19-0914; Rev 1; 6/97

MAXIM

AC-to-DC Regulator (110/220VAC to 5.0VDC)

General Description

The MAX610/MAX611/MAX612 AC-to-DC power converters reduce the component count, size, and weight of 1/4 watt power supplies, thus minimizing the overall cost and simplifying designs. With an $8V_{RMS}$ input voltage, the MAX610 needs only a single filter capacitor to make a complete 5V, 50mA power supply. With the addition of a current-limiting resistor and a current-limiting capacitor, the MAX610 connects directly to the 110VAC or 220VAC power line to make a minimum component count 110/220VAC to 5VDC power supply.

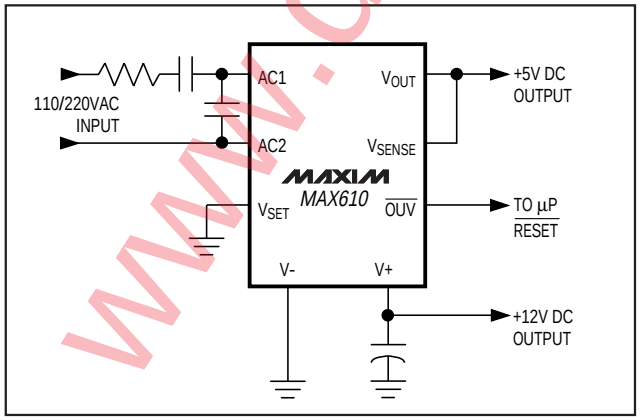
The devices in the MAX610 family differ in three respects: full- or half-wave rectification, 12V or 18V zener voltage, and the assignment of pin 4 to the function of setting the output voltage or setting the time delay. The MAX610 has a full-wave rectifier, a 12V zener, and the output voltage is either the internally preset +5V or user adjustable from +1.3V to +9V. The MAX611 has a half-wave rectifier, a 12V zener, a fixed +5V output, and pin 4 controls the time delay of the reset output. The MAX612 has a full-wave rectifier, an 18V zener, and the output voltage is either the internally preset +5V or user adjustable from +1.3V to +15V

The low-cost MAX610 family is ideal for applications where the size, weight, and component count of 1/4 watt power supplies must be reduced. Reliable power-up reset and over/undervoltage detection make these devices well suited for microprocessor-based controllers.

Applications

Minimum-Component-Count Power Supplies
Uninterruptible 5V Power Supplies
Precision Battery Chargers
Line-Powered Appliances
Industrial Controls
Off-Line Instruments
Triac Output Power Controllers

Typical Operating Circuit



Features

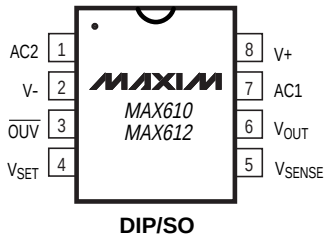
- **Direct 110/220VAC to 5VDC Conversion**
- **Minimum External Component Count**
- **Output Voltage Preset to 5V ±4%**
- **70µA Typical Quiescent Current**
- **Over/Undervoltage Detection**
- **Power-Up Reset Circuit with Programmable Delay**
- **Programmable Current Limiting**
- **Programmable Output Voltage: 1.3V to 15V**

Ordering Information

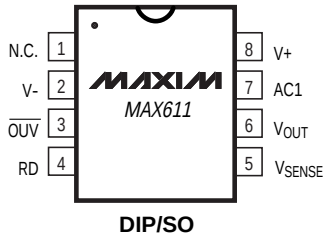
PART	TEMP. RANGE	PIN-PACKAGE
MAX610CPA	0°C to +70°C	8 Plastic DIP
MAX610CSA	0°C to +70°C	8 SO
MAX611CPA	0°C to +70°C	8 Plastic DIP
MAX611CSA	0°C to +70°C	8 SO
MAX612CPA	0°C to +70°C	8 Plastic DIP
MAX612CSA	0°C to +70°C	8 SO

Pin Configurations

TOP VIEW



DIP/SO



DIP/SO

www.datasheet live

For free samples & the latest literature: http://www.maxim-ic.com, or phone 1-800-998-8800.
For small orders, phone 408-737-7600 ext. 3468.

AC-to-DC Regulator (110/220VAC to 5.0VDC)

ABSOLUTE MAXIMUM RATINGS

Operating Temperature Range.....0°C to +70°C
Maximum Junction Temperature .....+125°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10sec) .....+300°C
Continuous Power Dissipation (T_A = +70°C)
Plastic DIP (derate 9.09mW/°C above +70°C) 727mW
SO (derate 5.88mW/°C above +70°C).....471mW
Input Current
MAX611
AC1, V-: 250µs non-repetitive pulse 5A
AC1, V-: continuous.....180mA_{RMS}
V+.....60mA
MAX610, MAX612
AC1, AC2: 250µs non-repetitive pulse.....5A
AC1, AC2: continuous.....120mA RMS
V+.....60mA
All Other Terminals.....10mA
Input Voltage
MAX610/MAX611 (Note 1)
AC1, AC2 .....11.5V
V+.....10.8V
MAX612
AC1, AC2 .....17V
V+.....16.2V
$\overline{CUV}$.....(V- - 0.3V) to -16V
All Other Terminals .....(V- - 0.3V) to (V+ + 0.3V)
Output Current
V+, V_{OUT} 60mA
$\overline{OUV}$.....10mA

Note 1: The maximum input voltage may be exceeded if the maximum input current and power dissipation specifications are observed.

