

3-TERMINAL POSITIVE VOLTAGE REGULATOR

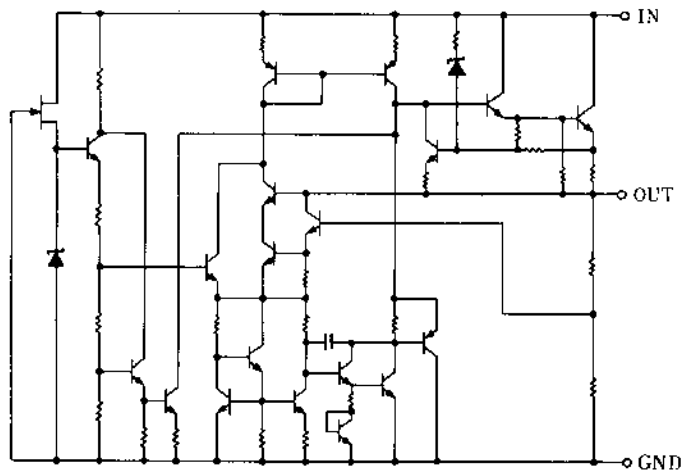
■ GENERAL DESCRIPTION

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

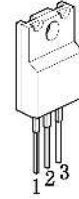
- Internal Short Circuit Current Limit
- Internal Thermal Overload Protection
- Excellent Ripple Rejection
- Guaranteed 1.5A Output Current
- Package Outline TO-220F, TO-252
- Bipolar Technology

