AN78Lxx/AN78LxxM Series

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

■ Overview

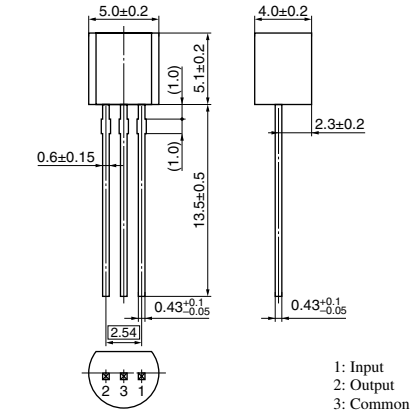
The AN78Lxx series and the AN78LxxM series are 3-pin fixed positive output type monolithic voltage regulator.

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

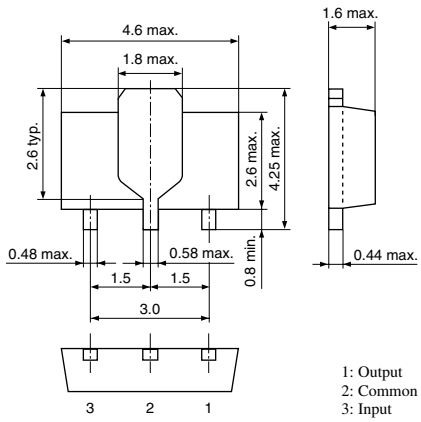
- No external components
- Output voltage: 4V, 5V, 6V, 7V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V
- Built-in overcurrent limit circuit
- Built-in thermal overload protection circuit

AN78Lxx series Unit: mm



SSIP003-P-0000

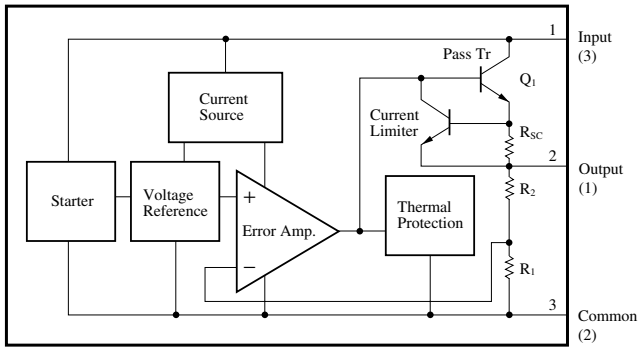
AN78LxxM series Unit: mm



HSIP003-P-0000B

Note) The packages (SSIP003-P-0000 and HSIP003-P-0000B) of this product will be changed to lead-free type (SSIP003-P-0000S and HSIP003-P-0000Q). See the new package dimensions section later of this datasheet.

■ Block Diagram (AN78Lxx series)



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

■ Absolute Maximum Ratings at T_a = 25°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	°C
Storage temperature	AN78Lxx series	T_{stg}	−55 to +150	°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°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 1cm² or more).

■ Electrical Characteristics at T_a = 25°C

• AN78L04, AN78L04M (4V type)

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

Note 1) The specified condition T_j = 25°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 = 9V, I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF, T_j = 0 to 125°C (AN78L04) and T_j = 0 to 100°C (AN78L04M)

■ Electrical Characteristics at T_a = 25°C (continued)

• AN78L05, AN78L05M (5V type)

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

Note 1) The specified condition T_j = 25°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 = 10V, I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF, T_j = 0 to 125°C (AN78L05) and T_j = 0 to 100°C (AN78L05M)

• AN78L06, AN78L06M (6V type)

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

Note 1) The specified condition T_j = 25°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 = 11V, I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF, T_j = 0 to 125°C (AN78L06) and T_j = 0 to 100°C (AN78L06M)

■ Electrical Characteristics at T_a = 25°C (continued)

• AN78L07, AN78L07M (7V type)

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

Note 1) The specified condition T_j = 25°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 = 12V, I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF, T_j = 0 to 125°C (AN78L07) and T_j = 0 to 100°C (AN78L07M)

• AN78L08, AN78L08M (8V type)

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

Note 1) The specified condition T_j = 25°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 = 14V, I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF, T_j = 0 to 125°C (AN78L08) and T_j = 0 to 100°C (AN78L08M)