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(T_A = +25°C, V+ = 10V, R_{SENSE} = 0Ω, V_{SET} connected to V-, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Diode Forward Voltage	V_F	I_F = 1mA			0.62		V
		I_F = 50mA			1.1	2.0	
Zener Voltage	V_Z	I_Z = 50mA, measure at V+	MAX610/MAX611		12.4		V
			MAX612		18.6		
Zener Dynamic Resistance	R_Z	I_Z = 50mA	MAX610/MAX611		6		Ω
			MAX612		9		
SERIES VOLTAGE REGULATOR							
Preset Output Voltage	V_{OUT}	0.5mA ≤ I_{OUT} ≤ 50mA	T_A = +25°C	4.80	5.00	5.20	V
			T_A = 0°C to +70°C	4.75	5.00	5.25	
Temperature Coefficient of Output Voltage	$\frac{\Delta V_{OUT}}{\Delta T}$	T_A = 0°C to +70°C			±100		ppm/°C
Internal Voltage Reference	V_{SET}	MAX610/MAX612			1.3		V
Line Regulation (DC Input)	$\frac{\Delta V_{OUT}}{\Delta V}$	8V ≤ V+ ≤ V_Z			0.25		%/V
Line Regulation (AC Input)	$\frac{\Delta V_{OUT}}{\Delta VAC}$	I_{OUT} = 10mA, Figures 3, 4	70V_{RMS} < V_{IN} < 140V_{RMS}		0.001		%/V
			140V_{RMS} < V_{IN} < 280V_{RMS}		0.001		
Output Impedance	$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	I_{OUT} changing from 1mA to 51mA			0.6	2.0	Ω
Input-Output Voltage Differential	V+ - V_{OUT}	I_{OUT} = 25mA			1.1	2.0	V
V_{SET} Input Current	I_{SET}				0.01	100	nA
Supply Current	I+				70	150	µA

ELECTRICAL CHARACTERISTICS (continued)

(T_A = +25°C, V+ = 10V, R_{SENSE} = 0Ω, V_{SET} connected to V-, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Overvoltage Detection Voltage	V_{OUVH}	Measured at V_{SENSE}		5.4	5.65	V
Undervoltage Detection Voltage	V_{OUVL}	Measured at V_{SENSE}	4.35	4.65		V
$\overline{OUV}$ Output Leakage	I_{OUV}	V_{SENSE} = 5V, $\overline{OUV}$ = 5V		0.001	10	µA
$\overline{OUV}$ Output Voltage	V_{OUV}	$V_{SENSE} \geq$ 5.65V or $V_{SENSE} \leq$ 4.35V, I_{OUV} = 1mA			0.4	V
Reset Time Delay	t_{DELAY}	Figure 9a, MAX611 only, C3 = 0.01µF		30		ms
Reset Pin Threshold	V_{TH}	MAX611 only, V+ = V_Z		8.0		V

Pin Description

PIN	NAME	FUNCTION
1	AC2 (MAX610/612)	Second AC input to the full- wave bridge rectifier.
	N.C. (MAX611)	This pin is not connected on the MAX611.
2	V-	Negative output terminal. This terminal is also an AC input for the half-wave rectifier of the MAX611.
3	$\overline{OUV}$	The open-drain pin goes low during undervoltage and overvoltage conditions. The undervoltage and overvoltage thresholds are fixed at 4.65V (undervoltage) and 5.4V (overvoltage) and do not change, even if the output voltage is changed via the V_{SET} terminal.
5	V_{SENSE}	Current-limit input. The output short-circuit current limit is 0.6V/R_{SENSE}, where R_{SENSE} is a current-sensing resistor connected between V_{OUT} and V_{SENSE}.
6	V_{OUT}	Positive regulated DC output.
7	AC1	AC input to the internal diode rectifier
4	RD (MAX611)	An external capacitor connected to the Reset Delay pin determines the Reset Delay period. The reset time delay is directly proportional to the capacitance connected to this pin; each 0.01µF of capacitance results in 30 milliseconds of delay. This delay period must elapse before the Reset/$\overline{OUV}$ pin goes high after an overvoltage or undervoltage condition (Figure 9).
	V_{SET} (MAX610/612)	If the V_{SET} terminal is grounded, the MAX610 and MAX612 output voltage will be the preset 5V ±4%. Alternatively, the V_{SET} input can be used to set the output voltage to any voltage from 1.3V to 15V (MAX612) or 1.3V to 10V (MAX610/MAX611), using a simple resistive voltage divider (Figure 7).
8	V+	Positive unregulated or raw DC output of the rectifier. The raw DC filter capacitor connects to this terminal.

AC-to-DC Regulator (110/220VAC to 5.0VDC)

Block Diagrams

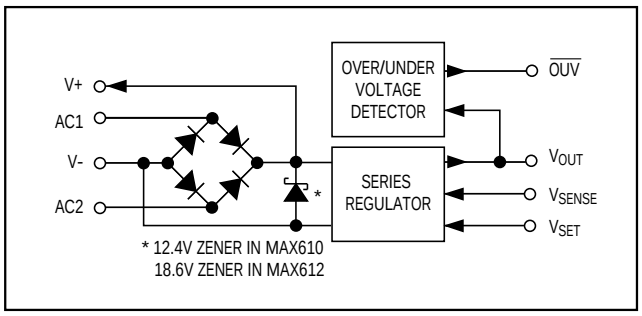


Figure 1. MAX610/MAX612 Block Diagram

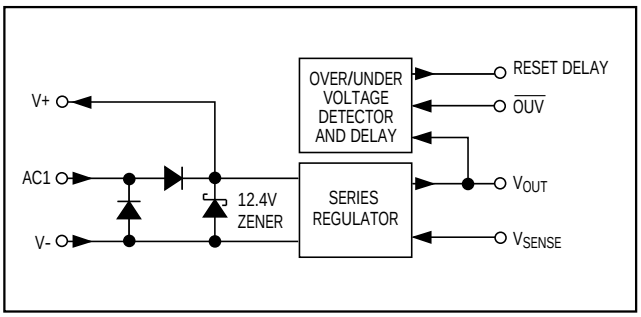


Figure 2. MAX611 Block Diagram

Typical Applications

Simple Line-Powered 5V Supply

Figure 3 shows a 50mA, 5V power supply using the full-wave MAX610. Typical component values for both 110VAC and 220VAC 50/60Hz operation are shown. The output of this power supply is **NOT ISOLATED** from the power line: **the MAX610 and any equipment powered by the MAX610 must be enclosed to avoid shock hazards.** To avoid a second potential shock hazard, include the 1MΩ resistor across C1. This resistor will discharge the voltage left on C1 when the 110/220VAC is disconnected.

110/220VAC to 5V, Half-Wave Rectification

Figure 4 shows a 50mA, 5V power supply using the half-wave MAX611. The circuit differs from Figure 3 in that the 5V output is referenced to one side of the 110VAC power line. This circuit is generally preferred for systems that control triacs, where it is desirable to connect V- to the power line. Note that for a given amount of output current, the value of C1 must be twice the value used in the full-wave circuit of Figure 3. As with all MAX610 family circuits that do not use a transformer to isolate the circuit, this circuit is **NOT ISOLATED** from the power line.

