

# AN78MxxNSP Series

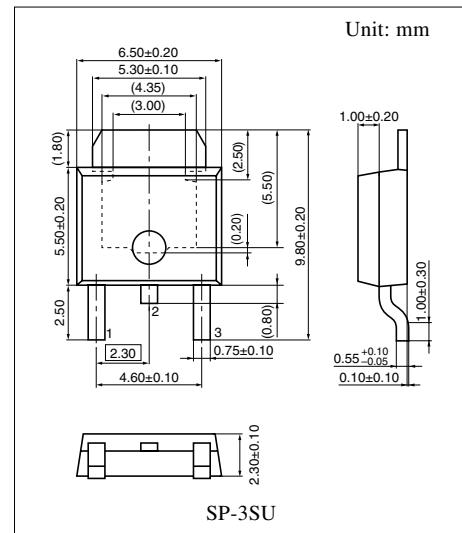
3-pin positive output voltage regulator (500 mA type)

## ■ Overview

The AN78MxxNSP series is a 3-pin fixed positive output type monolithic voltage regulator housed in surface mounting package. Stabilized fixed output voltage is obtained from unstable DC input voltage with using minimum external components. 9 types of fixed output voltage are available; 5 V, 6 V, 7 V, 8 V, 9 V, 10 V, 12 V, 15 V and 18 V. They can be used widely in power circuits with current capacity up to 500 mA.

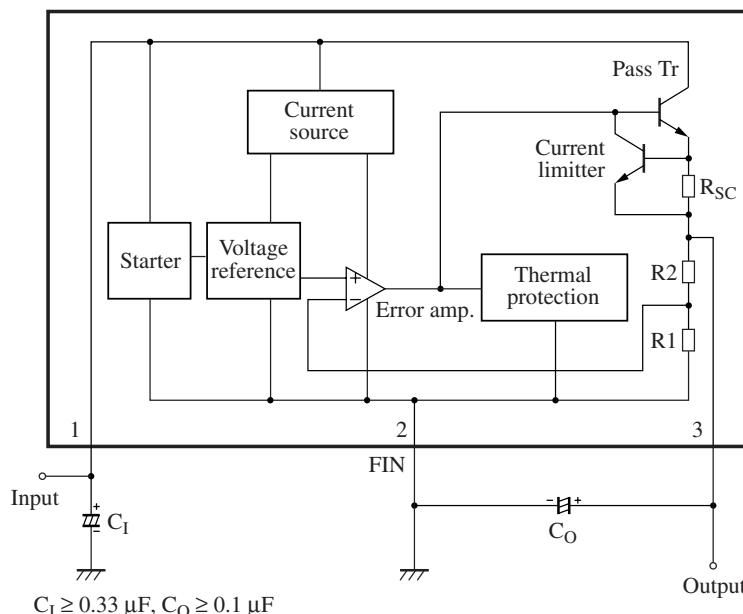
## ■ Features

- Output voltage: 5V, 6V, 7V, 8V, 9V, 10V, 12V, 15V, 18V
- Built-in overcurrent limit circuit
- Built-in thermal overload protection circuit
- Built-in ASO (area of safe operation) protection circuit



Note) The package of this product will be changed to lead-free type (SP-3SUA). See the new package dimensions section later of this datasheet.

## ■ Block Diagram



## ■ Pin Descriptions

Pin No.	Description	
1	Input	Input voltage pin
2	GND	Ground pin (FIN)
3	Output	Output voltage pin

## ■ Absolute Maximum Ratings

Parameter	Symbol	Range	Unit
Supply voltage <sup>*2</sup>	V <sub>CC</sub>	35	V
Supply current <sup>*3</sup>	I <sub>CC</sub>	—	mA
Power dissipation <sup>*4</sup>	P <sub>D</sub>	—	mW
Operating ambient temperature <sup>*1</sup>	T <sub>opr</sub>	−30 to +85	°C
Storage temperature <sup>*1</sup>	T <sub>stg</sub>	−55 to +150	°C

Note) 1. \*1: Except for the operating ambient temperature and storage temperature, all ratings are for T<sub>a</sub> = 25°C.

