4.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.0	8.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	0.03	0.5	mA
		V_I = 7V to 25V		–	0.3	1.3	
Output Voltage Drift (Note 3)	$\Delta V_O/\Delta T$	I_O = 5mA		–	−0.8	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	42.0	–	μV/V_O
Ripple Rejection (Note 3)	RR	f = 120Hz, V_O = 8V to 18V		62.0	73.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 3)	rO	f = 1KHz		–	15.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	230	–	mA
Peak Current (Note 3)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 2: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 3: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7806)

(Refer to the test circuits. −40°C < T_J < 125°C, I_O = 500mA, V_I = 11V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		5.75	6.0	6.25	V
		5mA ≤ I_O ≤ 1A, P_O ≤ 15W, V_I = 8.0V to 21V		5.7	6.0	6.3	
Line Regulation	Regline	T_J = +25°C	V_I = 8V to 25V	–	5.0	120	mV
(Note 4)			V_I = 9V to 13V	–	1.5	60.0	
Load Regulation	Regload	T_J = +25°C	I_O = 5mA to 1.5mA	–	9.0	120	mV
(Note 4)			I_O = 250mA to 750mA	–	3.0	60.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.0	8.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 8V to 25V		–	–	1.3	
Output Voltage Drift (Note 5)	$\Delta V_O/\Delta T$	I_O = 5mA		–	−0.8	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	45.0	–	μV/V_O
Ripple Rejection (Note 5)	RR	f = 120Hz, V_O = 8V to 18V		62.0	73.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 5)	rO	f = 1KHz		–	19.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 5)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 4: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 5: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7808)

(Refer to the test circuits. −40°C < T_J < 125°C, I_O = 500mA, V_I = 14V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		7.7	8.0	8.3	V
		5mA ≤ I_O ≤ 1A, P_O ≤ 15W, V_I = 10.5V to 23V		7.6	8.0	8.4	
Line Regulation	Regline	T_J = +25°C	V_I = 10.5V to 25V	–	5.0	160	mV
(Note 6)			V_I = 11.5V to 17V	–	2.0	80.0	
Load Regulation	Regload	T_J = +25°C	I_O = 5mA to 1.5mA	–	10.0	160	mV
(Note 6)			I_O = 250mA to 750mA	–	5.0	80.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.0	8.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	0.05	0.5	mA
		V_I = 10.5V to 25V		–	0.5	1.0	
Output Voltage Drift (Note 7)	$\Delta V_O/\Delta T$	I_O = 5mA		–	−0.8	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	52.0	–	μV/V_O
Ripple Rejection (Note 7)	RR	f = 120Hz, V_O = 11.5V to 21.5V		56.0	73.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 7)	rO	f = 1KHz		–	17.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	230	–	mA
Peak Current (Note 7)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 6: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 7: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7809)

(Refer to the test circuits. −40°C < T_J < 125°C, I_O = 500mA, V_I = 15V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		8.65	9.0	9.35	V
		5mA ≤ I_O ≤ 1A, P_O ≤ 15W, V_I = 11.5V to 24V		8.6	9.0	9.4	
Line Regulation	Regline	T_J = +25°C	V_I = 11.5V to 25V	–	6.0	180	mV
(Note 8)			V_I = 12V to 17V	–	2.0	90.0	
Load Regulation	Regload	T_J = +25°C	I_O = 5mA to 1.5mA	–	12.0	180	mV
(Note 8)			I_O = 250mA to 750mA	–	4.0	90.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.0	8.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 11.5V to 26V		–	–	1.3	
Output Voltage Drift (Note 9)	$\Delta V_O/\Delta T$	I_O = 5mA		–	−1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	58.0	–	μV/V_O
Ripple Rejection (Note 9)	RR	f = 120Hz, V_O = 13V to 23V		56.0	71.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 9)	rO	f = 1KHz		–	17.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 9)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 8: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 9: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7810)

(Refer to the test circuits. −40°C < T_J < 125°C, I_O = 500mA, V_I = 16V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		9.6	10.0	10.4	V
		5mA ≤ I_O ≤ 1A, P_O ≤ 15W, V_I = 12.5V to 25V		9.5	10.0	10.5	
Line Regulation	Regline	T_J = +25°C	V_I = 12.5V to 25V	–	10.0	200	mV
(Note 10)			V_I = 13V to 25V	–	3.0	100	
Load Regulation	Regload	T_J = +25°C	I_O = 5mA to 1.5mA	–	12.0	200	mV
(Note 10)			I_O = 250mA to 750mA	–	4.0	400	
Quiescent Current	I_Q	T_J = +25°C		–	5.1	8.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 12.5V to 29V		–	–	1.0	
Output Voltage Drift (Note 11)	$\Delta V_O/\Delta T$	I_O = 5mA		–	−1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	58.0	–	μV/V_O
Ripple Rejection (Note 11)	RR	f = 120Hz, V_O = 13V to 23V		56.0	71.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 11)	rO	f = 1KHz		–	17.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 11)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 10: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 11: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7812)