Minimum-Component-Count 10mA, 5V Power Supply

For output currents of less than 10mA, capacitor C1 of Figure 3 can be omitted, resulting in the circuit shown in Figure 5. The available output current is determined by the value of R1. For example, with R1 = 8.2kΩ, the available output current is 10mA, while the power dissipation in R1 is 1.3W. Double both the resistance value and the wattage rating of R1 for use with a 220VAC input.

Transformer-Isolated 5V Power Supply

If isolation from the power line is required, use the MAX612 in the circuit of Figure 6. The MAX612 must have an input voltage of at least 8V peak to maintain a regulated 5V output, but the peak transformer output voltage must not exceed 17V unless the current is limited as shown in Figures 3 and 4. The AC input line voltage can range from $80V_{RMS}$ to $160V_{RMS}$ with the $8V_{RMS}$ nominal transformer voltage shown.

The MAX612 power dissipation is approximately $(V_{IN(peak)} - V_{OUT}) \times I_{LOAD}$. With the $8V_{RMS}$ transformer shown, the power dissipated in the MAX612 limits the maximum output current to 60mA at +25°C ambient and 30mA at +70°C.

Resistor R1 limits the peak input current, but is not needed if the transformer impedance limits the peak current to a suitable value. As a rule of thumb, R1 can be omitted if the short-circuit output current of the transformer is less than 2A.

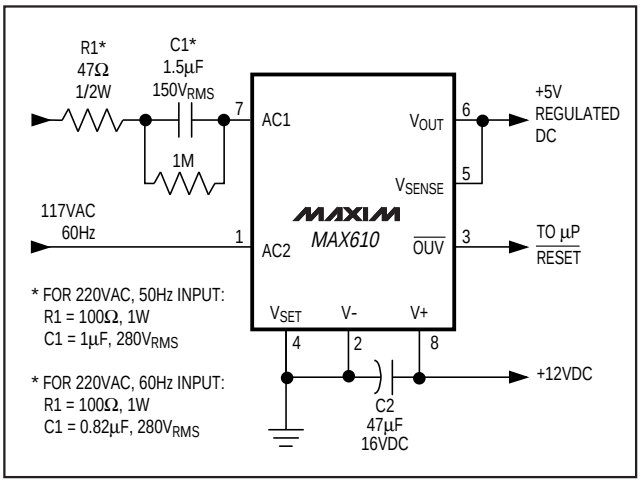


Figure 3. Simple Line-Powered 5V Supply

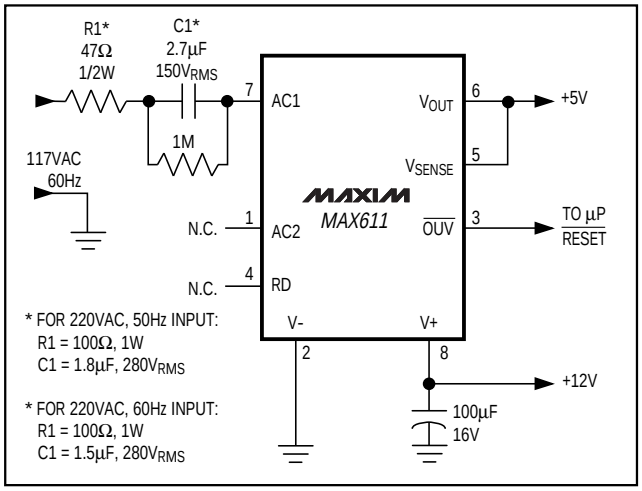


Figure 4. 110/220VAC to 5V, Half-Wave Rectification

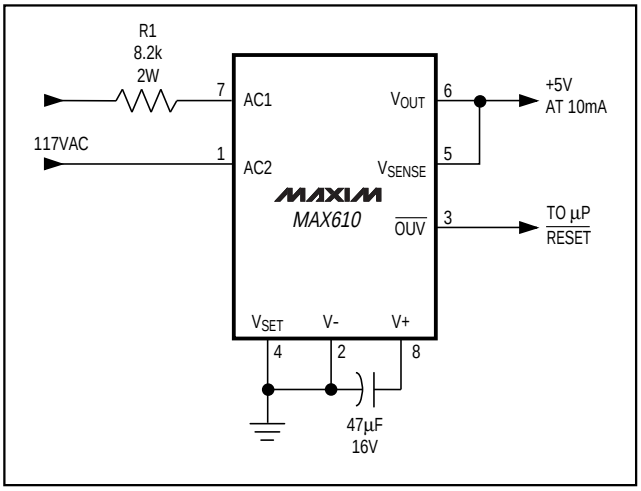


Figure 5. Minimum-Component-Count 10mA, 5V Supply

Adjustable Output Voltage

The MAX611 output voltage is fixed at 5V ±4%. The MAX610 and MAX612 output voltages can be set to 5V ±4% by simply connecting the V_{SET} terminal to V-. Other output voltages can be selected by connecting an external resistive voltage divider between the output and V_{SET} as shown in Figure 7. Calculate the resistor values for other voltages using the formula:

$$V_{OUT} = 1.3V \times \left(1 + \frac{R2}{R3}\right)$$

The maximum input voltage to the MAX612 is limited to 16V, enabling the MAX612 to supply any voltage from 1.3V to 15V. The maximum input voltage to the MAX610 is 10V, and the MAX610 can supply any output voltage from 1.3V to 9V.

The output voltage of the standard MAX610 is set to 5V ±4% with an undervoltage trip point of 4.65V and an overvoltage trip point of 5.4V. Other output voltages are available through fusible link programming. The overvoltage and undervoltage trip points are fixed at 107% and 93% of the pretrimmed output voltage. Consult the factory regarding availability and minimum order requirements for preset voltages other than 5V.

Output Circuit Current Limiting

Figure 8 shows how a resistor, R_{SENSE}, can be added to any of the above circuits to provide short-circuit current-limit protection. A voltage difference between V_{SENSE} and V_{OUT} greater than a base-emitter voltage (approximately 0.6V) activates the MAX610/MAX611/MAX612 output-current-limit protection circuitry.

$$I_{CURRENT\ LIMIT} = \frac{0.6V}{R_{SENSE}}$$

When current limiting occurs, the voltage at V_{SENSE} will fall below 4.65V, causing the $\overline{OUV}$ output to go low.

