AP78L05/08/12

AP78LXX SERIES 3-TERMINAL POSITIVE REGULATORS

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.

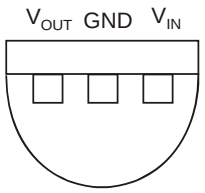
The AP78LXX is available in the plastic TO92, SOT89 and SO-8 using industrial standard package technology. The regulator can deliver 100mA output current with adequate heat sinking. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors 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 ±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)

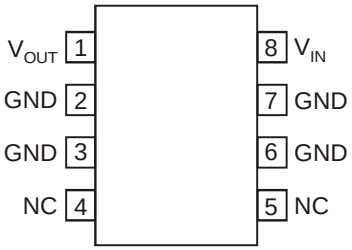
Pin Assignments

(Bottom View)



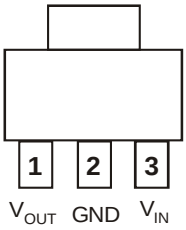
TO92

(Top View)



SO-8

(Top View)



SOT89

Applications

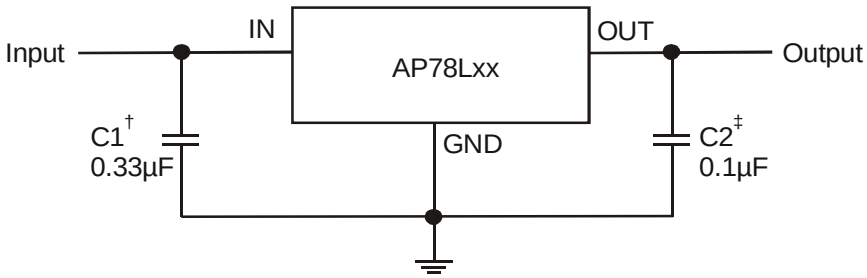
- Communication
- CD-ROM
- DVD-Player
- Set-Top Box

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.

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Typical Application Circuit

Fixed Output Regulator



(†) 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_{IN}	Operating Voltage Input
V_{OUT}	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.

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Absolute Maximum Ratings (T_A = 25°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	°C
T_{OP}	Operating Junction Temperature		-20 to +125	°C
T_{MJ}	Maximum Junction Temperature		150	°C

Recommended Operating Conditions (T_A = 25°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	°C

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AP78Lxx Electrical Characteristics (All Output Voltage Versions)

Limits in standard typeface are for T_A = 25°C, **Bold typeface applies over T_J = -20°C to +125°C for TO92, SOT89 and SO-8 packages.**
Unless otherwise specified: I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF.

AP78L05

Unless otherwise specified, V_{IN} = 10V

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

Notes:
4. Recommend 0.01µF 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.

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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 ≤ V_{IN} ≤ 23V 1mA ≤ I_O ≤ 40mA	**7.6**		**8.4**	
		1mA ≤ I_O ≤ 70mA	**7.6**		**8.4**	
ΔV_O	Line Regulation	10.5V ≤ V_{IN} ≤ 23V		42	175	mV
		11V ≤ V_{IN} ≤ 23V		36	125	
ΔV_O	Load Regulation	1mA ≤ I_O ≤ 100mA		18	80	mV
		1mA ≤ I_O ≤ 40mA		10	40	
I_Q	Quiescent Current			2	5.5	mA
ΔI_Q	Quiescent Current Change	11V ≤ V_{IN} ≤ 23V			**1.5**	
		1mA ≤ I_O ≤ 40mA			**0.1**	
V_N	Output Noise Voltage	f = 10Hz to 100kHz (Note 4)	-	54		μV
$\Delta V_{IN}/\Delta V_{OUT}$	Ripple Rejection	f = 120Hz 13V ≤ V_{IN} ≤ 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
θ_{JA}	Thermal Resistance Junction to Ambient	TO92 (Note 5)		176		°C/W
		SO-8 (Note 6)		153		
		SOT89 (Note 7)		157		
θ_{JC}	Thermal Resistance Junction to case	TO92 (Note 5)		33		°C/W
		SO-8 (Note 6)		18		
		SOT89 (Note 7)		33		

Notes: 4. Recommend 0.01μF 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.

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AP78Lxx Electrical Characteristics (cont.)

