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### Description

The AP78LXX Series is a three terminal positive regulator available with fixed output voltages from 5V, 8V and 12V, making them useful in a wide range of applications. When used as a Zener diode/resistor combination replacement, the AP78LXX can improve output impedance by two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the AP78LXX's to be used in logic systems. Instrumentation, HiFi and other solid state electronic equipment.

The AP78LXX is available in the plastic TO92, SOT89 and SO-8 using industrial standard package technology. The regulator can deliver 100mA output current with adequate heat sinking. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors is provided to limit internal power dissipation. Thermal overload protection is integrated to prevent the IC from overheat due to abnormal condition.

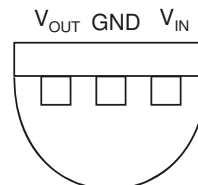
### Features

- Output voltages of 5.0V, 8.0V, 12V
- Output voltage tolerances of  $\pm 5\%$  over the operating temperature ranges
- Output current in excess of 100mA
- Internal thermal overload protection
- Output transistor safe area protection
- Internal short circuit current limiting
- No external components
- Available in plastic TO92, SOT89 and plastic SO-8 low profile packages
- Lead Free Package: TO92 (Note 1)
- SO-8 and SOT89: Available in "Green" Molding Compound (No Br, Sb) (Note 2)
- Lead Free Finish / RoHS Compliant (Note 3)

Notes: 1. TO92 is available in "Lead Free" product only.  
 2. SO-8 and SOT89 are available in "Green" products only.  
 3. EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2). All applicable RoHS exemptions applied.

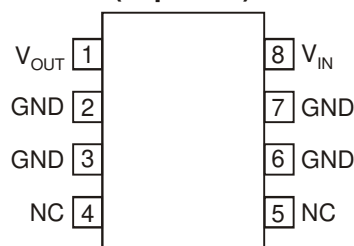
### Pin Assignments

#### (Bottom View)



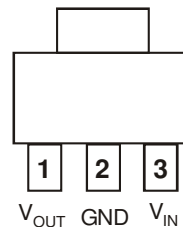
**TO92**

#### (Top View)



**SO-8**

#### (Top View)

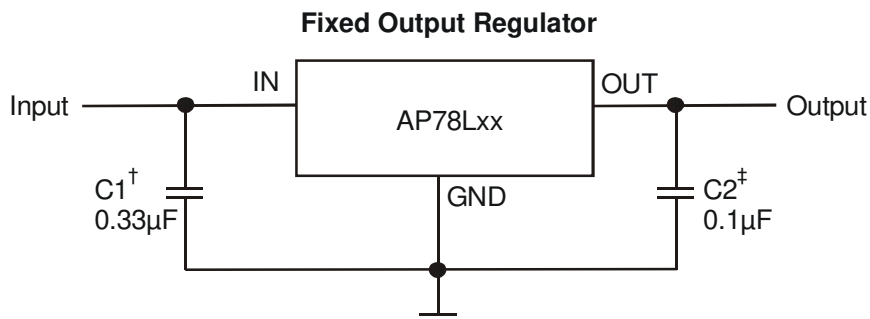


**SOT89**

### Applications

- Communication
- CD-ROM
- DVD-Player
- Set-Top Box

## Typical Application Circuit



(†) Required if the regulator is located more than 3" from the power supply filter

(‡) See Note 5 in the electrical characteristics table

## Pin Descriptions

| Pin Name         | Description             |
|------------------|-------------------------|
| V <sub>IN</sub>  | Operating Voltage Input |
| V <sub>OUT</sub> | Voltage Output Pin      |
| GND              | Ground                  |
| NC               | No Connection           |

## Functional Block Diagram

### Introduction

The AP78LXX series is a three terminal device with fixed output voltages from 5V, 8V and 12V. The AP78LXX fixed voltage regulator series has built-in thermal overload protection which prevents the device from being damaged due to excessive junction temperature. The regulator also contains internal short-circuit protection which limits the maximum output current, and safe-area protection for the pass transistor which reduces the short-circuit current as the voltage across the pass transistor is increased.

**Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ )**

| Symbol    | Parameter                       |         | Rating      | Unit             |
|-----------|---------------------------------|---------|-------------|------------------|
| ESD HBM   | Human Body Model ESD Protection |         | 3           | KV               |
| ESD MM    | Machine Model ESD Protection    |         | 250         | V                |
| $V_{CC}$  | Supply Voltage                  |         | 30          | V                |
| $V_{OUT}$ | Output Voltage to Ground        | AP78L05 | 5           | V                |
|           |                                 | AP78L08 | 8           |                  |
|           |                                 | AP78L12 | 12          |                  |
| $T_{ST}$  | Storage Temperature             |         | -65 to +150 | $^\circ\text{C}$ |
| $T_{OP}$  | Operating Junction Temperature  |         | -20 to +125 | $^\circ\text{C}$ |
| $T_{MJ}$  | Maximum Junction Temperature    |         | 150         | $^\circ\text{C}$ |

**Recommended Operating Conditions ( $T_A = 25^\circ\text{C}$ )**

| Symbol    | Parameter                     |         | Min  | Max | Unit             |
|-----------|-------------------------------|---------|------|-----|------------------|
| $V_{IN}$  | Input Voltage                 | AP78L05 | 7    | 20  | V                |
|           |                               | AP78L08 | 10.5 | 23  |                  |
|           |                               | AP78L12 | 14.5 | 27  |                  |
| $I_{OUT}$ | Output Current                |         | 0    | 100 | mA               |
| $T_A$     | Operating Ambient Temperature |         | -20  | +85 | $^\circ\text{C}$ |



### AP78Lxx Electrical Characteristics (All Output Voltage Versions)

Limits in standard typeface are for  $T_A = 25^\circ\text{C}$ , **Bold typeface applies over  $T_J = -20^\circ\text{C}$  to  $+125^\circ\text{C}$  for TO92, SOT89 and SO-8 packages.**

Unless otherwise specified:  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ .

#### AP78L05

Unless otherwise specified,  $V_{IN} = 10\text{V}$

| Symbol                         | Parameter   | Conditions  | Min         | Typ.  | Max         | Unit                       |
|--------------------------------|---|---|-------------|-------|-------------|----------------------------|
| $V_O$                          | Output Voltage  |   | 4.8         | 5     | 5.2         | V                          |
|                                |   | $7\text{V} \leq V_{IN} \leq 20\text{V}$<br>$1\text{mA} \leq I_O \leq 40\text{mA}$ | <b>4.75</b> |       | <b>5.25</b> |                            |
|                                |   | $1\text{mA} \leq I_O \leq 70\text{mA}$  | <b>4.75</b> |       | <b>5.25</b> |                            |
| $\Delta V_O$                   | Line Regulation   | $7\text{V} \leq V_{IN} \leq 20\text{V}$   |             | 18    | 75          | mV                         |
|                                |   | $8\text{V} \leq V_{IN} \leq 20\text{V}$   |             | 10    | 54          |                            |
| $\Delta V_O$                   | Load Regulation   | $1\text{mA} \leq I_O \leq 100\text{mA}$   |             | 20    | 60          | mV                         |
|                                |   | $1\text{mA} \leq I_O \leq 40\text{mA}$  |             | 5     | 30          |                            |
| $I_Q$                          | Quiescent Current   |   |             | 3     | 5           | mA                         |
| $\Delta I_Q$                   | Quiescent Current Change  | $8\text{V} \leq V_{IN} \leq 20\text{V}$   |             |       | <b>1.0</b>  |                            |
|                                |   | $1\text{mA} \leq I_O \leq 40\text{mA}$  |             |       | <b>0.1</b>  |                            |
| $V_N$                          | Output Noise Voltage  | $f = 10\text{Hz to } 100\text{kHz}$<br>(Note 4)                                   | -           | 40    |             | $\mu\text{V}$              |
| $\Delta V_{IN}/\Delta V_{OUT}$ | Ripple Rejection  | $f = 120\text{Hz}$<br>$8\text{V} \leq V_{IN} \leq 16\text{V}$                     | 47          | 62    |             | dB                         |
| $I_{PK}$                       | Peak Output Current   |   |             | 140   |             | mA                         |
| $\Delta V_O/\Delta T$          | Average Output Voltage Tempco                                       | $I_O = 5\text{mA}$  |             | -0.65 |             | $\text{mV}/^\circ\text{C}$ |
| $V_{IN(MIN)}$                  | Minimum Value of Input Voltage Required to Maintain Line Regulation |   |             | 6.7   | 7           | V                          |
| $\theta_{JA}$                  | Thermal Resistance Junction to Ambient                              | TO92 (Note 5)   |             | 176   |             | $^\circ\text{C}/\text{W}$  |
|                                |   | SO-8 (Note 6)   |             | 153   |             |                            |
|                                |   | SOT89 (Note 7)  |             | 145   |             |                            |
| $\theta_{JC}$                  | Thermal Resistance Junction to Case                                 | TO92 (Note 5)   |             | 33    |             |                            |
|                                |   | SO-8 (Note 6)   |             | 18    |             |                            |
|                                |   | SOT89 (Note 7)  |             | 25    |             |                            |

- Notes:
4. Recommend  $0.01\mu\text{F}$  minimum load capacitance at output to suppress high frequency noise.
  5. Test conditions for TO92: No heat sink, no air flow.
  6. Test conditions for SO-8: Device mounted on 2oz copper, minimum recommended pad layout, FR-4 PCB.
  7. Test conditions for SOT89: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

### AP78Lxx Electrical Characteristics (cont.)

#### AP78L08

Unless otherwise specified,  $V_{IN} = 14V$

| Symbol                         | Parameter   | Conditions   | Min | Typ. | Max | Unit    |
|--------------------------------|---|--|-----|------|-----|---------|
| $V_O$                          | Output Voltage  |  | 7.7 | 8    | 8.3 | V       |
|                                |   | $10.5V \leq V_{IN} \leq 23V$<br>$1mA \leq I_O \leq 40mA$ | 7.6 |      | 8.4 |         |
|                                |   | $1mA \leq I_O \leq 70mA$                                 | 7.6 |      | 8.4 |         |
| $\Delta V_O$                   | Line Regulation   | $10.5V \leq V_{IN} \leq 23V$                             |     | 42   | 175 | mV      |
|                                |   | $11V \leq V_{IN} \leq 23V$                               |     | 36   | 125 |         |
| $\Delta V_O$                   | Load Regulation   | $1mA \leq I_O \leq 100mA$                                |     | 18   | 80  | mV      |
|                                |   | $1mA \leq I_O \leq 40mA$                                 |     | 10   | 40  |         |
| $I_Q$                          | Quiescent Current   |  |     | 2    | 5.5 | mA      |
| $\Delta I_Q$                   | Quiescent Current Change  | $11V \leq V_{IN} \leq 23V$                               |     |      | 1.5 |         |
|                                |   | $1mA \leq I_O \leq 40mA$                                 |     |      | 0.1 |         |
| $V_N$                          | Output Noise Voltage  | $f = 10Hz \text{ to } 100kHz$<br>(Note 4)                | -   | 54   |     | $\mu V$ |
| $\Delta V_{IN}/\Delta V_{OUT}$ | Ripple Rejection  | $f = 120Hz$<br>$13V \leq V_{IN} \leq 23V$                | 37  | 46   |     | dB      |
| $I_{PK}$                       | Peak Output Current   |  |     | 140  |     | mA      |
| $\Delta V_O/\Delta T$          | Average Output Voltage Tempco                                       | $I_O = 5mA$  |     | -0.8 |     | mV/°C   |
| $V_{IN(MIN)}$                  | Minimum Value of Input Voltage Required to Maintain Line Regulation |  |     | 9.7  |     | V       |
| $\theta_{JA}$                  | Thermal Resistance Junction to Ambient                              | TO92 (Note 5)  |     | 176  |     | °C/W    |
|                                |   | SO-8 (Note 6)  |     | 153  |     |         |
|                                |   | SOT89 (Note 7)   |     | 157  |     |         |
| $\theta_{JC}$                  | Thermal Resistance Junction to case                                 | TO92 (Note 5)  |     | 33   |     | °C/W    |
|                                |   | SO-8 (Note 6)  |     | 18   |     |         |
|                                |   | SOT89 (Note 7)   |     | 33   |     |         |