Power-Up Reset Delay

The MAX611 differs from the MAX610/MAX612 in that its pin 4 (RD) controls a reset delay period, whereas the MAX610/MAX612's pin 4 (V_{SET}) is used to adjust the output voltage. Both the MAX610/MAX612's $\overline{OUV}$ pin and the MAX611's $\overline{OUV}$ pin go low immediately after the output voltage goes below the undervoltage or above the overvoltage threshold. The MAX610/MAX612 $\overline{OUV}$ pin will go high immediately after the output returns to 5V. The MAX611 $\overline{OUV}$ pin will go high only after the output has

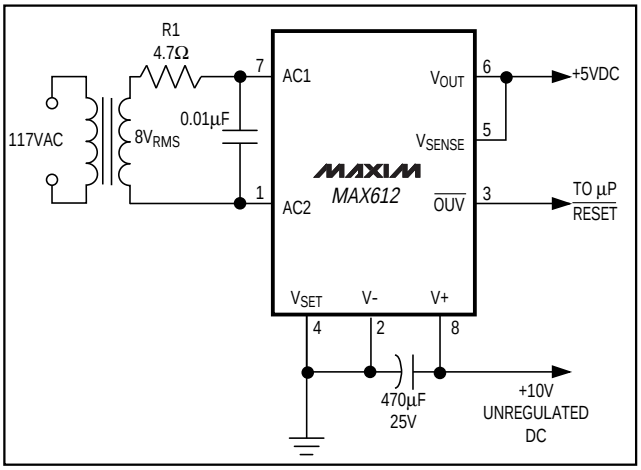


Figure 6. Transformer-Isolated 5V Power Supply

AC-to-DC Regulator (110/220VAC to 5.0VDC)

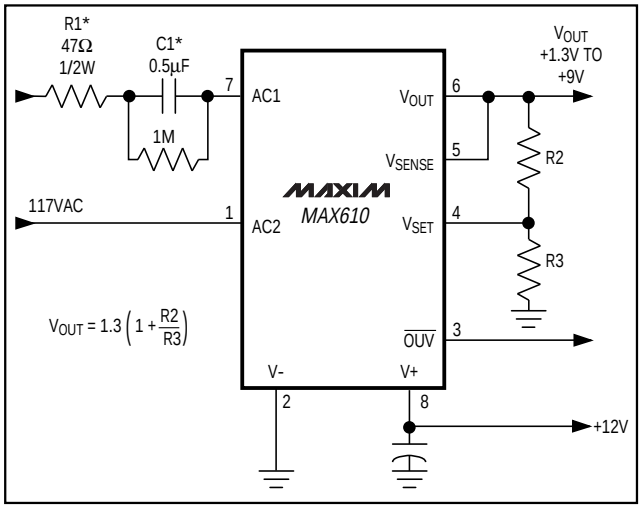


Figure 7. Adjustable Output Voltage

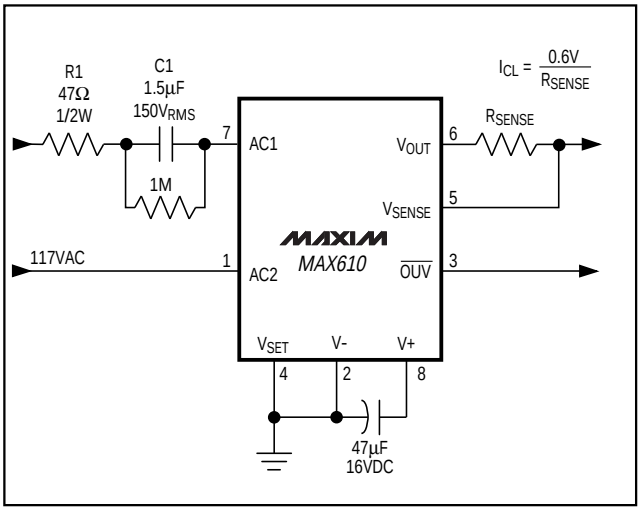


Figure 8. Short-Circuit Current Limiting

been at 5V for a delay period determined by the value of a capacitor connected between V- and RD. This makes the $\overline{OUV}$ output well suited for driving the reset input of microprocessors.

Upon power-up, the MAX611 $\overline{OUV}$ output will stay low until the output has been at 5V for the length of the delay period (Figure 9). This provides a reliable power-up reset to the microprocessor. Whenever the MAX611 output falls below 4.65V (as during a brownout), the $\overline{OUV}$ pin will go low, resetting the microprocessor. The output voltage must remain above 4.65V for the entire delay period before the $\overline{OUV}$ pin will go high: each time the voltage falls below 4.65V the reset delay period is restarted.

The delay period is approximately 30 milliseconds for each 0.01µF of capacitance. Leave pin 4 floating if this additional delay is not desired.

+12V Output for Driving Triacs, Relays, and MOSFETs

In some circuits, a voltage higher than 5V is needed to drive relays, triacs, or power MOSFET gates. The DC output voltage at V+ is +12V (+18V for MAX612) and can be used to trigger triacs as shown in Figure 11. The V+ voltage is equal to the MAX610/MAX611 zener voltage until the load current (total current drawn from the +12V and the +5V) approaches the maximum available output current (40mA for each µF of C1 capacitance with 110VAC 60Hz input, 70mA/µF with 220VAC 50Hz input). The ripple on the +12V is relatively low. With the components shown in Figure 10 the ripple voltage is about 5mVp-p at 10mA load current and 20mV at 40mA load current.

