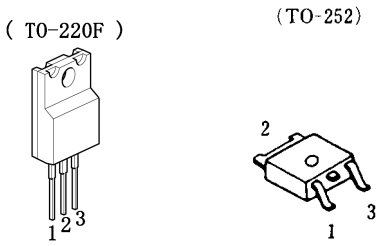
3-TERMINAL POSITIVE VOLTAGE REGULATOR

■ 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.

■ PACKAGE OUTLINE



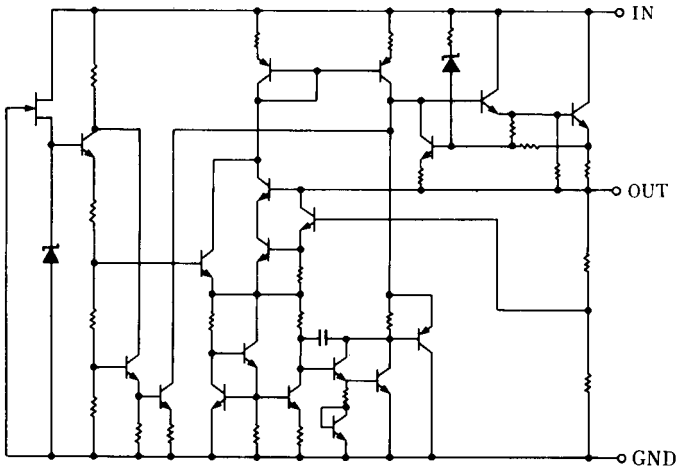
NJM7800FA	NJM7800DL1A
1. IN	1. IN
2. GND	2. GND
3. OUT	3. OUT

(note) The radiation fin is connected pin2.

■ FEATURES

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

■ EQUIVALENT CIRCUIT



■ ABSOLUTE MAXIMUM RATINGS (Ta=25ºC)

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			ºC
Operating Temperature Range	Operating Junction Temperature		T_j	-40 to +150	ºC
	Operating Junction Temperature		T_{opr}	-40 to +85	
Power Dissipation	P_D	TO-220F 16(T_C≤70ºC) TO-252 10(T_C=25ºC) 1(Ta≤25ºC)			W

■ ELECTRICAL CHARACTERISTICS (C_1=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.	
NJM7805FA/DL1A									
Output Voltage	V_O	V_{IN}=10V, I_0=0.5A	4.8	5.0	5.2	4.8	5.0	5.2	V
Quiescent Current	I_Q	V_{IN}=10V, I_O=0mA	-	4.2	6.0	-	4.2	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=10V, I_O=0.005 to 1.5A	-	15	50	-	15	100	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=7 to 25V, I_O=0.5A	-	3	50	-	3	100	mV
Ripple Rejection	RR	V_{IN}=10V, I_O=0.5A , e_{in}=2V_{P-P}, f=120Hz	68	78	-	68	78	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=10V, BW=10Hz to 100kHz, I_O=0.5A	-	45	-	-	45	-	µV
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=10V, I_O=5mA	-	-0.5	-	-	-0.5	-	mV/ºC

