

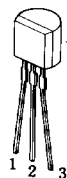
### 3-TERMINAL POSITIVE VOLTAGE REGULATOR

■ GENERAL DESCRIPTION

The NJM78L00 series of 3-Terminal Positive Voltage Regulators is constructed using the New JRC Planar epitaxial process. These regulators employ internal current-limiting and thermal-shutdown, making them essentially indestructible. If adequate heat sinking is provided, they can deliver up to 100mA output current. They are intended as fixed voltage regulators in a wide range of applications including local or on-card regulation for elimination of noise and distribution problems associated with single-point regulation. In addition, they can be used with power pass elements to make high-current voltage regulators. The NJM78L00 series used as a Zener diode/resistor combination replacement, offers an effective output impedance improvement of typically two orders of magnitude, along with lower quiescent current and lower noise.

■ PACKAGE OUTLINE

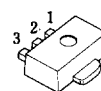
(TO-92)



NJM78L00A

- 1 . OUT
- 2 . GND
- 3 . IN

(SOT-89)



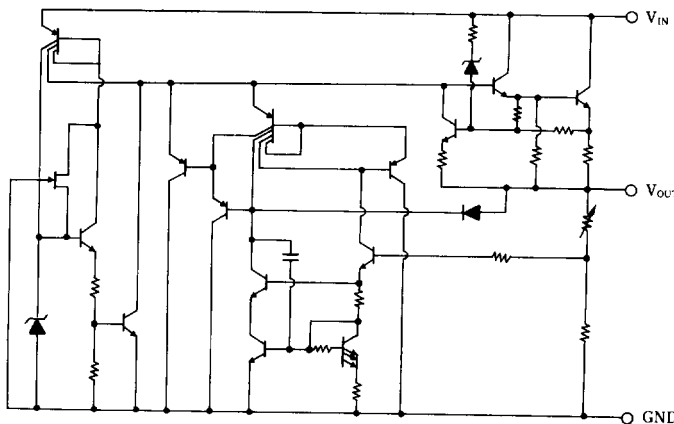
NJM78L00A

- 1 . OUT
- 2 . GND
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■ FEATURES

- Internal Short Circuit Current Limit
- Internal Thermal Overload Protection
- Excellent Ripple Rejection
- Guarantee'd 100mA Output Current
- Package Outline TO-92, SOT-89
- Bipolar Technology

■ EQUIVALENT CIRCUIT



## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Input Voltage	V <sub>IN</sub>	(78L02A~78L09A)30	V
		(78L12A~78L15A)35	V
		(78L18A~78L24A)40	V
Output Current	I <sub>O</sub>	100	mA
Power Dissipation	P <sub>D</sub>	(TO92) 500	mW
		(SOT89) 350	mW
Operating Temperature Range	T <sub>opr</sub>	-30~+75	°C
Storage Temperature Range	T <sub>stg</sub>	-40~+125	°C