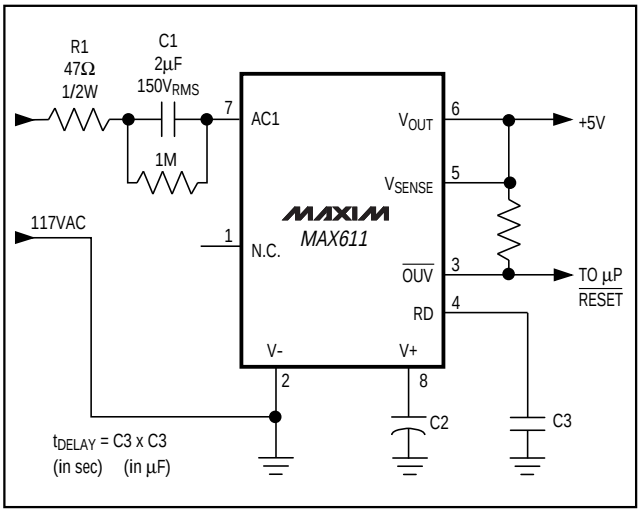


Figure 9a. Power-Up Reset Delay

Uninterruptible 5V Power Supply

Figure 11 shows a simple way to combine a MAX610 with a battery to form an uninterruptible 5V power supply. When the 110VAC line voltage is present, resistor R2 trickle charges the 7.2V NiCd battery. When the 110VAC is removed, the NiCd battery will supply current through diode D1, and the MAX610 output will remain a constant 5V. The MAX610 will continue to deliver 5V out until V+ is approximately 5.8V and the battery voltage is approximately 6.5V. Alkaline 9V or NiCd 8.4V batteries are also suitable; R2 should not be used with the non-rechargeable 9V alkaline battery. If isolation from the power line is required, drive AC1 and AC2 with a transformer as shown in Figure 6.

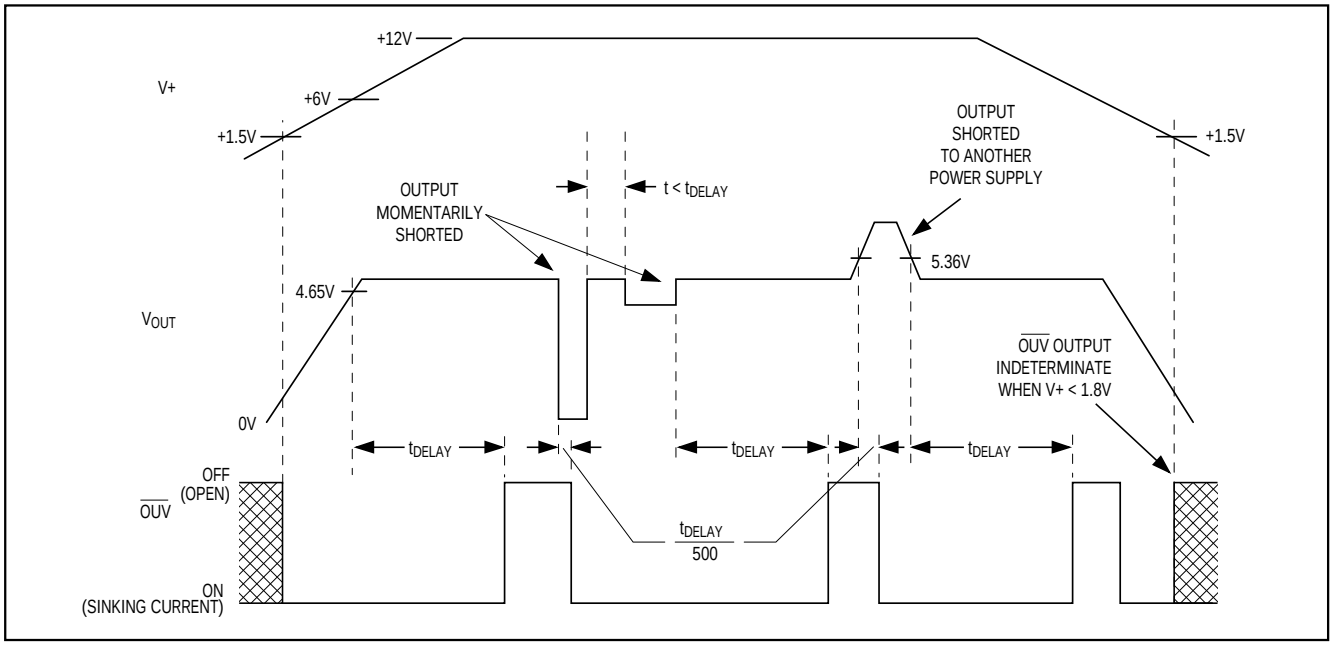


Figure 9b. Power-Up Reset Delay

Polarity Insensitive Battery-Powered Supply

Figure 12 shows a +5V power supply that works even if the battery is installed backwards: the full-wave bridge rectifier of the MAX612 corrects the battery polarity. The MAX612 is well suited for battery-powered circuits since its quiescent current is only 70µA. The MAX610 can also be used if the battery voltage is less than 10V.

Battery Charger

The +6.7V open circuit or float voltage of Figure 13 is set by R2 and R3; the maximum charging current of 60mA is set by the value of C1. Since, unlike transformer-driven battery chargers, C1 conducts current throughout most of each line cycle, the ratio of the RMS charging current to the average charging current is only about 1.2:1, and capacitor C2 is optional.

$I_{AVG(MAX)} = V_{IN} \times 5.56\ f_{IN} \times C1$ (maximum charging current) (A)

f_{IN} = Input Frequency

$I_{RMS} = 1.2\ I_{AVG}$; without C2

$I_{RMS} = I_{AVG}$; with C2.

The half-wave MAX611 can also be used in this circuit, but the value of C1 must be doubled and the ratio of RMS current to average current increases to about 1.7:1.

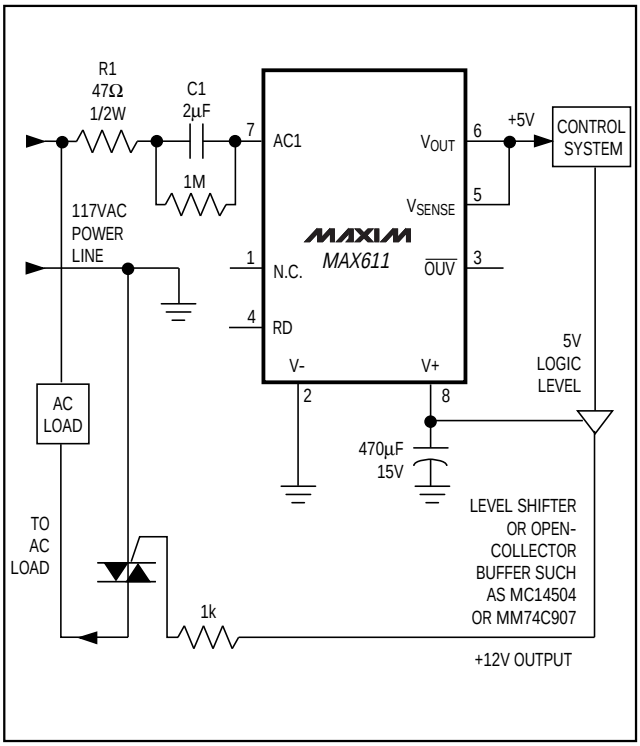


Figure 10. Driving Triacs with +12V Supply

AC-to-DC Regulator (110/220VAC to 5.0VDC)