AP78L12

Unless otherwise specified, V_{IN} = 19V

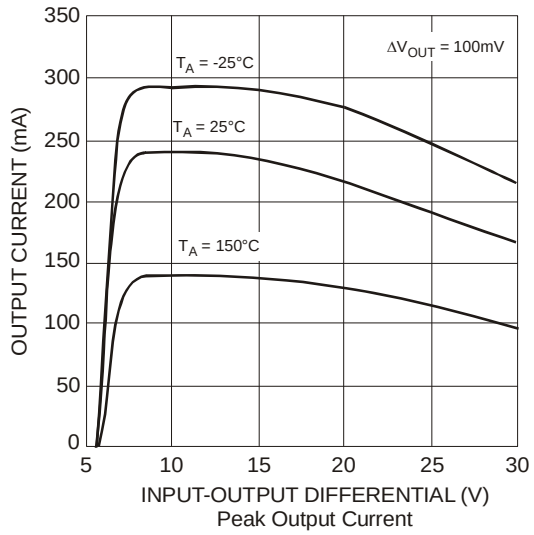
Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
V_O	Output Voltage		11.5	12	12.5	V
		14.5V ≤ V_{IN} ≤ 27V 1mA ≤ I_O ≤ 40mA	**11.4**		**12.6**	
		1mA ≤ I_O ≤ 70mA	**11.4**		**12.6**	
ΔV_O	Line Regulation	14.5V ≤ V_{IN} ≤ 27V		30	180	mV
		16V ≤ V_{IN} ≤ 27V		20	110	
ΔV_O	Load Regulation	1mA ≤ I_O ≤ 100mA		30	100	mV
		1mA ≤ I_O ≤ 40mA		10	50	
I_Q	Quiescent Current			3	5	mA
ΔI_Q	Quiescent Current Change	16V ≤ V_{IN} ≤ 27V			**1**	
		1mA ≤ I_O ≤ 40mA			**0.1**	
V_N	Output Noise Voltage			80		μV
$\Delta V_{IN}/\Delta V_{OUT}$	Ripple Rejection	f = 120Hz 15V ≤ V_{IN} ≤ 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/ °C
$V_{IN(MIN)}$	Minimum Value of Input Voltage Required to Maintain Line Regulation			13.7	14.5	V
θ_{JA}	Thermal Resistance Junction to Ambient	TO92 (Note 5)		176		°C/W
		SO-8 (Note 6)		153		
		SOT89 (Note 7)		145		
θ_{JC}	Thermal Resistance Junction to case	TO92 (Note 5)		33		°C/W
		SO-8 (Note 6)		18		
		SOT89 (Note 7)		25		

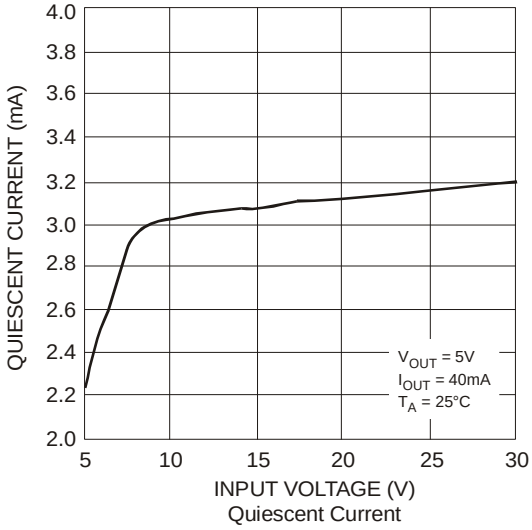
Notes: 5. Test conditions for TO92: No heat sink, no air flow.
6. Test conditions for SO-8: Device mounted on 2oz copper, minimum recommended pad layout, FR-4 PCB.
7. Test conditions for SOT89: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