(Refer to the test circuits. −40°C < T_J < 125°C, I_O = 500mA, V_I = 19V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		11.5	12.0	12.5	V
		5mA ≤ I_O ≤ 1A, P_O ≤ 15W, V_I = 14.5V to 27V		11.4	12.0	12.6	
Line Regulation	Regline	T_J = +25°C	V_I = 14.5V to 30V	–	10.0	240	mV
(Note 12)			V_I = 16V to 22V	–	3.0	120	
Load Regulation	Regload	T_J = +25°C	I_O = 5mA to 1.5mA	–	11.0	240	mV
(Note 12)			I_O = 250mA to 750mA	–	5.0	120	
Quiescent Current	I_Q	T_J = +25°C		–	5.1	8.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	0.1	0.5	mA
		V_I = 14.5V to 30V		–	0.5	1.0	
Output Voltage Drift (Note 13)	$\Delta V_O/\Delta T$	I_O = 5mA		–	−1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	76.0	–	μV/V_O
Ripple Rejection (Note 13)	RR	f = 120Hz, V_I = 15V to 25V		55.0	71.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 13)	rO	f = 1KHz		–	18.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	230	–	mA
Peak Current (Note 13)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 12: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 13: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7815)

(Refer to the test circuits. −40°C < T_J < 125°C, I_O = 500mA, V_I = 23V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		14.4	15.0	15.6	V
		5mA ≤ I_O ≤ 1A, P_O ≤ 15W, V_I = 17.5V to 30V		14.25	15.0	15.75	
Line Regulation	Regline	T_J = +25°C	V_I = 17.5V to 30V	–	11.0	300	mV
(Note 14)			V_I = 20V to 26V	–	3.0	150	
Load Regulation	Regload	T_J = +25°C	I_O = 5mA to 1.5mA	–	12.0	300	mV
(Note 14)			I_O = 250mA to 750mA	–	4.0	150	
Quiescent Current	I_Q	T_J = +25°C		–	5.2	8.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 17.5V to 30V		–	–	1.0	
Output Voltage Drift (Note 15)	$\Delta V_O/\Delta T$	I_O = 5mA		–	−1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	90.0	–	μV/V_O
Ripple Rejection (Note 15)	RR	f = 120Hz, V_I = 18.5V to 28.5V		54.0	70.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 15)	rO	f = 1KHz		–	19.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 15)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 14: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 15: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7818)

(Refer to the test circuits. −40°C < T_J < 125°C, I_O = 500mA, V_I = 27V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		17.3	18.0	18.7	V
		5mA ≤ I_O ≤ 1A, P_O ≤ 15W, V_I = 21V to 33V		17.1	18.0	18.9	
Line Regulation	Regline	T_J = +25°C	V_I = 21V to 33V	–	15.0	360	mV
(Note 12)			V_I = 24V to 30V	–	5.0	180	
Load Regulation	Regload	T_J = +25°C	I_O = 5mA to 1.5mA	–	15.0	360	mV
(Note 12)			I_O = 250mA to 750mA	–	5.0	180	
Quiescent Current	I_Q	T_J = +25°C		–	5.2	8.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 21V to 33V		–	–	1.0	
Output Voltage Drift (Note 17)	$\Delta V_O/\Delta T$	I_O = 5mA		–	−1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	110	–	μV/V_O
Ripple Rejection (Note 17)	RR	f = 120Hz, V_I = 22V to 32V		53.0	69.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 17)	rO	f = 1KHz		–	22.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 17)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 16: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 17: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7824)

(Refer to the test circuits. −40°C < T_J < 125°C, I_O = 500mA, V_I = 33V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		23.0	24.0	25.0	V
		5mA ≤ I_O ≤ 1A, P_O ≤ 15W, V_I = 27V to 38V		22.8	24.0	25.25	
Line Regulation	Regline	T_J = +25°C	V_I = 27V to 38V	–	17.0	480	mV
(Note 18)			V_I = 30V to 36V	–	6.0	240	
Load Regulation	Regload	T_J = +25°C	I_O = 5mA to 1.5mA	–	15.0	480	mV
(Note 18)			I_O = 250mA to 750mA	–	5.0	240	
Quiescent Current	I_Q	T_J = +25°C		–	5.2	8.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	0.1	0.5	mA
		V_I = 27V to 38V		–	0.5	1.0	
Output Voltage Drift (Note 19)	$\Delta V_O/\Delta T$	I_O = 5mA		–	−1.5	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	60.0	–	μV/V_O
Ripple Rejection (Note 19)	RR	f = 120Hz, V_I = 28V to 38V		50.0	67.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 19)	rO	f = 1KHz		–	28.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	230	–	mA
Peak Current (Note 19)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 18: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 19: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7805A)