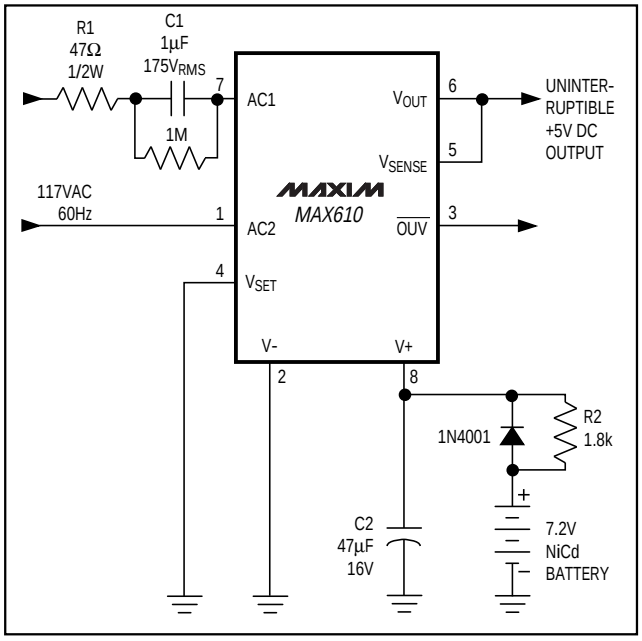


Figure 11. Uninterruptible 5V Power Supply

Component Selection

The component values shown in the *Typical Applications* section are suitable for most applications. The following section gives the reasons for the particular component values chosen, explains the effect of using other values, and discusses the component specifications.

Current-Limiting Capacitor, C1

The current-limiting capacitor (C1) is the most critical component for a 110/220VAC input power supply based on the MAX610 family. It must continuously withstand the full line voltage, so it should be rated for AC operation. A conservative designer will use a capacitor rated for at least $150V_{RMS}$ working voltage for 110VAC circuits, and at least $280V_{RMS}$ for 220VAC or 240VAC circuits. This capacitor must be a **non-polarized** type such as polyester (Mylar™) or polypropylene metallized film. Metallized film capacitors are preferred over metal foil capacitors, since metal foil capacitors are more likely to fail as a short circuit.

The value of C1 determines both the power dissipation of the MAX610/MAX611/MAX612 and the maximum available output current. The value of C1 should be the smallest value that will deliver the desired output current at minimum line voltage, since the power dissipated by the MAX610/MAX611/MAX612 increases with increasing values of C1. Table 1 gives the formula for calculating C1 as a function of the desired output current. Table 2 shows some typical component suppliers and part numbers.

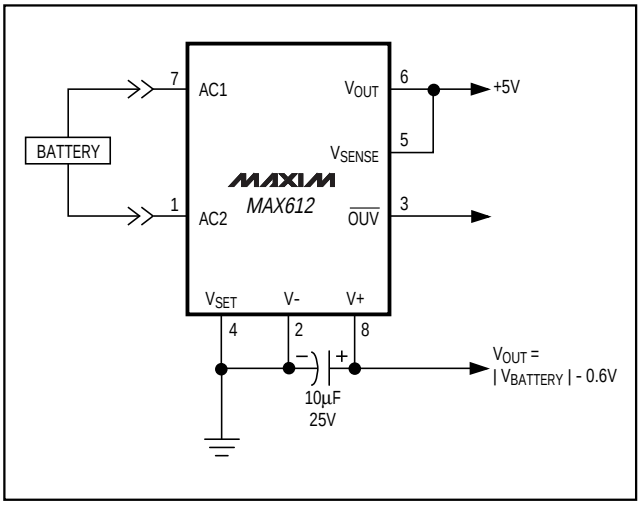


Figure 12. Polarity Insensitive Battery-Powered Supply

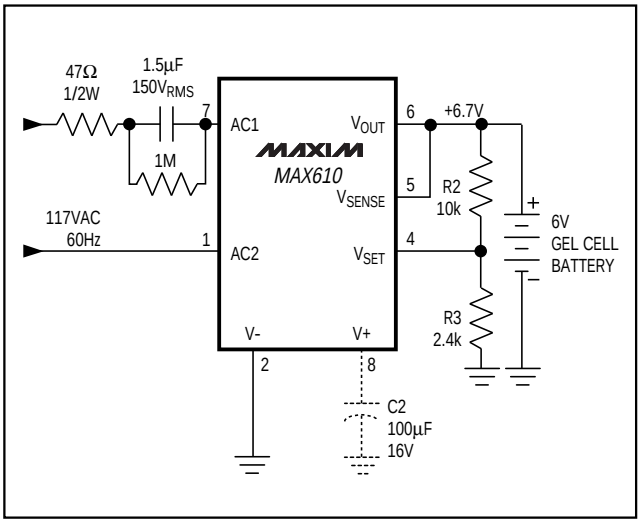


Figure 13. Simple Battery Charger

Current-Limiting Resistor, R1

The current-limiting resistor (R1) limits the maximum peak current that occurs when power is first applied to the MAX610 just as the power line voltage is at its maximum. The instantaneous peak current must be limited to 5A. For 110VAC, input voltage R1 must be 33Ω or greater; for 220VAC, input voltage R1 must be 68Ω or greater. The recommended values are 47Ω for 110VAC and 100Ω for 220VAC. The power dissipation in R1 is constant, independent of the load current.