\*2: When V<sub>CC</sub> of 35 V is applied, the overvoltage protection of ASO protection circuit may shut off the output.

\*3: Since this IC has incorporated a current limiter, the current value does not exceed the rating.

\*4: When T<sub>j</sub> exceeds 150°C (designed value), the internal circuit cuts off the output. Note that the relationship between IC power dissipation and the ambient temperature must follow the derating curve.

2. This IC is not suitable for car electronics equipment.

## ■ Electrical Characteristics at T<sub>a</sub> = 25°C

### • AN78M05NSP (5 V type)

The specified condition T<sub>j</sub> = 25°C means that the test should be carried out within so short a test time (within 10 ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Unless otherwise specified, V<sub>I</sub> = 10 V, I<sub>O</sub> = 350 mA, C<sub>I</sub> = 0.33 μF and C<sub>O</sub> = 0.1 μF

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	V <sub>O1</sub>	T <sub>j</sub> = 25°C	4.8	5	5.2	V
Output voltage tolerance	V <sub>O2</sub>	V <sub>I</sub> = 7.5 V to 20 V, I <sub>O</sub> = 5 mA to 350 mA T <sub>j</sub> = 25°C	4.75	—	5.25	V
Line regulation 1	REG <sub>IN1</sub>	V <sub>I</sub> = 7.5 V to 25 V, T <sub>j</sub> = 25°C	—	3	100	mV
Line regulation 2	REG <sub>IN2</sub>	V <sub>I</sub> = 8 V to 25 V, T <sub>j</sub> = 25°C	—	1	50	mV
Load regulation 1	REG <sub>L1</sub>	I <sub>O</sub> = 5 mA to 500 mA, T <sub>j</sub> = 25°C	—	20	100	mV
Load regulation 2	REG <sub>L2</sub>	I <sub>O</sub> = 5 mA to 200 mA, T <sub>j</sub> = 25°C	—	10	50	mV
Bias current	I <sub>Bias</sub>	T <sub>j</sub> = 25°C	—	4	6	mA
Bias current fluctuation to input	ΔI <sub>Bias(IN)</sub>	V <sub>I</sub> = 8 V to 25 V, T <sub>j</sub> = 25°C	—	—	0.8	mA
Bias current fluctuation to load	ΔI <sub>Bias(L)</sub>	I <sub>O</sub> = 5 mA to 350 mA, T <sub>j</sub> = 25°C	—	—	0.5	mA
Ripple rejection ratio	RR	V <sub>I</sub> = 8 V to 18 V, I <sub>O</sub> = 100 mA, f = 120 Hz	62	—	—	dB

### • Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output noise voltage	V <sub>NO</sub>	f = 10 Hz to 100 kHz	—	40	—	μV
Minimum input/output voltage difference	V <sub>DIF(min)</sub>	I <sub>O</sub> = 500 mA, T <sub>j</sub> = 25°C	—	2	—	V
Output short-circuit current	I <sub>O(Short)</sub>	V <sub>I</sub> = 35 V, T <sub>j</sub> = 25°C	—	300	—	mA
Peak output current	I <sub>O(Peak)</sub>	T <sub>j</sub> = 25°C	—	1 000	—	mA
Output voltage temperature coefficient	ΔV <sub>O</sub> / T <sub>a</sub>	I <sub>O</sub> = 5 mA, T <sub>j</sub> = 0°C to 125°C	—	−0.5	—	mV/°C
Thermal protection operating temperature	T <sub>j(TH)</sub>	I <sub>O</sub> = 5 mA	—	150	—	°C