(Refer to the test circuits. $0°C < T_J < 125°C$, I_O = 1A, V_I = 10V, C_I = 0.33µF, C_O = 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		4.9	5.0	5.1	V
		I_O = 5mA to 1A, $P_O \leq$ 15W, V_I = 7.5V to 20V		4.8	5.0'	5.2	
Line Regulation	Regline	V_I = 7.5V to 25V, I_O = 500mA		–	5.0	50.0	mV
(Note 20)		V_I = 8V to 12V		–	3.0	50.0	
		T_J = +25°C	V_I = 7.3V to 20V	–	5.0	50.0	
			V_I = 8V to 12V	–	1.5	25.0	
Load Regulation	Regload	T_J = +25°C, I_O = 5mA to 1.5mA		–	9.0	100	mV
(Note 20)		I_O = 5mA to 1mA		–	9.0	100	
		I_O = 250mA to 750mA		–	4.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.0	6.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 8V to 25V, I_O = 500mA		–	–	0.8	
		V_I = 7.5V to 20V, T_J = +25°C		–	–	0.8	
Output Voltage Drift (Note 21)	$\Delta V_O/\Delta T$	I_O = 5mA		–	–0.8	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	10.0	–	µV/V_O
Ripple Rejection (Note 21)	RR	f = 120Hz, I_O = 500mA, V_I = 8V to 18V		–	68.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 21)	rO	f = 1KHz		–	17.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 21)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 20: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 21: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7806A)

(Refer to the test circuits. $0°C < T_J < 125°C$, I_O = 1A, V_I = 11V, C_I = 0.33µF, C_O = 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		5.58	6.0	6.12	V
		I_O = 5mA to 1A, $P_O \leq$ 15W, V_I = 8.6V to 21V		5.76	6.0	6.24	
Line Regulation	Regline	V_I = 8.6V to 25V, I_O = 500mA		–	5.0	60.0	mV
(Note 22)		V_I = 9V to 13V		–	3.0	60.0	
		T_J = +25°C	V_I = 8.3V to 21V	–	5.0	60.0	
			V_I = 9V to 13V	–	1.5	30.0	
Load Regulation	Regload	T_J = +25°C, I_O = 5mA to 1.5mA		–	9.0	100	mV
(Note 22)		I_O = 5mA to 1mA		–	4.0	100	
		I_O = 250mA to 750mA		–	5.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	4.3	6.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 19V to 25V, I_O = 500mA		–	–	0.8	
		V_I = 8.5V to 21V, T_J = +25°C		–	–	0.8	
Output Voltage Drift (Note 23)	$\Delta V_O/\Delta T$	I_O = 5mA		–	–0.8	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	10.0	–	µV/V_O
Ripple Rejection (Note 23)	RR	f = 120Hz, I_O = 500mA, V_I = 9V to 19V		–	65.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 23)	rO	f = 1KHz		–	17.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 23)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 22: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 23: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7808A)

(Refer to the test circuits. $0°C < T_J < 125°C$, I_O = 1A, V_I = 14V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_O	T_J = +25°C		7.84	8.0	8.16	V
		I_O = 5mA to 1A, $P_O \leq$ 15W, V_I = 10.6V to 23V		7.7	8.0	8.3	
Line Regulation	Regline	V_I = 10.6V to 25V, I_O = 500mA		–	6.0	80.0	mV
(Note 24)		V_I = 11V to 17V		–	3.0	80.0	
		T_J = +25°C	V_I = 10.4V to 23V	–	6.0	80.0	
			V_I = 11V to 17V	–	2.0	40.0	
Load Regulation	Regload	T_J = +25°C, I_O = 5mA to 1.5mA		–	12.0	100	mV
(Note 24)		I_O = 5mA to 1mA		–	12.0	100	
		I_O = 250mA to 750mA		–	5.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.0	6.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 11V to 25V, I_O = 500mA		–	–	0.8	
		V_I = 10.6V to 23V, T_J = +25°C		–	–	0.8	
Output Voltage Drift (Note 25)	$\Delta V_O/\Delta T$	I_O = 5mA		–	–0.8	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	10.0	–	$\mu V/V_O$
Ripple Rejection (Note 25)	RR	f = 120Hz, I_O = 500mA, V_I = 11.5V to 21.5V		–	62.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 25)	rO	f = 1KHz		–	18.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 25)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 24: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 25: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7809A)

(Refer to the test circuits. $0°C < T_J < 125°C$, I_O = 1A, V_I = 15V, C_I = 0.33µF, C_O = 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Output Voltage	V_O	T_J = +25°C		8.82	9.0	9.16	V
		I_O = 5mA to 1A, $P_O \leq$ 15W, V_I = 11.2V to 24V		8.65	9.0	9.35	
Line Regulation	Regline	V_I = 11.7V to 25V, I_O = 500mA		–	6.0	90.0	mV
(Note 26)		V_I = 12.5V to 19V		–	4.0	45.0	
		T_J = +25°C	V_I = 11.5V to 24V	–	6.0	90.0	
			V_I = 12.5V to 19V	–	2.0	45.0	
Load Regulation	Regload	T_J = +25°C, I_O = 5mA to 1.0mA		–	12.0	100	mV
(Note 26)		I_O = 5mA to 1mA		–	12.0	100	
		I_O = 250mA to 750mA		–	5.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.0	6.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 12V to 25V, I_O = 500mA		–	–	0.8	
		V_I = 11.7V to 25V, T_J = +25°C		–	–	0.8	
Output Voltage Drift (Note 27)	$\Delta V_O/\Delta T$	I_O = 5mA		–	–1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	10.0	–	$\mu V/V_O$
Ripple Rejection (Note 27)	RR	f = 120Hz, I_O = 500mA, V_I = 12V to 22V		–	62.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 27)	rO	f = 1KHz		–	17.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 27)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 26: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 27: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7810A)

