Panasonic

AN78xx/AN78xxF Series

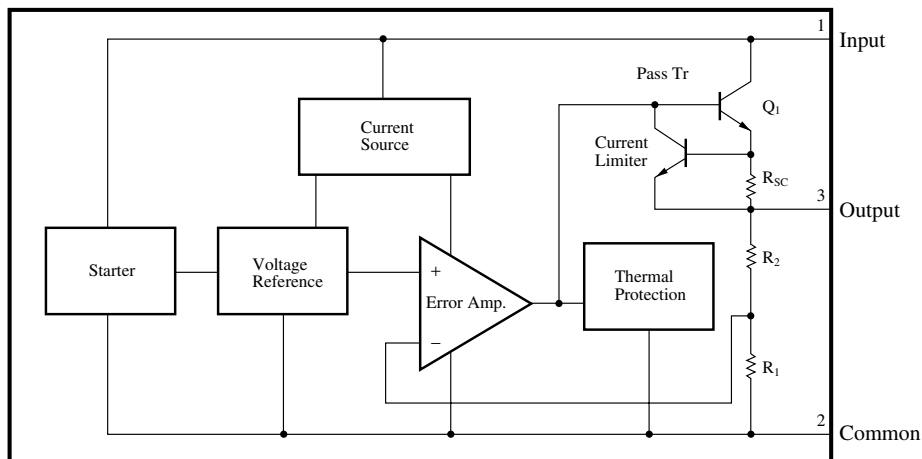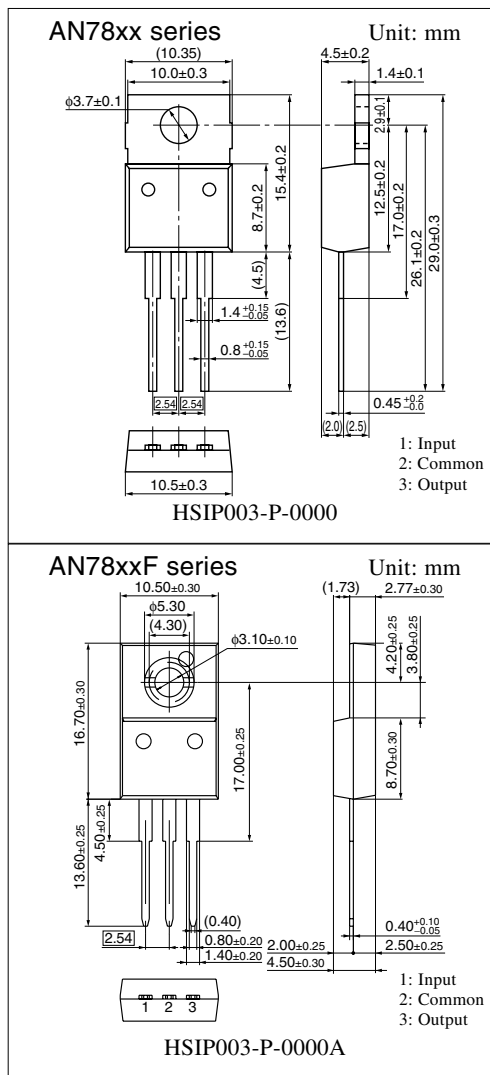## 3-pin positive output voltage regulator (1 A type)

■ Overview

The AN78xx series and the AN78xxF 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 of up to 1A.

■ 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

AN78xx series — Unit: mm

1: Input
2: Common
3: Output

HSIP003-P-0000

AN78xxF series — Unit: mm

1: Input
2: Common
3: Output

HSIP003-P-0000A

■ Block Diagram

Input 1
Pass Tr — Q_1
Current Source
Current Limiter
R_{SC}
Output 3
Starter
Voltage Reference
Error Amp. (+, −)
Thermal Protection
R_2
R_1
Common 2

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■ Absolute Maximum Ratings at $T_a = 25°C$

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}	−30 to +80	°C
Storage temperature		T_{stg}	−55 to +150	°C

[*1] AN7805/F, AN7806/F, AN7807/F, AN7808/F, AN7809/F, AN7810/F, AN7812/F, AN7815/F, AN7818/F
[*2] AN7820/F, AN7824/F
[*3] Follow the derating curve. When T_j exceeds 150°C, the internal circuit cuts off the output.