■ **ELECTRICAL CHARACTERISTICS** (C_1=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.	
NJM7806FA/DL1A									
Output Voltage	V_O	V_{IN}=11V, I_0=0.5A	5.75	6.0	6.25	5.75	6.0	6.25	V
Quiescent Current	I_Q	V_{IN}=11V, I_O=0mA	-	4.3	6.0	-	4.3	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=11V, I_O=0.005 to 1.5A	-	15	60	-	15	120	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=8 to 25V, I_O=0.5A	-	5	60	-	5	120	mV
Ripple Rejection	RR	V_{IN}=11V, I_O=0.5A , e_{in}=2V_{P-P}, f=120Hz	65	75	-	65	75	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=11V, BW=10Hz to 100kHz, I_O=0.5A	-	45	-	-	45	-	μV
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=11V, I_O=5mA	-	-0.6	-	-	-0.6	-	mV/ºC
NJM7808FA/DL1A									
Output Voltage	V_O	V_{IN}=14V, I_0=0.5A	7.7	8.0	8.3	7.7	8.0	8.3	V
Quiescent Current	I_Q	V_{IN}=14V, I_O=0mA	-	4.3	6.0	-	4.3	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=14V, I_O=0.005 to 1.5A	-	15	80	-	15	160	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=10.5 to 25V, I_O=0.5A	-	6	80	-	6	160	mV
Ripple Rejection	RR	V_{IN}=14V, I_O=0.5A , e_{in}=2V_{P-P}, f=120Hz	62	72	-	62	72	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=14V, BW=10Hz to 100kHz, I_O=0.5A	-	55	-	-	55	-	μV
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=14V, I_O=5mA	-	-0.8	-	-	-0.8	-	mV/ºC
NJM7809FA/DL1A									
Output Voltage	V_O	V_{IN}=15V, I_0=0.5A	8.65	9.0	9.35	8.65	9.0	9.35	V
Quiescent Current	I_Q	V_{IN}=15V, I_O=0mA	-	4.3	6.0	-	4.3	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=15V, I_O=0.005 to 1.5A	-	15	90	-	15	180	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=11.5 to 25V, I_O=0.5A	-	7	90	-	7	180	mV
Ripple Rejection	RR	V_{IN}=15V, I_O=0.5A , e_{in}=2V_{P-P}, f=120Hz	62	72	-	62	72	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=15V, BW=10Hz to 100kHz, I_O=0.5A	-	60	-	-	60	-	μV
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=15V, I_O=5mA	-	-0.9	-	-	-0.9	-	mV/ºC
NJM7810FA/DL1A									
Output Voltage	V_O	V_{IN}=17V, I_0=0.5A	9.60	10.0	10.4	9.6	10.0	10.4	V
Quiescent Current	I_Q	V_{IN}=17V, I_O=0mA	-	4.3	6.0	-	4.3	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=17V, I_O=0.005 to 1.5A	-	15	130	-	15	200	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=12.5 to 25V, I_O=0.5A	-	7	100	-	7	200	mV
Ripple Rejection	RR	V_{IN}=17V, I_O=0.5A , e_{in}=2V_{P-P}, f=120Hz	62	72	-	62	72	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=17V, BW=10Hz to 100kHz, I_O=0.5A	-	60	-	-	65	-	μV
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=17V, I_O=5mA	-	-0.9	-	-	-1.0	-	mV/ºC

■ **ELECTRICAL CHARACTERISTICS** (C_1=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_0=0.5A	11.5	12.0	12.5	11.5	12.0	12.5	V
Quiescent Current	I_Q	V_{IN}=19V, I_O=0mA	-	4.3	6.0	-	4.3	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=19V, I_O=0.005 to 1.5A	-	25	120	-	25	240	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=14.5 to 30V, I_O=0.5A	-	10	120	-	10	240	mV
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
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=19V, I_O=5mA	-	-1.2	-	-	-1.2	-	mV/ºC
NJM7815FA/DL1A									
Output Voltage	V_O	V_{IN}=23V, I_0=0.5A	14.4	15.0	15.6	14.4	15.0	15.6	V
Quiescent Current	I_Q	V_{IN}=23V, I_O=0mA	-	4.4	6.0	-	4.4	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=23V, I_O=0.005 to 1.5A	-	35	150	-	35	300	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=17.5 to 30V, I_O=0.5A	-	11	150	-	11	300	mV
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
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=23V, I_O=5mA	-	-1.5	-	-	-1.5	-	mV/ºC
NJM7818FA/DL1A									
Output Voltage	V_O	V_{IN}=27V, I_0=0.5A	17.3	18.0	18.7	17.3	18.0	18.7	V
Quiescent Current	I_Q	V_{IN}=27V, I_O=0mA	-	4.5	6.0	-	4.5	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=27V, I_O=0.005 to 1.5A	-	55	180	-	55	360	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=21 to 33V, I_O=0.5A	-	15	180	-	15	360	mV
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
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=27V, I_O=5mA	-	-1.8	-	-	-1.8	-	mV/ºC
NJM7820FA/DL1A									
Output Voltage	V_O	V_{IN}=29V, I_0=0.5A	19.2	20.0	20.8	19.2	20.0	20.8	V
Quiescent Current	I_Q	V_{IN}=29V, I_O=0mA	-	4.5	6.0	-	4.5	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=29V, I_O=0.005 to 1.5A	-	61	200	-	61	400	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=23 to 35V, I_O=0.5A	-	16	200	-	16	400	mV
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
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=29V, I_O=5mA	-	-2.0	-	-	-2.0	-	mV/ºC

■ **ELECTRICAL CHARACTERISTICS** (C_1=0.33μF, C_O=0.1μF, T_j=25°C)