(Refer to the test circuits. $0°C < T_J < 125°C$, I_O = 1A, V_I = 16V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Output Voltage	V_O	T_J = +25°C		9.8	10.0	10.2	V
		I_O = 5mA to 1A, $P_O \leq$ 15W, V_I = 12.8V to 25V		9.6	10.0	10.4	
Line Regulation	Regline	V_I = 12.8V to 26V, I_O = 500mA		–	8.0	100	mV
(Note 28)		V_I = 13V to 20V		–	4.0	50.0	
		T_J = +25°C	V_I = 12.5V to 25V	–	8.0	100	
			V_I = 13V to 20V	–	3.0	50.0	
Load Regulation	Regload	T_J = +25°C, I_O = 5mA to 1.5mA		–	12.0	100	mV
(Note 28)		I_O = 5mA to 1mA		–	12.0	100	
		I_O = 250mA to 750mA		–	5.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.0	6.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 12.8V to 25V, I_O = 500mA		–	–	0.8	
		V_I = 13V to 26V, T_J = +25°C		–	–	0.5	
Output Voltage Drift (Note 29)	$\Delta V_O/\Delta T$	I_O = 5mA		–	–1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	10.0	–	$\mu V/V_O$
Ripple Rejection (Note 29)	RR	f = 120Hz, I_O = 500mA, V_I = 14V to 24V		–	62.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 29)	rO	f = 1KHz		–	17.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 29)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 28: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 29: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7812A)

(Refer to the test circuits. $0°C < T_J < 125°C$, I_O = 1A, V_I = 19V, C_I = 0.33µF, C_O = 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Output Voltage	V_O	T_J = +25°C		11.75	12.0	12.25	V
		I_O = 5mA to 1A, $P_O \leq$ 15W, V_I = 14.8V to 27V		11.5	12.0	12.5	
Line Regulation	Regline	V_I = 14.8V to 30V, I_O = 500mA		–	10.0	120	mV
(Note 30)		V_I = 16V to 22V		–	4.0	120	
		T_J = +25°C	V_I = 14.5V to 27V	–	10.0	120	
			V_I = 16V to 22V	–	3.0	60.0	
Load Regulation	Regload	T_J = +25°C, I_O = 5mA to 1.5mA		–	12.0	100	mV
(Note 30)		I_O = 5mA to 1mA		–	12.0	100	
		I_O = 250mA to 750mA		–	5.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.1	6.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 14V to 27V, I_O = 500mA		–	–	0.8	
		V_I = 15V to 30V, T_J = +25°C		–	–	0.8	
Output Voltage Drift (Note 31)	$\Delta V_O/\Delta T$	I_O = 5mA		–	–1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	10.0	–	$\mu V/V_O$
Ripple Rejection (Note 31)	RR	f = 120Hz, I_O = 500mA, V_I = 14V to 24V		–	60.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 31)	rO	f = 1KHz		–	18.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 31)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 30: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 31: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7815A)

(Refer to the test circuits. $0°C < T_J < 125°C$, I_O = 1A, V_I = 23V, C_I = 0.33µF, C_O = 0.1µF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Output Voltage	V_O	T_J = +25°C		14.75	15.0	15.3	V
		I_O = 5mA to 1A, $P_O \leq$ 15W, V_I = 17.7V to 30V		14.4	15.0	15.6	
Line Regulation	Regline	V_I = 17.4V to 30V, I_O = 500mA		–	10.0	150	mV
(Note 32)		V_I = 20V to 26V		–	5.0	150	
		T_J = +25°C	V_I = 17.5V to 30V	–	11.0	150	
			V_I = 20V to 26V	–	3.0	75.0	
Load Regulation	Regload	T_J = +25°C, I_O = 5mA to 1.5mA		–	12.0	100	mV
(Note 32)		I_O = 5mA to 1mA		–	12.0	100	
		I_O = 250mA to 750mA		–	5.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.2	6.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 17.5V to 30V, I_O = 500mA		–	–	0.8	
		V_I = 17.5V to 30V, T_J = +25°C		–	–	0.8	
Output Voltage Drift (Note 33)	$\Delta V_O/\Delta T$	I_O = 5mA		–	–1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	10.0	–	µV/V_O
Ripple Rejection (Note 33)	RR	f = 120Hz, I_O = 500mA, V_I = 18.5V to 28.5V		–	58.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 33)	rO	f = 1KHz		–	19.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 33)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 32: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 33: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7818A)