■ Electrical Characteristics at $T_a = 25°C$

• AN7805, AN7805F (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	$V_I = 8$ to 20V, $I_O = 5mA$ to 1A, $T_j = 0$ to 125°C, $P_D \leq *$	4.75	——	5.25	V
Line regulation	REG_{IN}	$V_I = 7.5$ to 25 V, $T_j = 25°C$	——	3	100	mV
		$V_I = 8$ to 12V, $T_j = 25°C$	——	1	50	mV
Load regulation	REG_L	$I_O = 5mA$ to 1.5A, $T_j = 25°C$	——	15	100	mV
		$I_O = 250$ to 750mA, $T_j = 25°C$	——	5	50	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	3.9	8	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 7.5$ to 25V, $T_j = 25°C$	——	——	1.3	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to 1A, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to 100kHz	——	40	——	μV
Ripple rejection ratio	RR	$V_I = 8$ to 18V, $I_O = 100mA$, $f = 120Hz$	62	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	17	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 25V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5mA$, $T_j = 0$ to 125°C	——	− 0.3	——	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, $V_I = 10V$, $I_O = 500mA$, $C_I = 0.33μF$ and $C_O = 0.1μF$.
*   AN78xx series: 15W, AN78xxF series: 10.25W

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

• AN7806, 7806F (6V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	V_O	$T_j = 25°C$	5.75	6	6.25	V
Output voltage tolerance	V_O	$V_I = 9$ to 21V, $I_O = 5mA$ to 1A, $T_j = 0$ to 125°C, $P_D \leq *$	5.7	——	6.3	V
Line regulation	REG_{IN}	$V_I = 8.5$ to 25V, $T_j = 25°C$	——	5	120	mV
		$V_I = 9$ to 13V, $T_j = 25°C$	——	1.5	60	mV
Load regulation	REG_L	$I_O = 5mA$ to 1.5A, $T_j = 25°C$	——	14	120	mV
		$I_O = 250$ to 750mA, $T_j = 25°C$	——	4	60	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	3.9	8	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 8.5$ to 25V, $T_j = 25°C$	——	——	1.3	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to 1A, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to 100kHz	——	40	——	μV
Ripple rejection ratio	RR	$V_I = 9$ to 19V, $I_O = 100mA$, $f = 120Hz$	59	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	17	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 25V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5mA$, $T_j = 0$ to 125°C	——	− 0.4	——	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, $V_I = 11V$, $I_O = 500mA$, $C_I = 0.33μF$ and $C_O = 0.1μF$.
*   AN78xx series: 15W, AN78xxF series: 10.25W

• AN7807, 7807F (7V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	V_O	$T_j = 25°C$	6.7	7	7.3	V
Output voltage tolerance	V_O	$V_I = 10$ to 22V, $I_O = 5mA$ to 1A, $T_j = 0$ to 125°C, $P_D \leq *$	6.6	——	7.4	V
Line regulation	REG_{IN}	$V_I = 9.5$ to 25V, $T_j = 25°C$	——	5	140	mV
		$V_I = 10$ to 15V, $T_j = 25°C$	——	1.5	70	mV
Load regulation	REG_L	$I_O = 5mA$ to 1.5A, $T_j = 25°C$	——	14	140	mV
		$I_O = 250$ to 750mA, $T_j = 25°C$	——	4	70	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	3.9	8	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 9.5$ to 25V, $T_j = 25°C$	——	——	1	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to 1A, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to 100kHz	——	46	——	μV
Ripple rejection ratio	RR	$V_I = 10$ to 20V, $I_O = 100mA$, $f = 120Hz$	57	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	16	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 25V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5mA$, $T_j = 0$ to 125°C	——	− 0.5	——	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, $V_I = 12V$, $I_O = 500mA$, $C_I = 0.33μF$ and $C_O = 0.1μF$.
*   AN78xx series: 15W, AN78xxF series: 10.25W