## ■ ELECTRICAL CHARACTERISTICS (C<sub>IN</sub>=0.33 μf, C<sub>O</sub>=0.1 μf, T<sub>J</sub>=25°C) Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
<b>NJM78L02A</b>						
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =9V, I <sub>O</sub> =400mA	2.47	2.6	2.73	V
Line Regulation 1	ΔV <sub>O</sub> -V <sub>IN1</sub>	V <sub>IN</sub> =4.75~20V, I <sub>O</sub> =40mA	—	—	125	mV
Line Regulation 2	ΔV <sub>O</sub> -V <sub>IN2</sub>	V <sub>IN</sub> =5~20V, I <sub>O</sub> =40mA	—	—	100	mV
Load Regulation 1	ΔV <sub>O</sub> -I <sub>O1</sub>	V <sub>IN</sub> =9V, I <sub>O</sub> =1~40mA	—	—	25	mV
Load Regulation 2	ΔV <sub>O</sub> -I <sub>O2</sub>	V <sub>IN</sub> =9V, I <sub>O</sub> =1~100mA	—	—	50	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =9V, I <sub>O</sub> =0mA	—	2.0	6	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =9V, I <sub>O</sub> =1mA	—	0.2	—	mV/°C
Ripple Rejections	RR	6V<V <sub>IN</sub> <16V, I <sub>O</sub> =40mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz	43	73	—	dB
Output Noise Voltage	V <sub>NO</sub>	BW=10Hz~100kHz, V <sub>IN</sub> =9V, I <sub>O</sub> =40mA	—	35	—	μV
<b>NJM78L05A</b>						
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =10V, I <sub>O</sub> =40mA	4.75	5	5.25	V
Line Regulation 1	ΔV <sub>O</sub> -V <sub>IN1</sub>	V <sub>IN</sub> =7~20V, I <sub>O</sub> =40mA	—	—	200	mV
Line Regulation 2	ΔV <sub>O</sub> -V <sub>IN2</sub>	V <sub>IN</sub> =8~20V, I <sub>O</sub> =40mA	—	—	150	mV
Load Regulation 1	ΔV <sub>O</sub> -I <sub>O1</sub>	V <sub>IN</sub> =10V, I <sub>O</sub> =1~40mA	—	—	30	mV
Load Regulation 2	ΔV <sub>O</sub> -I <sub>O2</sub>	V <sub>IN</sub> =10V, I <sub>O</sub> =1~100mA	—	—	60	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =10V, I <sub>O</sub> =0mA	—	2.0	6	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =10V, I <sub>O</sub> =1mA	—	0.4	—	mV/°C
Ripple Rejections	RR	8V<V <sub>IN</sub> <18V, I <sub>O</sub> =40mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz	40	69	—	dB
Output Noise Voltage	V <sub>NO</sub>	BW=10Hz~100kHz, V <sub>IN</sub> =10V, I <sub>O</sub> =40mA	—	70	—	μV

■ **ELECTRICAL CHARACTERISTICS** ( $C_{IN}=0.33\ \mu\text{f}$ ,  $C_O=0.1\ \mu\text{f}$ ,  $T_j=25^\circ\text{C}$ ) Measurement is to be conducted in pulse testing.