(Refer to the test circuits. $0°C < T_J < 125°C$, I_O = 1A, V_I = 27V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Output Voltage	V_O	T_J = +25°C		17.64	18.0	18.36	V
		I_O = 5mA to 1A, $P_O \leq$ 15W, V_I = 21V to 33V		17.3	18.0	18.7	
Line Regulation	Regline	V_I = 21V to 33V, I_O = 500mA		–	15.0	180	mV
(Note 34)		V_I = 21V to 33V		–	5.0	180	
		T_J = +25°C	V_I = 20.6V to 33V	–	15.0	180	
			V_I = 24V to 30V	–	5.0	90.0	
Load Regulation	Regload	T_J = +25°C, I_O = 5mA to 1.5mA		–	15.0	100	mV
(Note 34)		I_O = 5mA to 1mA		–	15.0	100	
		I_O = 250mA to 750mA		–	7.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.2	6.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 12V to 33V, I_O = 500mA		–	–	0.8	
		V_I = 12V to 33V, T_J = +25°C		–	–	0.8	
Output Voltage Drift (Note 35)	$\Delta V_O/\Delta T$	I_O = 5mA		–	–1.0	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	10.0	–	$\mu V/V_O$
Ripple Rejection (Note 35)	RR	f = 120Hz, I_O = 500mA, V_I = 22V to 32V		–	57.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 35)	rO	f = 1KHz		–	19.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 35)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 34: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 35: These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (LM7824A)

(Refer to the test circuits. $0°C < T_J < 125°C$, I_O = 1A, V_I = 33V, C_I = 0.33μF, C_O = 0.1μF, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Output Voltage	V_O	T_J = +25°C		23.5	24.0	24.5	V
		I_O = 5mA to 1A, $P_O \leq$ 15W, V_I = 27.3V to 38V		23.0	24.0	25.0	
Line Regulation	Regline	V_I = 27V to 38V, I_O = 500mA		–	18.0	240	mV
(Note 36)		V_I = 21V to 33V		–	6.0	240	
		T_J = +25°C	V_I = 26.7V to 38V	–	18.0	240	
			V_I = 30V to 36V	–	6.0	120	
Load Regulation	Regload	T_J = +25°C, I_O = 5mA to 1.5mA		–	15.0	100	mV
(Note 36)		I_O = 5mA to 1mA		–	15.0	100	
		I_O = 250mA to 750mA		–	7.0	50.0	
Quiescent Current	I_Q	T_J = +25°C		–	5.2	6.0	mA
Quiescent Current Change	ΔI_Q	I_O = 5mA to 1A		–	–	0.5	mA
		V_I = 27.3V to 38V, I_O = 500mA		–	–	0.8	
		V_I = 27.3V to 38V, T_J = +25°C		–	–	0.8	
Output Voltage Drift (Note 37)	$\Delta V_O/\Delta T$	I_O = 5mA		–	–1.5	–	mV/°C
Output Noise Voltage	V_N	f = 10Hz to 100KHz, T_A = +25°C		–	10.0	–	$\mu V/V_O$
Ripple Rejection (Note 37)	RR	f = 120Hz, I_O = 500mA, V_I = 28V to 38V		–	54.0	–	dB
Dropout Voltage	V_{DROP}	I_O = 1A, T_J = +25°C		–	2.0	–	V
Output Resistance (Note 37)	rO	f = 1KHz		–	20.0	–	mΩ
Short Circuit Current	I_{SC}	V_I = 35V, T_A = +25°C		–	250	–	mA
Peak Current (Note 37)	I_{PK}	T_J =+25°C		–	2.2	–	A

Note 36: Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Note 37: These parameters, although guaranteed, are not 100% tested in production.