Notes: 4. Recommend 0.01 $\mu F$  minimum load capacitance at output to suppress high frequency noise.  
5. Test conditions for TO92: No heat sink, no air flow.  
6. Test conditions for SO-8: Device mounted on 2oz copper, minimum recommended pad layout, FR-4 PCB.  
7. Test conditions for SOT89: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

### AP78Lxx Electrical Characteristics (cont.)

#### AP78L12

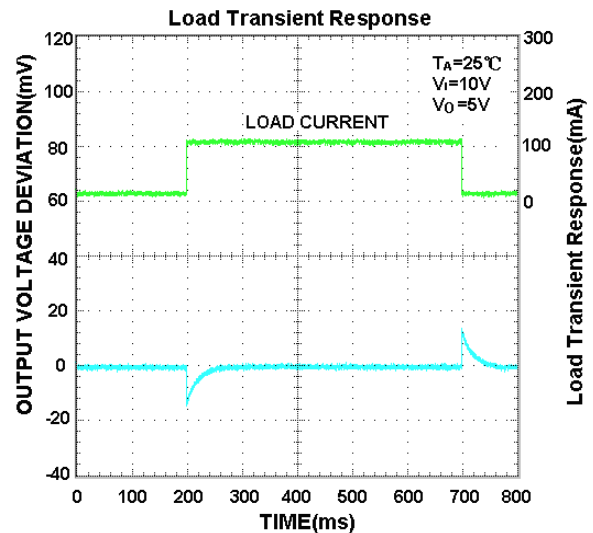
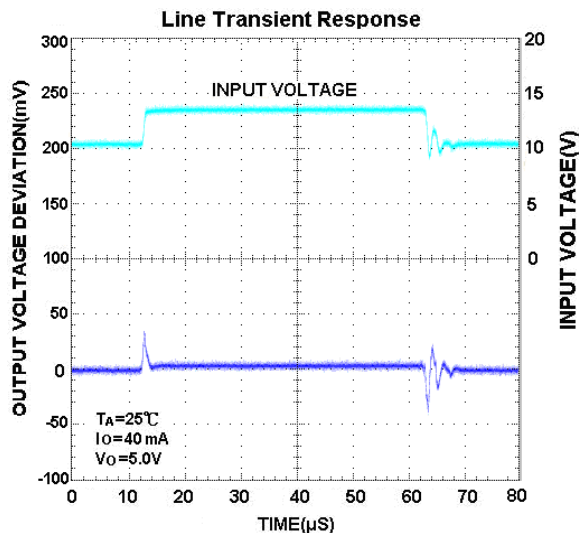
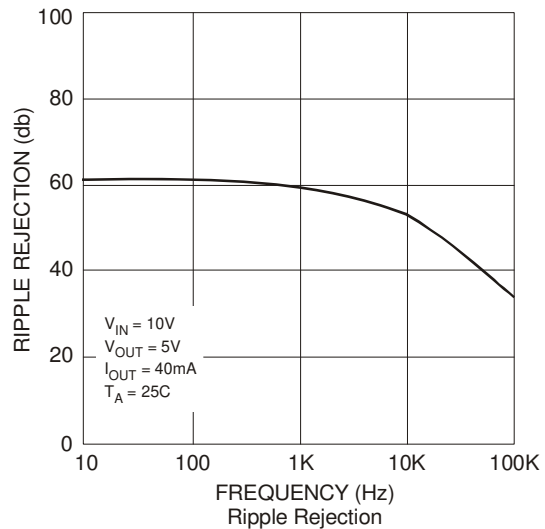
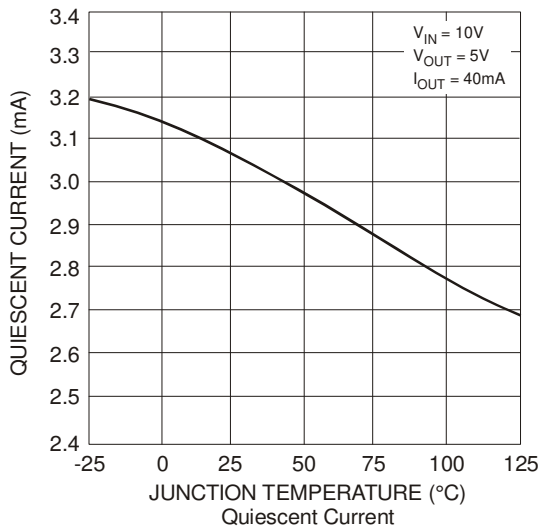
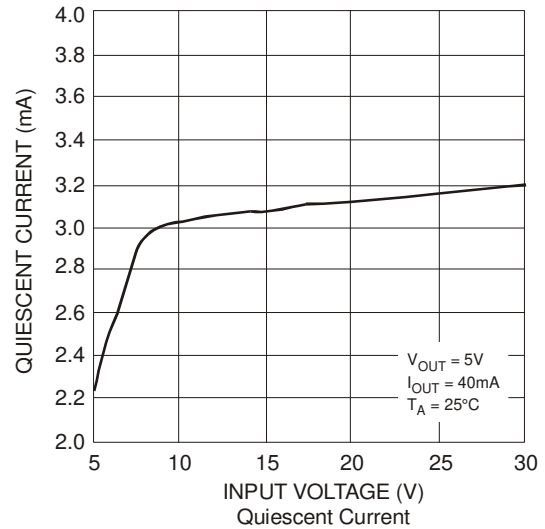
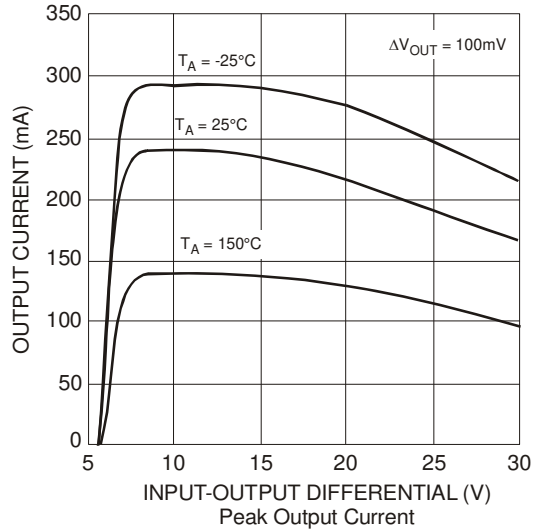
Unless otherwise specified,  $V_{IN} = 19V$