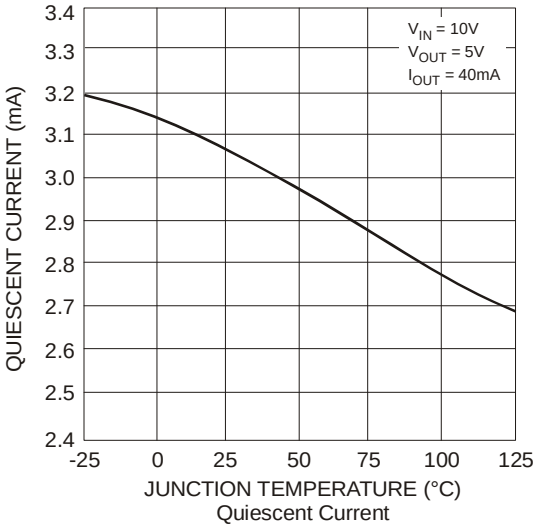
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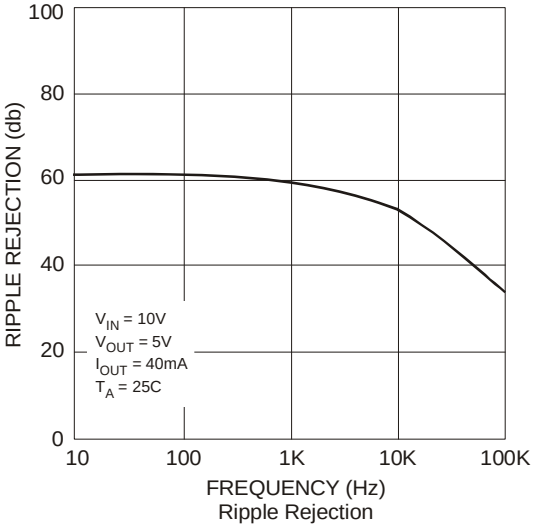
Typical Performance Characteristics

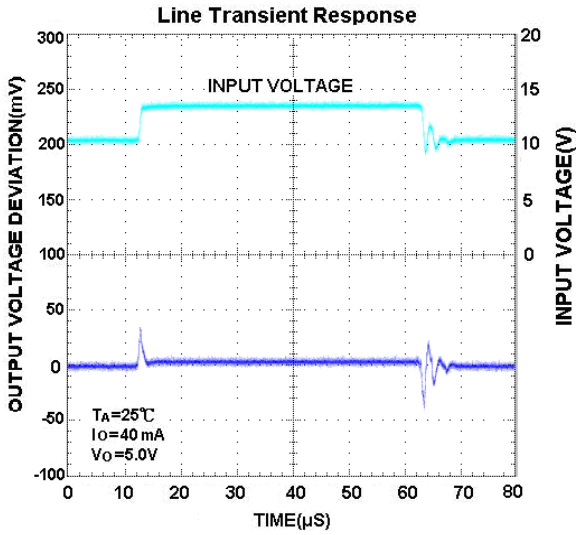
For AP78L05

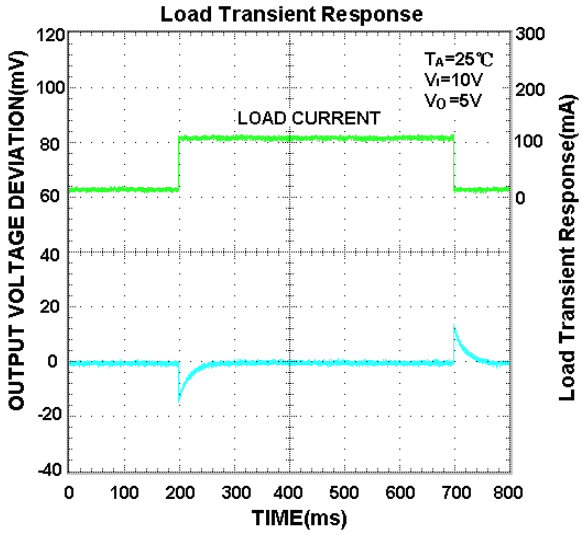








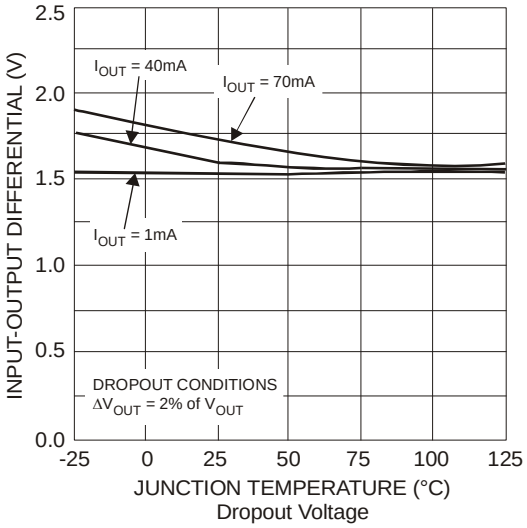




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Typical Performance Characteristics (cont.)