Table 1. Design Formulas

FORMULA	EXAMPLE IN FIGURE No:	COMMENTS
$V_{OUT} = 5V \pm 4\%$, V_{SET} grounded	3	
$V_{OUT} = 1.3V (1 + \frac{R2}{R3})$	8	MAX610 and MAX612
$I_{OUT(MAX)} = C1 \times 4 \sqrt{2} \times V_{RMS} \times f_{IN}$	3	Full wave—MAX610, MAX612
$I_{OUT(MAX)} = C1 \times 2 \sqrt{2} \times V_{RMS} \times f_{IN}$	4	Half wave—MAX611
$I_{CURRENT\ LIMIT} = \frac{0.6V}{R_{SENSE}}$	9	
$C1 = \frac{I_{OUT(MAX)}}{(V_{RMS} - V_{OUT}) \times 4 \sqrt{2} \times f_{IN}}$	3	Full wave—MAX610, MAX612
$C1 = \frac{I_{OUT(MAX)}}{(V_{RMS} - V_{OUT}) \times 2 \sqrt{2} \times f_{IN}}$	4	Half wave—MAX611
Time delay = C3 x 3 (in secs) (in µF)	10	MAX611 only

With 110VAC, 60Hz input:

$Pd (R1) = 1.6 \times C1^2 \times R1$

(in mW) (in µF) (in Ω)

With 220VAC, 50Hz input:

$Pd (R1) = 2.7 \times C1^2 \times R1$

(in mW) (in µF) (in Ω)

Raw DC Filter Capacitor, C2

The raw DC filter capacitor (C2) is normally an aluminum or tantalum electrolytic capacitor. C2 is ordinarily 47µF when the MAX610/MAX612 are driven from the 110/220VAC power line. The half-wave MAX611 requires larger values for C2 since the output current is supplied by C2 for one-half of each line cycle.

Reset Delay Capacitor

The reset delay capacitor, labeled C3 in Figure 9a, is non-critical and is usually a low-cost ceramic capacitor.

Table 2. Component Manufacturers

MANU-FACTURER	PART NO.	DESCRIPTION
Panasonic	ECQ-E2105KF	1µF, 250VDC metallized polypropylene capacitor
	ECQ-E2155KF	1.5µF, 250VDC metallized polypropylene capacitor
	ECQ-E2275KF	2.7µF, 250VDC metallized polypropylene capacitor
	ECQ-E6105KF	1µF, 630VDC metallized polypropylene capacitor
	ECQ-E6155KF	1.5µF, 630VDC metallized polypropylene capacitor
Aavid	5801B	Slip-on heatsink for 8-pin plastic DIP

Panasonic Industrial Company
Electronic Components Division
1600 McCandless Drive
Milpitas, CA 95035
(408) 946-4311

Aavid Engineering, Inc.
30 Cook Ct., Box 400
Laconia, NH 03247
(603) 524-4443

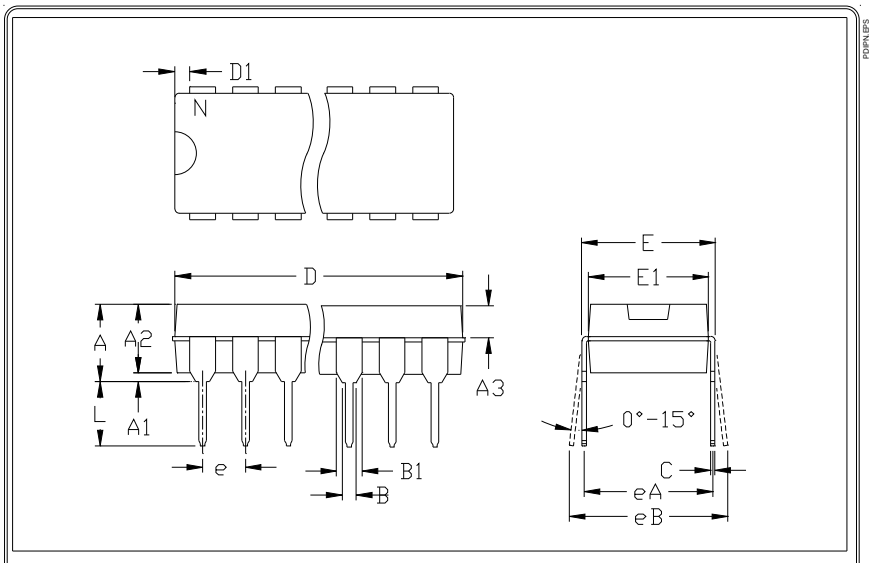
AC-to-DC Regulator (110/220VAC to 5.0VDC)

Cautions and Application Hints

1) Unless driven by a transformer, the 5V output of the MAX610/MAX611/MAX612 is **NOT ISOLATED** from the power line, and all circuitry connected to the MAX610/MAX611/MAX612 should be treated as if it were directly connected to the power line. The MAX610/MAX611/MAX612, its circuitry, and all components driven by the 5V output present a shock hazard and should be in a protective enclosure to prevent accidental contact.
2) Use an isolation transformer or ground fault interrupter (GFI) when breadboarding, testing, or trouble-shooting a MAX610 family based power supply or any circuitry powered by the MAX610 family. If the MAX610/MAX611/MAX612 is connected directly to the power line, do **NOT** connect the ground of an oscilloscope to the circuit—this will severely damage the oscilloscope and destroy the MAX610/MAX611/MAX612.
3) When the 110/220VAC input is disconnected from a MAX610 family based power supply, the input capacitor, C1, may be left charged to the peak input line voltage, creating a shock hazard on the input terminals. The 1MΩ resistor shown in Figure 3 is recommended for use in any of the circuits when the input to the power supply may be disconnected or where the input capacitor must be discharged to prevent shock hazards to maintenance or service personnel.
4) C1 must be able to withstand the peak AC input voltage. The power source should be properly fused.
5) Observe th power dissipation limit. Excessive power dissipation will cause the junction temperature to rise above the absolute maximum rating and will degrade reliability.
6) Use the minimum value of C1 that will deliver the desired output current. Minimizing the value of C1 minimizes the dissipation of the MAX610/MAX611/MAX612, thus increasing the reliability of the power supply.
7) The over/undervoltage detection circuit is set up for 5V operation. Even if the V_{SET} terminal is used to set another output voltage, the over/undervoltage detection is left set at 4.65V and 5.4V.
8) If the value of C2, the raw DC filter capacitor, is above 750µF, limit the maximum output current by inserting a resistor between V_{OUT} and V_{SENSE}. This prevents damage to the MAX610/MAX611/MAX612 that might occur if the energy stored in a large valued C2 were discharged into a short circuit. If C2 is below 750µF, this protection is not necessary.
9) While the MAX610 family is stable without an output filter capacitor, it is good engineering practice to have power-supply bypass capacitors on the output to compensate for the increased output impedance of the MAX610/MAX611/MAX612 at high frequency. A 47µF in parallel with a 0.1µF will keep the effective output impedance low from DC to greater than 1MHz.
10) When powering the MAX610 or MAX612 through the V+ terminal and using only the DC linear regulator, connect both AC1 and AC2 terminals to V-.

