

3-TERMINAL POSITIVE VOLTAGE REGULATOR

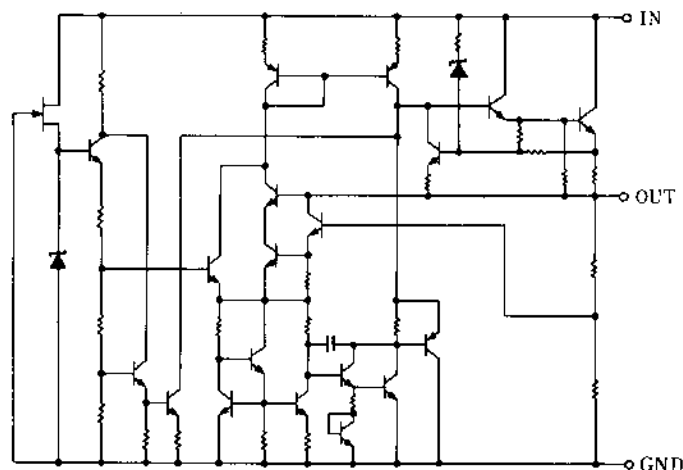
■ GENERAL DESCRIPTION

The NJM7800 series of monolithic 3-Terminal Positive Voltage Regulators is constructed using the New JRC Planar epitaxial process. These regulators employ internal current-limiting, thermal-shutdown and safe-area compensation making them essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. They are intended as fixed voltage regulators in a wide range of applications including local (on card) regulation for elimination of distribution problems associated with single point regulation. In addition to use as fixed voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents.

■ FEATURES

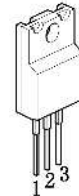
- Internal Short Circuit Current Limit
- Internal Thermal Overload Protection
- Excellent Ripple Rejection
- Guaranteed 1.5A Output Current
- Package Outline TO-220F, TO-252
- Bipolar Technology

■ EQUIVALENT CIRCUIT

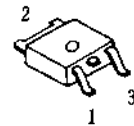


■ PACKAGE OUTLINE

(TO-220F)



(TO-252)



NJM7800FA

1. IN
2. GND
3. OUT

NJM7800DL1A

1. IN
2. GND
3. OUT

(note) The radiation fin is connected pin 2.

NJM7800

■ ABSOLUTE MAXIMUM RATINGS

(Ta = 25°C)

PARAMETER	SYMBOL	MAXIMUM RATINGS		UNIT
Input Voltage	V_{IN}	7805 to 7810 7812 to 7815 7818 to 7824	35 35 40	V
Storage Temperature Range	T_{stg}	-40 to +150		°C
Operating Temperature Range	Operating Junction Temperature	T_j	-40 to +150	°C
		Operating Temperature	T_{opr}	
Power Dissipation	P_D	TO-220F TO-252	16($T_C \leq 70^\circ\text{C}$) 10($T_C = 25^\circ\text{C}$) 1($T_a \leq 25^\circ\text{C}$)	W

■ ELECTRICAL CHARACTERISTICS ($C_I = 0.33\mu\text{F}$, $C_O = 0.1\mu\text{F}$, $T_j = 25^\circ\text{C}$)

Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITIONS	TO-220F			TO-252			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
NJM7805FA/DL1A									
Output Voltage	V_O	$V_{IN}=10\text{V}$, $I_O=0.5\text{A}$	4.8	5.0	5.2	4.8	5.0	5.2	V
Line Regulation	$\Delta V_O - V_{IN}$	$V_{IN}=7$ to 25V, $I_O=0.5\text{A}$	-	3	50	-	3	100	mV
Load Regulation	$\Delta V_O - I_O$	$V_{IN}=10\text{V}$, $I_O=0.005$ to 1.5A	-	15	50	-	15	100	mV
Quiescent Current	I_Q	$V_{IN}=10\text{V}$, $I_O=0\text{mA}$	-	4.2	6.0	-	4.2	6.0	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=10\text{V}$, $I_O=5\text{mA}$	-	-0.5	-	-	-0.5	-	mV/°C
Ripple Rejection	RR	$V_{IN}=10\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2V_{P-P}$, $f=120\text{Hz}$	68	78	-	68	78	-	dB
Output Noise Voltage	V_{NO}	$V_{IN}=10\text{V}$, $BW=10\text{Hz}$ to 100kHz, $I_O=0.5\text{A}$	-	45	-	-	45	-	μV
NJM7806FA/DL1A									
Output Voltage	V_O	$V_{IN}=11\text{V}$, $I_O=0.5\text{A}$	5.75	6.0	6.25	5.75	6.0	6.25	V
Line Regulation	$\Delta V_O - V_{IN}$	$V_{IN}=8$ to 25V, $I_O=0.5\text{A}$	-	5	60	-	5	120	mV
Load Regulation	$\Delta V_O - I_O$	$V_{IN}=11\text{V}$, $I_O=0.005$ to 1.5A	-	15	60	-	15	120	mV
Quiescent Current	I_Q	$V_{IN}=11\text{V}$, $I_O=0\text{mA}$	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=11\text{V}$, $I_O=5\text{mA}$	-	-0.6	-	-	-0.6	-	mV/°C
Ripple Rejection	RR	$V_{IN}=11\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2V_{P-P}$, $f=120\text{Hz}$	65	75	-	65	75	-	dB
Output Noise Voltage	V_{NO}	$V_{IN}=11\text{V}$, $BW=10\text{Hz}$ to 100kHz, $I_O=0.5\text{A}$	-	45	-	-	45	-	μV

■ **ELECTRICAL CHARACTERISTICS** ($C_1 = 0.33\mu\text{F}$, $C_O = 0.1\mu\text{F}$, $T_j = 25^\circ\text{C}$)

Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITIONS	TO-220F			TO-252			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
NJM7808FA/DL1A									
Output Voltage	V_O	$V_{IN}=14\text{V}$, $I_O=0.5\text{A}$	7.7	8.0	8.3	7.7	8.0	8.3	V
Line Regulation	$\Delta V_O - V_{IN}$	$V_{IN}=10.5$ to 25V , $I_O=0.5\text{A}$	-	6	80	-	6	160	mV
Load Regulation	$\Delta V_O - I_O$	$V_{IN}=14\text{V}$, $I_O=0.005$ to 1.5A	-	15	80	-	15	160	mV
Quiescent Current	I_Q	$V_{IN}=14\text{V}$, $I_O=0\text{mA}$	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=14\text{V}$, $I_O=5\text{mA}$	-	-0.8	-	-	-0.8	-	mV/°C
Ripple Rejection	RR	$V_{IN}=14\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2V_{P-P}$, $f=120\text{Hz}$	62	72	-	62	72	-	dB
Output Noise Voltage	V_{No}	$V_{IN}=14\text{V}$, $BW=10\text{Hz}$ to 100kHz , $I_O=0.5\text{A}$	-	55	-	-	55	-	μV
NJM7809FA/DL1A									
Output Voltage	V_O	$V_{IN}=15\text{V}$, $I_O=0.5\text{A}$	8.65	9.0	9.35	8.65	9.0	9.35	V
Line Regulation	$\Delta V_O - V_{IN}$	$V_{IN}=11.5$ to 25V , $I_O=0.5\text{A}$	-	7	90	-	7	180	mV
Load Regulation	$\Delta V_O - I_O$	$V_{IN}=15\text{V}$, $I_O=0.005$ to 1.5A	-	15	90	-	15	180	mV
Quiescent Current	I_Q	$V_{IN}=15\text{V}$, $I_O=0\text{mA}$	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=15\text{V}$, $I_O=5\text{mA}$	-	-0.9	-	-	-0.9	-	mV/°C
Ripple Rejection	RR	$V_{IN}=15\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2V_{P-P}$, $f=120\text{Hz}$	62	72	-	62	72	-	dB
Output Noise Voltage	V_{No}	$V_{IN}=15\text{V}$, $BW=10\text{Hz}$ to 100kHz , $I_O=0.5\text{A}$	-	60	-	-	60	-	μV
NJM7810FA/DL1A									
Output Voltage	V_O	$V_{IN}=17\text{V}$, $I_O=0.5\text{A}$	9.60	10.0	10.4	9.60	10.0	10.4	V
Line Regulation	$\Delta V_O - V_{IN}$	$V_{IN}=12.5$ to 25V , $I_O=0.5\text{A}$	-	7	100	-	7	200	mV
Load Regulation	$\Delta V_O - I_O$	$V_{IN}=17\text{V}$, $I_O=0.005$ to 1.5A	-	15	130	-	15	200	mV
Quiescent Current	I_Q	$V_{IN}=17\text{V}$, $I_O=0\text{mA}$	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=17\text{V}$, $I_O=5\text{mA}$	-	-0.9	-	-	-1.0	-	mV/°C
Ripple Rejection	RR	$V_{IN}=17\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2V_{P-P}$, $f=120\text{Hz}$	62	72	-	62	72	-	dB
Output Noise Voltage	V_{No}	$V_{IN}=17\text{V}$, $BW=10\text{Hz}$ to 100kHz , $I_O=0.5\text{A}$	-	60	-	-	65	-	μV