For AP78L05

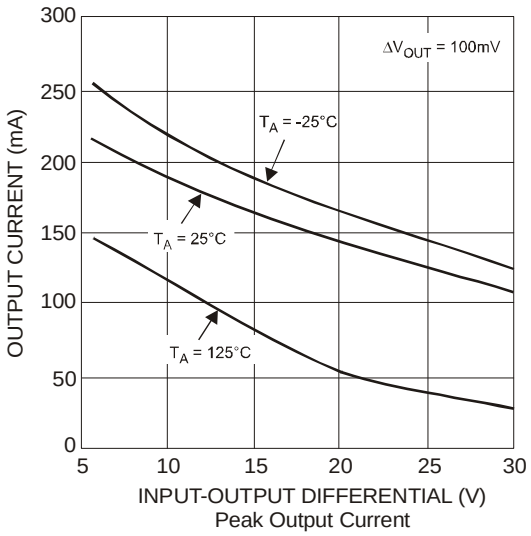


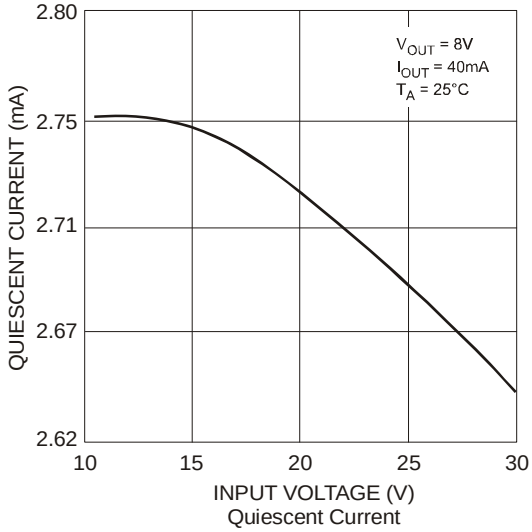
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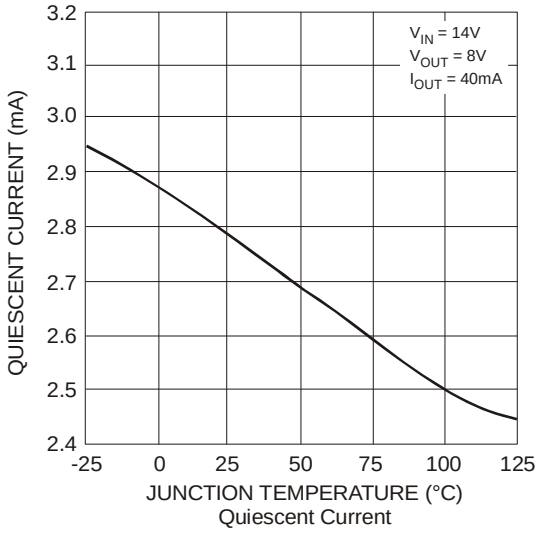
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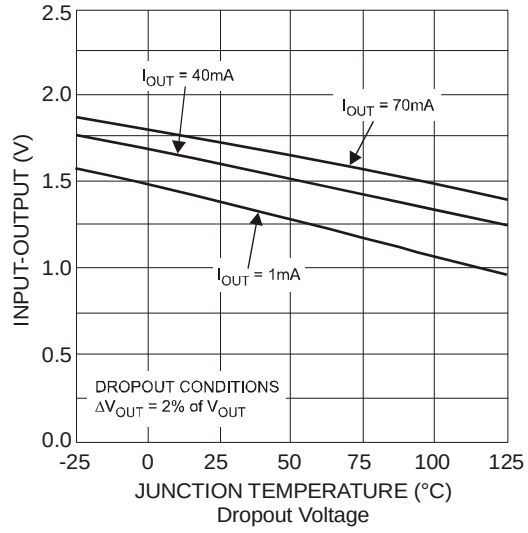
Typical Performance Characteristics