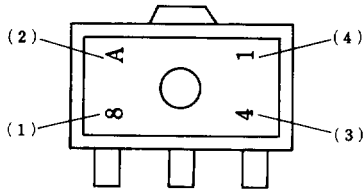
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
<b>NJM78L06A</b>						
Output Voltage	$V_O$	$V_{IN}=12\text{V}$ , $I_O=40\text{mA}$	5.7	6	6.3	V
Line Regulation 1	$\Delta V_O-V_{IN1}$	$V_{IN}=8.5\sim 20\text{V}$ , $I_O=40\text{mA}$	—	—	200	mV
Line Regulation 2	$\Delta V_O-V_{IN2}$	$V_{IN}=9\sim 20\text{V}$ , $I_O=40\text{mA}$	—	—	150	mV
Load Regulation 1	$\Delta V_O-I_{O1}$	$V_{IN}=12\text{V}$ , $I_O=1\sim 40\text{mA}$	—	—	40	mV
Load Regulation 2	$\Delta V_O-I_{O2}$	$V_{IN}=12\text{V}$ , $I_O=1\sim 100\text{mA}$	—	—	80	mV
Quiescent Current	$I_Q$	$V_{IN}=12\text{V}$ , $I_O=0\text{mA}$	—	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=12\text{V}$ , $I_O=1\text{mA}$	—	0.5	—	mV/ $^\circ\text{C}$
Ripple Rejections	RR	$9\text{V}<V_{IN}<20\text{V}$ , $I_O=40\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$	40	67	—	dB
Output Noise Voltage	$V_{NO}$	$BW=10\text{Hz}\sim 100\text{kHz}$ , $V_{IN}=12\text{V}$ , $I_O=40\text{mA}$	—	80	—	$\mu\text{V}$
<b>NJM78L08A</b>						
Output Voltage	$V_O$	$V_{IN}=14\text{V}$ , $I_O=40\text{mA}$	7.6	8	8.4	V
Line Regulation 1	$\Delta V_O-V_{IN1}$	$V_{IN}=10.5\sim 23\text{V}$ , $I_O=40\text{mA}$	—	—	225	mV
Line Regulation 2	$\Delta V_O-V_{IN2}$	$V_{IN}=11\sim 23\text{V}$ , $I_O=40\text{mA}$	—	—	175	mV
Load Regulation 1	$\Delta V_O-I_{O1}$	$V_{IN}=14\text{V}$ , $I_O=1\sim 40\text{mA}$	—	—	50	mV
Load Regulation 2	$\Delta V_O-I_{O2}$	$V_{IN}=14\text{V}$ , $I_O=1\sim 100\text{mA}$	—	—	100	mV
Quiescent Current	$I_Q$	$V_{IN}=14\text{V}$ , $I_O=0\text{mA}$	—	2.1	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=14\text{V}$ , $I_O=1\text{mA}$	—	0.6	—	mV/ $^\circ\text{C}$
Ripple Rejections	RR	$11\text{V}<V_{IN}<20\text{V}$ , $I_O=40\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$	39	66	—	dB
Output Noise Voltage	$V_{NO}$	$BW=10\text{Hz}\sim 100\text{kHz}$ , $V_{IN}=14\text{V}$ , $I_O=40\text{mA}$	—	115	—	$\mu\text{V}$
<b>NJM78L09A</b>						
Output Voltage	$V_O$	$V_{IN}=15\text{V}$ , $I_O=40\text{mA}$	8.55	9	9.45	V
Line Regulation 1	$\Delta V_O-V_{IN1}$	$V_{IN}=11.5\sim 23\text{V}$ , $I_O=40\text{mA}$	—	—	250	mV
Line Regulation 2	$\Delta V_O-V_{IN2}$	$V_{IN}=12\sim 23\text{V}$ , $I_O=40\text{mA}$	—	—	200	mV
Load Regulation 1	$\Delta V_O-I_{O1}$	$V_{IN}=15\text{V}$ , $I_O=1\sim 40\text{mA}$	—	—	50	mV
Load Regulation 2	$\Delta V_O-I_{O2}$	$V_{IN}=15\text{V}$ , $I_O=1\sim 100\text{mA}$	—	—	100	mV
Quiescent Current	$I_Q$	$V_{IN}=15\text{V}$ , $I_O=0\text{mA}$	—	2.1	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=15\text{V}$ , $I_O=1\text{mA}$	—	0.65	—	mV/ $^\circ\text{C}$
Ripple Rejections	RR	$12\text{V}<V_{IN}<21\text{V}$ , $I_O=40\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$	38	65	—	dB
Output Noise Voltage	$V_{NO}$	$BW=10\text{Hz}\sim 100\text{kHz}$ , $V_{IN}=15\text{V}$ , $I_O=40\text{mA}$	—	125	—	$\mu\text{V}$
<b>NJM78L12A</b>						
Output Voltage	$V_O$	$V_{IN}=19\text{V}$ , $I_O=40\text{mA}$	11.4	12	12.6	V
Line Regulation 1	$\Delta V_O-V_{IN1}$	$V_{IN}=14.5\sim 27\text{V}$ , $I_O=40\text{mA}$	—	—	250	mV
Line Regulation 2	$\Delta V_O-V_{IN2}$	$V_{IN}=16\sim 27\text{V}$ , $I_O=40\text{mA}$	—	—	200	mV
Load Regulation 1	$\Delta V_O-I_{O1}$	$V_{IN}=19\text{V}$ , $I_O=1\sim 40\text{mA}$	—	—	50	mV
Load Regulation 2	$\Delta V_O-I_{O2}$	$V_{IN}=19\text{V}$ , $I_O=1\sim 100\text{mA}$	—	—	100	mV
Quiescent Current	$I_Q$	$V_{IN}=19\text{V}$ , $I_O=0\text{mA}$	—	2.1	6.5	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=19\text{V}$ , $I_O=1\text{mA}$	—	0.9	—	mV/ $^\circ\text{C}$
Ripple Rejections	RR	$15\text{V}<V_{IN}<25\text{V}$ , $I_O=40\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$	37	62	—	dB
Output Noise Voltage	$V_{NO}$	$BW=10\text{Hz}\sim 100\text{kHz}$ , $V_{IN}=19\text{V}$ , $I_O=40\text{mA}$	—	160	—	$\mu\text{V}$