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■ ELECTRICAL CHARACTERISTICS (C₁ = 0.33μF, C_O = 0.1μF, T_j = 25°C)

Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITIONS	TO-220F			TO-252			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
NJM7812FA/DL1A									
Output Voltage	V _O	V _{IN} =19V, I _O =0.5A	11.5	12.0	12.5	11.5	12.0	12.5	V
Line Regulation	ΔV _O - V _{IN}	V _{IN} =14.5 to 30V, I _O =0.5A	-	10	120	-	10	240	mV
Load Regulation	ΔV _O - I _O	V _{IN} =19V, I _O =0.005 to 1.5A	-	25	120	-	25	240	mV
Quiescent Current	I _Q	V _{IN} =19V, I _O =0mA	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV _O /ΔT	V _{IN} =19V, I _O =5mA	-	-1.2	-	-	-1.2	-	mV/°C
Ripple Rejection	RR	V _{IN} =19V, I _O =0.5A, e _{in} =2V _{P-P} , f=120Hz	61	71	-	61	71	-	dB
Output Noise Voltage	V _{NO}	V _{IN} =19V, BW=10Hz to 100kHz, I _O =0.5A	-	75	-	-	75	-	μV
NJM7815FA/DL1A									
Output Voltage	V _O	V _{IN} =23V, I _O =0.5A	14.4	15.0	15.6	14.4	15.0	15.6	V
Line Regulation	ΔV _O - V _{IN}	V _{IN} =17.5 to 30V, I _O =0.5A	-	11	150	-	11	300	mV
Load Regulation	ΔV _O - I _O	V _{IN} =23V, I _O =0.005 to 1.5A	-	35	150	-	35	300	mV
Quiescent Current	I _Q	V _{IN} =23V, I _O =0mA	-	4.4	6.0	-	4.4	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV _O /ΔT	V _{IN} =23V, I _O =5mA	-	-1.5	-	-	-1.5	-	mV/°C
Ripple Rejection	RR	V _{IN} =23V, I _O =0.5A, e _{in} =2V _{P-P} , f=120Hz	60	70	-	60	70	-	dB
Output Noise Voltage	V _{NO}	V _{IN} =23V, BW=10Hz to 100kHz, I _O =0.5A	-	90	-	-	90	-	μV
NJM7818FA/DL1A									
Output Voltage	V _O	V _{IN} =27V, I _O =0.5A	17.3	18.0	18.7	17.3	18.0	18.7	V
Line Regulation	ΔV _O - V _{IN}	V _{IN} =21 to 33V, I _O =0.5A	-	15	180	-	15	360	mV
Load Regulation	ΔV _O - I _O	V _{IN} =27V, I _O =0.005 to 1.5A	-	55	180	-	55	360	mV
Quiescent Current	I _Q	V _{IN} =27V, I _O =0mA	-	4.5	6.0	-	4.5	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV _O /ΔT	V _{IN} =27V, I _O =5mA	-	-1.8	-	-	-1.8	-	mV/°C
Ripple Rejection	RR	V _{IN} =27V, I _O =0.5A, e _{in} =2V _{P-P} , f=120Hz	59	69	-	59	69	-	dB
Output Noise Voltage	V _{NO}	V _{IN} =27V, BW=10Hz to 100kHz, I _O =0.5A	-	100	-	-	100	-	μV
NJM7820FA/DL1A									
Output Voltage	V _O	V _{IN} =29V, I _O =0.5A	19.2	20.0	20.8	19.2	20.0	20.8	V
Line Regulation	ΔV _O - V _{IN}	V _{IN} =23 to 35V, I _O =0.5A	-	16	200	-	16	400	mV
Load Regulation	ΔV _O - I _O	V _{IN} =29V, I _O =0.005 to 1.5A	-	61	200	-	61	400	mV
Quiescent Current	I _Q	V _{IN} =29V, I _O =0mA	-	4.5	6.0	-	4.5	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV _O /ΔT	V _{IN} =29V, I _O =5mA	-	-2.0	-	-	-2.0	-	mV/°C
Ripple Rejection	RR	V _{IN} =29V, I _O =0.5A, e _{in} =2V _{P-P} , f=120Hz	58	68	-	58	68	-	dB
Output Noise Voltage	V _{NO}	V _{IN} =29V, BW=10Hz to 100kHz, I _O =0.5A	-	120	-	-	120	-	μV