| Symbol                         | Parameter   | Conditions   | Min  | Typ. | Max  | Unit           |
|--------------------------------|---|--|------|------|------|----------------|
| $V_O$                          | Output Voltage  |  | 11.5 | 12   | 12.5 | V              |
|                                |   | $14.5V \leq V_{IN} \leq 27V$<br>$1mA \leq I_O \leq 40mA$ | 11.4 |      | 12.6 |                |
|                                |   | $1mA \leq I_O \leq 70mA$                                 | 11.4 |      | 12.6 |                |
| $\Delta V_O$                   | Line Regulation   | $14.5V \leq V_{IN} \leq 27V$                             |      | 30   | 180  | mV             |
|                                |   | $16V \leq V_{IN} \leq 27V$                               |      | 20   | 110  |                |
| $\Delta V_O$                   | Load Regulation   | $1mA \leq I_O \leq 100mA$                                |      | 30   | 100  | mV             |
|                                |   | $1mA \leq I_O \leq 40mA$                                 |      | 10   | 50   |                |
| $I_Q$                          | Quiescent Current   |  |      | 3    | 5    | mA             |
| $\Delta I_Q$                   | Quiescent Current Change  | $16V \leq V_{IN} \leq 27V$                               |      |      | 1    |                |
|                                |   | $1mA \leq I_O \leq 40mA$                                 |      |      | 0.1  |                |
| $V_N$                          | Output Noise Voltage  |  |      | 80   |      | $\mu V$        |
| $\Delta V_{IN}/\Delta V_{OUT}$ | Ripple Rejection  | $f = 120Hz$<br>$15V \leq V_{IN} \leq 25V$                | 40   | 54   |      | dB             |
| $I_{PK}$                       | Peak Output Current   |  |      | 140  |      | mA             |
| $\Delta V_O/\Delta T$          | Average Output Voltage Tempco                                       | $I_O = 5mA$  |      | -1.0 |      | $mV/^{\circ}C$ |
| $V_{IN(MIN)}$                  | Minimum Value of Input Voltage Required to Maintain Line Regulation |  |      | 13.7 | 14.5 | V              |
| $\theta_{JA}$                  | Thermal Resistance Junction to Ambient                              | TO92 (Note 5)  |      | 176  |      | $^{\circ}C/W$  |
|                                |   | SO-8 (Note 6)  |      | 153  |      |                |
|                                |   | SOT89 (Note 7)   |      | 145  |      |                |
| $\theta_{JC}$                  | Thermal Resistance Junction to case                                 | TO92 (Note 5)  |      | 33   |      | $^{\circ}C/W$  |
|                                |   | SO-8 (Note 6)  |      | 18   |      |                |
|                                |   | SOT89 (Note 7)   |      | 25   |      |                |

Notes: 5. Test conditions for TO92: No heat sink, no air flow.  
6. Test conditions for SO-8: Device mounted on 2oz copper, minimum recommended pad layout, FR-4 PCB.  
7. Test conditions for SOT89: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