6

■ **ELECTRICAL CHARACTERISTICS** ( $C_{IN}=0.33\ \mu\text{F}$ ,  $C_O=0.1\ \mu\text{F}$ ,  $T_J=25^\circ\text{C}$ ) Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
<b>NJM78L15A</b>						
Output Voltage	$V_O$	$V_{IN}=23\text{V}$ , $I_O=40\text{mA}$	14.3	15	15.7	V
Line Regulation 1	$\Delta V_O \cdot V_{IN1}$	$V_{IN}=17.5\sim 30\text{V}$ , $I_O=40\text{mA}$	—	—	300	mV
Line Regulation 2	$\Delta V_O \cdot V_{IN2}$	$V_{IN}=20\sim 30\text{V}$ , $I_O=40\text{mA}$	—	—	250	mV
Load Regulation 1	$\Delta V_O \cdot I_{O1}$	$V_{IN}=23\text{V}$ , $I_O=1\sim 40\text{mA}$	—	—	75	mV
Load Regulation 2	$\Delta V_O \cdot I_{O2}$	$V_{IN}=23\text{V}$ , $I_O=1\sim 100\text{mA}$	—	—	150	mV
Quiescent Current	$I_Q$	$V_{IN}=23\text{V}$ , $I_O=0\text{mA}$	—	2.2	6.5	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O / \Delta T$	$V_{IN}=23\text{V}$ , $I_O=1\text{mA}$	—	1.0	—	mV/ $^\circ\text{C}$
Ripple Rejections	RR	$18.5\text{V} < V_{IN} < 28.5\text{V}$ , $I_O=40\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$	34	60	—	dB
Output Noise Voltage	$V_{NO}$	$BW=10\text{Hz}\sim 100\text{kHz}$ , $V_{IN}=23\text{V}$ , $I_O=40\text{mA}$	—	190	—	$\mu\text{V}$
<b>NJM78L18A</b>						
Output Voltage	$V_O$	$V_{IN}=27\text{V}$ , $I_O=40\text{mA}$	17.1	18	18.9	V
Line Regulation 1	$\Delta V_O \cdot V_{IN1}$	$V_{IN}=22\sim 33\text{V}$ , $I_O=40\text{mA}$	—	—	320	mV
Line Regulation 2	$\Delta V_O \cdot V_{IN2}$	$V_{IN}=23\sim 33\text{V}$ , $I_O=40\text{mA}$	—	—	270	mV
Load Regulation 1	$\Delta V_O \cdot I_{O1}$	$V_{IN}=27\text{V}$ , $I_O=1\sim 40\text{mA}$	—	—	80	mV
Load Regulation 2	$\Delta V_O \cdot I_{O2}$	$V_{IN}=27\text{V}$ , $I_O=1\sim 100\text{mA}$	—	—	160	mV
Quiescent Current	$I_Q$	$V_{IN}=27\text{V}$ , $I_O=0\text{mA}$	—	2.2	6.5	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O / \Delta T$	$V_{IN}=27\text{V}$ , $I_O=1\text{mA}$	—	1.1	—	mV/ $^\circ\text{C}$
Ripple Rejections	RR	$23\text{V} < V_{IN} < 33\text{V}$ , $I_O=40\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$	33	59	—	dB
Output Noise Voltage	$V_{NO}$	$BW=10\text{Hz}\sim 100\text{kHz}$ , $V_{IN}=27\text{V}$ , $I_O=40\text{mA}$	—	230	—	$\mu\text{V}$