    When using only the DC linear regulator portion of the MAX611, the AC1 terminal should be connected to V-.
11) A 0.01µF (50V) capacitor connected between AC1 and AC2 for the MAX610/MAX612 or between AC1 and GND for the MAX611 protects the bridge rectifier from damage due to input transients.

Package Information



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	---	0.200	---	5.08
A1	0.015	---	0.38	---
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.016	0.022	0.41	0.56
B1	0.045	0.065	1.14	1.65
C	0.008	0.012	0.20	0.30
D1	0.005	0.080	0.13	2.03
E	0.300	0.325	7.62	8.26
E1	0.240	0.310	6.10	7.87
e	0.100	---	2.54	---
eA	0.300	---	7.62	---
eB	---	0.400	---	10.16
L	0.115	0.150	2.92	3.81

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS001
D	0.348	0.390	8.84	9.91	8	AB
D	0.735	0.765	18.67	19.43	14	AC
D	0.745	0.765	18.92	19.43	16	AA
D	0.885	0.915	22.48	23.24	18	AD
D	1.015	1.045	25.78	26.54	20	AE
D	1.14	1.265	28.96	32.13	24	AF
D	1.360	1.380	34.54	35.05	28	*5

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC MS001-XX AS SHOWN IN ABOVE TABLE
5. SIMILIAR TO JEDEC MO-058AB
6. N = NUMBER OF PINS

MAXIM — 120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION

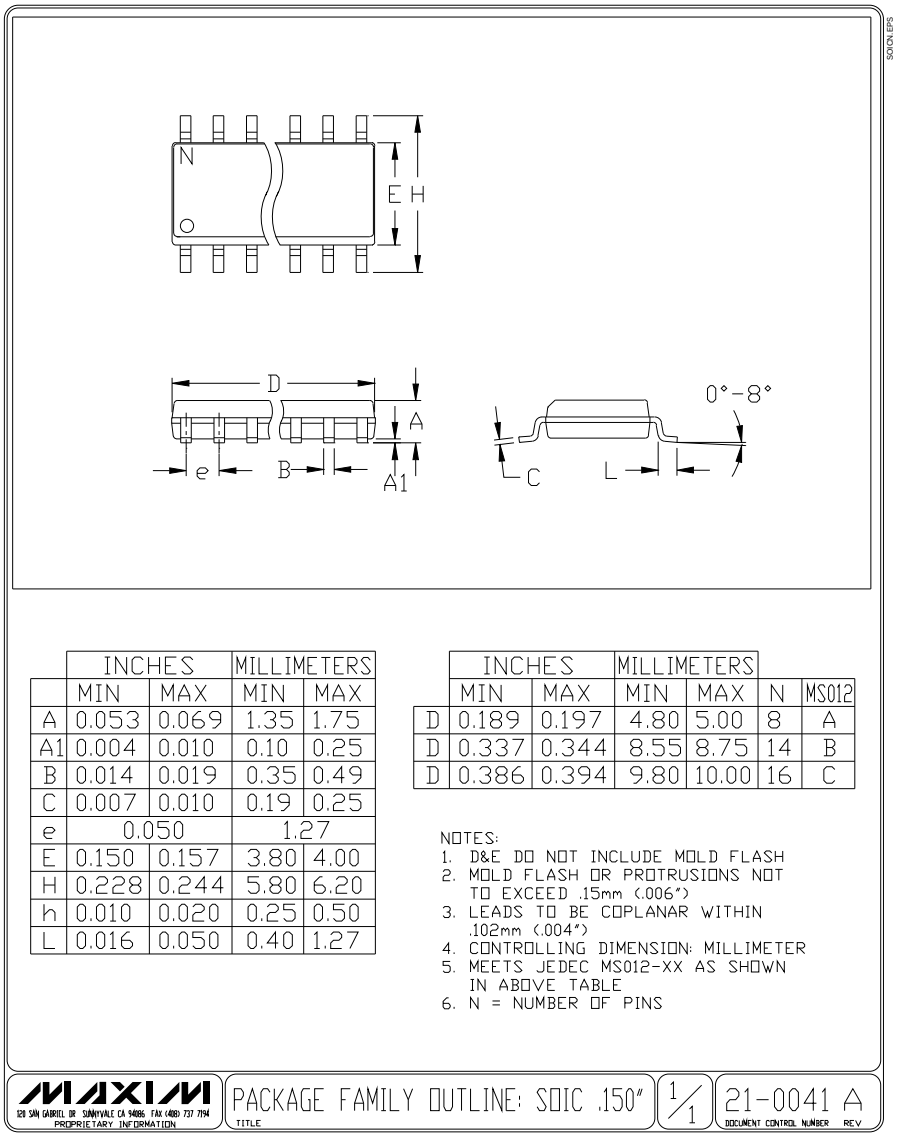
PACKAGE FAMILY OUTLINE: PDIP .300" — TITLE

1/1

21-0043 A — DOCUMENT CONTROL NUMBER — REV

AC-to-DC Regulator (110/220VAC to 5.0VDC)

Package Information (continued)



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050		1.27	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
h	0.010	0.020	0.25	0.50
L	0.016	0.050	0.40	1.27

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	A
D	0.337	0.344	8.55	8.75	14	B
D	0.386	0.394	9.80	10.00	16	C

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. LEADS TO BE COPLANAR WITHIN .102mm (.004")
4. CONTROLLING DIMENSION: MILLIMETER
5. MEETS JEDEC MS012-XX AS SHOWN IN ABOVE TABLE
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION | TITLE: PACKAGE FAMILY OUTLINE: SOIC .150" | 1/1 | 21-0041 A DOCUMENT CONTROL NUMBER REV

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