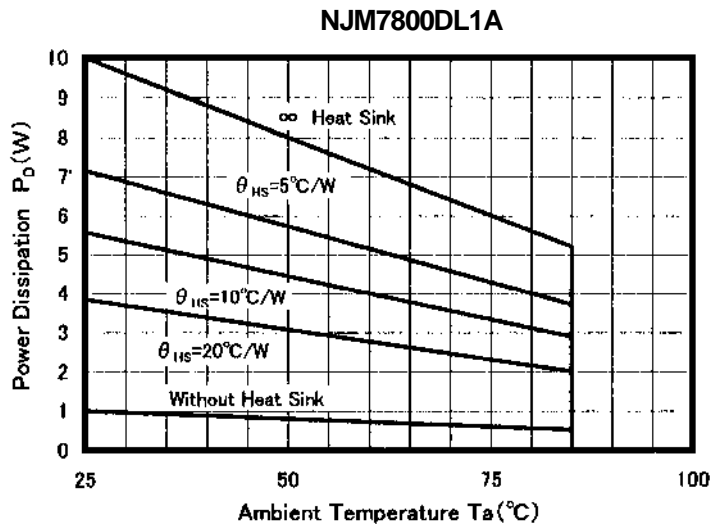
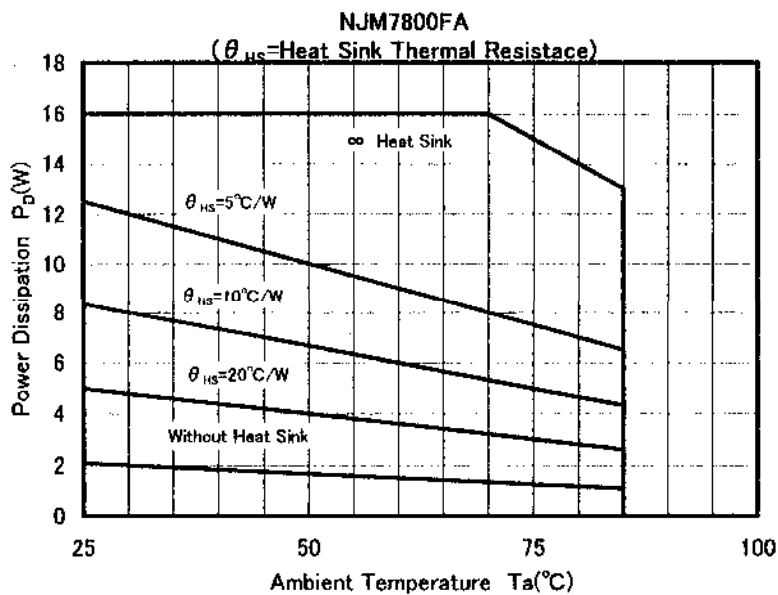
■ ELECTRICAL CHARACTERISTICS ($C_1 = 0.33\mu\text{F}$, $C_O = 0.1\mu\text{F}$, $T_j = 25^\circ\text{C}$)

Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITIONS	TO-220F			TO-252			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
NJM7824FA/DL1A									
Output Voltage	V_O	$V_{IN}=33\text{V}$, $I_O=0.5\text{A}$	23.0	24.0	25.0	23.0	24.0	25.0	V
Line Regulation	$\Delta V_O - V_{IN}$	$V_{IN}=27$ to 38V , $I_O=0.5\text{A}$	-	18	240	-	18	480	mV
Load Regulation	$\Delta V_O - I_O$	$V_{IN}=33\text{V}$, $I_O=0.005$ to 1.5A	-	65	240	-	65	480	mV
Quiescent Current	I_Q	$V_{IN}=33\text{V}$, $I_O=0\text{mA}$	-	4.6	6.0	-	4.6	6.0	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=33\text{V}$, $I_O=5\text{mA}$	-	-2.4	-	-	-2.4	-	mV/°C
Ripple Rejection	RR	$V_{IN}=33\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2\text{V}_{P-P}$, $f=120\text{Hz}$	56	66	-	56	66	-	dB
Output Noise Voltage	V_{No}	$V_{IN}=33\text{V}$, $BW=10\text{Hz}$ to 100kHz , $I_O=0.5\text{A}$	-	120	-	-	120	-	μV

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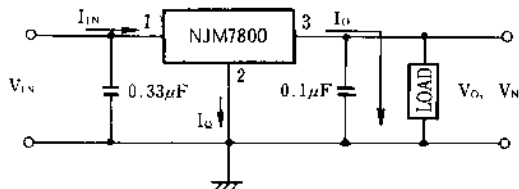
POWER DISSIPATION VS. AMBIENT TEMPERATURE



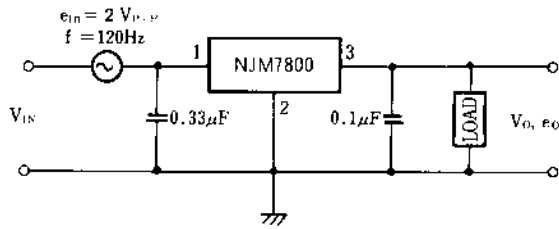
TEST CIRCUIT

1. Output Voltage, Line Regulation, Load Regulation, Quiescent Current, Average Temperature Coefficient of Output Voltage, Output Noise Voltage

2. Ripple Rejection



$$I_Q = I_{IN} - I_O$$



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

■ Input Capacitor C_{IN}

Input Capacitor C_{IN} is required to prevent oscillation and reduce power supply ripple for applications when high power supply impedance or a long power supply line.

Therefore, use the recommended C_{IN} value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and V_{IN} as shortest path as possible to avoid the problem.

■ Output Capacitor C_O

Output capacitor (C_O) will be required for a phase compensation of the internal error amplifier.

The capacitance and the equivalent series resistance (ESR) influence to stable operation of the regulator.

Use of a smaller C_O may cause excess output noise or oscillation of the regulator due to lack of the phase compensation.

On the other hand, Use of a larger C_O reduces output noise and ripple output, and also improves output transient response when rapid load change.

Therefore, use the recommended C_O value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and V_{OUT} as shortest path as possible for stable operation

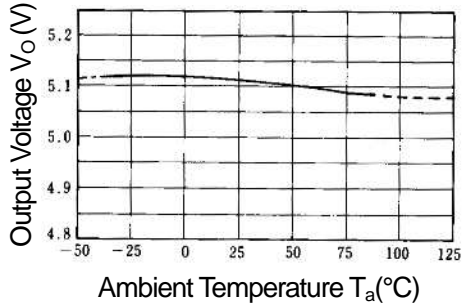
In addition, you should consider varied characteristics of capacitor (a frequency characteristic, a temperature characteristic, a DC bias characteristic and so on) and unevenness peculiar to a capacitor supplier enough.