■ Electrical Characteristics at T_a = 25°C (continued)

• AN78L09, AN78L09M (9V type)

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

Note 1) The specified condition T_j = 25°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 = 15V, I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF, T_j = 0 to 125°C (AN78L09) and T_j = 0 to 100°C (AN78L09M)

• AN78L10, AN78L10M (10V type)

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

Note 1) The specified condition T_j = 25°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 = 16V, I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF, T_j = 0 to 125°C (AN78L10) and T_j = 0 to 100°C (AN78L10M)

■ Electrical Characteristics at T_a = 25°C (continued)

• AN78L12, AN78L12M (12V type)

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

Note 1) The specified condition T_j = 25°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 = 19V, I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF, T_j = 0 to 125°C (AN78L12) and T_j = 0 to 100°C (AN78L12M)

• AN78L15, AN78L15M (15V type)

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

Note 1) The specified condition T_j = 25°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 = 23V, I_O = 40mA, C_I = 0.33µF, C_O = 0.1µF, T_j = 0 to 125°C (AN78L15) and T_j = 0 to 100°C (AN78L15M)

■ Electrical Characteristics at T_a = 25°C (continued)

• AN78L18, AN78L18M (18V type)

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

Note 1) The specified condition T_j = 25°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 = 27V, I_O = 40mA, C_I = 0.33μF, C_O = 0.1μF, T_j = 0 to 125°C (AN78L18) and T_j = 0 to 100°C (AN78L18M)

• AN78L20, AN78L20M (20V type)

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

Note 1) The specified condition T_j = 25°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 = 29V, I_O = 40mA, C_I = 0.33μF, C_O = 0.1μF, T_j = 0 to 125°C (AN78L20) and T_j = 0 to 100°C (AN78L20M)

■ Electrical Characteristics at T_a = 25°C (continued)

• AN78L24, AN78L24M (24V type)

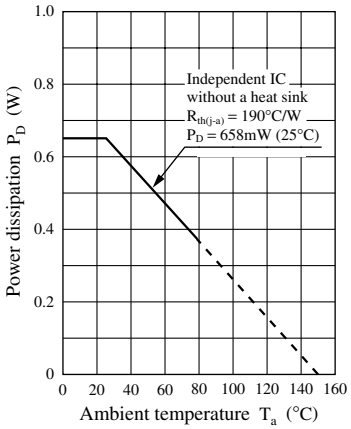
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	V_O	T_j = 25°C	23	24	25	V
Output voltage tolerance	V_O	V_I = 26.5 to 39V, I_O = 1 to 70mA	22.8	—	25.2	V
Line regulation	REG_{IN}	V_I = 26.5 to 39V, T_j = 25℃	—	60	300	mV
		V_I = 27 to 39V, T_j = 25℃	—	50	250	mV
Load regulation	REG_L	I_O = 1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

Note 1) The specified condition T_j = 25°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.

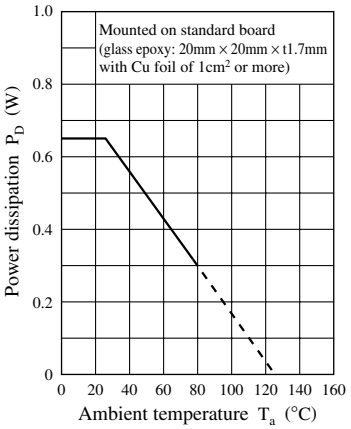
Note 2) Unless otherwise specified, V_I = 33V, I_O = 40mA, C_I = 0.33μF, C_O = 0.1μF, T_j = 0 to 125°C (AN78L24) and T_j = 0 to 100°C (AN78L24M)

■ Main Characteristics

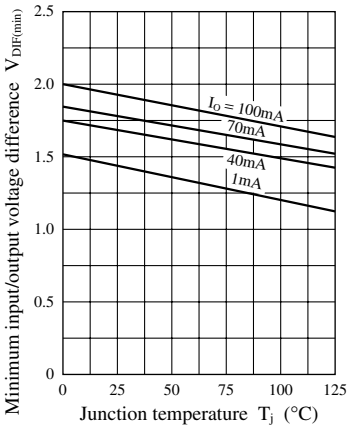
P_D — T_a (AN78Lxx series)