## Typical Performance Characteristics

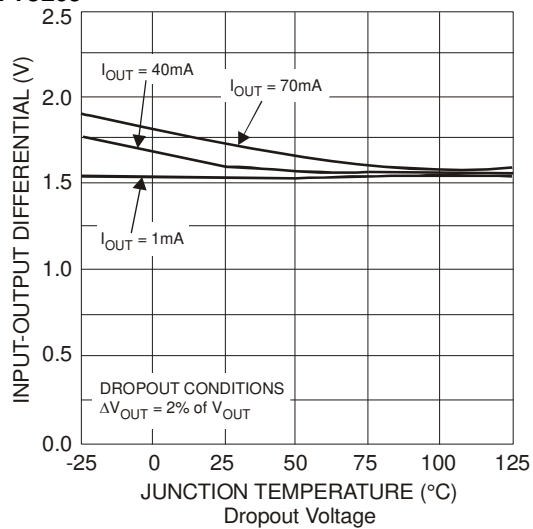
For AP78L05





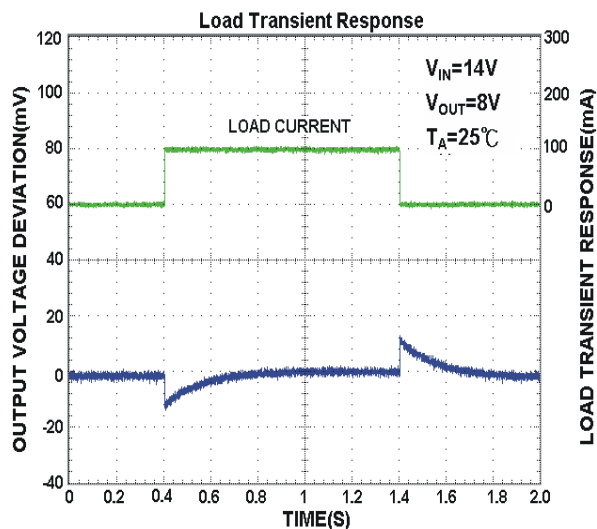
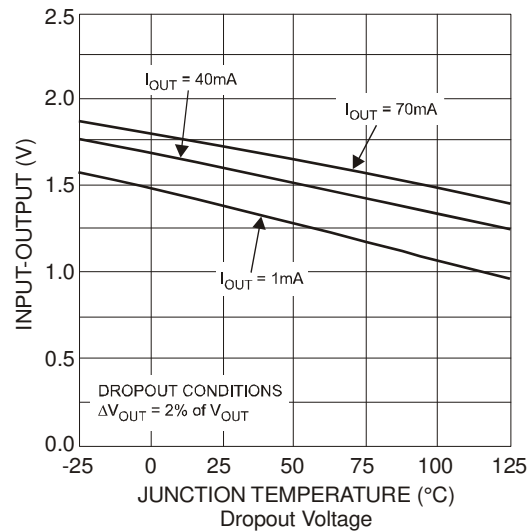
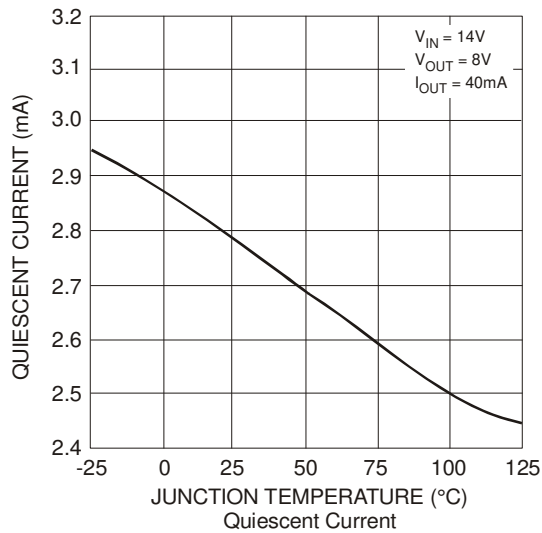
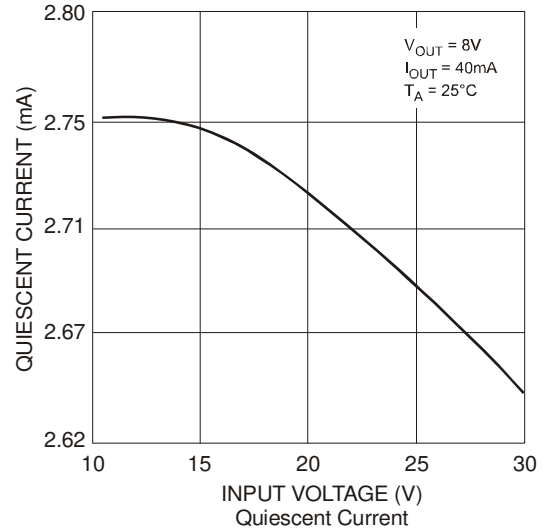
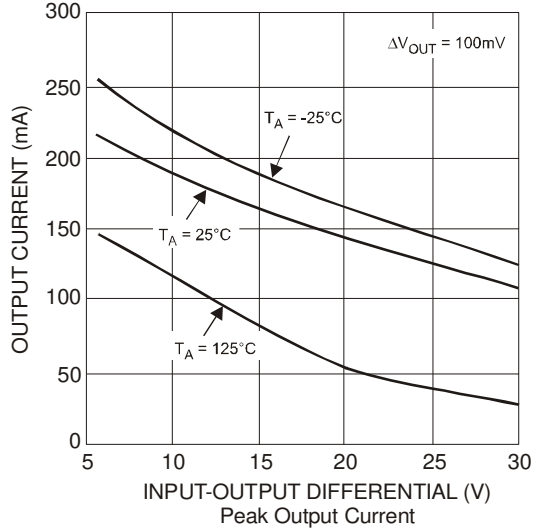
## Typical Performance Characteristics (cont.)