<b>NJM78L20A</b>						
Output Voltage	$V_O$	$V_{IN}=29\text{V}$ , $I_O=40\text{mA}$	19.0	20	21	V
Line Regulation 1	$\Delta V_O \cdot V_{IN1}$	$V_{IN}=23\sim 34\text{V}$ , $I_O=40\text{mA}$	—	—	330	mV
Line Regulation 2	$\Delta V_O \cdot V_{IN2}$	$V_{IN}=24\sim 34\text{V}$ , $I_O=40\text{mA}$	—	—	280	mV
Load Regulation 1	$\Delta V_O \cdot I_{O1}$	$V_{IN}=29\text{V}$ , $I_O=1\sim 40\text{mA}$	—	—	90	mV
Load Regulation 2	$\Delta V_O \cdot I_{O2}$	$V_{IN}=29\text{V}$ , $I_O=1\sim 100\text{mA}$	—	—	180	mV
Quiescent Current	$I_Q$	$V_{IN}=29\text{V}$ , $I_O=1\text{mA}$	—	2.3	7	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O / \Delta T$	$V_{IN}=29\text{V}$ , $I_O=1\text{mA}$	—	1.2	—	mV/ $^\circ\text{C}$
Ripple Rejections	RR	$24\text{V} < V_{IN} < 34\text{V}$ , $I_O=40\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$	32	58	—	dB
Output Noise Voltage	$V_{NO}$	$BW=10\text{Hz}\sim 100\text{kHz}$ , $V_{IN}=29\text{V}$ , $I_O=40\text{mA}$	—	250	—	$\mu\text{V}$
<b>NJM78L24A</b>						
Output Voltage	$V_O$	$V_{IN}=33\text{V}$ , $I_O=40\text{mA}$	22.8	24	25.2	V
Line Regulation 1	$\Delta V_O \cdot V_{IN1}$	$V_{IN}=27\sim 38\text{V}$ , $I_O=40\text{mA}$	—	—	350	mV
Line Regulation 2	$\Delta V_O \cdot V_{IN2}$	$V_{IN}=28\sim 38\text{V}$ , $I_O=40\text{mA}$	—	—	300	mV
Load Regulation 1	$\Delta V_O \cdot I_{O1}$	$V_{IN}=33\text{V}$ , $I_O=1\sim 40\text{mA}$	—	—	100	mV
Load Regulation 2	$\Delta V_O \cdot I_{O2}$	$V_{IN}=33\text{V}$ , $I_O=1\sim 100\text{mA}$	—	—	200	mV
Quiescent Current	$I_Q$	$V_{IN}=33\text{V}$ , $I_O=0\text{mA}$	—	2.3	7	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O / \Delta T$	$V_{IN}=33\text{V}$ , $I_O=1\text{mA}$	—	1.4	—	mV/ $^\circ\text{C}$
Ripple Rejections	RR	$27.5\text{V} < V_{IN} < 37.5\text{V}$ , $I_O=40\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$	32	57	—	dB
Output Noise Voltage	$V_{NO}$	$BW=10\text{Hz}\sim 100\text{kHz}$ , $V_{IN}=33\text{V}$ , $I_O=40\text{mA}$	—	280	—	$\mu\text{V}$

■ SOT- 89 MARK



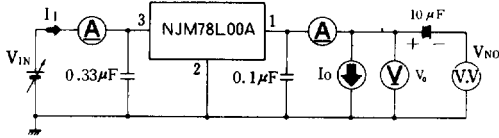
- (1)8: Positive Output
- (2)Vo Rank
- (3)The end of A.D.
- (4)Production Month

