

# AN78Mxx/AN78MxxF Series

3-pin positive output voltage regulator (500 mA type)

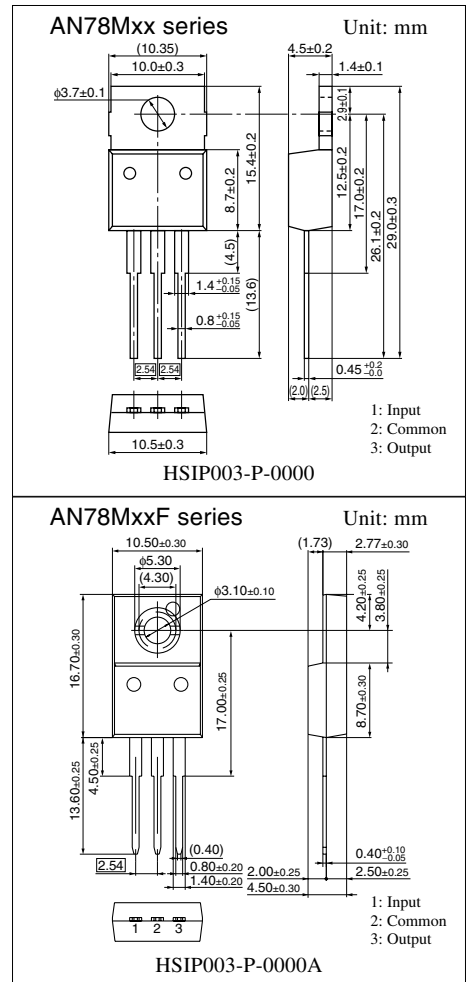
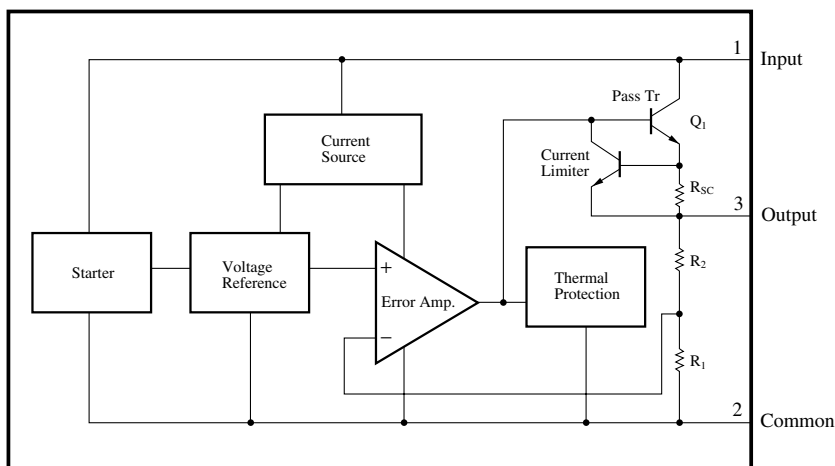
## Overview

The AN78Mxx series and the AN78MxxF series are 3-pin fixed positive output type monolithic voltage regulators. Stabilized fixed output voltage is obtained from unstable DC input voltage without using any external components. 11 types of fixed output voltage are available; 5V, 6V, 7V, 8V, 9V, 10V, 12V, 15V, 18V, 20V and 24V. They can be used widely in power circuits with current capacity up to 500mA.

## Features

- No external components
- Output voltage: 5V, 6V, 7V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V
- Built-in overcurrent limit circuit
- Built-in thermal overload protection circuit
- Built-in ASO (area of safe operation) protection circuit

## Block Diagram



### ■ 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	AN78xx series	$P_D$	15 *3	W
	AN78xxF series		10.25 *3	
Operating ambient temperature		$T_{opr}$	-20 to +80	$^\circ\text{C}$
Storage temperature		$T_{stg}$	-55 to +150	$^\circ\text{C}$

\*1 AN78M05/F, AN78M06/F, AN78M07/F, AN78M08/F, AN78M09/F, AN78M10/F, AN78M12/F, AN78M15/F, AN78M18/F

\*2 AN78M20/F, AN78M24/F

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

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

#### • AN78M05, AN78M05F (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 $20\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	4.75	—	5.25	V
Line regulation	$REG_{IN}$	$V_I = 7.5$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	3	100	mV
		$V_I = 8$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	1	50	mV
Load regulation	$REG_L$	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	20	100	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	50	mV
Bias current	$I_{Bias}$	$T_j = 25^\circ\text{C}$	—	4	6	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 8$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{no}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	40	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 8$ to $18\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	62	—	—	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{O(Short)}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25^\circ\text{C}$	—	700	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.5	—	$\text{mV}/^\circ\text{C}$