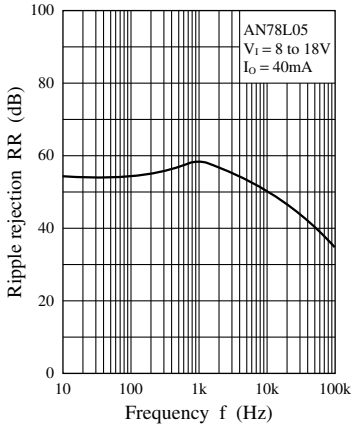
P_D — T_a (AN78LxxM series)



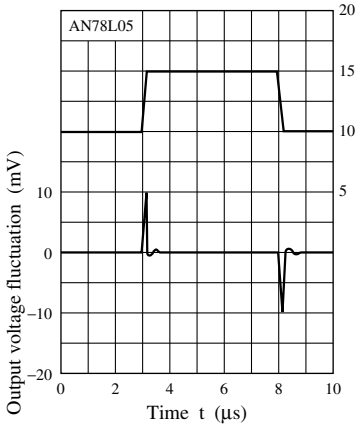
$V_{DIF(min)}$ — T_j



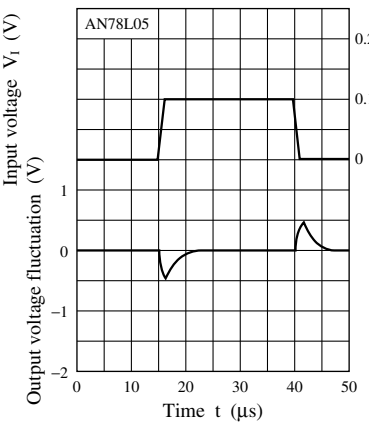
RR — f



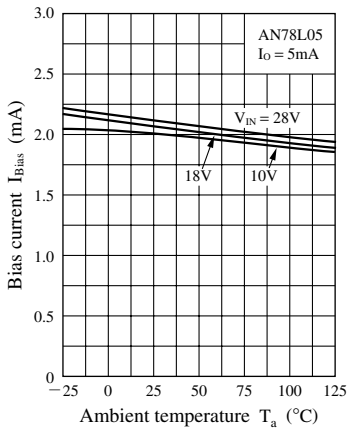
Input transient response



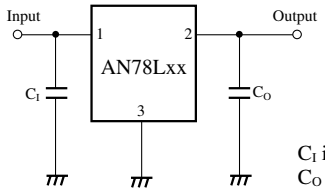
Load transient response



I_{Bias} — T_a



■ Basic Regulator Circuit



C_I is necessary when the input line is long.
C_O improves the transient response.

■ Usage Notes

1. Cautions for a basic circuit

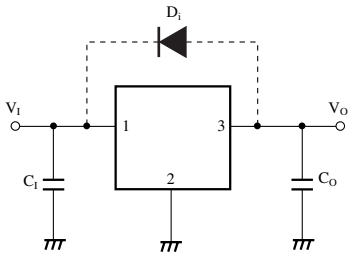


Figure 1

C_I: 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_O: 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_i: Normally unnecessary. But add it in the case that there is a residual voltage at the output capacitor Co 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-circuitted 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.

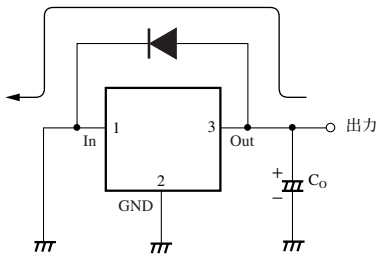
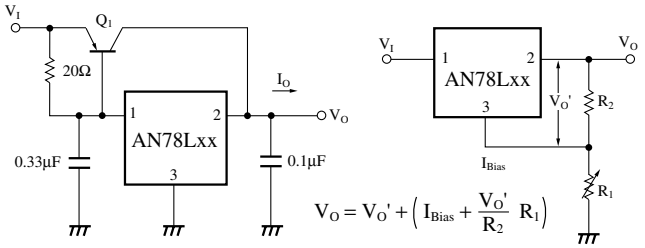