When selecting C_O , recommend that have withstand voltage margin against output voltage and superior temperature characteristic though

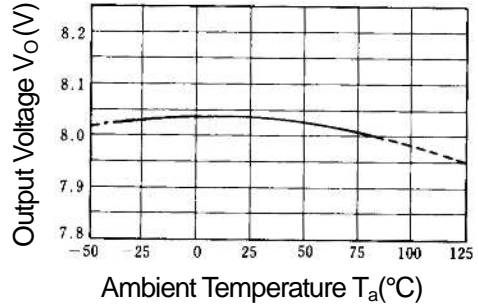
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■ TYPICAL CHARACTERISTICS

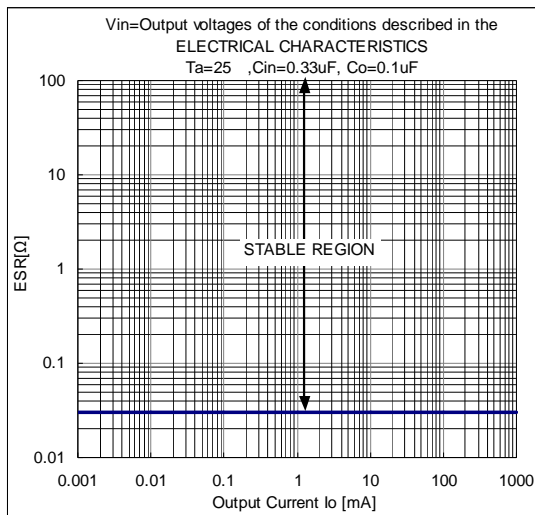
NJM7805 Output Voltage vs. Temperature



NJM7808 Output Voltage vs. Temperature

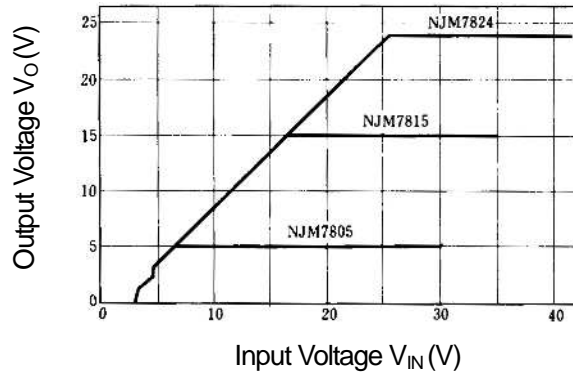


NJM78M00 Series Equivalent Series Resistance vs. Output Current

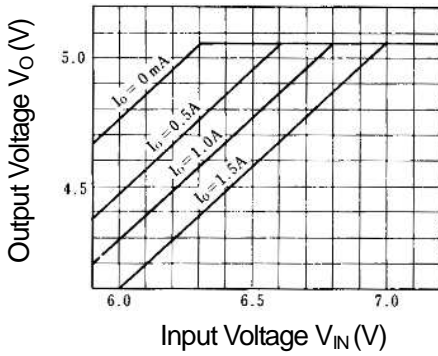


■ TYPICAL CHARACTERISTICS

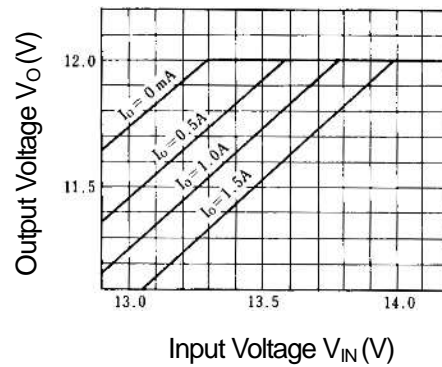
NJM7805/15/24 Output Characteristics ($I_o=0.5A, T_j=25^\circ C$)