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,  $V_I = 10\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

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

#### • AN78M06, AN78M06F (6V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	5.75	6	6.25	V
Output voltage tolerance	$V_O$	$V_I = 8.5$ to $21\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	5.7	—	6.3	V
Line regulation	REG <sub>IN</sub>	$V_I = 8.5$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	5	100	mV
		$V_I = 9$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	1.5	50	mV
Load regulation	REG <sub>L</sub>	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	20	120	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	60	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 9$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	45	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 9$ to $19\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	59	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.5	—	$\text{mV}/^\circ\text{C}$

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,  $V_I = 11\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

#### • AN78M07, AN78M07F (7V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	6.7	7	7.3	V
Output voltage tolerance	$V_O$	$V_I = 9.5$ to $22\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	6.65	—	7.35	V
Line regulation	REG <sub>IN</sub>	$V_I = 9.5$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	6	100	mV
		$V_I = 10$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation	REG <sub>L</sub>	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	20	140	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	70	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 10$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	48	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 10$ to $20\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	57	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.5	—	$\text{mV}/^\circ\text{C}$

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,  $V_I = 12\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

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

#### • AN78M08, AN78M08F (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 $23\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	7.6	—	8.4	V
Line regulation	REG <sub>IN</sub>	$V_I = 10.5$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	6	100	mV
		$V_I = 11$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation	REG <sub>L</sub>	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	25	160	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	80	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.1	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 10.5$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	52	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 11.5$ to $21.5\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	56	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.5	—	$\text{mV}/^\circ\text{C}$

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,  $V_I = 14\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

#### • AN78M09, AN78M09F (9V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	8.65	9	9.35	V
Output voltage tolerance	$V_O$	$V_I = 11.5$ to $24\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	8.55	—	9.45	V
Line regulation	REG <sub>IN</sub>	$V_I = 11.5$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	7	100	mV
		$V_I = 12$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation	REG <sub>L</sub>	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	25	180	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	90	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.1	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 12$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	60	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 12$ to $22\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	56	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.5	—	$\text{mV}/^\circ\text{C}$

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,  $V_I = 15\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

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

#### • AN78M10, AN78M10F (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 $25\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	9.5	—	10.5	V
Line regulation	REG <sub>IN</sub>	$V_I = 12.5$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	7	100	mV
		$V_I = 13$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation	REG <sub>L</sub>	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	25	200	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	100	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.1	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 13$ to $25\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	65	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 13$ to $23\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	56	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-0.5	—	$\text{mV}/^\circ\text{C}$

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,  $V_I = 16\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

#### • AN78M12, AN78M12F (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 $27\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	11.4	—	12.6	V
Line regulation	REG <sub>IN</sub>	$V_I = 14.5$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	8	100	mV
		$V_I = 16$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation	REG <sub>L</sub>	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	25	240	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	120	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.3	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 14.5$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	75	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 15$ to $25\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	55	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	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,  $V_I = 19\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

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

• AN78M15, AN78M15F (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 $30\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	14.25	—	15.75	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 17.5$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	10	100	mV
		$V_I = 20$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	3	50	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	25	300	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	150	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.3	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 17.5$ to $30\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	90	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 18.5$ to $28.5\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	54	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	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,  $V_I = 23\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

• AN78M18, AN78M18F (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	$V_O$	$V_I = 21$ to $33\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	17.1	—	18.9	V
Line regulation	$\text{REG}_{\text{IN}}$	$V_I = 21$ to $33\text{V}$ , $T_j = 25^\circ\text{C}$	—	10	100	mV
		$V_I = 22$ to $33\text{V}$ , $T_j = 25^\circ\text{C}$	—	5	50	mV
Load regulation	$\text{REG}_{\text{L}}$	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	30	360	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	180	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.4	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 21$ to $33\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	100	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 22$ to $32\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	53	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-1.0	—	$\text{mV}/^\circ\text{C}$

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,  $V_I = 27\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

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

• AN78M20, AN78M20F (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	$V_O$	$V_I = 23$ to $35\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	19	—	21	V
Line regulation	REG <sub>IN</sub>	$V_I = 23$ to $35\text{V}$ , $T_j = 25^\circ\text{C}$	—	10	100	mV
		$V_I = 24$ to $35\text{V}$ , $T_j = 25^\circ\text{C}$	—	5	50	mV
Load regulation	REG <sub>L</sub>	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	30	400	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	200	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.4	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 23$ to $35\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	110	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 24$ to $34\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	53	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-1.0	—	$\text{mV}/^\circ\text{C}$

