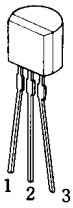
3-TERMINAL POSITIVE VOLTAGE REGULATOR

■ 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.

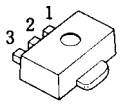
■ PACKAGE OUTLINE

(TO-92)



NJM78L00A
1.OUT
2.GND
3.IN

(SOT-89)

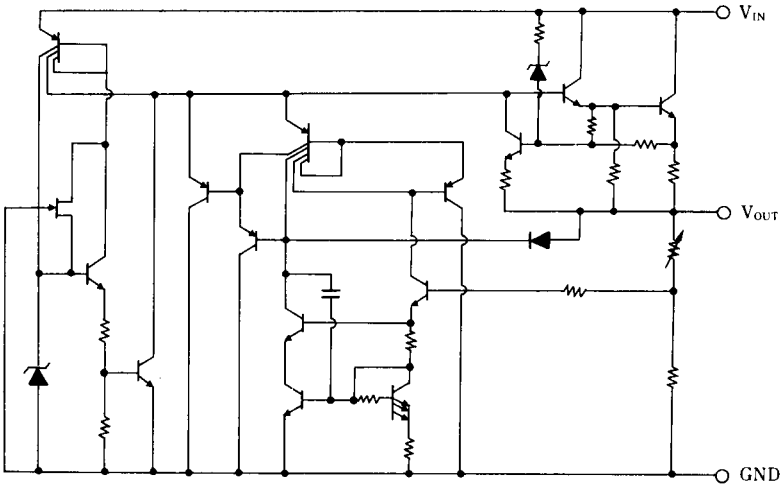


NJM78L00UA
1.OUT
2.GND
3.IN

■ 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 (T_a=25°C)

PARAMETER	SYMBOL	MAXIMUM RATINGS	UNIT
Input Voltage	V_{IN}	(78L02A to 78L09A) 30 (78L12A to 78L15A) 35 (78L18A to 78L24A) 40	V
Power Dissipation	P_D	(TO-92) 500 (EMP8) 350 (SOT-89) 300	mW
Operating Temperature Range	T_{opr}	-40 to +85	°C
Storage Temperature Range	T_{stg}	-40 to +150	°C

■ ELECTRICAL CHARACTERISTICS(C_{IN}=0.33µF, C_O=0.1µF, T_j=25°C)

Measurement is to be conducted is pulse testing.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L02A						
Output Voltage	V_O	V_{IN}=9V, I_O=40mA	2.47	2.6	2.73	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=4.75V to 20V, I_O=40mA	-	-	125	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=5V to 20V, I_O=40mA	-	-	100	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=9V, I_O=1 to 40mA	-	-	25	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=9V, I_O=1 to 100mA	-	-	50	mV
Quiescent Current	I_Q	V_{IN}=9V, I_O=0mA	-	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=9V, I_O=1mA	-	0.2	-	mV/°C
Ripple Rejection	RR	6V< V_{IN} <16V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	43	73	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=9V, BW=10Hz to 100kHz, I_O=40mA	-	35	-	µV
NJM78L03A(*1)						
Output Voltage	V_O	V_{IN}=9V, I_O=40mA	2.85	3.0	3.15	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=5V to 20V, I_O=40mA	-	-	125	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=6V to 20V, I_O=40mA	-	-	100	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=9V, I_O=1 to 40mA	-	-	25	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=9V, I_O=1 to 100mA	-	-	50	mV
Quiescent Current	I_Q	V_{IN}=9V, I_O=0mA	-	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=9V, I_O=1mA	-	0.2	-	mV/°C
Ripple Rejection	RR	6V< V_{IN} <16V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	43	72	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=9V, BW=10Hz to 100kHz, I_O=40mA	-	40	-	µV
NJM78L05A(*3)						
Output Voltage	V_O	V_{IN}=10V, I_O=40mA	4.75	5.0	5.25	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=7V to 20V, I_O=40mA	-	-	200	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=8V to 20V, I_O=40mA	-	-	150	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=10V, I_O=1 to 40mA	-	-	30	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=10V, I_O=1 to 100mA	-	-	60	mV
Quiescent Current	I_Q	V_{IN}=10V, I_O=0mA	-	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=10V, I_O=1mA	-	0.4	-	mV/°C
Ripple Rejection	RR	8V< V_{IN} <18V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	40	69	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=10V, BW=10Hz to 100kHz, I_O=40mA	-	70	-	µV