Typical Performance Characteristics

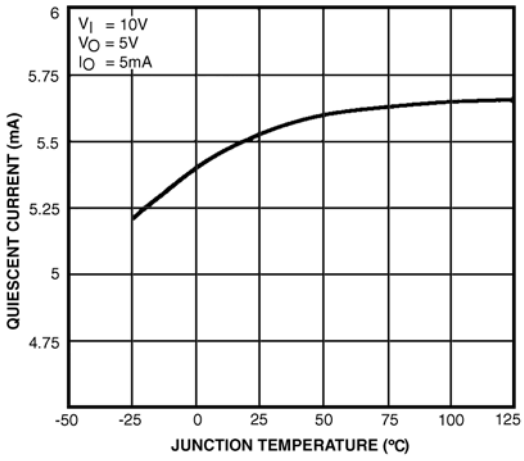


FIGURE 1. Quiescent Current

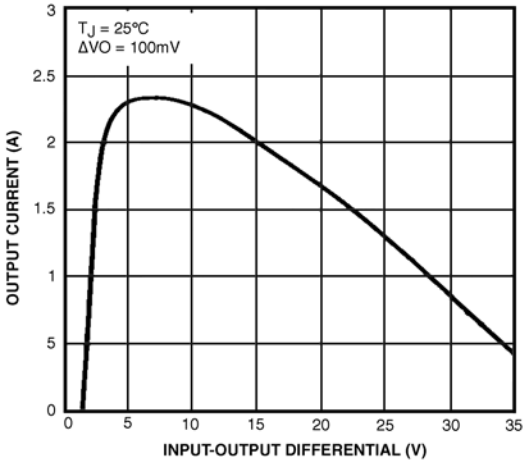


FIGURE 2. Peak Output Current

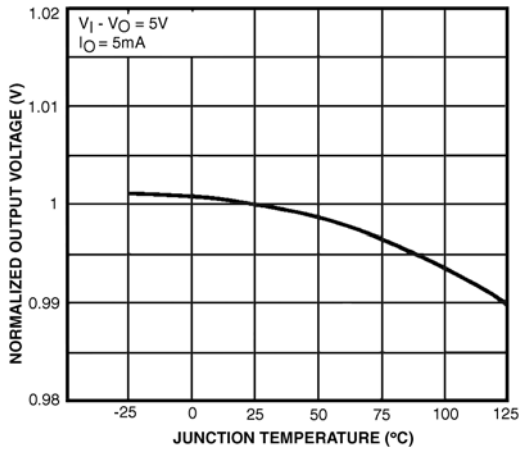


FIGURE 3. Output Voltage

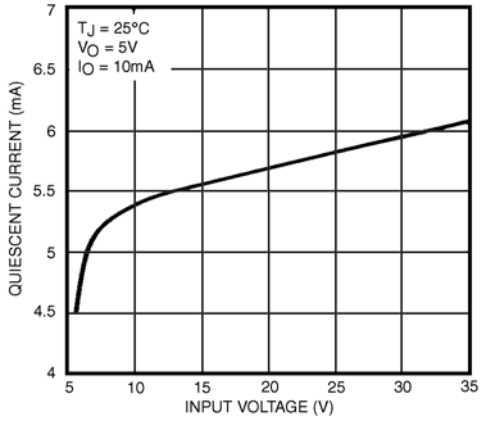


FIGURE 4. Quiescent Current

Typical Applications

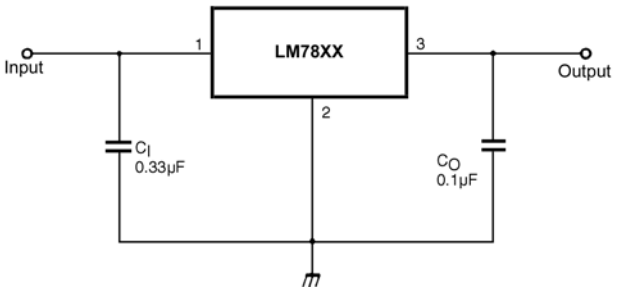


FIGURE 5. DC Parameters

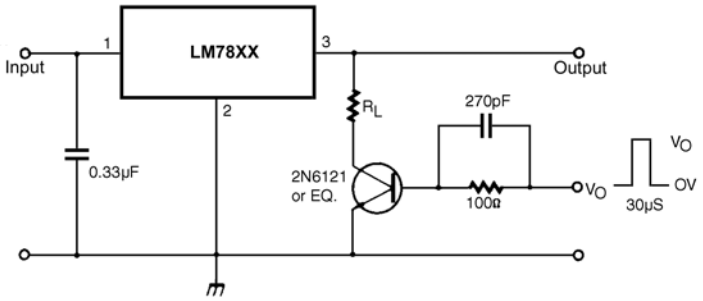


FIGURE 6. Load Regulation

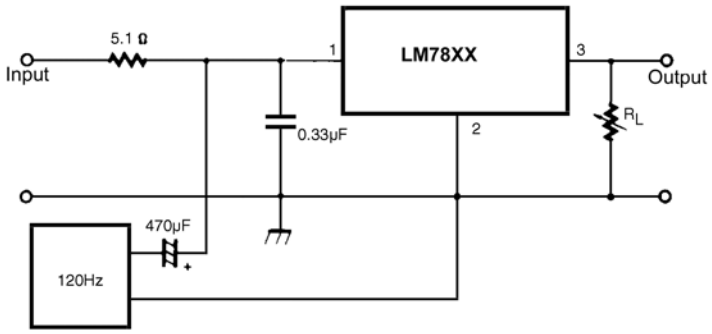


FIGURE 7. Ripple Rejection

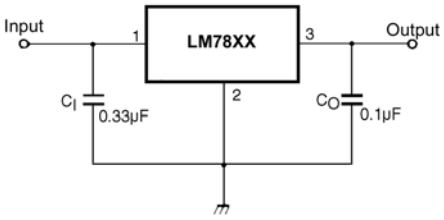
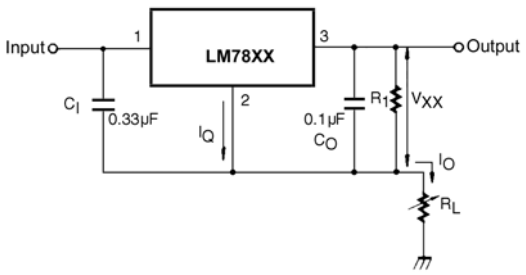


FIGURE 8. Fixed Output Regulator

Typical Applications (continued)



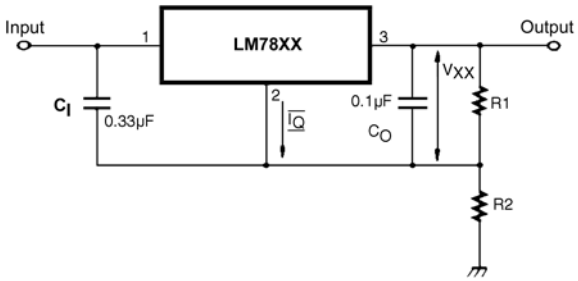
$$I_O = \frac{V_{XX}}{R_1} + I_Q$$

FIGURE 9.

