

# AN78Lxx/AN78LxxM Series

3-pin positive output voltage regulator (100 mA type)

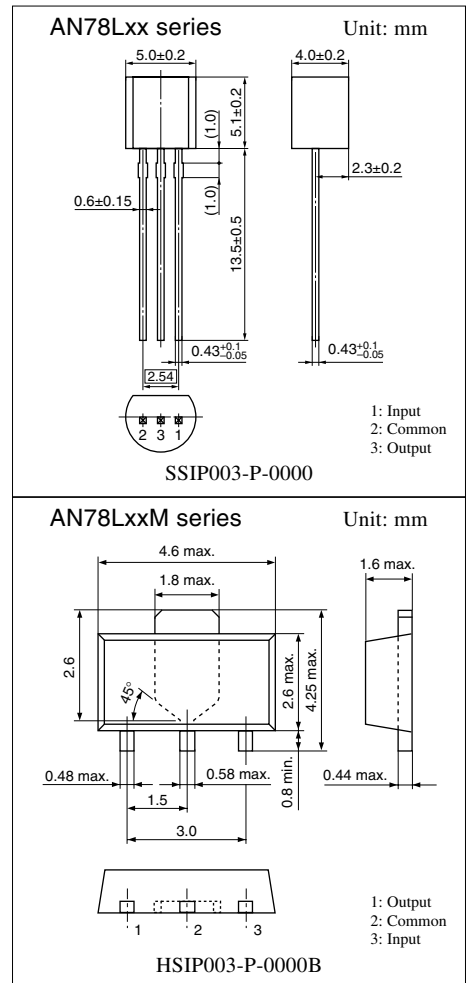
## Overview

The AN78Lxx series and the AN78LxxM series are 3-pin fixed positive output type monolithic voltage regulator.

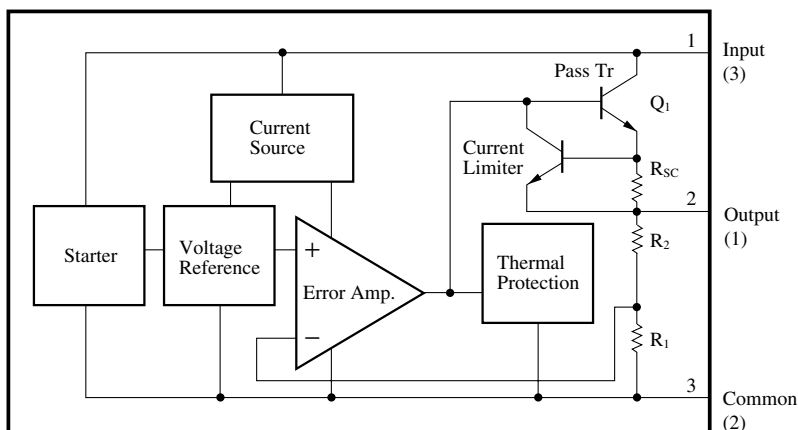
A stabilized fixed output voltage is obtained from an unstable DC input voltage without using any external parts. 12 types of fixed output voltage are available; 4V, 5V, 6V, 7V, 8V, 9V, 10V, 12V, 15V, 18V, 20V and 24V. They can be used widely as power circuits with a current capacity of up to 100mA.

## Features

- No external components
- Output voltage: 4V, 5V, 6V, 7V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V
- Built-in overcurrent limit circuit
- Built-in thermal overload protection circuit



## Block Diagram (AN78Lxx series)



Note) The number in ( ) shows the pin number for the AN78LxxM series.

### ■ Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter		Symbol	Rating	Unit
Input voltage		$V_I$	35 *1	V
			40 *2	V
Power dissipation		$P_D$	650 *3	mW
Operating ambient temperature		$T_{opr}$	-30 to +80	$^\circ\text{C}$
Storage temperature	AN78Lxx series	$T_{stg}$	-55 to +150	$^\circ\text{C}$
	AN78LxxM series		-55 to +125	

\*1 AN78L04/M, AN78L05/M, AN78L06/M, AN78L07/M, AN78L08/M, AN78L09/M, AN78L10/M, AN78L12/M, AN78L15/M

\*2 AN78L18/M, AN78L20/M, AN78L24/M

\*3 Follow the derating curve. When  $T_j$  exceeds  $150^\circ\text{C}$ , the internal circuit cuts off the output.