(*1) : SOT-89 package only.
(*2) : TO-92 package only.
(*3) : SOT-89, TO-92, EMP8

■ **ELECTRICAL CHARACTERISTICS**(C_{IN}=0.33μF, C_O=0.1μF, T_j=25°C)

Measurement is to be conducted is pulse testing.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L06A						
Output Voltage	V_O	V_{IN}=12V, I_O=40mA	5.7	6.0	6.3	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=8.5V to 20V, I_O=40mA	-	-	200	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=9V to 20V, I_O=40mA	-	-	150	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=12V, I_O=1 to 40mA	-	-	40	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=12V, I_O=1 to 100mA	-	-	80	mV
Quiescent Current	I_Q	V_{IN}=12V, I_O=0mA	-	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=12V, I_O=1mA	-	0.5	-	mV/°C
Ripple Rejection	RR	9V< V_{IN} <20V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	40	67	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=12V, BW=10Hz to 100kHz, I_O=40mA	-	80	-	μV
NJM78L62A(*2)						
Output Voltage	V_O	V_{IN}=12.2V, I_O=40mA	5.89	6.2	6.51	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=8.7V to 20.2V, I_O=40mA	-	-	200	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=9.2V to 20.2V, I_O=40mA	-	-	150	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=12.2V, I_O=1 to 40mA	-	-	40	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=12.2V, I_O=1 to 100mA	-	-	85	mV
Quiescent Current	I_Q	V_{IN}=12.2V, I_O=0mA	-	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=12.2V, I_O=1mA	-	0.5	-	mV/°C
Ripple Rejection	RR	9.2V< V_{IN} <20.2V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	40	67	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=12.2V, BW=10Hz to 100kHz, I_O=40mA	-	85	-	μV
NJM78L07A						
Output Voltage	V_O	V_{IN}=13V, I_O=40mA	6.65	7.0	7.35	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=9.5V to 22V, I_O=40mA	-	-	210	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=10V to 22V, I_O=40mA	-	-	160	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=13V, I_O=1 to 40mA	-	-	45	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=13V, I_O=1 to 100mA	-	-	90	mV
Quiescent Current	I_Q	V_{IN}=13V, I_O=0mA	-	2.1	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=13V, I_O=1mA	-	0.55	-	mV/°C
Ripple Rejection	RR	10V< V_{IN} <20V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	39	66	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=13V, BW=10Hz to 100kHz, I_O=40mA	-	100	-	μV
NJM78L08A						
Output Voltage	V_O	V_{IN}=14V, I_O=40mA	7.6	8.0	8.4	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=10.5V to 23V, I_O=40mA	-	-	225	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=11V to 23V, I_O=40mA	-	-	175	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=14V, I_O=1 to 40mA	-	-	50	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=14V, I_O=1 to 100mA	-	-	100	mV
Quiescent Current	I_Q	V_{IN}=14V, I_O=0mA	-	2.1	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=14V, I_O=1mA	-	0.6	-	mV/°C
Ripple Rejection	RR	11V< V_{IN} <20V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	39	66	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=14V, BW=10Hz to 100kHz, I_O=40mA	-	115	-	μV

(*1) : SOT-89 package only.
(*2) : TO-92 package only.
(*3) : SOT-89, TO-92, EMP8

■ **ELECTRICAL CHARACTERISTICS**(C_{IN}=0.33μF, C_O=0.1μF, T_j=25°C)