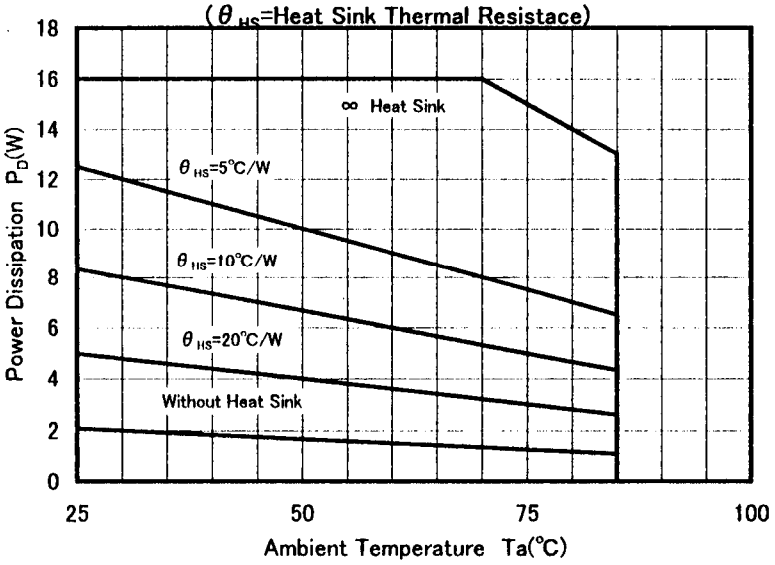
Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITIONS	TO-220F			TO-252			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
NJM7824FA/DL1A									
Output Voltage	V_O	V_{IN}=33V, I_0=0.5A	23.0	24.0	25.0	23.0	24.0	25.0	V
Quiescent Current	I_Q	V_{IN}=33V, I_O=0mA	-	4.6	6.0	-	4.6	6.0	mA
Load Regulation	ΔV_O - I_O	V_{IN}=33V, I_O=0.005 to 1.5A	-	65	240	-	65	480	mV
Line Regulation	ΔV_O - V_{IN}	V_{IN}=27 to 38V, I_O=0.5A	-	18	240	-	18	480	mV
Ripple Rejection	RR	V_{IN}=33V, I_O=0.5A , e_{in}=2V_{P-P}, f=120Hz	56	66	-	56	66	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=33V, BW=10Hz to 100kHz, I_O=0.5A	-	120	-	-	120	-	μV
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=33V, I_O=5mA	-	-2.4	-	-	-2.4	-	mV/ºC

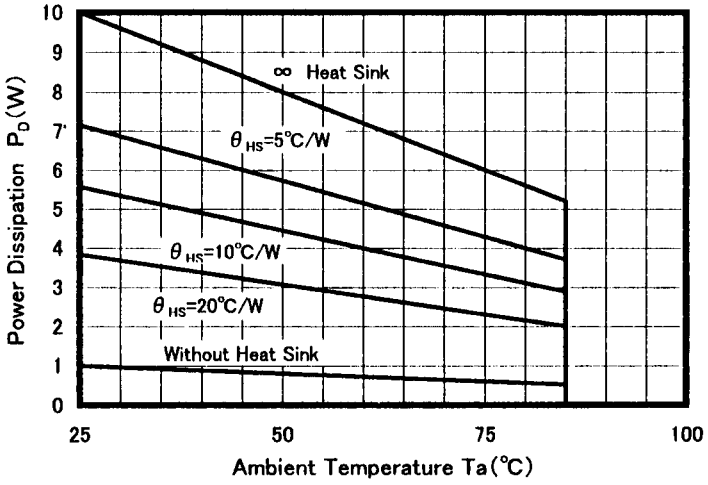
■ POWER DISSIPATION VS. AMBIENT TEMPERATURE

NJM7800FA

(θ_{HS}=Heat Sink Thermal Resistace)