■ EQUIVALENT CIRCUIT

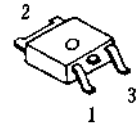


■ PACKAGE OUTLINE

(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 |

NJM7800

■ 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. | |
| NJM7812FA/DL1A | | | | | | | | | |
| Output Voltage | V_O | $V_{IN}=19\text{V}$, $I_O=0.5\text{A}$ | 11.5 | 12.0 | 12.5 | 11.5 | 12.0 | 12.5 | V |
| Line Regulation | $\Delta V_O - V_{IN}$ | $V_{IN}=14.5$ to 30V , $I_O=0.5\text{A}$ | - | 10 | 120 | - | 10 | 240 | mV |
| Load Regulation | $\Delta V_O - I_O$ | $V_{IN}=19\text{V}$, $I_O=0.005$ to 1.5A | - | 25 | 120 | - | 25 | 240 | mV |
| Quiescent Current | I_Q | $V_{IN}=19\text{V}$, $I_O=0\text{mA}$ | - | 4.3 | 6.0 | - | 4.3 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}=19\text{V}$, $I_O=5\text{mA}$ | - | -1.2 | - | - | -1.2 | - | $\text{mV}/^\circ\text{C}$ |
| Ripple Rejection | RR | $V_{IN}=19\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2\text{V}_{P-P}$, $f=120\text{Hz}$ | 61 | 71 | - | 61 | 71 | - | dB |
| Output Noise Voltage | V_{NO} | $V_{IN}=19\text{V}$, $\text{BW}=10\text{Hz}$ to 100kHz , $I_O=0.5\text{A}$ | - | 75 | - | - | 75 | - | μV |
| NJM7815FA/DL1A | | | | | | | | | |
| Output Voltage | V_O | $V_{IN}=23\text{V}$, $I_O=0.5\text{A}$ | 14.4 | 15.0 | 15.6 | 14.4 | 15.0 | 15.6 | V |
| Line Regulation | $\Delta V_O - V_{IN}$ | $V_{IN}=17.5$ to 30V , $I_O=0.5\text{A}$ | - | 11 | 150 | - | 11 | 300 | mV |
| Load Regulation | $\Delta V_O - I_O$ | $V_{IN}=23\text{V}$, $I_O=0.005$ to 1.5A | - | 35 | 150 | - | 35 | 300 | mV |
| Quiescent Current | I_Q | $V_{IN}=23\text{V}$, $I_O=0\text{mA}$ | - | 4.4 | 6.0 | - | 4.4 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}=23\text{V}$, $I_O=5\text{mA}$ | - | -1.5 | - | - | -1.5 | - | $\text{mV}/^\circ\text{C}$ |
| Ripple Rejection | RR | $V_{IN}=23\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2\text{V}_{P-P}$, $f=120\text{Hz}$ | 60 | 70 | - | 60 | 70 | - | dB |
| Output Noise Voltage | V_{NO} | $V_{IN}=23\text{V}$, $\text{BW}=10\text{Hz}$ to 100kHz , $I_O=0.5\text{A}$ | - | 90 | - | - | 90 | - | μV |
| NJM7818FA/DL1A | | | | | | | | | |
| Output Voltage | V_O | $V_{IN}=27\text{V}$, $I_O=0.5\text{A}$ | 17.3 | 18.0 | 18.7 | 17.3 | 18.0 | 18.7 | V |
| Line Regulation | $\Delta V_O - V_{IN}$ | $V_{IN}=21$ to 33V , $I_O=0.5\text{A}$ | - | 15 | 180 | - | 15 | 360 | mV |
| Load Regulation | $\Delta V_O - I_O$ | $V_{IN}=27\text{V}$, $I_O=0.005$ to 1.5A | - | 55 | 180 | - | 55 | 360 | mV |
| Quiescent Current | I_Q | $V_{IN}=27\text{V}$, $I_O=0\text{mA}$ | - | 4.5 | 6.0 | - | 4.5 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}=27\text{V}$, $I_O=5\text{mA}$ | - | -1.8 | - | - | -1.8 | - | $\text{mV}/^\circ\text{C}$ |
| Ripple Rejection | RR | $V_{IN}=27\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2\text{V}_{P-P}$, $f=120\text{Hz}$ | 59 | 69 | - | 59 | 69 | - | dB |
| Output Noise Voltage | V_{NO} | $V_{IN}=27\text{V}$, $\text{BW}=10\text{Hz}$ to 100kHz , $I_O=0.5\text{A}$ | - | 100 | - | - | 100 | - | μV |
| NJM7820FA/DL1A | | | | | | | | | |
| Output Voltage | V_O | $V_{IN}=29\text{V}$, $I_O=0.5\text{A}$ | 19.2 | 20.0 | 20.8 | 19.2 | 20.0 | 20.8 | V |
| Line Regulation | $\Delta V_O - V_{IN}$ | $V_{IN}=23$ to 35V , $I_O=0.5\text{A}$ | - | 16 | 200 | - | 16 | 400 | mV |
| Load Regulation | $\Delta V_O - I_O$ | $V_{IN}=29\text{V}$, $I_O=0.005$ to 1.5A | - | 61 | 200 | - | 61 | 400 | mV |
| Quiescent Current | I_Q | $V_{IN}=29\text{V}$, $I_O=0\text{mA}$ | - | 4.5 | 6.0 | - | 4.5 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}=29\text{V}$, $I_O=5\text{mA}$ | - | -2.0 | - | - | -2.0 | - | $\text{mV}/^\circ\text{C}$ |
| Ripple Rejection | RR | $V_{IN}=29\text{V}$, $I_O=0.5\text{A}$, $e_{in}=2\text{V}_{P-P}$, $f=120\text{Hz}$ | 58 | 68 | - | 58 | 68 | - | dB |
| Output Noise Voltage | V_{NO} | $V_{IN}=29\text{V}$, $\text{BW}=10\text{Hz}$ to 100kHz , $I_O=0.5\text{A}$ | - | 120 | - | - | 120 | - | μV |