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

## • AN78M06NSP (6 V type)

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

Unless otherwise specified,  $V_I = 11\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$  and  $C_O = 0.1\text{ }\mu\text{F}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_{O1}$	$T_j = 25^\circ\text{C}$	5.75	6	6.25	V
Output voltage tolerance	$V_{O2}$	$V_I = 8.5\text{ V to }21\text{ V}$ , $I_O = 5\text{ mA to }350\text{ mA}$ $T_j = 25^\circ\text{C}$	5.7	—	6.3	V
Line regulation 1	$\text{REG}_{\text{IN}1}$	$V_I = 8.5\text{ V to }25\text{ V}$ , $T_j = 25^\circ\text{C}$	—	5	100	mV
Line regulation 2	$\text{REG}_{\text{IN}2}$	$V_I = 9\text{ V to }25\text{ V}$ , $T_j = 25^\circ\text{C}$	—	1.5	50	mV
Load regulation 1	$\text{REG}_{\text{L}1}$	$I_O = 5\text{ mA to }500\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	20	120	mV
Load regulation 2	$\text{REG}_{\text{L}2}$	$I_O = 5\text{ mA to }200\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	10	60	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias}(\text{IN})}$	$V_I = 9\text{ V to }25\text{ V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias}(\text{L})}$	$I_O = 5\text{ mA to }350\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Ripple rejection ratio	RR	$V_I = 9\text{ V to }19\text{ V}$ , $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$	59	—	—	dB

## • Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output noise voltage	$V_{\text{NO}}$	$f = 10\text{ Hz to }100\text{ kHz}$	—	45	—	$\mu\text{V}$
Minimum input/output voltage difference	$V_{\text{DIF}(\text{min})}$	$I_O = 500\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O}(\text{Short})}$	$V_I = 35\text{ V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O}(\text{Peak})}$	$T_j = 25^\circ\text{C}$	—	1 000	—	mA
Output voltage temperature coefficient	$\Delta V_O / T_a$	$I_O = 5\text{ mA}$ , $T_j = 0^\circ\text{C to }125^\circ\text{C}$	—	- 0.5	—	$\text{mV/}^\circ\text{C}$
Thermal protection operating temperature	$T_{j(\text{TH})}$	$I_O = 5\text{ mA}$	—	150	—	$^\circ\text{C}$

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

## • AN78M07NSP (7 V type)

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

Unless otherwise specified,  $V_I = 12\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$  and  $C_O = 0.1\text{ }\mu\text{F}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_{O1}$	$T_j = 25^\circ\text{C}$	6.7	7	7.3	V
Output voltage tolerance	$V_{O2}$	$V_I = 9.5\text{ V to }22\text{ V}$ , $I_O = 5\text{ mA to }350\text{ mA}$ $T_j = 25^\circ\text{C}$	6.65	—	7.35	V
Line regulation 1	$\text{REG}_{\text{IN}1}$	$V_I = 9.5\text{ V to }25\text{ V}$ , $T_j = 25^\circ\text{C}$	—	6	100	mV
Line regulation 2	$\text{REG}_{\text{IN}2}$	$V_I = 10\text{ V to }25\text{ V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation 1	$\text{REG}_{\text{L}1}$	$I_O = 5\text{ mA to }500\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	20	140	mV
Load regulation 2	$\text{REG}_{\text{L}2}$	$I_O = 5\text{ mA to }200\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	10	70	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias}(\text{IN})}$	$V_I = 10\text{ V to }25\text{ V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias}(\text{L})}$	$I_O = 5\text{ mA to }350\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Ripple rejection ratio	RR	$V_I = 10\text{ V to }20\text{ V}$ , $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$	57	—	—	dB

## • Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output noise voltage	$V_{\text{NO}}$	$f = 10\text{ Hz to }100\text{ kHz}$	—	48	—	$\mu\text{V}$
Minimum input/output voltage difference	$V_{\text{DIF}(\text{min})}$	$I_O = 500\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O}(\text{Short})}$	$V_I = 35\text{ V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O}(\text{Peak})}$	$T_j = 25^\circ\text{C}$	—	1 000	—	mA
Output voltage temperature coefficient	$\Delta V_O / T_a$	$I_O = 5\text{ mA}$ , $T_j = 0^\circ\text{C to }125^\circ\text{C}$	—	- 0.5	—	$\text{mV}/^\circ\text{C}$
Thermal protection operating temperature	$T_{j(\text{TH})}$	$I_O = 5\text{ mA}$	—	150	—	$^\circ\text{C}$