Figure 2

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

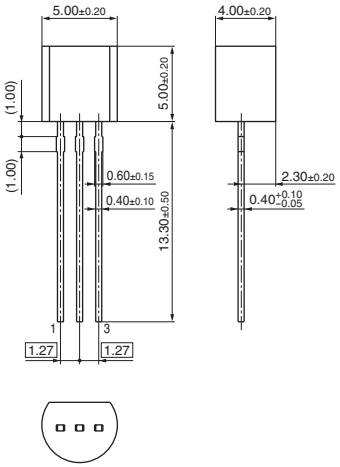


$$V_O = V_O' + \left(I_{Bias} + \frac{V_O'}{R_2} R_1 \right)$$

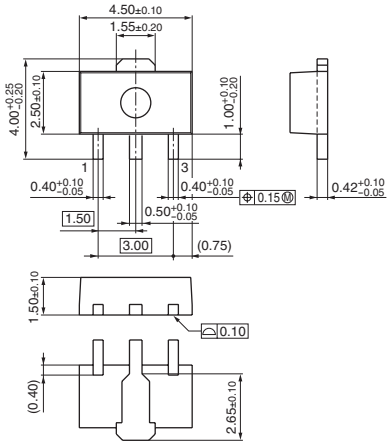
Note) V_O varies due to sample to sample variation of I_{Bias} .
Never fail to adjust individually with R_1 .

■ New Package Dimensions (Unit: mm)

• SSIP003-P-0000S (Lead-free package)



• HSIP003-P-0000Q (Lead-free package)



Request for your special attention and precautions in using the technical information and semiconductors described in this material

(1) An export permit needs to be obtained from the competent authorities of the Japanese Government if any of the products or technologies described in this material and controlled under the "Foreign Exchange and Foreign Trade Law" is to be exported or taken out of Japan.

(2) The technical information described in this material is limited to showing representative characteristics and applied circuit examples of the products. It does not constitute the warranting of industrial property, the granting of relative rights, or the granting of any license.

(3) The products described in this material are intended to be used for standard applications or general electronic equipment (such as office equipment, communications equipment, measuring instruments and household appliances).
Consult our sales staff in advance for information on the following applications:
- Special applications (such as for airplanes, aerospace, automobiles, traffic control equipment, combustion equipment, life support systems and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.
- Any applications other than the standard applications intended.

(4) The products and product specifications described in this material are subject to change without notice for reasons of modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.

(5) When designing your equipment, comply with the guaranteed values, in particular those of maximum rating, the range of operating power supply voltage and heat radiation characteristics. Otherwise, we will not be liable for any defect which may arise later in your equipment.
Even when the products are used within the guaranteed values, redundant design is recommended, so that such equipment may not violate relevant laws or regulations because of the function of our products.

(6) When using products for which dry packing is required, observe the conditions (including shelf life and after-unpacking standby time) agreed upon when specification sheets are individually exchanged.

(7) No part of this material may be reprinted or reproduced by any means without written permission from our company.

Please read the following notes before using the datasheets

A. These materials are intended as a reference to assist customers with the selection of Panasonic semiconductor products best suited to their applications.
Due to modification or other reasons, any information contained in this material, such as available product types, technical data, and so on, is subject to change without notice.
Customers are advised to contact our semiconductor sales office and obtain the latest information before starting precise technical research and/or purchasing activities.

B. Panasonic is endeavoring to continually improve the quality and reliability of these materials but there is always the possibility that further rectifications will be required in the future. Therefore, Panasonic will not assume any liability for any damages arising from any errors etc. that may appear in this material.

C. These materials are solely intended for a customer's individual use.
Therefore, without the prior written approval of Panasonic, any other use such as reproducing, selling, or distributing this material to a third party, via the Internet or in any other way, is prohibited.

2001 MAR

Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

- View AN78L08M-E1 on WIN SOURCE
- Panasonic Information

Optimize Your Supply Chain with WIN SOURCE Solutions

- Global Sourcing Solution
- Obsolete Management
- Cost Control Management
- Shortage Management
- Alternative Solution
- Excess Inventory Management