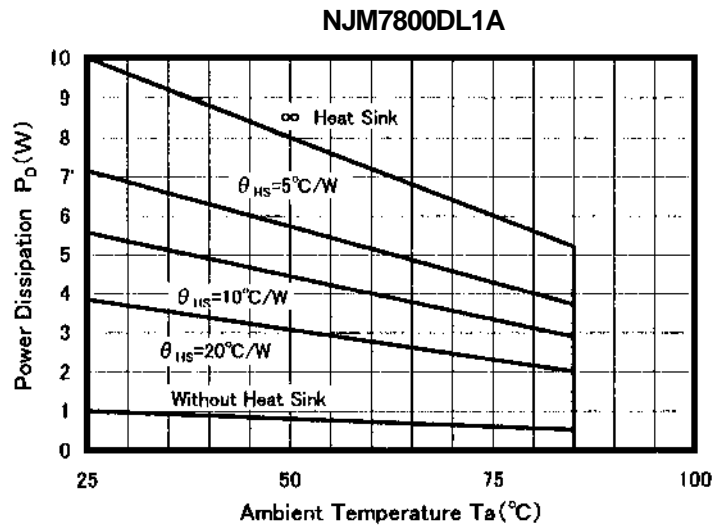
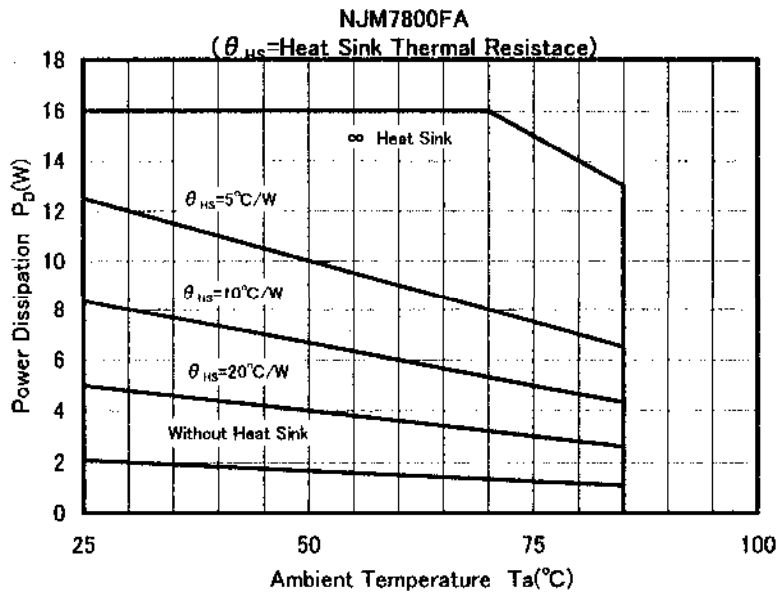
■ **ELECTRICAL CHARACTERISTICS** ($C_1 = 0.33\mu\text{F}$, $C_O = 0.1\mu\text{F}$, $T_j = 25^\circ\text{C}$)

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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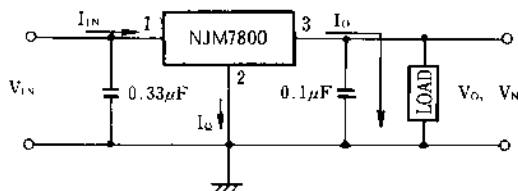
POWER DISSIPATION VS. AMBIENT TEMPERATURE



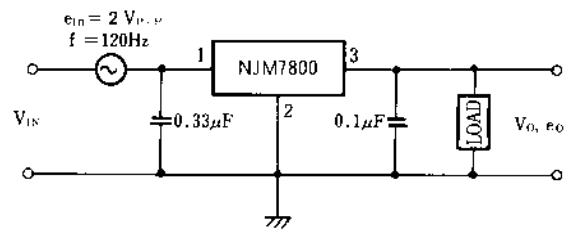
TEST CIRCUIT

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

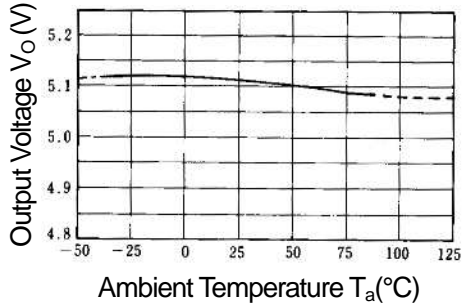
In addition, you should consider varied characteristics of capacitor (a frequency characteristic, a temperature characteristic, a DC bias characteristic and so on) and unevenness peculiar to a capacitor supplier enough.