AN78LxxM series is mounted on a standard board (glass epoxy: 20mm × 20mm × t1.7mm with Cu foil of 1cm<sup>2</sup> or more).

### ■ Electrical Characteristics at $T_a = 25^\circ\text{C}$

#### • AN78L04, AN78L04M (4V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	3.84	4	4.16	V
Output voltage tolerance	$V_O$	$V_I = 6.5$ to 19V, $I_O = 1$ to 70mA	3.8	—	4.2	V
Line regulation	$REG_{IN}$	$V_I = 6.5$ to 19V, $T_j = 25^\circ\text{C}$	—	50	145	mV
		$V_I = 7$ to 19V, $T_j = 25^\circ\text{C}$	—	40	95	mV
Load regulation	$REG_L$	$I_O = 1$ to 100mA, $T_j = 25^\circ\text{C}$	—	10	55	mV
		$I_O = 1$ to 40mA, $T_j = 25^\circ\text{C}$	—	4.5	30	mV
Bias current	$I_{Bias}$	$T_j = 25^\circ\text{C}$	—	2	3	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 7$ to 19V, $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 1$ to 40mA, $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{no}$	$f = 10\text{Hz}$ to 100kHz	—	40	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 7$ to 17V, $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	48	58	—	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{O(Short)}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.6	—	mV/ $^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 9\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L04) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L04M)

### ■ Electrical Characteristics at $T_a = 25^\circ\text{C}$ (continued)

#### • AN78L05, AN78L05M (5V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	4.8	5	5.2	V
Output voltage tolerance	$V_O$	$V_I = 7.5$ to $20\text{V}$ , $I_O = 1$ to $70\text{mA}$	4.75	—	5.25	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 7.5$ to $20\text{V}$ , $T_j = 25^\circ\text{C}$	—	55	150	mV
		$V_I = 8$ to $20\text{V}$ , $T_j = 25^\circ\text{C}$	—	45	100	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	11	60	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	5	30	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 8$ to $20\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	40	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 8$ to $18\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	47	57	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.65	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 10\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L05) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L05M)

#### • AN78L06, AN78L06M (6V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	5.76	6	6.24	V
Output voltage tolerance	$V_O$	$V_I = 8.5$ to $21\text{V}$ , $I_O = 1$ to $70\text{mA}$	5.7	—	6.3	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 8.5$ to $21\text{V}$ , $T_j = 25^\circ\text{C}$	—	60	155	mV
		$V_I = 9$ to $21\text{V}$ , $T_j = 25^\circ\text{C}$	—	50	105	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	12	65	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	5.5	35	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 9$ to $21\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	50	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 9$ to $19\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	46	56	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.7	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 11\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L06) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L06M)

### ■ Electrical Characteristics at $T_a = 25^\circ\text{C}$ (continued)

#### • AN78L07, AN78L07M (7V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	6.72	7	7.28	V
Output voltage tolerance	$V_O$	$V_I = 9.5$ to $22\text{V}$ , $I_O = 1$ to $70\text{mA}$	6.65	—	7.35	V
Line regulation	REG <sub>IN</sub>	$V_I = 9.5$ to $22\text{V}$ , $T_j = 25^\circ\text{C}$	—	70	165	mV
		$V_I = 10$ to $22\text{V}$ , $T_j = 25^\circ\text{C}$	—	60	115	mV
Load regulation	REG <sub>L</sub>	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	13	75	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	6	35	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 10$ to $22\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	50	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 10$ to $20\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	45	55	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.75	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 12\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L07) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L07M)

#### • AN78L08, AN78L08M (8V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	7.7	8	8.3	V
Output voltage tolerance	$V_O$	$V_I = 10.5$ to $23\text{V}$ , $I_O = 1$ to $70\text{mA}$	7.6	—	8.4	V
Line regulation	REG <sub>IN</sub>	$V_I = 10.5$ to $23\text{V}$ , $T_j = 25^\circ\text{C}$	—	80	175	mV
		$V_I = 11$ to $23\text{V}$ , $T_j = 25^\circ\text{C}$	—	70	125	mV
Load regulation	REG <sub>L</sub>	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	15	80	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	7	40	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 11$ to $23\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	60	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 11$ to $21\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	44	54	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.8	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 14\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L08) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L08M)