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,  $V_I = 29\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

• AN78M24, AN78M24F (24V type)

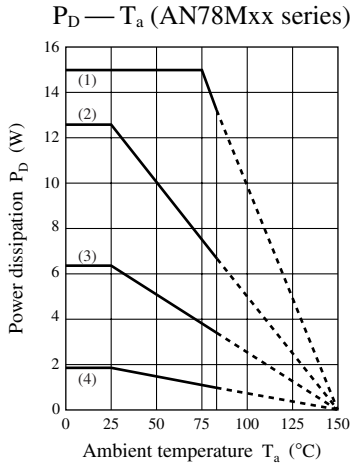
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_O$	$T_j = 25^\circ\text{C}$	23	24	25	V
Output voltage tolerance	$V_O$	$V_I = 27$ to $38\text{V}$ , $I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$ , $P_D \leq *$	22.8	—	25.2	V
Line regulation	REG <sub>IN</sub>	$V_I = 27$ to $38\text{V}$ , $T_j = 25^\circ\text{C}$	—	10	100	mV
		$V_I = 28$ to $38\text{V}$ , $T_j = 25^\circ\text{C}$	—	5	50	mV
Load regulation	REG <sub>L</sub>	$I_O = 5$ to $500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	30	480	mV
		$I_O = 5$ to $200\text{mA}$ , $T_j = 25^\circ\text{C}$	—	10	240	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.5	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias(IN)}}$	$V_I = 27$ to $38\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias(L)}}$	$I_O = 5$ to $350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Output noise voltage	$V_{\text{no}}$	$f = 10\text{Hz}$ to $100\text{kHz}$	—	170	—	$\mu\text{V}$
Ripple rejection ratio	RR	$V_I = 28$ to $38\text{V}$ , $I_O = 100\text{mA}$ , $f = 120\text{Hz}$	50	—	—	dB
Minimum input/output voltage difference	$V_{\text{DIF(min)}}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O(Short)}}$	$V_I = 35\text{V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O(Peak)}}$	$T_j = 25^\circ\text{C}$	—	700	—	mA
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5\text{mA}$ , $T_j = 0$ to $125^\circ\text{C}$	—	-1.2	—	$\text{mV}/^\circ\text{C}$

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,  $V_I = 33\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$  and  $C_O = 0.1\mu\text{F}$ .

\* AN78Mxx series: 15W, AN78MxxF series: 10.25W

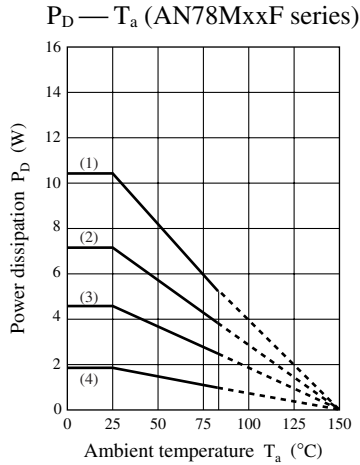
■ Main Characteristics



Thermal resistance value:  
 $R_{th(j-c)} = 5^\circ\text{C/W}$  (max.)  
 $R_{th(j-a)} = 65^\circ\text{C/W}$  (max.)

Installation condition to heat sink  
 Tightening torque 6kg·cm  
 Heat radiation compound used

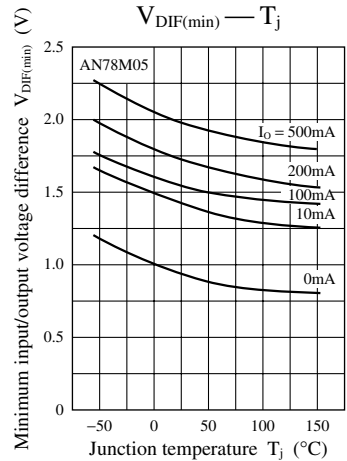
- (1) Infinite heat sink: 15.0W
- (2) 5°C/W heat sink: 12.5W
- (3) 15°C/W heat sink: 6.3W
- (4) Without heat sink: 1.923W



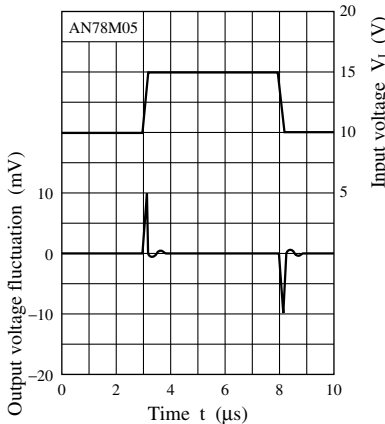
Thermal resistance value:  
 $R_{th(j-c)} = 12.2^\circ\text{C/W}$  (max.)  
 $R_{th(j-a)} = 65^\circ\text{C/W}$  (max.)