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

## • AN78M08NSP (8 V type)

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

Unless otherwise specified,  $V_I = 14 \text{ V}$ ,  $I_O = 350 \text{ mA}$ ,  $C_I = 0.33 \mu\text{F}$  and  $C_O = 0.1 \mu\text{F}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_{O1}$	$T_j = 25^\circ\text{C}$	7.7	8	8.3	V
Output voltage tolerance	$V_{O2}$	$V_I = 10.5 \text{ V to } 22 \text{ V}$ , $I_O = 5 \text{ mA to } 350 \text{ mA}$ $T_j = 25^\circ\text{C}$	7.6	—	8.4	V
Line regulation 1	$\text{REG}_{\text{IN}1}$	$V_I = 10.5 \text{ V to } 25 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	6	100	mV
Line regulation 2	$\text{REG}_{\text{IN}2}$	$V_I = 11 \text{ V to } 25 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation 1	$\text{REG}_{\text{L}1}$	$I_O = 5 \text{ mA to } 500 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	25	160	mV
Load regulation 2	$\text{REG}_{\text{L}2}$	$I_O = 5 \text{ mA to } 200 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	10	80	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.1	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias}(\text{IN})}$	$V_I = 10.5 \text{ V to } 25 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias}(\text{L})}$	$I_O = 5 \text{ mA to } 350 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Ripple rejection ratio	RR	$V_I = 11.5 \text{ V to } 21.5 \text{ V}$ , $I_O = 100 \text{ mA}$ , $f = 120 \text{ Hz}$	56	—	—	dB

- Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output noise voltage	$V_{\text{NO}}$	$f = 10 \text{ Hz to } 100 \text{ kHz}$	—	48	—	$\mu\text{V}$
Minimum input/output voltage difference	$V_{\text{DIF}(\text{min})}$	$I_O = 500 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O}(\text{Short})}$	$V_I = 35 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O}(\text{Peak})}$	$T_j = 25^\circ\text{C}$	—	1 000	—	mA
Output voltage temperature coefficient	$\Delta V_O / T_a$	$I_O = 5 \text{ mA}$ , $T_j = 0^\circ\text{C to } 125^\circ\text{C}$	—	- 0.5	—	$\text{mV}/^\circ\text{C}$
Thermal protection operating temperature	$T_{j(\text{TH})}$	$I_O = 5 \text{ mA}$	—	150	—	$^\circ\text{C}$

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

## • AN78M09NSP (9 V type)

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

Unless otherwise specified,  $V_I = 15 \text{ V}$ ,  $I_O = 350 \text{ mA}$ ,  $C_I = 0.33 \mu\text{F}$  and  $C_O = 0.1 \mu\text{F}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_{O1}$	$T_j = 25^\circ\text{C}$	8.65	9	9.35	V
Output voltage tolerance	$V_{O2}$	$V_I = 11.5 \text{ V to } 24 \text{ V}$ , $I_O = 5 \text{ mA to } 350 \text{ mA}$ $T_j = 25^\circ\text{C}$	8.55	—	9.45	V
Line regulation 1	$\text{REG}_{\text{IN}1}$	$V_I = 11.5 \text{ V to } 25 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	7	100	mV
Line regulation 2	$\text{REG}_{\text{IN}2}$	$V_I = 12 \text{ V to } 25 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation 1	$\text{REG}_{\text{L}1}$	$I_O = 5 \text{ mA to } 500 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	25	180	mV
Load regulation 2	$\text{REG}_{\text{L}2}$	$I_O = 5 \text{ mA to } 200 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	10	90	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.1	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias}(\text{IN})}$	$V_I = 12 \text{ V to } 25 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias}(\text{L})}$	$I_O = 5 \text{ mA to } 350 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Ripple rejection ratio	RR	$V_I = 12 \text{ V to } 22 \text{ V}$ , $I_O = 100 \text{ mA}$ , $f = 120 \text{ Hz}$	56	—	—	dB

## • Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output noise voltage	$V_{\text{NO}}$	$f = 10 \text{ Hz to } 100 \text{ kHz}$	—	60	—	$\mu\text{V}$
Minimum input/output voltage difference	$V_{\text{DIF}(\text{min})}$	$I_O = 500 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O}(\text{Short})}$	$V_I = 35 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O}(\text{Peak})}$	$T_j = 25^\circ\text{C}$	—	1 000	—	mA
Output voltage temperature coefficient	$\Delta V_O / T_a$	$I_O = 5 \text{ mA}$ , $T_j = 0^\circ\text{C to } 125^\circ\text{C}$	—	- 0.5	—	$\text{mV}/^\circ\text{C}$
Thermal protection operating temperature	$T_{j(\text{TH})}$	$I_O = 5 \text{ mA}$	—	150	—	$^\circ\text{C}$