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

• AN7808, 7808F (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	$V_I = 11$ to $23V$, $I_O = 5mA$ to $1A$, $T_j = 0$ to $125°C$, $P_D \leq$ *	7.6	——	8.4	V
Line regulation	REG_{IN}	$V_I = 10.5$ to $25V$, $T_j = 25°C$	——	6	160	mV
		$V_I = 11$ to $17V$, $T_j = 25°C$	——	2	80	mV
Load regulation	REG_L	$I_O = 5mA$ to $1.5A$, $T_j = 25°C$	——	12	160	mV
		$I_O = 250$ to $750mA$, $T_j = 25°C$	——	4	80	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	3.9	8	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 10.5$ to $25V$, $T_j = 25°C$	——	——	1	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to $1A$, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to $100kHz$	——	52	——	μV
Ripple rejection ratio	RR	$V_I = 11.5$ to $21.5V$, $I_O = 100mA$, $f = 120Hz$	56	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	16	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 25V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5mA$, $T_j = 0$ to $125°C$	——	-0.5	——	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, $V_I = 14V$, $I_O = 500mA$, $C_I = 0.33μF$ and $C_O = 0.1μF$.
*   AN78xx series: 15W, AN78xxF series: 10.25W

• AN7809, 7809F (9V type)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	V_O	$T_j = 25°C$	8.65	9	9.35	V
Output voltage tolerance	V_O	$V_I = 12$ to $24V$, $I_O = 5mA$ to $1A$, $T_j = 0$ to $125°C$, $P_D \leq$ *	8.55	——	9.45	V
Line regulation	REG_{IN}	$V_I = 11.5$ to $26V$, $T_j = 25°C$	——	7	180	mV
		$V_I = 12$ to $18V$, $T_j = 25°C$	——	2	90	mV
Load regulation	REG_L	$I_O = 5mA$ to $1.5A$, $T_j = 25°C$	——	12	180	mV
		$I_O = 250$ to $750mA$, $T_j = 25°C$	——	4	90	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	3.9	8	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 11.5$ to $26V$, $T_j = 25°C$	——	——	1	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to $1A$, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to $100kHz$	——	57	——	μV
Ripple rejection ratio	RR	$V_I = 12$ to $22V$, $I_O = 100mA$, $f = 120Hz$	56	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	16	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 26V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5mA$, $T_j = 0$ to $125°C$	——	-0.5	——	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, $V_I = 15V$, $I_O = 500mA$, $C_I = 0.33μF$ and $C_O = 0.1μF$.
*   AN78xx series: 15W, AN78xxF series: 10.25W

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

• AN7810, 7810F (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	$V_I = 13$ to $25V$, $I_O = 5mA$ to $1A$, $T_j = 0$ to $125°C$, $P_D \leq$ *	9.5	——	10.5	V
Line regulation	REG_{IN}	$V_I = 12.5$ to $27V$, $T_j = 25°C$	——	8	200	mV
		$V_I = 13$ to $19V$, $T_j = 25°C$	——	2.5	100	mV
Load regulation	REG_L	$I_O = 5mA$ to $1.5A$, $T_j = 25°C$	——	12	200	mV
		$I_O = 250$ to $750mA$, $T_j = 25°C$	——	4	100	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	3.9	8	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 12.5$ to $27V$, $T_j = 25°C$	——	——	1	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to $1A$, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to $100kHz$	——	63	——	μV
Ripple rejection ratio	RR	$V_I = 13$ to $23V$, $I_O = 100mA$, $f = 120Hz$	56	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	16	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 27V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
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, $V_I = 16V$, $I_O = 500mA$, $C_I = 0.33μF$ and $C_O = 0.1μF$.
*   AN78xx series: 15W, AN78xxF series: 10.25W

• AN7812, 7812F (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	$V_I = 15$ to $27V$, $I_O = 5mA$ to $1A$, $T_j = 0$ to $125°C$, $P_D \leq$ *	11.4	——	12.6	V
Line regulation	REG_{IN}	$V_I = 14.5$ to $30V$, $T_j = 25°C$	——	10	240	mV
		$V_I = 16$ to $22V$, $T_j = 25°C$	——	3	120	mV
Load regulation	REG_L	$I_O = 5mA$ to $1.5A$, $T_j = 25°C$	——	12	240	mV
		$I_O = 250$ to $750mA$, $T_j = 25°C$	——	4	120	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	4	8	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 14.5$ to $30V$, $T_j = 25°C$	——	——	1	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to $1A$, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to $100kHz$	——	75	——	μV
Ripple rejection ratio	RR	$V_I = 15$ to $25V$, $I_O = 100mA$, $f = 120Hz$	55	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	18	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 30V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
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, $V_I = 19V$, $I_O = 500mA$, $C_I = 0.33μF$ and $C_O = 0.1μF$.
*   AN78xx series: 15W, AN78xxF series: 10.25W