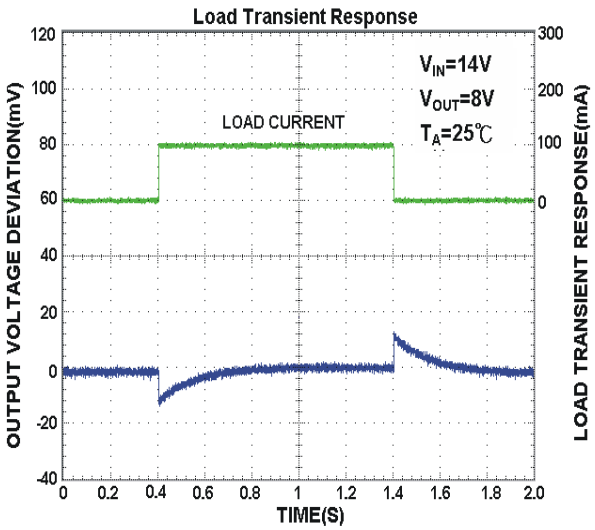
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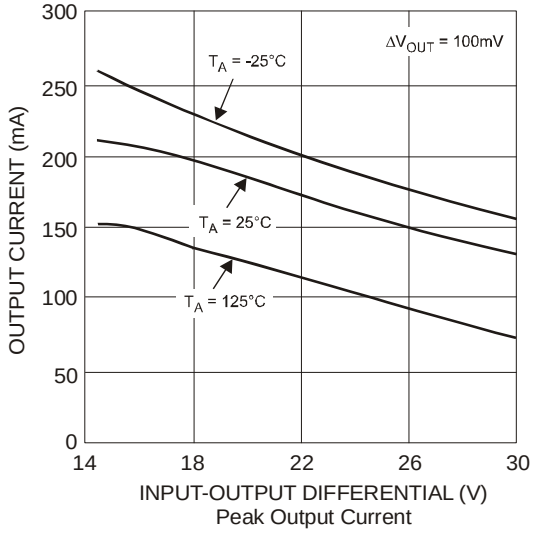