For AP78L05



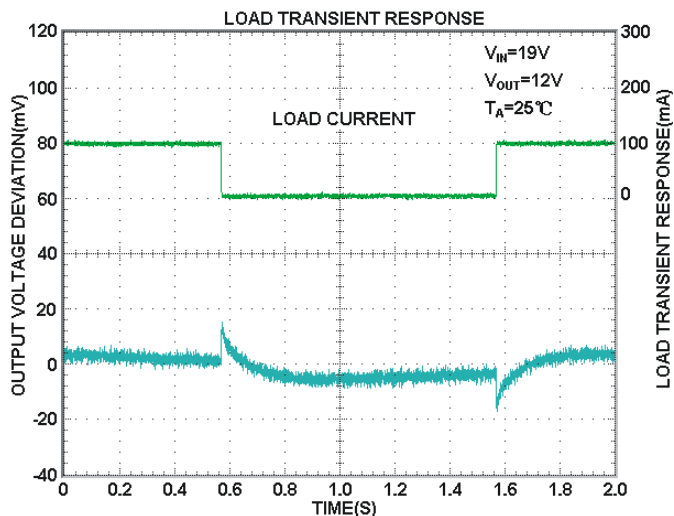
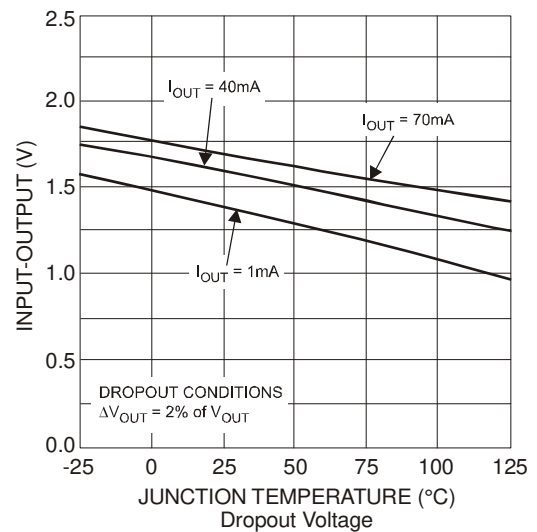
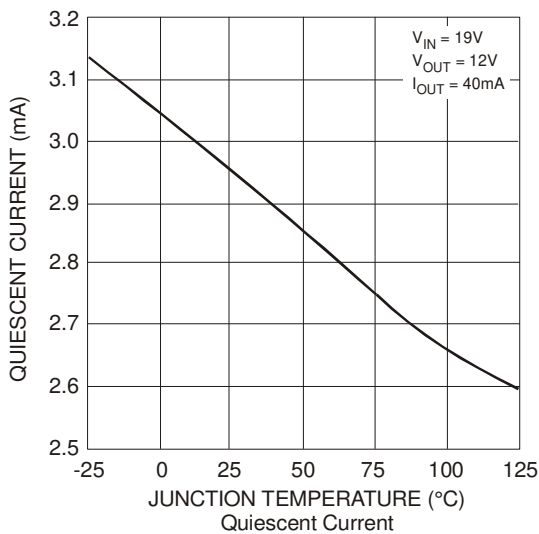
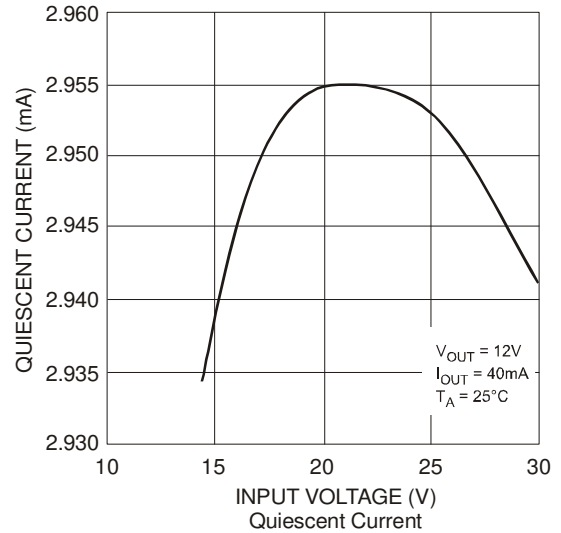
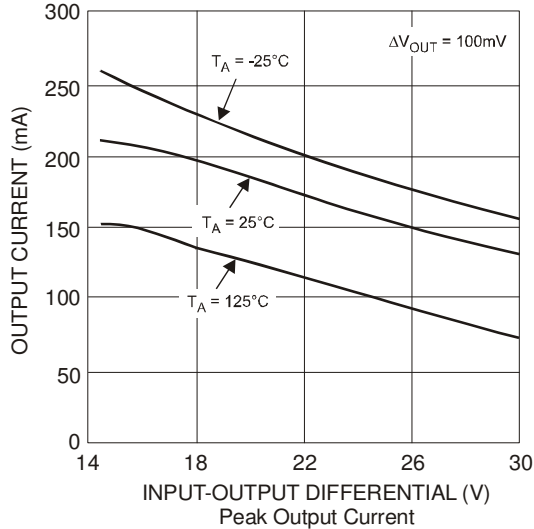
## Typical Performance Characteristics

For AP78L08

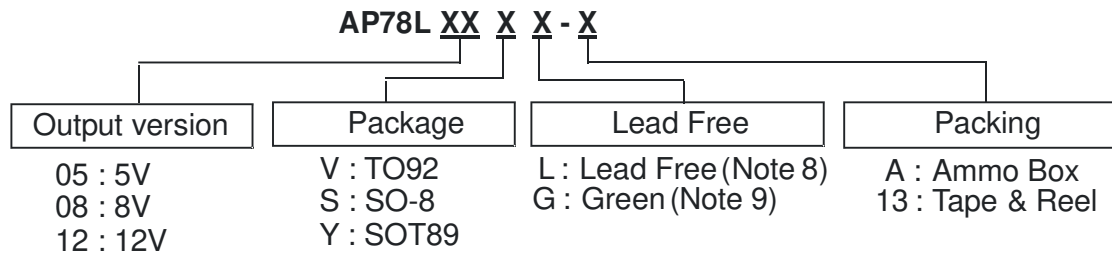





**Typical Performance Characteristics (cont.)**

For AP78L12



### Ordering Information



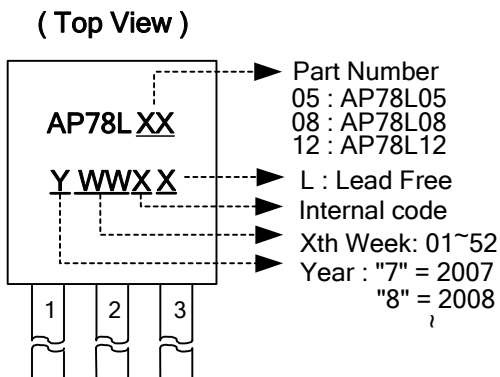
| Device   | Package Code | Packaging (Note 10) | Ammo Box / Tube |                    | 13" Tape and Reel |                    |
|--|--------------|---------------------|-----------------|--------------------|-------------------|--------------------|
|  |              |                     | Quantity        | Part Number Suffix | Quantity          | Part Number Suffix |
|  AP78LXXVL-A  | V            | TO92                | 2000/Box        | -A                 | NA                | NA                 |
|  AP78LXXSG-13 | S            | SO-8                | NA              | NA                 | 2500/Tape & Reel  | -13                |
|  AP78LXXYG-13 | Y            | SOT89               | NA              | NA                 | 2500/Tape & Reel  | -13                |