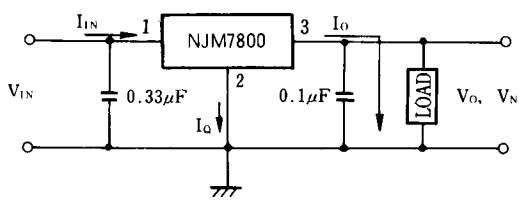


NJM7800DL1A



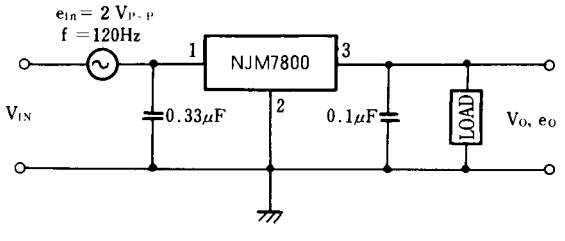
■ TEST CIRCUIT

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



$I_Q = I_{IN} - I_O$

2. Ripple Rejection



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

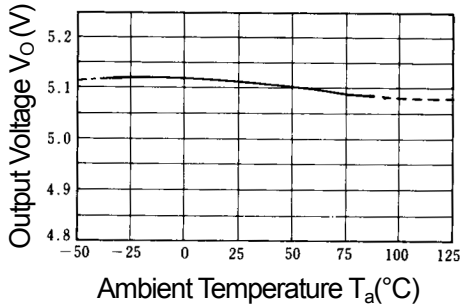
Therefore, use the recommended C_O value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and V_{OUT} as shortest path as possible for stable operation

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.

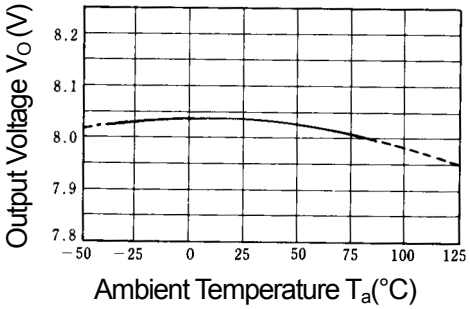
When selecting C_O, recommend that have withstand voltage margin against output voltage and superior temperature characteristic though

■ TYPICAL CHARACTERISTICS

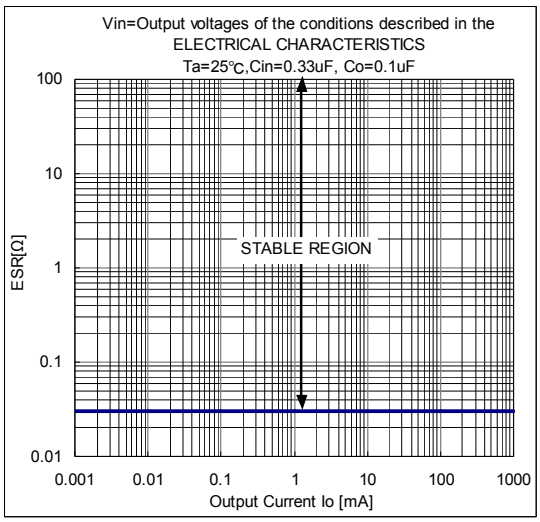
NJM7805 Output Voltage vs. Temperature



NJM7808 Output Voltage vs. Temperature



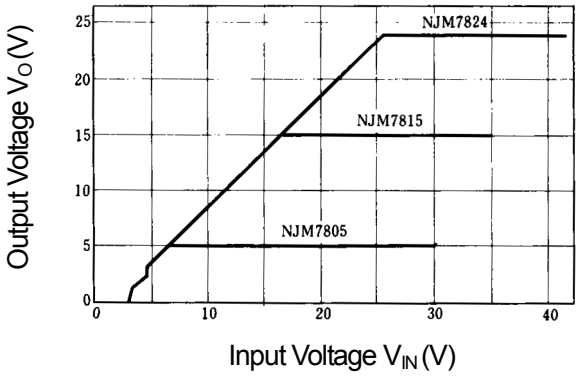
NJM78M00 Series Equivalent Series Resistance vs. Output Current



■ TYPICAL CHARACTERISTICS

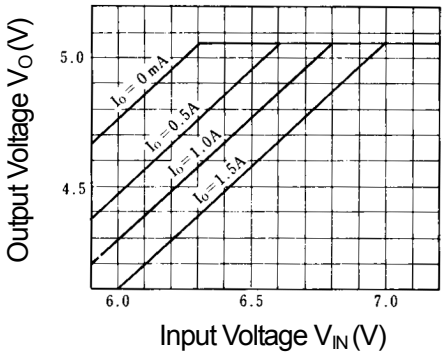
NJM7805/15/24 Output Characteristics

(Io=0.5A, Tj=25°C)