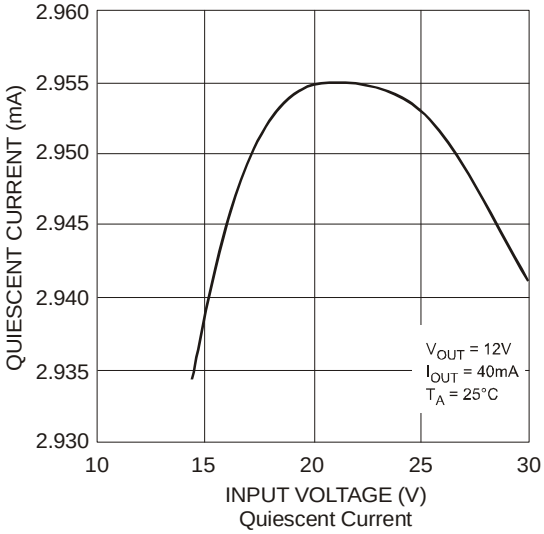


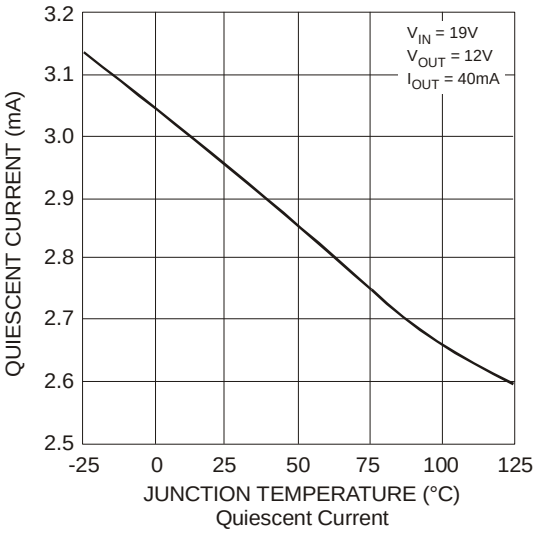
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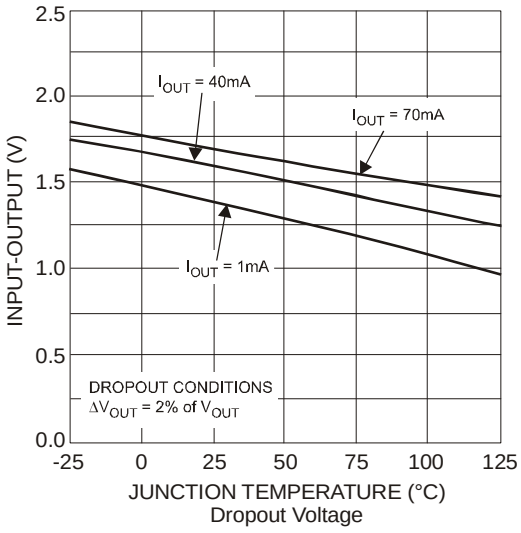
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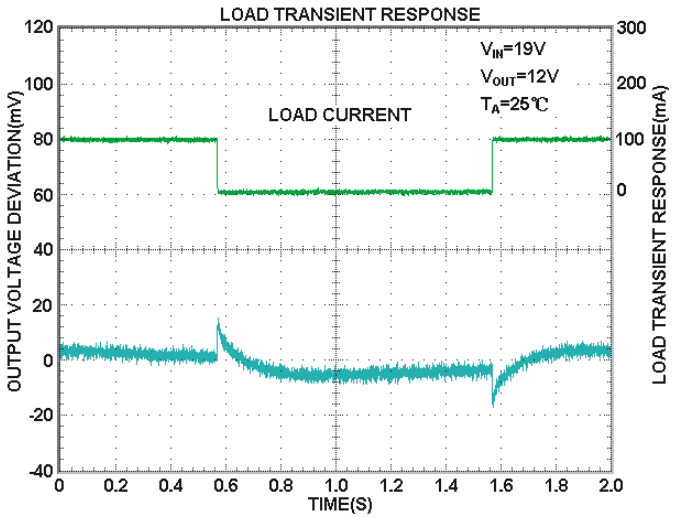
For AP78L12





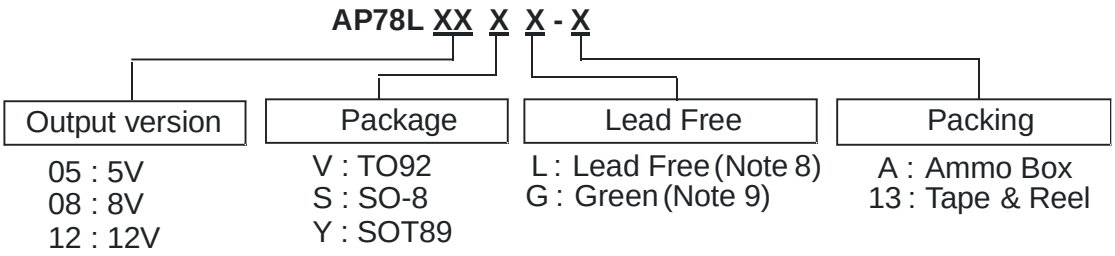






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Ordering Information



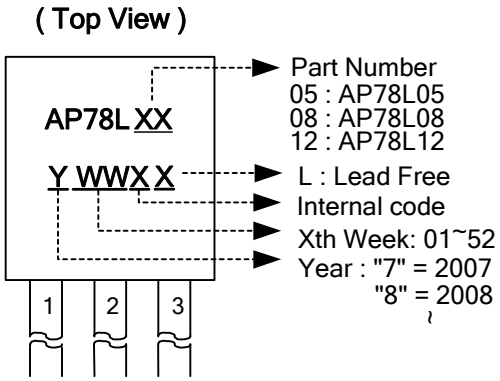
Device	Package Code	Packaging (Note 10)	Ammo Box / Tube		13" Tape and Reel	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix
AP78LXXVL-A	V	TO92	2000/Box	-A	NA	NA
AP78LXXSG-13	S	SO-8	NA	NA	2500/Tape & Reel	-13
AP78LXXYG-13	Y	SOT89	NA	NA	2500/Tape & Reel	-13

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.