Notes:

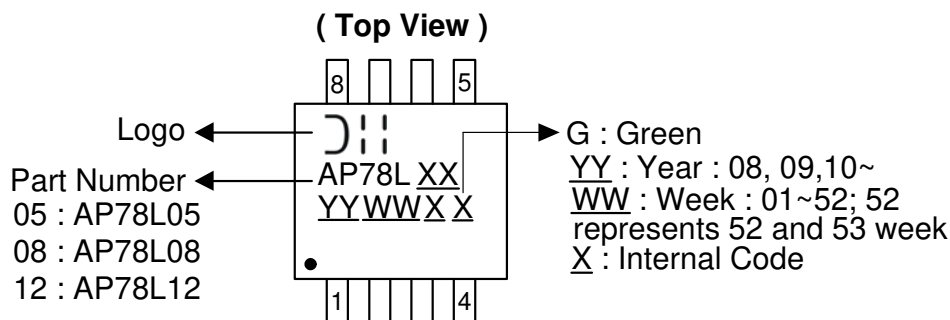
8. TO92 is available in "Lead Free" product only.
9. SO-8 and SOT89 are available in "Green" products only.
10. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.

## Marking Information

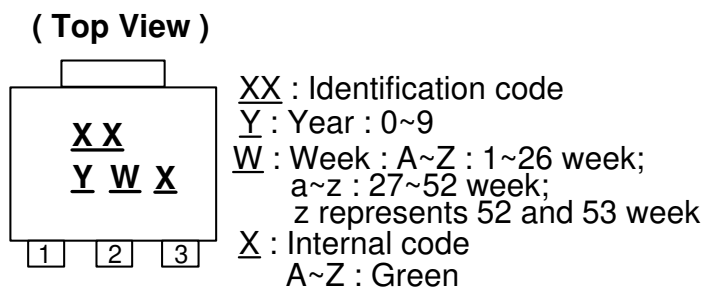
### (1) TO92



### (2) SO-8



### (3) SOT89

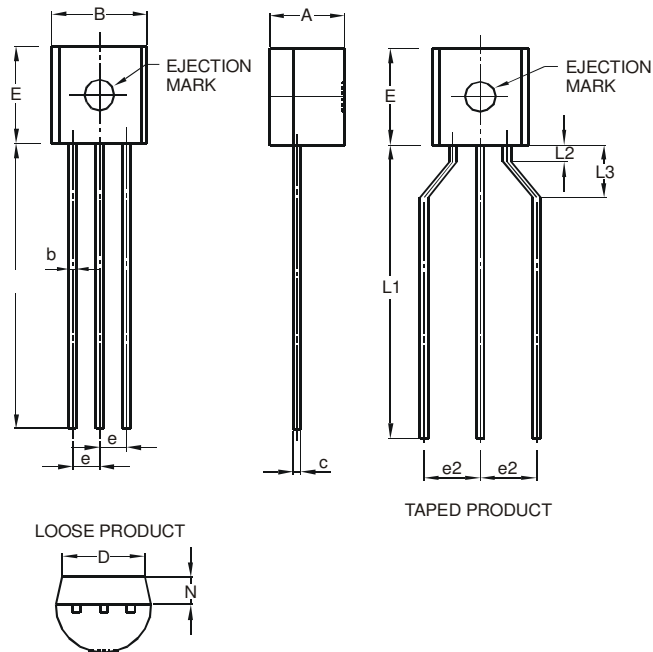


| Device  | Package | Identification Code |
|---------|---------|---------------------|
| AP78L05 | SOT89   | V2                  |
| AP78L08 | SOT89   | V3                  |
| AP78L12 | SOT89   | V4                  |



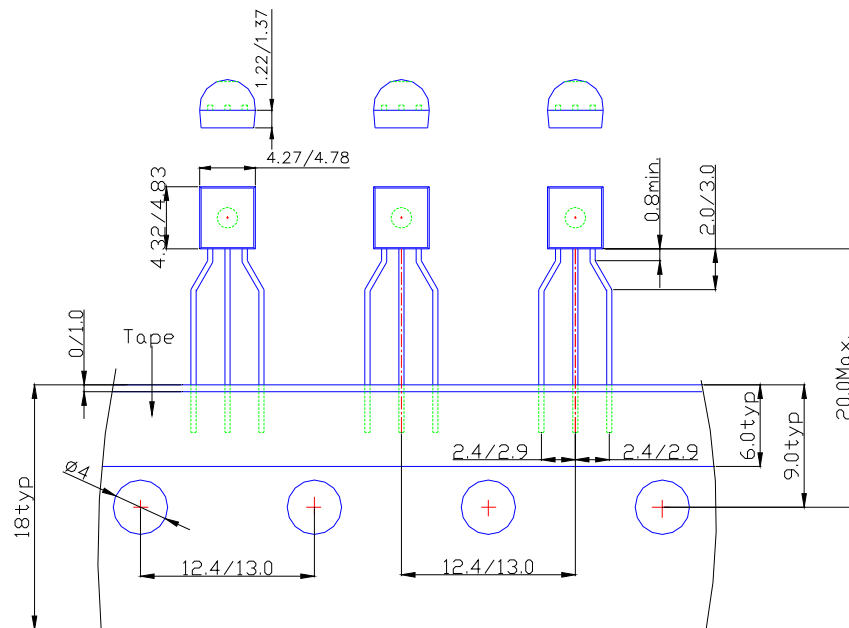
**Package Outline Dimensions (All Dimensions in mm)**