■ Electrical Characteristics at  $T_a = 25^\circ\text{C}$  (continued)

• AN78L09, AN78L09M (9V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	8.64	9	9.35	V
Output voltage tolerance	$V_O$	$V_I = 11.5$ to $24\text{V}$ , $I_O = 1$ to $70\text{mA}$	8.55	—	9.45	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 11.5$ to $24\text{V}$ , $T_j = 25^\circ\text{C}$	—	90	190	mV
		$V_I = 12$ to $24\text{V}$ , $T_j = 25^\circ\text{C}$	—	80	140	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	16	85	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	8	45	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 12$ to $24\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	65	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 12$ to $22\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	43	53	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.85	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 15\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L09) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L09M)

• AN78L10, AN78L10M (10V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	9.6	10	10.4	V
Output voltage tolerance	$V_O$	$V_I = 12.5$ to $25\text{V}$ , $I_O = 1$ to $70\text{mA}$	9.5	—	10.5	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 12.5$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	100	210	mV
		$V_I = 13$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	90	160	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	17	90	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	9	45	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 13$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	70	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 13$ to $23\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	42	52	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.9	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 16\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L10) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L10M)

### ■ Electrical Characteristics at $T_a = 25^\circ\text{C}$ (continued)

#### • AN78L12, AN78L12M (12V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	11.5	12	12.5	V
Output voltage tolerance	$V_O$	$V_I = 14.5$ to $27\text{V}$ , $I_O = 1$ to $70\text{mA}$	11.4	—	12.6	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 14.5$ to $27\text{V}$ , $T_j = 25^\circ\text{C}$	—	120	250	mV
		$V_I = 15$ to $27\text{V}$ , $T_j = 25^\circ\text{C}$	—	100	200	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	20	100	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	50	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3.5	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 15$ to $27\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	80	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 15$ to $25\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	40	50	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-1	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 19\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L12) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L12M)

#### • AN78L15, AN78L15M (15V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	14.4	15	15.6	V
Output voltage tolerance	$V_O$	$V_I = 17.5$ to $30\text{V}$ , $I_O = 1$ to $70\text{mA}$	14.25	—	15.75	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 17.5$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	130	300	mV
		$V_I = 18$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	110	250	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	25	150	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	12	75	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3.5	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 18$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	90	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 18$ to $28\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	38	48	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-1.3	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 23\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L15) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L15M)

### ■ Electrical Characteristics at $T_a = 25^\circ\text{C}$ (continued)

#### • AN78L18, AN78L18M (18V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	17.3	18	18.7	V
Output voltage tolerance	$V_O$	$V_I = 20.5$ to $33\text{V}$ , $I_O = 1$ to $70\text{mA}$	17.1	—	18.9	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 20.5$ to $33\text{V}$ , $T_j = 25^\circ\text{C}$	—	45	300	mV
		$V_I = 21$ to $33\text{V}$ , $T_j = 25^\circ\text{C}$	—	35	250	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	30	170	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	15	85	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3.5	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 21$ to $33\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	150	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 21$ to $31\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	36	46	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-1.5	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 27\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L18) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L18M)

#### • AN78L20, AN78L20M (20V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	19.2	20	20.8	V
Output voltage tolerance	$V_O$	$V_I = 22.5$ to $35\text{V}$ , $I_O = 1$ to $70\text{mA}$	19	—	21	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 22.5$ to $35\text{V}$ , $T_j = 25^\circ\text{C}$	—	50	300	mV
		$V_I = 23$ to $35\text{V}$ , $T_j = 25^\circ\text{C}$	—	40	250	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	35	180	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	17	90	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3.5	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 23$ to $35\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	170	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 23$ to $33\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	34	44	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-1.7	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 29\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L20) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L20M)

■ Electrical Characteristics at  $T_a = 25^\circ\text{C}$  (continued)

• AN78L24, AN78L24M (24V type)