Measurement is to be conducted is pulse testing.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L09A(*3)						
Output Voltage	V_O	V_{IN}=15V, I_O=40mA	8.55	9.0	9.45	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=11.5V to 23V, I_O=40mA	-	-	250	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=12V to 23V, I_O=40mA	-	-	200	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=15V, I_O=1 to 40mA	-	-	50	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=15V, I_O=1 to 100mA	-	-	100	mV
Quiescent Current	I_Q	V_{IN}=15V, I_O=0mA	-	2.1	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=15V, I_O=1mA	-	0.65	-	mV/°C
Ripple Rejection	RR	12V< V_{IN} <21V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	38	65	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=15V, BW=10Hz to 100kHz, I_O=40mA	-	125	-	μV
NJM78L10A						
Output Voltage	V_O	V_{IN}=16V, I_O=40mA	9.5	10.0	10.5	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=13V to 25V, I_O=40mA	-	-	250	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=14V to 25V, I_O=40mA	-	-	200	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=16V, I_O=1 to 40mA	-	-	50	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=16V, I_O=1 to 100mA	-	-	100	mV
Quiescent Current	I_Q	V_{IN}=16V, I_O=0mA	-	2.1	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=16V, I_O=1mA	-	0.7	-	mV/°C
Ripple Rejection	RR	13V< V_{IN} <22V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	37	64	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=16V, BW=10Hz to 100kHz, I_O=40mA	-	135	-	μV
NJM78L12A(*3)						
Output Voltage	V_O	V_{IN}=19V, I_O=40mA	11.4	12.0	12.6	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=14.5V to 27V, I_O=40mA	-	-	250	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=16V to 27V, I_O=40mA	-	-	200	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=19V, I_O=1 to 40mA	-	-	50	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=19V, I_O=1 to 100mA	-	-	100	mV
Quiescent Current	I_Q	V_{IN}=19V, I_O=0mA	-	2.1	6.5	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=19V, I_O=1mA	-	0.9	-	mV/°C
Ripple Rejection	RR	15V< V_{IN} <25V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	37	62	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=19V, BW=10Hz to 100kHz, I_O=40mA	-	160	-	μV
NJM78L15A						
Output Voltage	V_O	V_{IN}=23V, I_O=40mA	14.3	15.0	15.7	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=17.5V to 30V, I_O=40mA	-	-	300	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=20V to 30V, I_O=40mA	-	-	250	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=23V, I_O=1 to 40mA	-	-	75	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=23V, I_O=1 to 100mA	-	-	150	mV
Quiescent Current	I_Q	V_{IN}=23V, I_O=0mA	-	2.2	6.5	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=23V, I_O=1mA	-	1.0	-	mV/°C
Ripple Rejection	RR	18.5V< V_{IN} <28.5V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	34	60	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=23V, BW=10Hz to 100kHz, I_O=40mA	-	190	-	μV

(*1) : SOT-89 package only.
(*2) : TO-92 package only.
(*3) : SOT-89, TO-92, EMP8

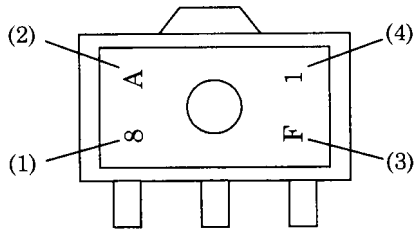
■ **ELECTRICAL CHARACTERISTICS**(C_{IN}=0.33µF, C_O=0.1µF, T_j=25°C)

Measurement is to be conducted is pulse testing.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L18A						
Output Voltage	V_O	V_{IN}=27V, I_O=40mA	17.1	18.0	18.9	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=22V to 33V, I_O=40mA	-	-	320	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=22V to 33V, I_O=40mA	-	-	270	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=27V, I_O=1 to 40mA	-	-	80	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=27V, I_O=1 to 100mA	-	-	160	mV
Quiescent Current	I_Q	V_{IN}=27V, I_O=0mA	-	2.2	6.5	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=27V, I_O=1mA	-	1.1	-	mV/°C
Ripple Rejection	RR	23V< V_{IN} <33V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	33	59	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=27V, BW=10Hz to 100kHz, I_O=40mA	-	230	-	µV
NJM78L20A						
Output Voltage	V_O	V_{IN}=29V, I_O=40mA	19.0	20.0	21.0	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=23V to 34V, I_O=40mA	-	-	330	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=24V to 34V, I_O=40mA	-	-	280	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=29V, I_O=1 to 40mA	-	-	90	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=29V, I_O=1 to 100mA	-	-	180	mV
Quiescent Current	I_Q	V_{IN}=29V, I_O=0mA	-	2.3	7	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=29V, I_O=1mA	-	1.2	-	mV/°C
Ripple Rejection	RR	24V< V_{IN} <34V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	32	58	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=29V, BW=10Hz to 100kHz, I_O=40mA	-	250	-	µV
NJM78L24A						
Output Voltage	V_O	V_{IN}=33V, I_O=40mA	22.8	24	25.2	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=27V to 38V, I_O=40mA	-	-	350	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=28V to 38V, I_O=40mA	-	-	300	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=33V, I_O=1 to 40mA	-	-	100	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=33V, I_O=1 to 100mA	-	-	200	mV
Quiescent Current	I_Q	V_{IN}=33V, I_O=0mA	-	2.3	7	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=33V, I_O=1mA	-	1.4	-	mV/°C
Ripple Rejection	RR	27.5V< V_{IN} <37.5V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	32	57	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=33V, BW=10Hz to 100kHz, I_O=40mA	-	280	-	µV