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

## • AN78M10NSP (10 V type)

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

Unless otherwise specified,  $V_I = 16 \text{ V}$ ,  $I_O = 350 \text{ mA}$ ,  $C_I = 0.33 \mu\text{F}$  and  $C_O = 0.1 \mu\text{F}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_{O1}$	$T_j = 25^\circ\text{C}$	9.6	10	10.4	V
Output voltage tolerance	$V_{O2}$	$V_I = 12.5 \text{ V to } 25 \text{ V}$ , $I_O = 5 \text{ mA to } 350 \text{ mA}$ $T_j = 25^\circ\text{C}$	9.5	—	10.5	V
Line regulation 1	$\text{REG}_{\text{IN}1}$	$V_I = 12.5 \text{ V to } 30 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	7	100	mV
Line regulation 2	$\text{REG}_{\text{IN}2}$	$V_I = 13 \text{ V to } 25 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation 1	$\text{REG}_{\text{L}1}$	$I_O = 5 \text{ mA to } 500 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	25	200	mV
Load regulation 2	$\text{REG}_{\text{L}2}$	$I_O = 5 \text{ mA to } 200 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	10	100	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.1	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias}(\text{IN})}$	$V_I = 13 \text{ V to } 25 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias}(\text{L})}$	$I_O = 5 \text{ mA to } 350 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Ripple rejection ratio	RR	$V_I = 13 \text{ V to } 23 \text{ V}$ , $I_O = 100 \text{ mA}$ , $f = 120 \text{ Hz}$	56	—	—	dB

## • Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output noise voltage	$V_{\text{NO}}$	$f = 10 \text{ Hz to } 100 \text{ kHz}$	—	65	—	$\mu\text{V}$
Minimum input/output voltage difference	$V_{\text{DIF}(\text{min})}$	$I_O = 500 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O}(\text{Short})}$	$V_I = 35 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O}(\text{Peak})}$	$T_j = 25^\circ\text{C}$	—	1 000	—	mA
Output voltage temperature coefficient	$\Delta V_O / T_a$	$I_O = 5 \text{ mA}$ , $T_j = 0^\circ\text{C to } 125^\circ\text{C}$	—	- 0.5	—	$\text{mV}/^\circ\text{C}$
Thermal protection operating temperature	$T_{j(\text{TH})}$	$I_O = 5 \text{ mA}$	—	150	—	$^\circ\text{C}$

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

## • AN78M12NSP (12 V type)

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

Unless otherwise specified,  $V_I = 19\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$  and  $C_O = 0.1\text{ }\mu\text{F}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_{O1}$	$T_j = 25^\circ\text{C}$	11.5	12	12.5	V
Output voltage tolerance	$V_{O2}$	$V_I = 14.5\text{ V to }27\text{ V}$ , $I_O = 5\text{ mA to }350\text{ mA}$ $T_j = 25^\circ\text{C}$	11.4	—	12.6	V
Line regulation 1	$\text{REG}_{\text{IN}1}$	$V_I = 14.5\text{ V to }30\text{ V}$ , $T_j = 25^\circ\text{C}$	—	8	100	mV
Line regulation 2	$\text{REG}_{\text{IN}2}$	$V_I = 16\text{ V to }30\text{ V}$ , $T_j = 25^\circ\text{C}$	—	2	50	mV
Load regulation 1	$\text{REG}_{\text{L}1}$	$I_O = 5\text{ mA to }500\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	25	240	mV
Load regulation 2	$\text{REG}_{\text{L}2}$	$I_O = 5\text{ mA to }200\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	10	120	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.3	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias}(\text{IN})}$	$V_I = 14.5\text{ V to }30\text{ V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias}(\text{L})}$	$I_O = 5\text{ mA to }350\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Ripple rejection ratio	RR	$V_I = 15\text{ V to }25\text{ V}$ , $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$	55	—	—	dB

## • Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output noise voltage	$V_{\text{NO}}$	$f = 10\text{ Hz to }100\text{ kHz}$	—	75	—	$\mu\text{V}$
Minimum input/output voltage difference	$V_{\text{DIF}(\text{min})}$	$I_O = 500\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O}(\text{Short})}$	$V_I = 35\text{ V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O}(\text{Peak})}$	$T_j = 25^\circ\text{C}$	—	1 000	—	mA
Output voltage temperature coefficient	$\Delta V_O / T_a$	$I_O = 5\text{ mA}$ , $T_j = 0^\circ\text{C to }125^\circ\text{C}$	—	- 0.5	—	$\text{mV}/^\circ\text{C}$
Thermal protection operating temperature	$T_{j(\text{TH})}$	$I_O = 5\text{ mA}$	—	150	—	$^\circ\text{C}$

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

## • AN78M15NSP (15 V type)

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

Unless otherwise specified,  $V_I = 23\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$  and  $C_O = 0.1\text{ }\mu\text{F}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_{O1}$	$T_j = 25^\circ\text{C}$	14.4	15	15.6	V
Output voltage tolerance	$V_{O2}$	$V_I = 17.5\text{ V to }30\text{ V}$ , $I_O = 5\text{ mA to }350\text{ mA}$ $T_j = 25^\circ\text{C}$	14.25	—	15.75	V
Line regulation 1	$\text{REG}_{\text{IN}1}$	$V_I = 17.5\text{ V to }30\text{ V}$ , $T_j = 25^\circ\text{C}$	—	10	100	mV
Line regulation 2	$\text{REG}_{\text{IN}2}$	$V_I = 20\text{ V to }30\text{ V}$ , $T_j = 25^\circ\text{C}$	—	3	50	mV
Load regulation 1	$\text{REG}_{\text{L}1}$	$I_O = 5\text{ mA to }500\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	25	300	mV
Load regulation 2	$\text{REG}_{\text{L}2}$	$I_O = 5\text{ mA to }200\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	10	150	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.3	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias}(\text{IN})}$	$V_I = 17.5\text{ V to }30\text{ V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias}(\text{L})}$	$I_O = 5\text{ mA to }350\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Ripple rejection ratio	RR	$V_I = 18.5\text{ V to }28.5\text{ V}$ , $I_O = 100\text{ mA}$ , $f = 120\text{ Hz}$	54	—	—	dB

## • Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output noise voltage	$V_{\text{NO}}$	$f = 10\text{ Hz to }100\text{ kHz}$	—	90	—	$\mu\text{V}$
Minimum input/output voltage difference	$V_{\text{DIF}(\text{min})}$	$I_O = 500\text{ mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O}(\text{Short})}$	$V_I = 35\text{ V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O}(\text{Peak})}$	$T_j = 25^\circ\text{C}$	—	1 000	—	mA
Output voltage temperature coefficient	$\Delta V_O / T_a$	$I_O = 5\text{ mA}$ , $T_j = 0^\circ\text{C to }125^\circ\text{C}$	—	- 0.5	—	$\text{mV/}^\circ\text{C}$
Thermal protection operating temperature	$T_{j(\text{TH})}$	$I_O = 5\text{ mA}$	—	150	—	$^\circ\text{C}$