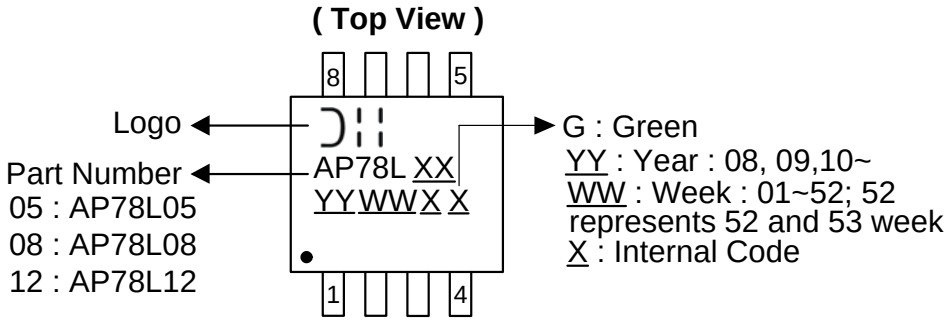
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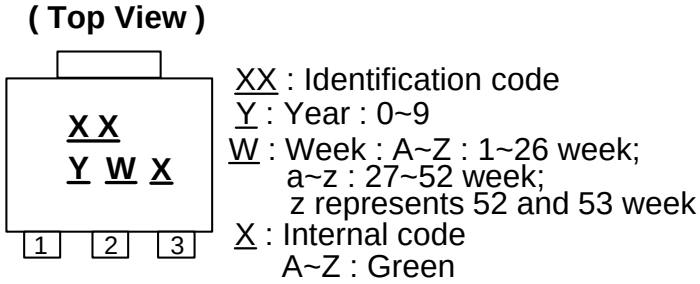
(1) TO92



(2) SO-8



(3) SOT89

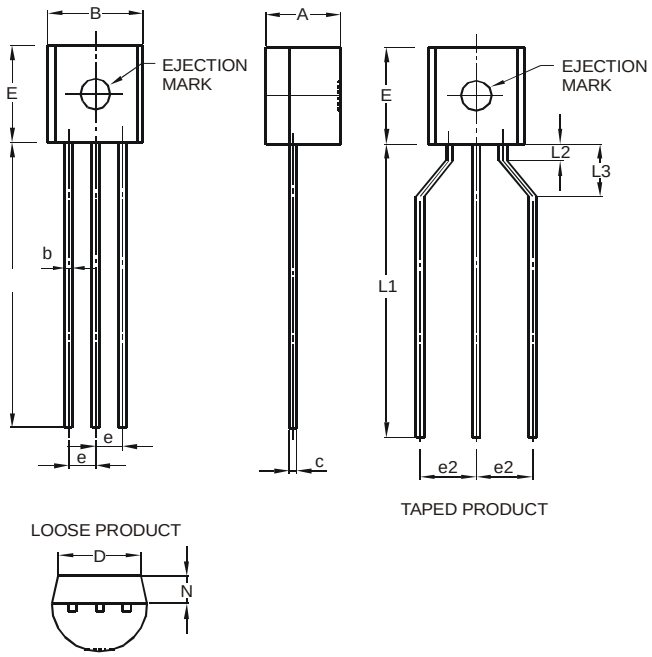


Device	Package	Identification Code
AP78L05	SOT89	V2
AP78L08	SOT89	V3
AP78L12	SOT89	V4

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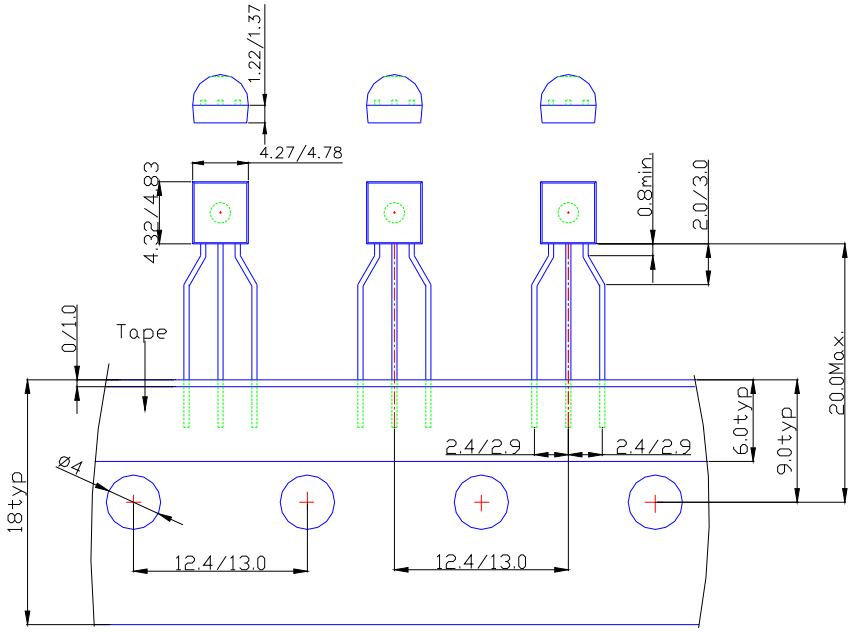
Package Outline Dimensions (All Dimensions in mm)