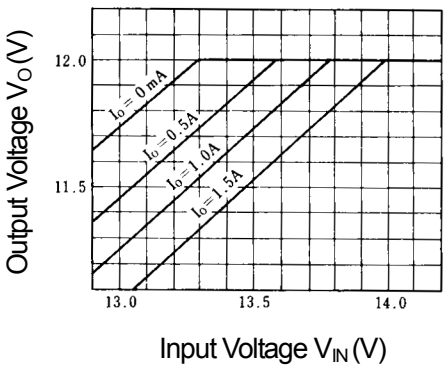
NJM7805 Dropout Characteristics

(Tj=25°C)



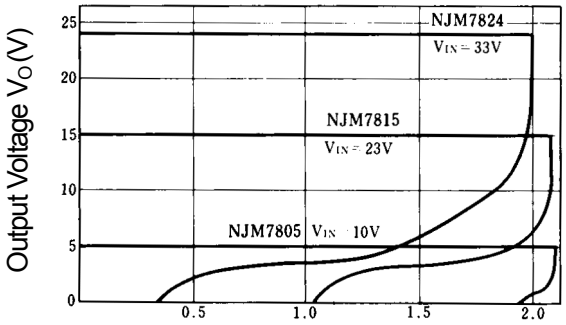
NJM7812 Dropout Characteristics

(Tj=25°C)



NJM7805/15/24 Load Characteristics

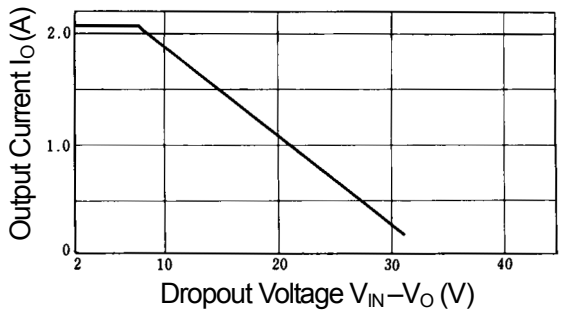
(Tj=25°C)



■ TYPICAL CHARACTERISTICS

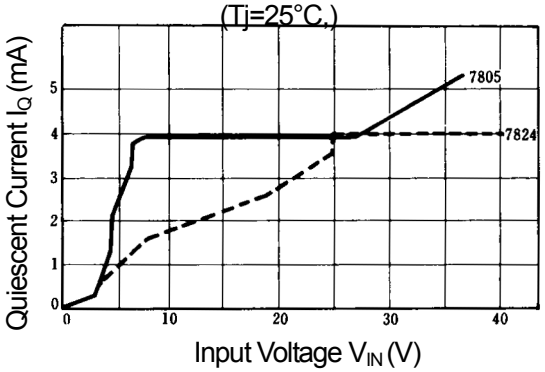
NJM7800 Series Short Circuit Output Current

(Tj=25°C, ∞ Heat Sink)

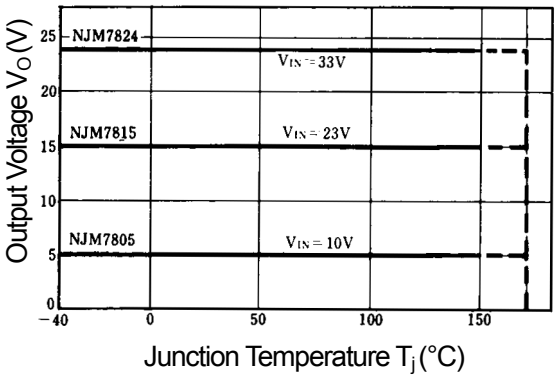


NJM7805/24 Quiescent Current vs. Input Voltage

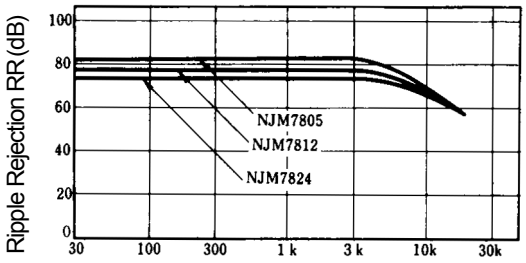
(Tj=25°C,)



NJM7805/15/24 Output Voltage vs. Junction Temperature



NJM7805/15/24 Ripple Rejection vs. Frequency



V_{IN} = 10V (05) e_{in} = $2V_{P-P}$
19V (12)
33V (24)
Tj = 25°C