Installation condition to heat sink  
 Tightening torque 6kg·cm  
 Heat radiation compound used

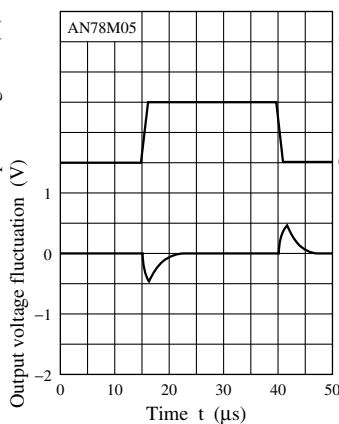
- (1) Infinite heat sink: 10.25W
- (2) 5°C/W heat sink: 7.3W
- (3) 15°C/W heat sink: 4.5W
- (4) Without heat sink: 1.923W



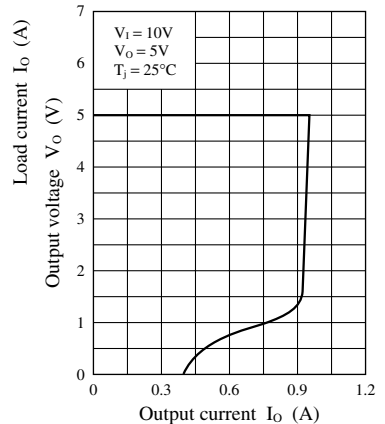
Input transient response



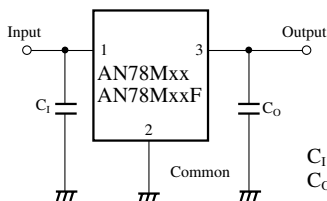
Load transient response



Current limiting



■ Basic Regulator Circuit



$C_1$  is necessary when the input line is long.  
 $C_o$  improves the transient response.



■ Usage Notes

1. Cautions for a basic circuit

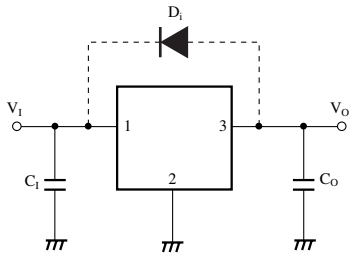


Figure 1

C<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.

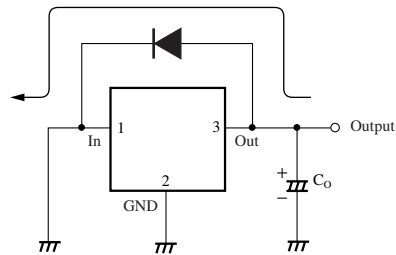
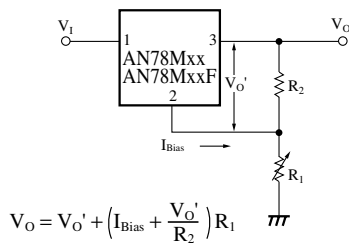


Figure 2

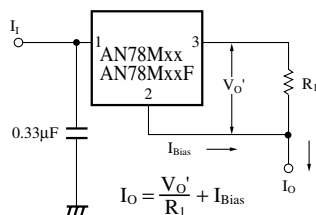
2) Floating of GND pin

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.

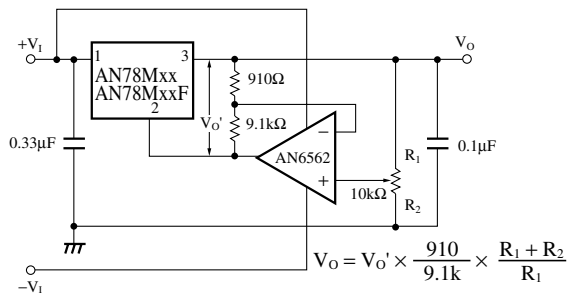
■ Application Circuit Examples



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



$$I_o = \frac{V_o'}{R_1} + I_{Bias}$$



$$V_o = V_o' \times \frac{910}{9.1k} \times \frac{R_1 + R_2}{R_1}$$

V<sub>O</sub> varies with the value of the input voltage V<sub>1</sub>.  
(In case of R<sub>1</sub> + R<sub>2</sub> = 10kΩ)