Note: To specify an output voltage, substitute voltage value for "XX". A common ground is required between the Input and the Output voltage. The input voltage must remain typically 2.0V above the output voltage even during the low point on the input ripple voltage.

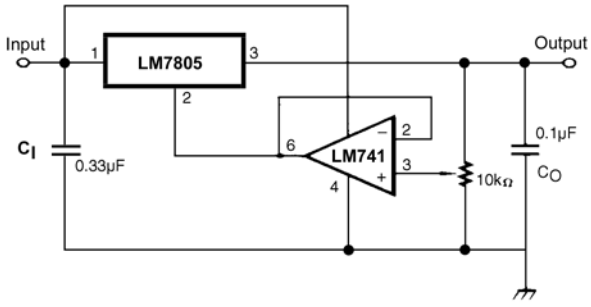
Note: C_I is required if regulator is located an appreciable distance from the power supply filter.

Note: C_O improves stability and transient response.



$$I_{RI} \geq 5\, I_Q$$
$$V_O = V_{XX}\,(1\, R_2 / R_1) + I_Q\, R_2$$

FIGURE 10. Circuit for Increasing Output Voltage



$$I_{RI} \geq 5\, I_Q$$
$$V_O = V_{XX}\,(1\, R_2 / R_1) + I_Q\, R_2$$

FIGURE 11. Adjustable Output Regulator (7V to 30V)

Typical Applications (continued)

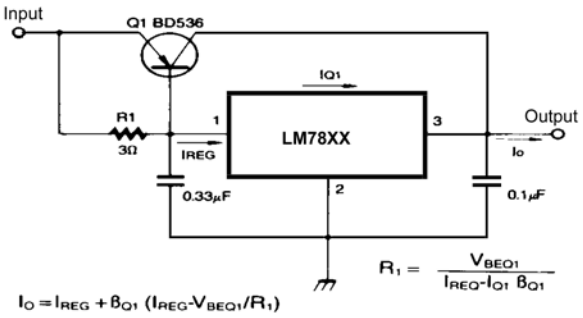


FIGURE 12. High Current Voltage Regulator

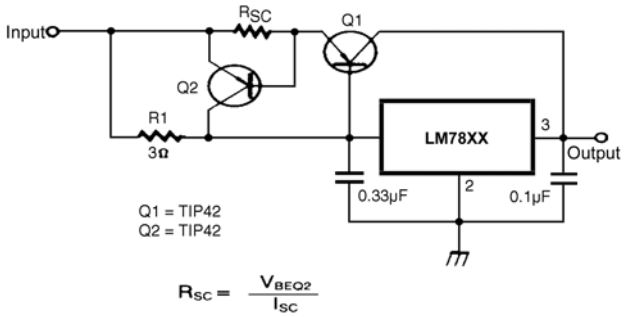


FIGURE 13. High Output Current with Short Circuit Protection

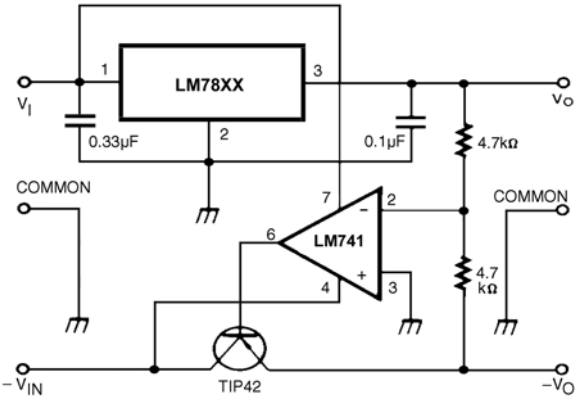


FIGURE 14. Tracking Voltage Regulator

Typical Applications (continued)

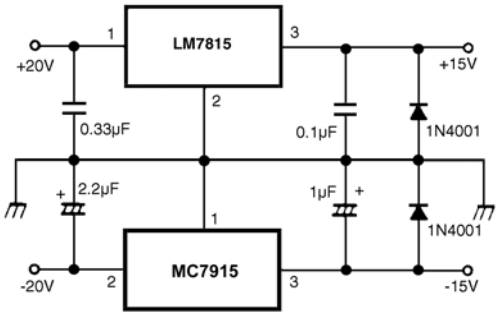


FIGURE 15. Split Power Supply (±15V - 1A)