(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			

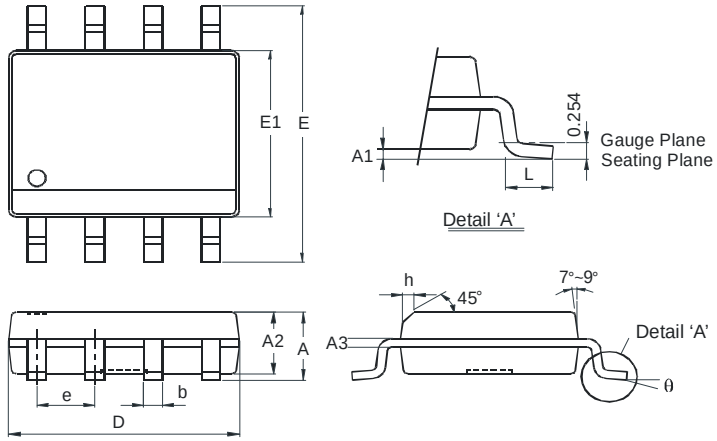
(2) TO92 for Ammo pack



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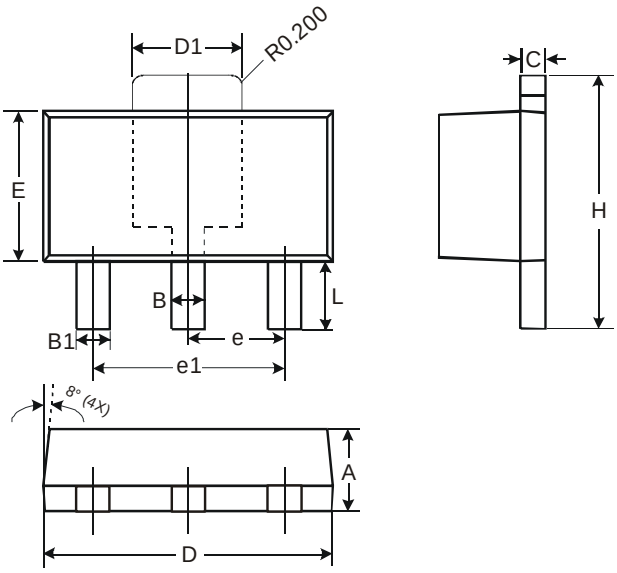
Package Outline Dimensions (cont.) (All Dimensions in mm)

(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

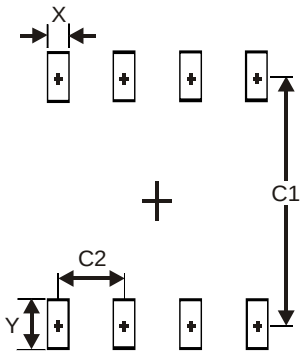


SOT89		
Dim	**Min**	**Max**
A	1.40	1.60
B	0.44	0.62
B1	0.35	0.54
C	0.35	0.43
D	4.40	4.60
D1	1.52	1.83
E	2.29	2.60
e	1.50 Typ	
e1	3.00 Typ	
H	3.94	4.25
L	0.89	1.20
All Dimensions in mm		

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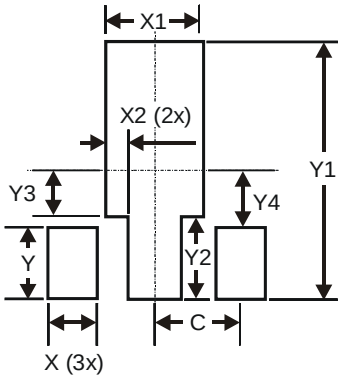
Suggested Pad Layout (All Dimensions in mm)

(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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