**(1) Package Type: TO92**



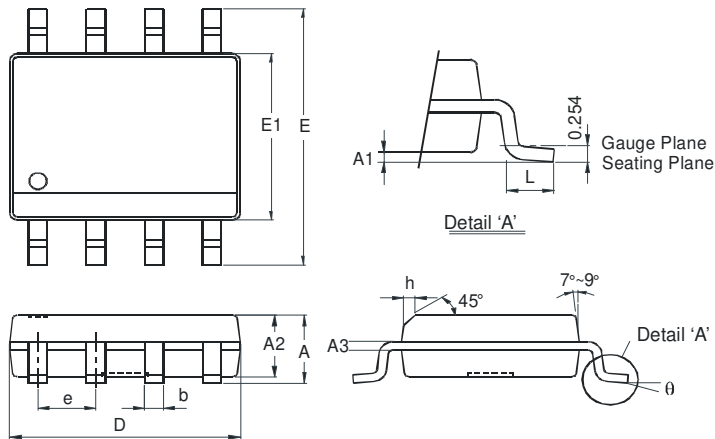
| TO92-3L              |       |       |      |
|----------------------|-------|-------|------|
| Dim                  | Min   | Max   | Typ  |
| A                    | 3.45  | 3.66  | -    |
| B                    | 4.27  | 4.78  | -    |
| b                    | -     | -     | 0.38 |
| c                    | -     | -     | 0.38 |
| D                    | -     | -     | 3.87 |
| E                    | 4.32  | 4.83  | -    |
| e                    | -     | -     | 1.27 |
| e2                   | 2.40  | 2.90  | -    |
| L                    | 12.98 | 15.00 | -    |
| L1                   | 12.80 | 15.00 | -    |
| L2                   | 0.80  | -     | -    |
| L3                   | 2.00  | 3.00  | -    |
| N                    | 1.22  | 1.37  | -    |
| All Dimensions in mm |       |       |      |

**(2) TO92 for Ammo pack**



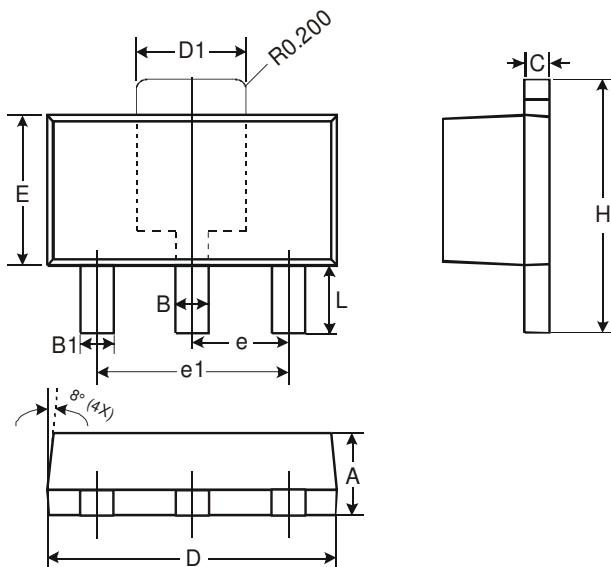
**Package Outline Dimensions (cont.) (All Dimensions in mm)**

**(3) Package Type: SO-8**



| SO-8                 |          |      |
|----------------------|----------|------|
| Dim                  | Min      | Max  |
| A                    | -        | 1.75 |
| A1                   | 0.10     | 0.20 |
| A2                   | 1.30     | 1.50 |
| A3                   | 0.15     | 0.25 |
| b                    | 0.3      | 0.5  |
| D                    | 4.85     | 4.95 |
| E                    | 5.90     | 6.10 |
| E1                   | 3.85     | 3.95 |
| e                    | 1.27 Typ |      |
| h                    | -        | 0.35 |
| L                    | 0.62     | 0.82 |
| θ                    | 0°       | 8°   |
| All Dimensions in mm |          |      |

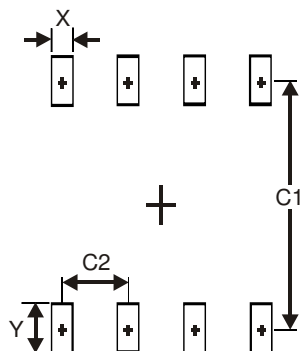
**(4) Package Type: SOT89**



| SOT89                |          |      |
|----------------------|----------|------|
| Dim                  | Min      | Max  |
| A                    | 1.40     | 1.60 |
| B                    | 0.44     | 0.62 |
| B1                   | 0.35     | 0.54 |
| C                    | 0.35     | 0.43 |
| D                    | 4.40     | 4.60 |
| D1                   | 1.52     | 1.83 |
| E                    | 2.29     | 2.60 |
| e                    | 1.50 Typ |      |
| e1                   | 3.00 Typ |      |
| H                    | 3.94     | 4.25 |
| L                    | 0.89     | 1.20 |
| All Dimensions in mm |          |      |

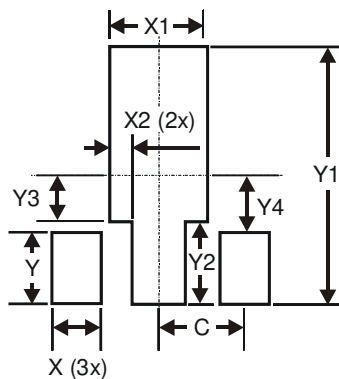
**Suggested Pad Layout (All Dimensions in mm)**

**(1) Package Type: SO-8**



| Dimensions | Value (in mm) |
|------------|---------------|
| X          | 0.60          |
| Y          | 1.55          |
| C1         | 5.4           |
| C2         | 1.27          |

**(2) Package Type: SOT89**



| Dimensions | Value (in mm) |
|------------|---------------|
| X          | 0.900         |
| X1         | 1.733         |
| X2         | 0.416         |
| Y          | 1.300         |
| Y1         | 4.600         |
| Y2         | 1.475         |
| Y3         | 0.950         |
| Y4         | 1.125         |
| C          | 1.500         |

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