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

## • AN78M18NSP (18 V type)

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

Unless otherwise specified,  $V_I = 27 \text{ V}$ ,  $I_O = 350 \text{ mA}$ ,  $C_I = 0.33 \mu\text{F}$  and  $C_O = 0.1 \mu\text{F}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage	$V_{O1}$	$T_j = 25^\circ\text{C}$	17.3	18	18.7	V
Output voltage tolerance	$V_{O2}$	$V_I = 21 \text{ V to } 33 \text{ V}$ , $I_O = 5 \text{ mA to } 350 \text{ mA}$ $T_j = 25^\circ\text{C}$	17.1	—	18.9	V
Line regulation 1	$\text{REG}_{\text{IN}1}$	$V_I = 21 \text{ V to } 33 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	10	100	mV
Line regulation 2	$\text{REG}_{\text{IN}2}$	$V_I = 22 \text{ V to } 33 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	5	50	mV
Load regulation 1	$\text{REG}_{\text{L}1}$	$I_O = 5 \text{ mA to } 500 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	30	360	mV
Load regulation 2	$\text{REG}_{\text{L}2}$	$I_O = 5 \text{ mA to } 200 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	10	180	mV
Bias current	$I_{\text{Bias}}$	$T_j = 25^\circ\text{C}$	—	4.4	6	mA
Bias current fluctuation to input	$\Delta I_{\text{Bias}(\text{IN})}$	$V_I = 21 \text{ V to } 33 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	—	0.8	mA
Bias current fluctuation to load	$\Delta I_{\text{Bias}(\text{L})}$	$I_O = 5 \text{ mA to } 350 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	—	0.5	mA
Ripple rejection ratio	RR	$V_I = 22 \text{ V to } 32 \text{ V}$ , $I_O = 100 \text{ mA}$ , $f = 120 \text{ Hz}$	53	—	—	dB

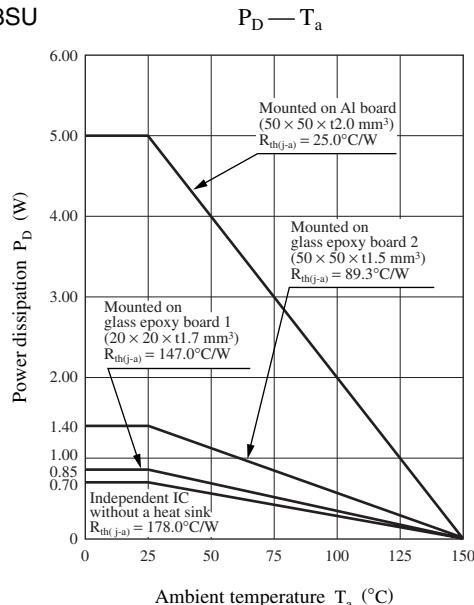
## • Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output noise voltage	$V_{\text{NO}}$	$f = 10 \text{ Hz to } 100 \text{ kHz}$	—	100	—	$\mu\text{V}$
Minimum input/output voltage difference	$V_{\text{DIF}(\text{min})}$	$I_O = 500 \text{ mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V
Output short-circuit current	$I_{\text{O}(\text{Short})}$	$V_I = 35 \text{ V}$ , $T_j = 25^\circ\text{C}$	—	300	—	mA
Peak output current	$I_{\text{O}(\text{Peak})}$	$T_j = 25^\circ\text{C}$	—	1 000	—	mA
Output voltage temperature coefficient	$\Delta V_O / T_a$	$I_O = 5 \text{ mA}$ , $T_j = 0^\circ\text{C to } 125^\circ\text{C}$	—	- 0.5	—	$\text{mV}/^\circ\text{C}$
Thermal protection operating temperature	$T_{j(\text{TH})}$	$I_O = 5 \text{ mA}$	—	150	—	$^\circ\text{C}$