(*1) : SOT-89 package only.
(*2) : TO-92 package only.
(*3) : SOT-89, TO-92, EMP8

■ **SOT-89 MARK**

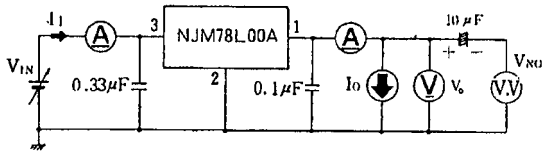


(1) 8 : Positive Output
(2) V_O Rank
(3) The end of A.D.
(4) Production Mouth
Oct. ···X
Nov. ···Y
Dec. ···Z

NJM78L02A	8	A
NJM78L03A	8	B
NJM78L05A	8	C
NJM78L06A	8	E
NJM78L62A	8	Z
NJM78L07A	8	F
NJM78L08A	8	G
NJM78L09A	8	H
NJM78L10A	8	J
NJM78L12A	8	K
NJM78L15A	8	L
NJM78L18A	8	M
NJM78L20A	8	N
NJM78L24A	8	P

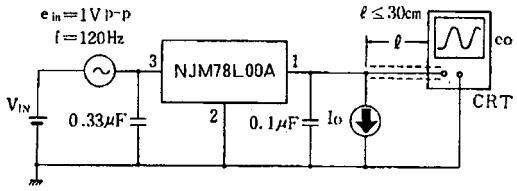
■ TEST CIRCUIT

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



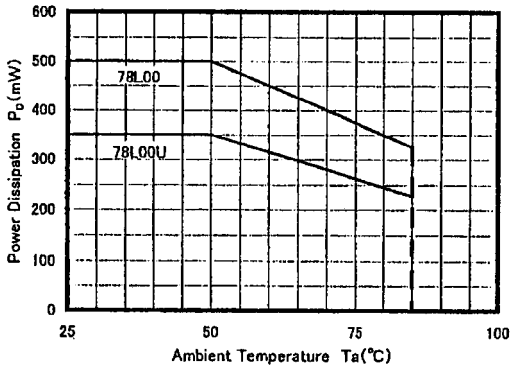
○ Measurement is to be conducted in pulse testing.
○ $I_Q = I_I - I_O$

2. Ripple Rejection



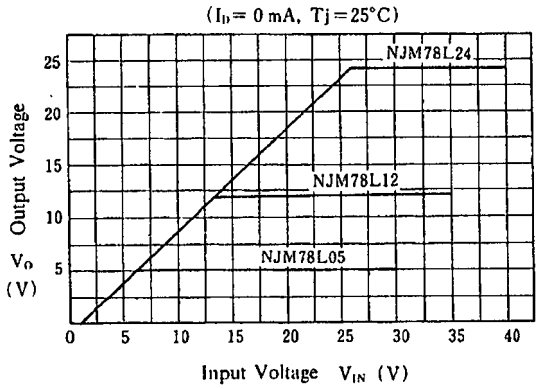
$$RR = 20\log_{10}\left(\frac{e_{in}}{e_O}\right) \quad (dB)$$

■ AMBIENT TEMPERATURE VS.POWER DISSIPATION

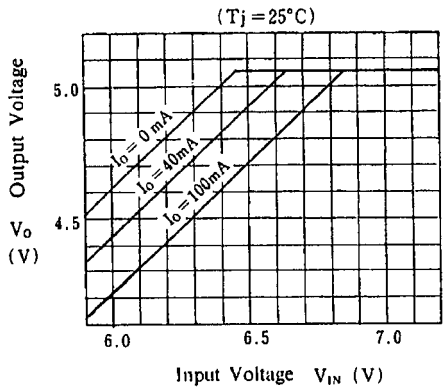


■ TYPICAL CHARACTERISTICS

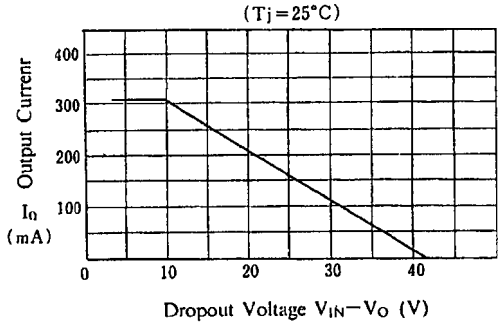
NJM78L05 / L12 / L24 Output Characteristics