Oct. ...X  
 Nov. ...Y  
 Dec. ...Z

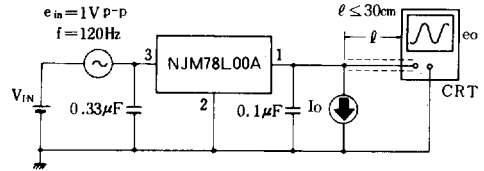
	(1)	(2)
NJM78L02UA	8	A
NJM78L05UA	8	C
NJM78L06UA	8	E
NJM78L08UA	8	G
NJM78L09UA	8	H
NJM78L12UA	8	K
NJM78L15UA	8	L
NJM78L18UA	8	M
NJM78L20UA	8	N
NJM78L24UA	8	P

## ■ TEST CIRCUIT

1. Output Voltage, Line Regulation, Load Regulation, Quiescent Current, Average Temperature Coefficient of Output Voltage, Output Noise Voltage, Peak Output/Short-Circuit Current
2. Ripple Rejection

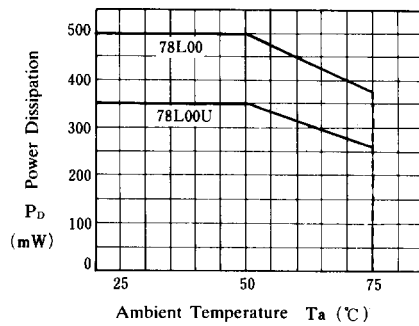


- Measurement is to be conducted in pulse testing.
- $I_Q = I_1 - I_o$



$$RR = 20 \log_{10} \left( \frac{e_{in}}{e_o} \right) \text{ (dB)}$$

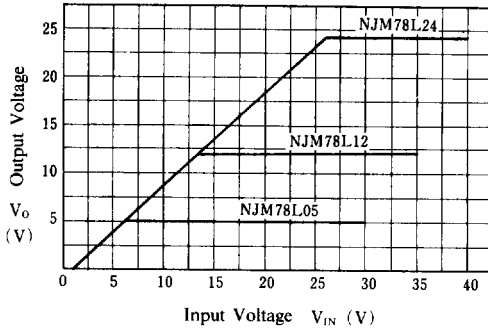
## ■ AMBIENT TEMPERATURE VS. POWER DISSIPATION



## ■ TYPICAL CHARACTERISTICS

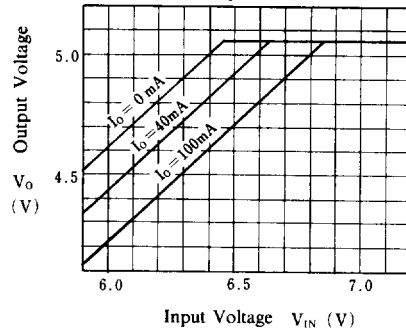
**NJM78L05/L12/L24**  
Output Characteristics

( $I_O = 0 \text{ mA}$ ,  $T_j = 25^\circ\text{C}$ )



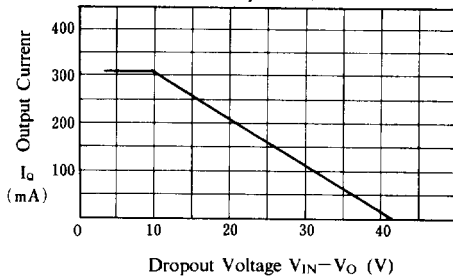
**NJM78L05 Dropout Characteristics**

( $T_j = 25^\circ\text{C}$ )



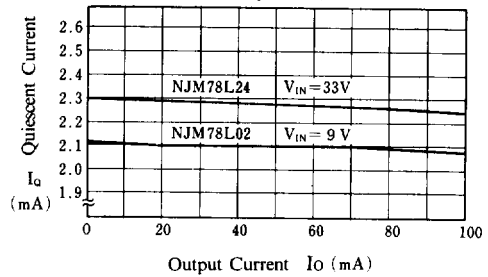
**NJM78L00 Series Short Circuit**  
Output Current

( $T_j = 25^\circ\text{C}$ )