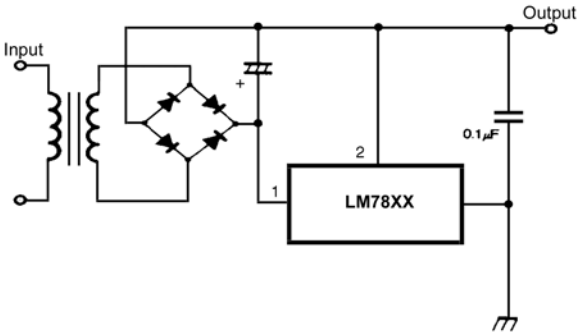


FIGURE 16. Negative Output Voltage Circuit

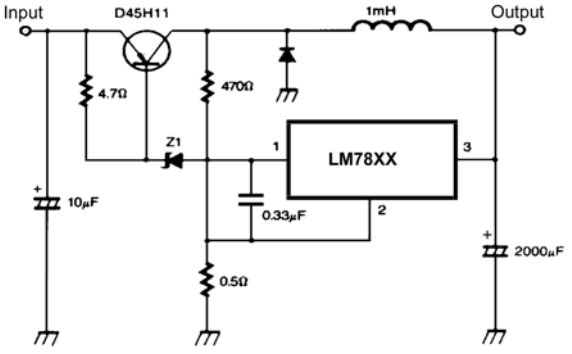
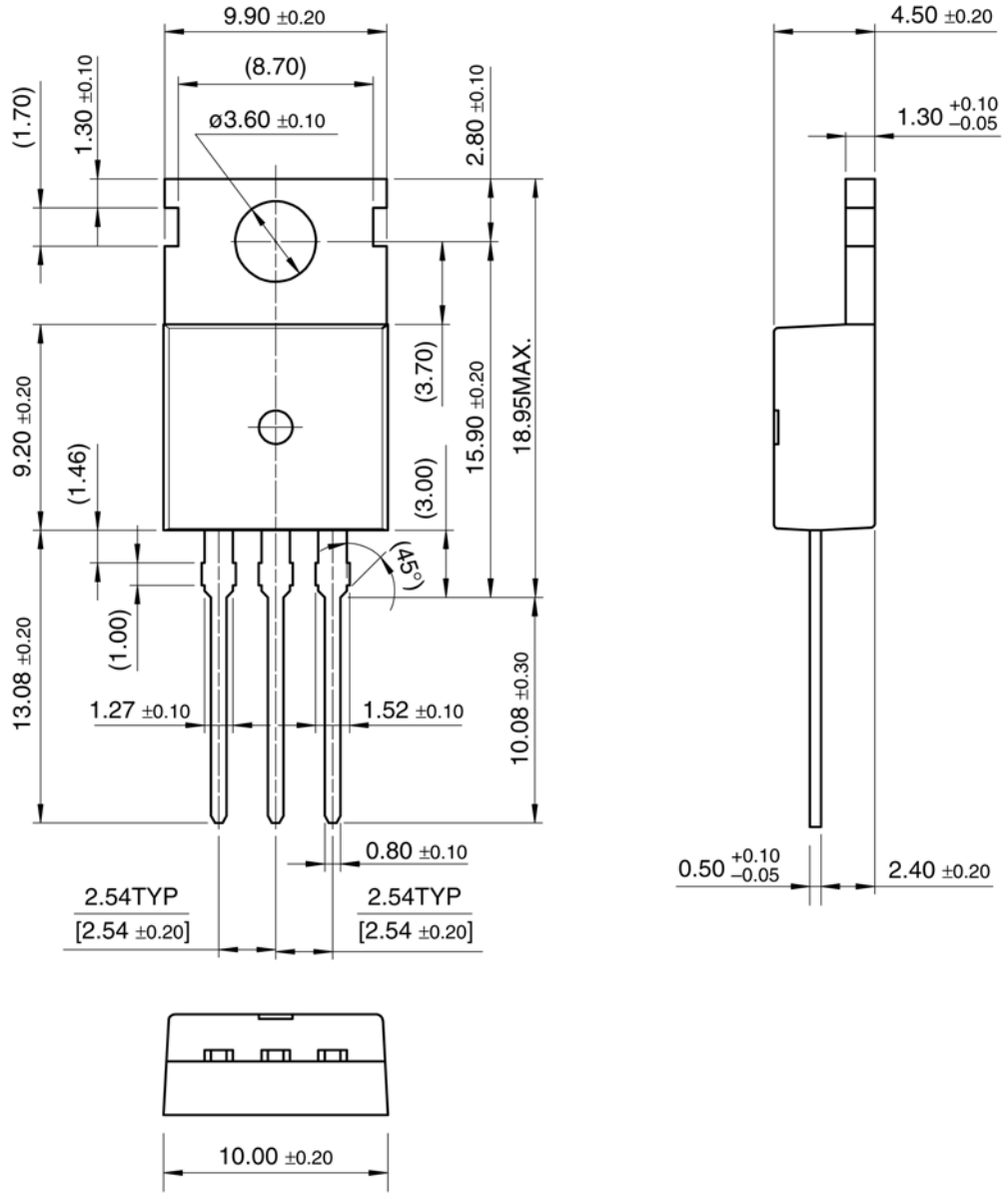


FIGURE 17. Switching Regulator

Physical Dimensions inches (millimeters) unless otherwise noted

TO-220



Package Number TO-220

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