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

• AN7815, 7815F (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	$V_I = 18$ to 30V, $I_O = 5mA$ to 1A, $T_j = 0$ to 125°C, $P_D \leq$ *	14.25	——	15.75	V
Line regulation	REG_{IN}	$V_I = 17.5$ to 30V, $T_j = 25°C$	——	11	300	mV
		$V_I = 20$ to 26V, $T_j = 25°C$	——	3	150	mV
Load regulation	REG_L	$I_O = 5mA$ to 1.5A, $T_j = 25°C$	——	12	300	mV
		$I_O = 250$ to 750mA, $T_j = 25°C$	——	4	150	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	4	8	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 17.5$ to 30V, $T_j = 25°C$	——	——	1	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to 1A, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to 100kHz	——	90	——	µV
Ripple rejection ratio	RR	$V_I = 18.5$ to 28.5V, $f = 120Hz$	54	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	19	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 30V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
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, $V_I = 23V$, $I_O = 500mA$, $C_I = 0.33µF$ and $C_O = 0.1µF$.
* AN78xx series: 15W, AN78xxF series: 10.25W

• AN7818, 7818F (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	$V_I = 21$ to 33V, $I_O = 5mA$ to 1A, $T_j = 0$ to 125°C, $P_D \leq$ *	17.1	——	18.9	V
Line regulation	REG_{IN}	$V_I = 21$ to 33V, $T_j = 25°C$	——	14	360	mV
		$V_I = 24$ to 30V, $T_j = 25°C$	——	4	180	mV
Load regulation	REG_L	$I_O = 5mA$ to 1.5A, $T_j = 25°C$	——	12	360	mV
		$I_O = 250$ to 750mA, $T_j = 25°C$	——	4	180	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	4.1	8	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	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to 1A, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to 100kHz	——	110	——	µV
Ripple rejection ratio	RR	$V_I = 22$ to 32V, $I_O = 100mA$, $f = 120Hz$	53	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	16	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 35V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5mA$, $T_j = 0$ to 125°C	——	−1.1	——	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, $V_I = 27V$, $I_O = 500mA$, $C_I = 0.33µF$ and $C_O = 0.1µF$.
* AN78xx series: 15W, AN78xxF series: 10.25W

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

• AN7820, 7820F (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	$V_I = 24$ to 35V, $I_O = 5mA$ to 1A, $T_j = 0$ to 125°C, $P_D \leq$ *	19	——	21	V
Line regulation	REG_{IN}	$V_I = 23$ to 35V, $T_j = 25°C$	——	15	400	mV
		$V_I = 26$ to 32V, $T_j = 25°C$	——	5	200	mV
Load regulation	REG_L	$I_O = 5mA$ to 1.5A, $T_j = 25°C$	——	12	400	mV
		$I_O = 250$ to 750mA, $T_j = 25°C$	——	4	200	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	4.1	8	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	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to 1A, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to 100kHz	——	110	——	μV
Ripple rejection ratio	RR	$V_I = 24$ to 34V, $I_O = 100mA$, $f = 120Hz$	53	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	22	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 35V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5mA$, $T_j = 0$ to 125°C	——	−1.2	——	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, $V_I = 29V$, $I_O = 500mA$, $C_I = 0.33μF$ and $C_O = 0.1μF$.
* AN78xx series: 15W, AN78xxF series: 10.25W

• AN7824, 7824F (24V type)