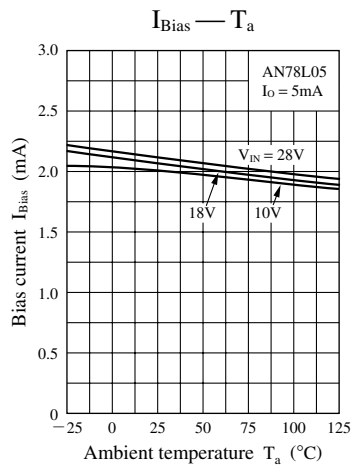
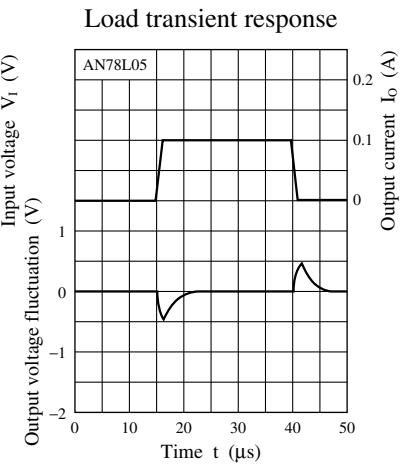
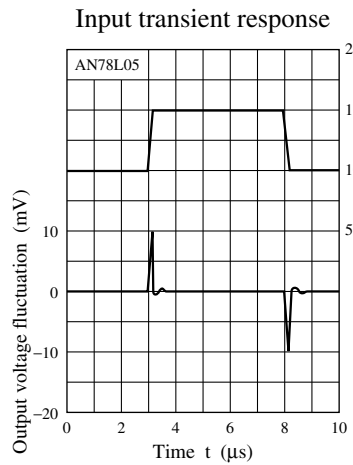
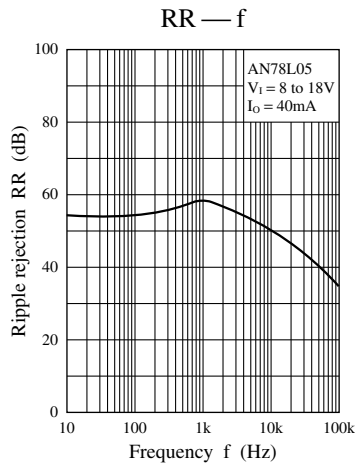
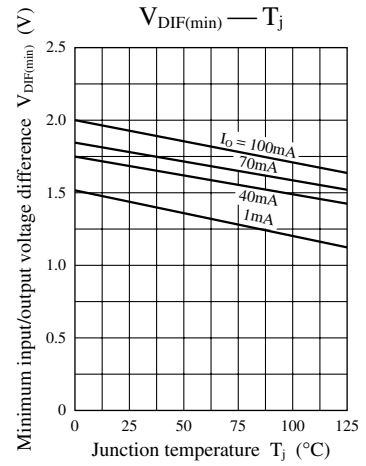
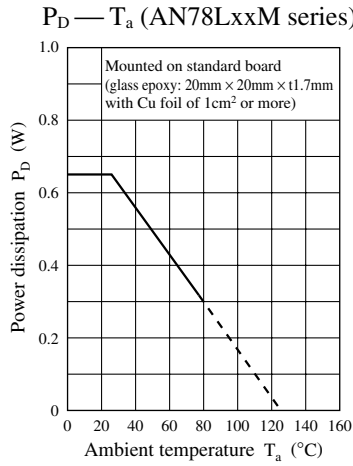
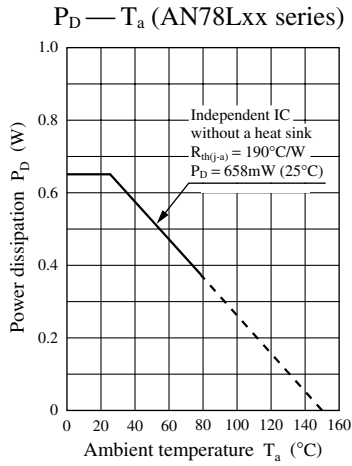
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	23	24	25	V
Output voltage tolerance	$V_O$	$V_I = 26.5$ to $39\text{V}$ , $I_O = 1$ to $70\text{mA}$	22.8	—	25.2	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 26.5$ to $39\text{V}$ , $T_j = 25^\circ\text{C}$	—	60	300	mV
		$V_I = 27$ to $39\text{V}$ , $T_j = 25^\circ\text{C}$	—	50	250	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 1$ to $100\text{mA}$ , $T_j = 25^\circ\text{C}$	—	40	200	mV
		$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	20	100	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	2	3.5	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 27$ to $39\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 1$ to $40\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.1	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	200	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 27$ to $37\text{V}$ , $I_O = 40\text{mA}$ , $f = 120\text{Hz}$	34	44	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$T_j = 25^\circ\text{C}$	—	1.7	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$T_j = 25^\circ\text{C}$ , $V_I = 35\text{V}$	—	140	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-2	—	$\text{mV}/^\circ\text{C}$

Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

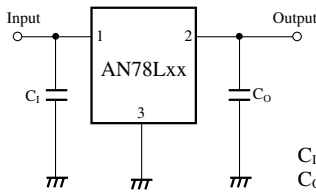
Note 2) Unless otherwise specified,  $V_I = 33\text{V}$ ,  $I_O = 40\text{mA}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ ,  $T_j = 0$  to  $125^\circ\text{C}$  (AN78L24) and  $T_j = 0$  to  $100^\circ\text{C}$  (AN78L24M)



## ■ Main Characteristics



■ Basic Regulator Circuit



C<sub>1</sub> is necessary when the input line is long.  
C<sub>O</sub> improves the transient response.

■ Usage Notes

1. Cautions for a basic circuit

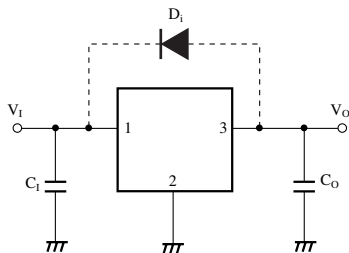


Figure 1

C<sub>1</sub>: When a wiring from a smoothing circuit to a three-pin regulator is long, it is likely to oscillate at output. A capacitor of 0.1μF to 0.47μF should be connected near an input pin.

C<sub>O</sub>: When any sudden change of load current is likely to occur, connect an electrolytic capacitor of 10μF to 100μF to improve a transitional response of output voltage.

D<sub>1</sub>: Normally unnecessary. But add it in the case that there is a residual voltage at the output capacitor C<sub>O</sub> even after switching off the supply power because a current is likely to flow into an output pin of the IC and damage the IC.

2. Other caution items

1) Short-circuit between the input pin and GND pin

If the input pin is short-circuited to GND or is cut off when a large capacitance capacitor has been connected to the IC's load, a voltage of a capacitor connected to an output pin is applied between input/output of the IC and this likely results in damage of the IC. It is necessary, therefore, to connect a diode, as shown in figure 2, to counter the reverse bias between input/output pins.

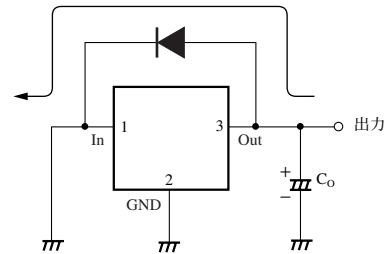
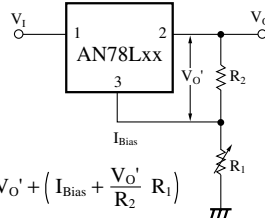
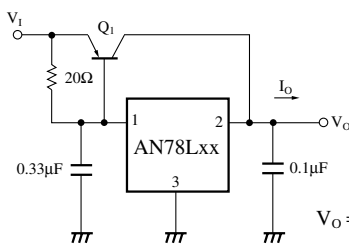


Figure 2

2) Floating of GND pin

If a GND pin is made floating in an operating mode, an unstabilized input voltage is outputted. In this case, a thermal protection circuit inside the IC does not normally operate. In this state, if the load is short-circuited or overloaded, it is likely to damage the IC.

■ Application Circuit Examples



$$V_O = V_O' + \left( I_{Bias} + \frac{V_O'}{R_2} \right) R_1$$

Note) V<sub>O</sub> varies due to sample to sample variation of I<sub>Bias</sub>.  
Never fail to adjust individually with R<sub>1</sub>.

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