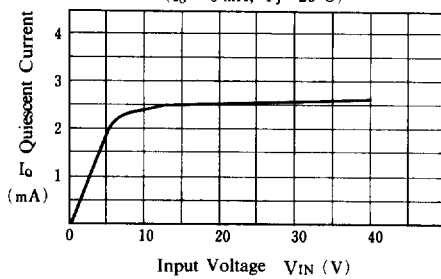
**NJM78L02/L24 Quiescent Current**  
vs. Output Current

( $T_j = 25^\circ\text{C}$ )

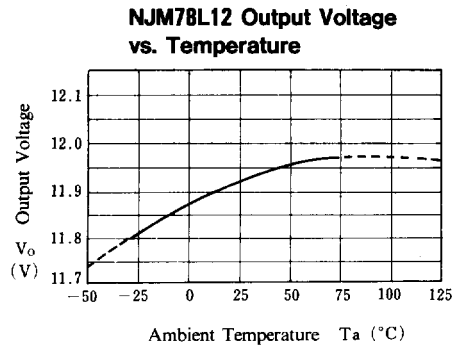
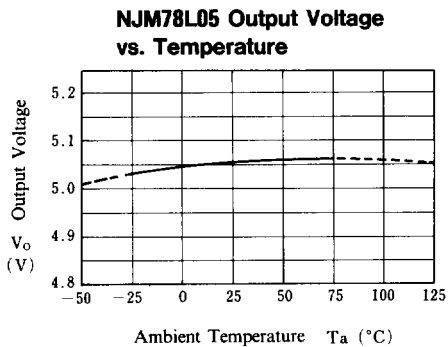
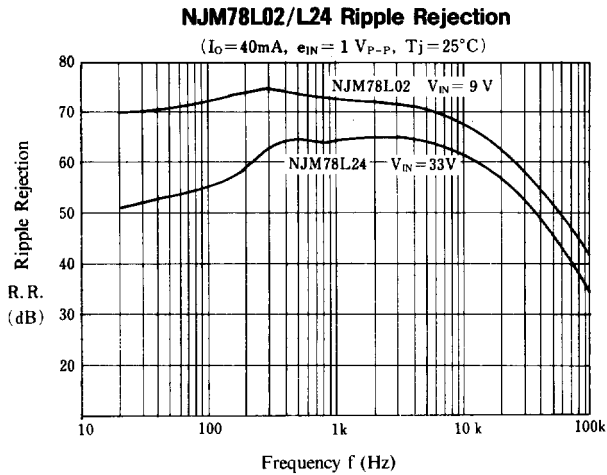
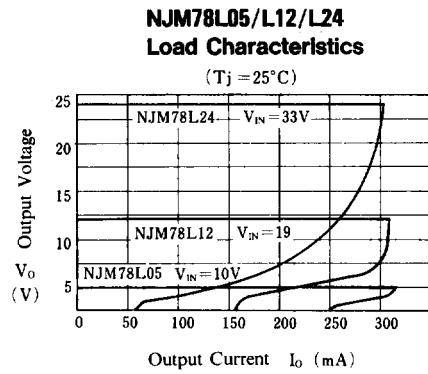
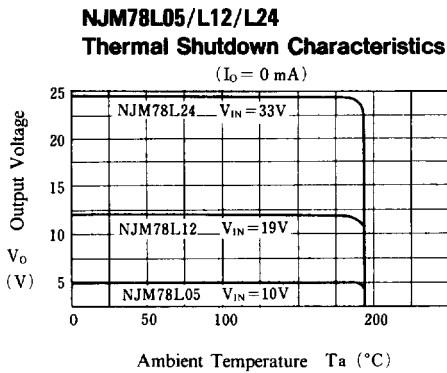


**NJM78L05 Quiescent Current**  
vs. Input Voltage

( $I_O = 0 \text{ mA}$ ,  $T_j = 25^\circ\text{C}$ )



## TYPICAL CHARACTERISTICS





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