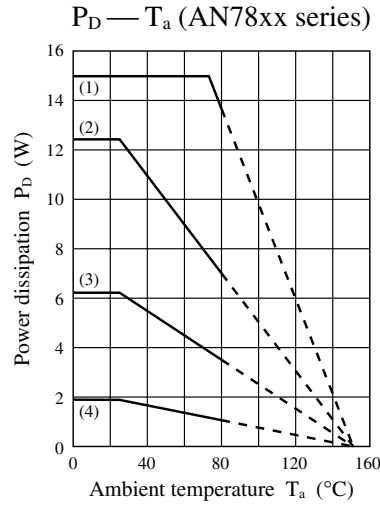| Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	V_O	$T_j = 25°C$	23	24	25	V
Output voltage tolerance	V_O	$V_I = 28$ to 38V, $I_O = 5mA$ to 1A, $T_j = 0$ to 125°C, $P_D \leq$ *	22.8	——	25.2	V
Line regulation	REG_{IN}	$V_I = 27$ to 38V, $T_j = 25°C$	——	18	480	mV
		$V_I = 30$ to 36V, $T_j = 25°C$	——	6	240	mV
Load regulation	REG_L	$I_O = 5mA$ to 1.5A, $T_j = 25°C$	——	12	480	mV
		$I_O = 250$ to 750mA, $T_j = 25°C$	——	4	240	mV
Bias current	I_{Bias}	$T_j = 25°C$	——	4.1	8	mA
Bias current fluctuation to input	$\Delta I_{Bias(IN)}$	$V_I = 27$ to 38V, $T_j = 25°C$	——	——	1	mA
Bias current fluctuation to load	$\Delta I_{Bias(L)}$	$I_O = 5mA$ to 1A, $T_j = 25°C$	——	——	0.5	mA
Output noise voltage	V_{no}	$f = 10Hz$ to 100kHz	——	170	——	μV
Ripple rejection ratio	RR	$V_I = 28$ to 38V, $I_O = 100mA$, $f = 120Hz$	50	——	——	dB
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 1A$, $T_j = 25°C$	——	2	——	V
Output impedance	Z_O	$f = 1kHz$	——	28	——	mΩ
Output short-circuit current	$I_{O(Short)}$	$V_I = 38V$, $T_j = 25°C$	——	700	——	mA
Peak output current	$I_{O(Peak)}$	$T_j = 25°C$	——	2	——	A
Output voltage temperature coefficient	$\Delta V_O/T_a$	$I_O = 5mA$, $T_j = 0$ to 125°C	——	−1.4	——	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, $V_I = 33V$, $I_O = 500mA$, $C_I = 0.33μF$ and $C_O = 0.1μF$.
* AN78xx series: 15W, AN78xxF series: 10.25W

■ Main Characteristic Curve

P_D — T_a (AN78xx series)

Power dissipation P_D (W)

Ambient temperature T_a (°C)

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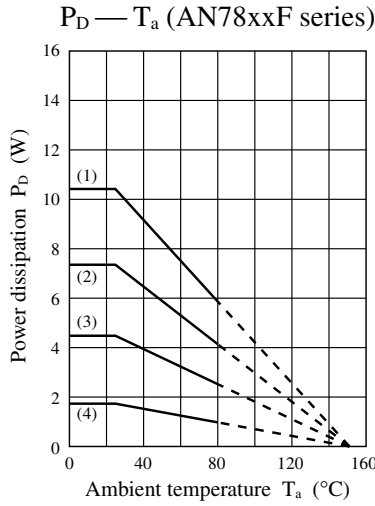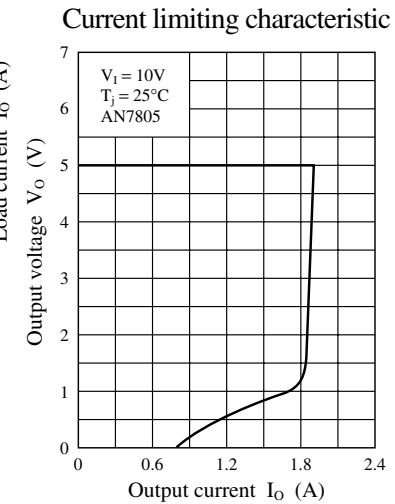 $R_{th(j-a)} = 65°C/W$ (max.)

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

P_D — T_a (AN78xxF series)

Power dissipation P_D (W)