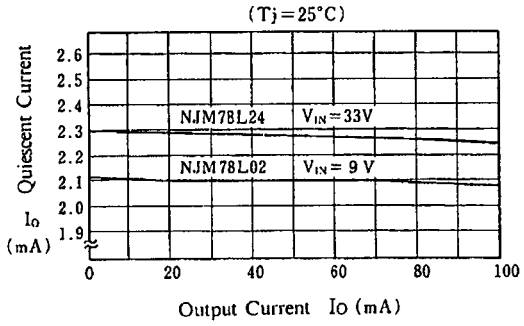
NJM78L05 Dropout Characteristics



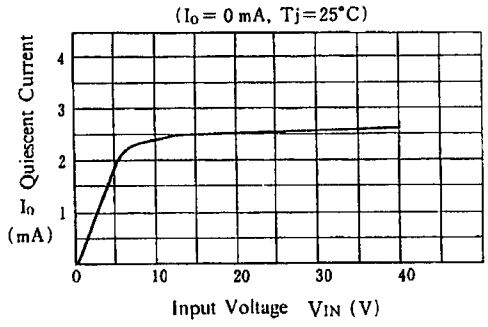
NJM78L00 Series Short Circuit Output Current



NJM78L02 / L24 Quiescent Current vs. Output Current

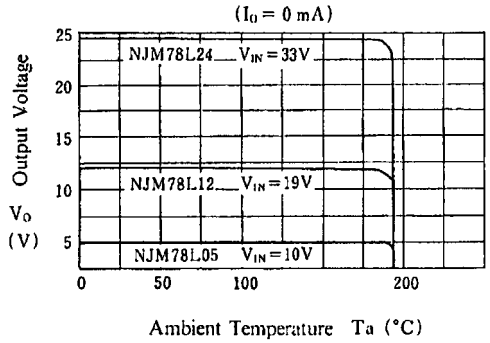


NJM78L05 Quiescent Current vs. Input Voltage

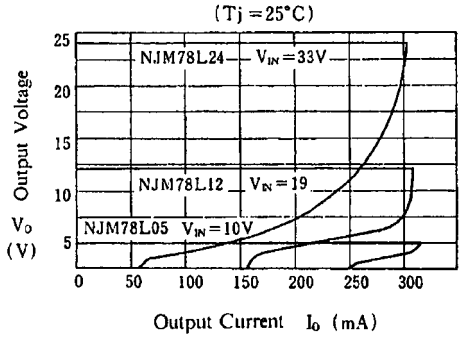


■ TYPICAL CHARACTERISTICS

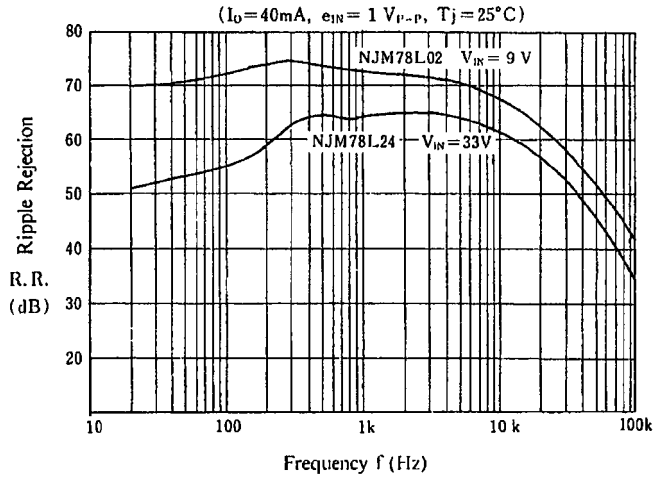
NJM78L05 / L12 / L24
Thermal Shutdown Characteristics



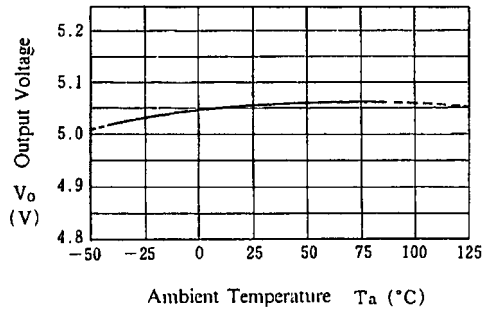
NJM78L05 / L12 / L24
Load Characteristics



NJM78L02 / L24 Ripple Rejection



NJM78L05 Output Voltage
vs. Temperature



NJM78L12 Output Voltage
vs. Temperature