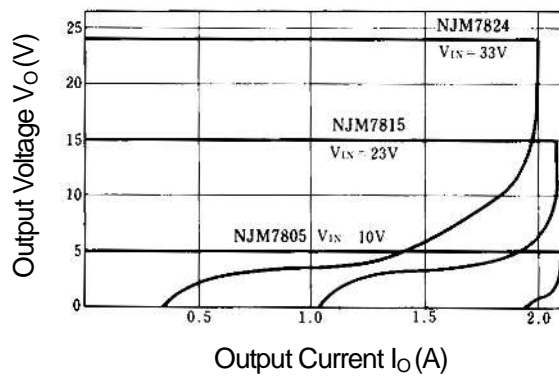
NJM7805 Dropout Characteristics ($T_j=25^\circ C$)



NJM7812 Dropout Characteristics ($T_j=25^\circ C$)



NJM7805/15/24 Load Characteristics ($T_j=25^\circ C$)

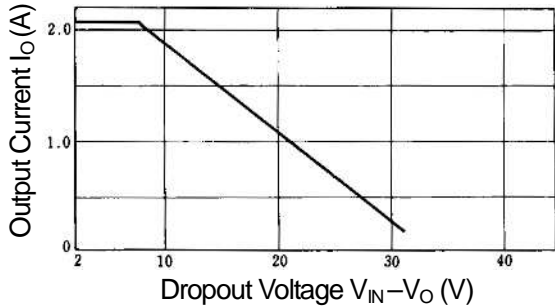


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■ TYPICAL CHARACTERISTICS

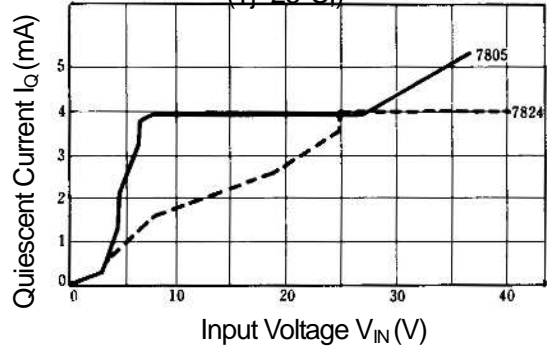
NJM7800 Series Short Circuit Output Current

($T_j=25^\circ\text{C}$, ∞ Heat Sink)

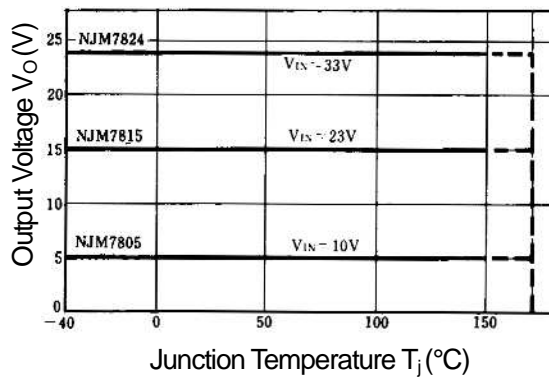


NJM7805/24 Quiescent Current vs. Input Voltage

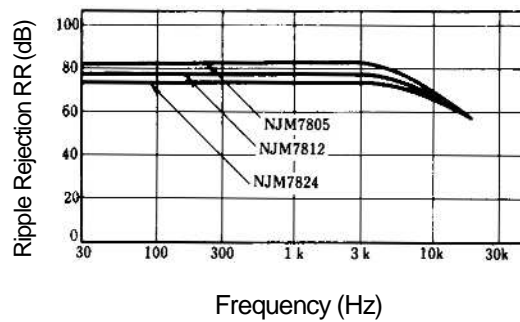
($T_j=25^\circ\text{C}$.)



NJM7805/15/24 Output Voltage vs. Junction Temperature



NJM7805/15/24 Ripple Rejection vs. Frequency



$V_{IN} = 10\text{V}$ (05) $e_{in} = 2V_{P-P}$
 19V (12)
 33V (24)
 $T_j = 25^\circ\text{C}$

[CAUTION]

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