Ambient temperature T_a (°C)
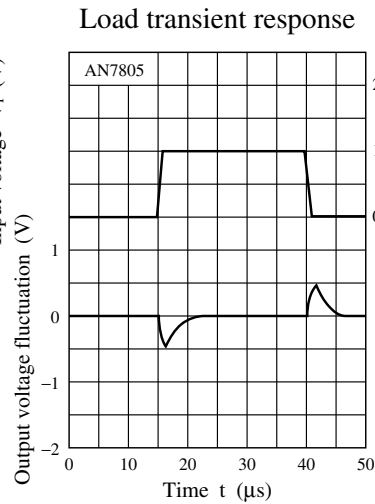
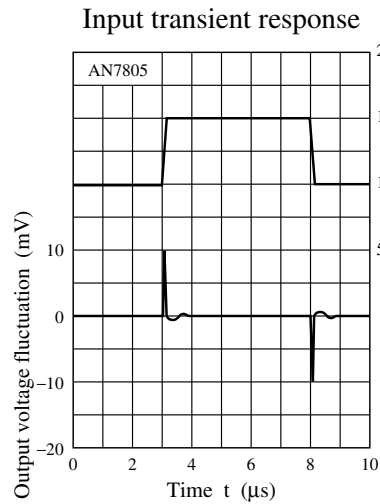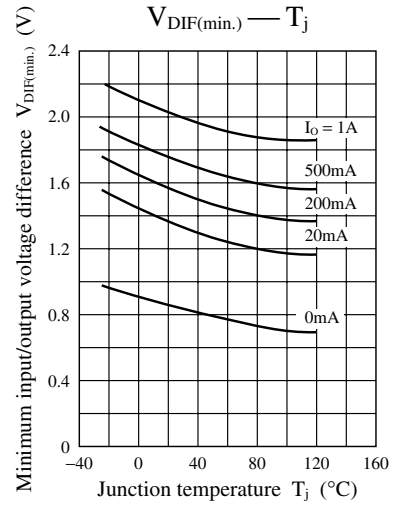Thermal resistance value:
  $R_{th(j-c)} = 12.2°C/W$ (max.)
  $R_{th(j-a)} = 65°C/W$ (max.)

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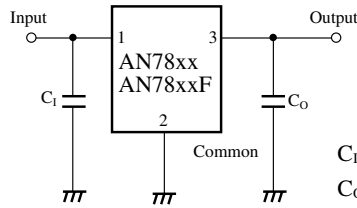 Tightening torque 6kg·cm
  Heat radiation compound used

(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

$V_{DIF(min.)}$ — T_j

Minimum input/output voltage difference $V_{DIF(min.)}$ (V)

$I_O = 1A$
500mA
200mA
20mA
0mA

Junction temperature T_j (°C)

Input transient response

AN7805

Output voltage fluctuation (mV)

Input voltage V_I (V)

Time t (μs)

Load transient response

AN7805

Output voltage fluctuation (V)

Load current I_O (A)

Time t (μs)

Current limiting characteristic

$V_I = 10V$
$T_j = 25°C$
AN7805

Output voltage V_O (V)

Output current I_O (A)

■ Basic Regulator Circuit

Input   Output

1   3
AN78xx
AN78xxF
C_I C_O
2
Common

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

■ Usage Notes

1. Cautions for a basic circuit

D_i

V_I V_O
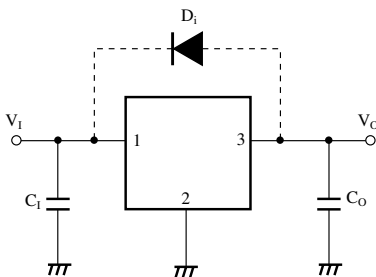1   3
2
C_I C_O

Figure 1

C_I: When a wiring from a smoothing circuit to a three-pin regulator is long, it is likely to oscillate in 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.

In   1   3   Out   Output
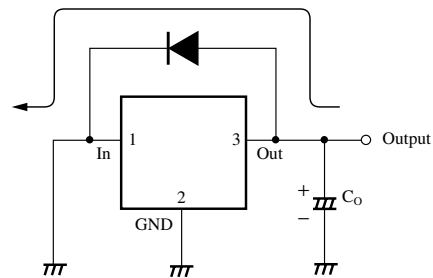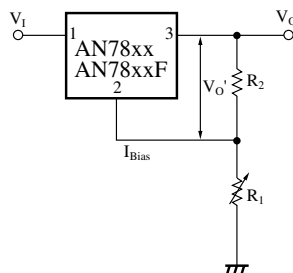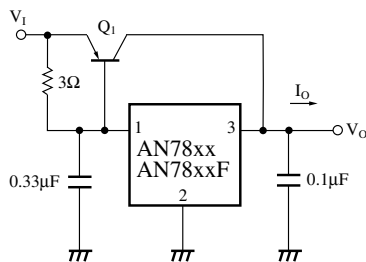2
GND C_O

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

1. Current bootstrap circuit

V_I Q_1

3Ω I_O

1   3 V_O
AN78xx
AN78xxF
0.33μF   2   0.1μF

2. Adjustable output regulator

V_I V_O
1   3
AN78xx
AN78xxF
2   V_O' R_2
I_{Bias}

R_1

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

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

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