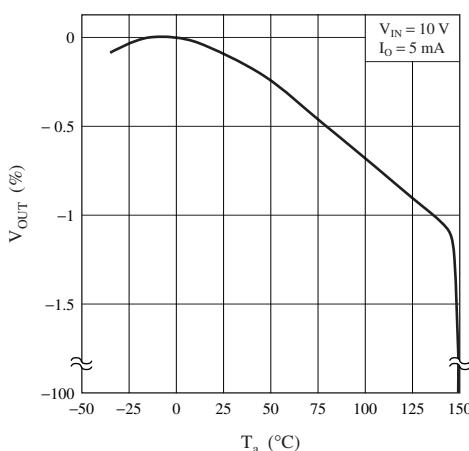
## ■ Application Notes

### 1. $P_D$ — $T_a$ curves of SP-3SU

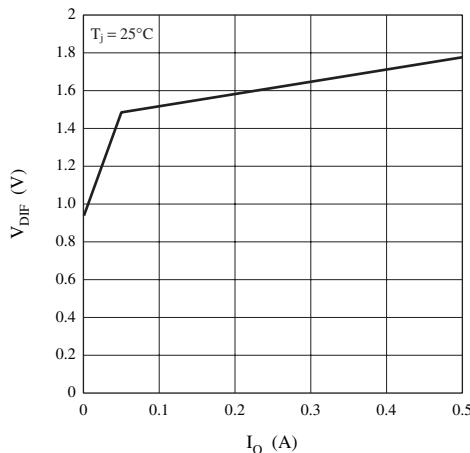


### 2. Main Characteristics

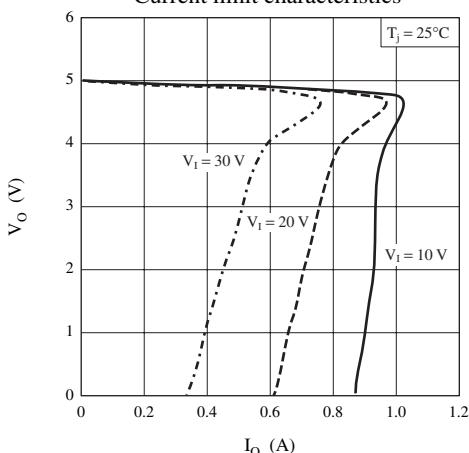
#### Output voltage temperature characteristic



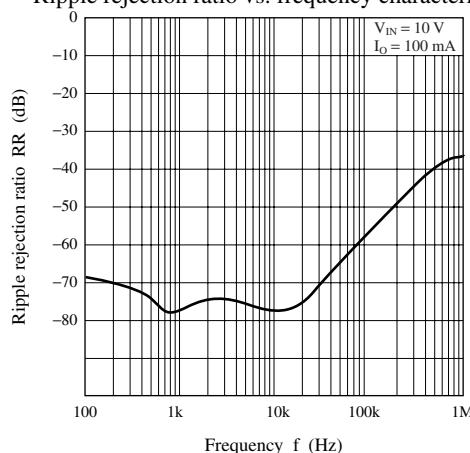
#### Minimum input/output voltage difference vs. load current characteristic



#### Current limit characteristics

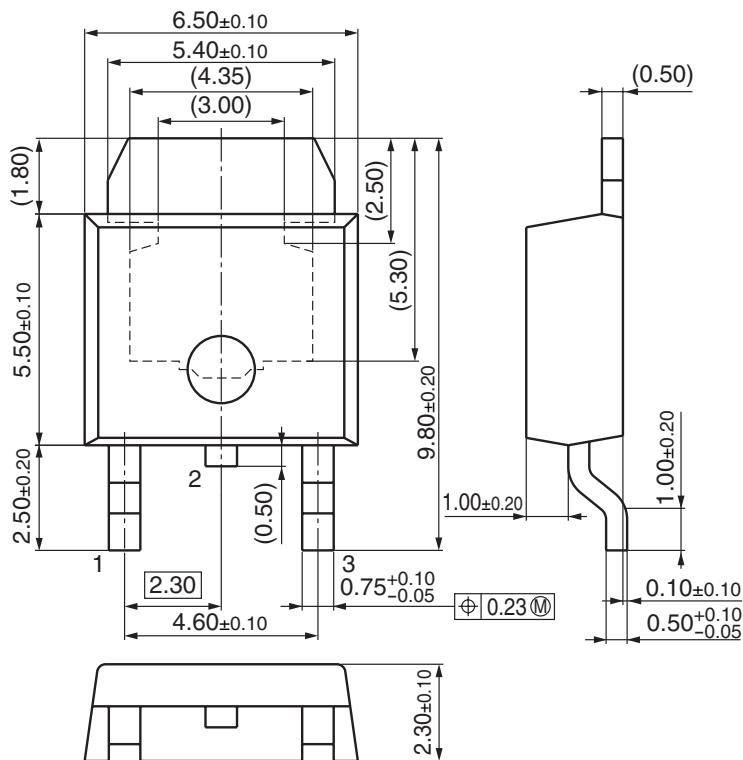


#### Ripple rejection ratio vs. frequency characteristic



## ■ New Package Dimensions (Unit: mm)

- SP-3SUA (Lead-free package)



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