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

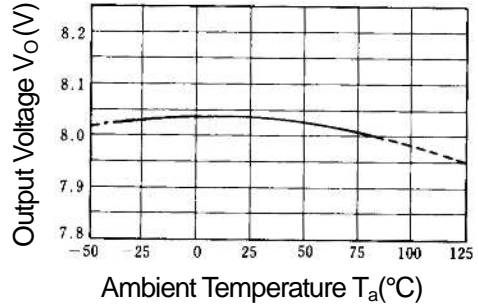
NJM7800

■ TYPICAL CHARACTERISTICS

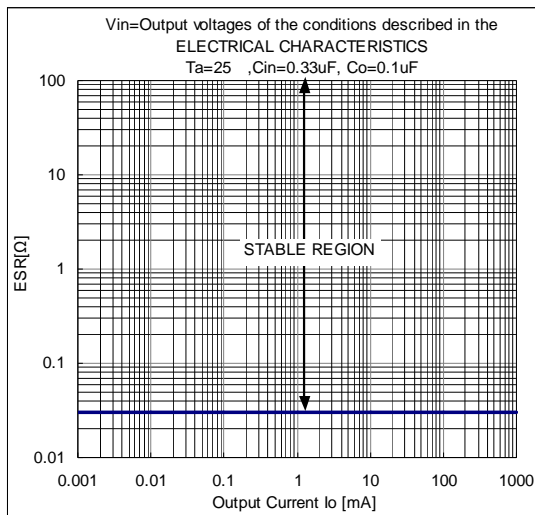
NJM7805 Output Voltage vs. Temperature



NJM7808 Output Voltage vs. Temperature

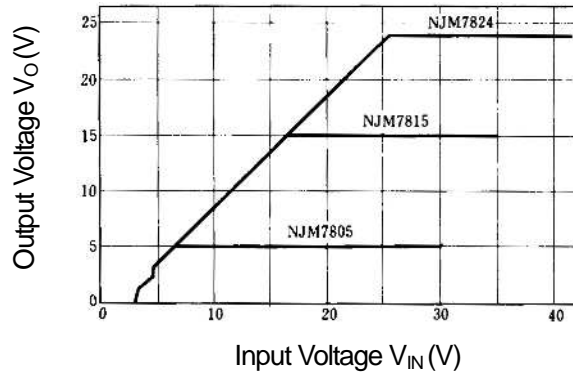


NJM78M00 Series Equivalent Series Resistance vs. Output Current

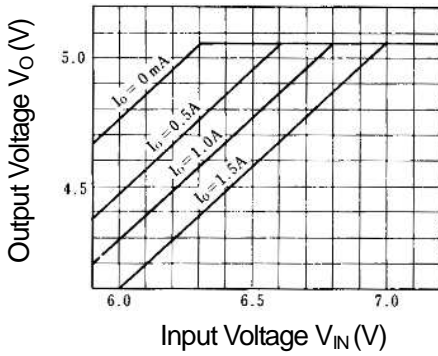


■ TYPICAL CHARACTERISTICS

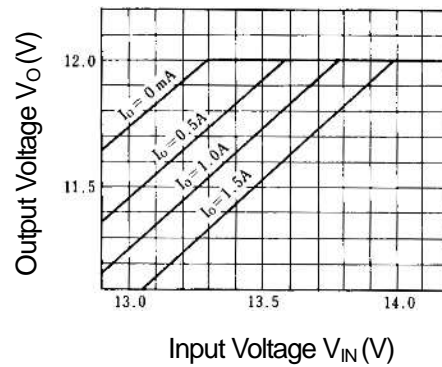
NJM7805/15/24 Output Characteristics ($I_o=0.5A, T_j=25^\circ C$)



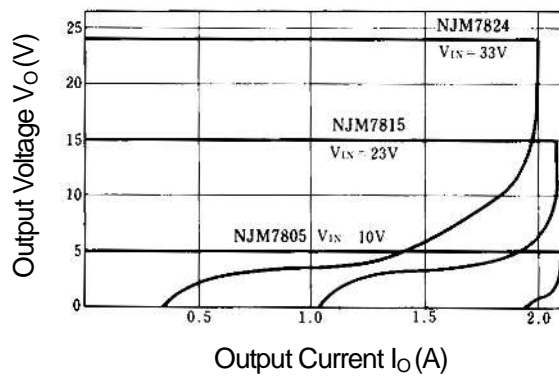
NJM7805 Dropout Characteristics ($T_j=25^\circ C$)



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



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

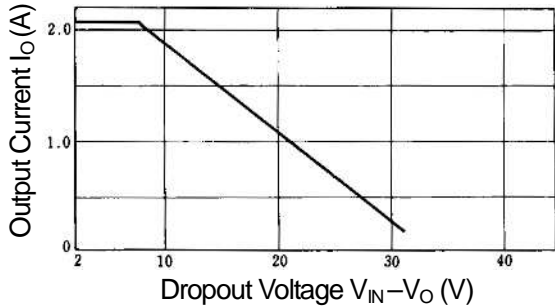


NJM7800

■ TYPICAL CHARACTERISTICS

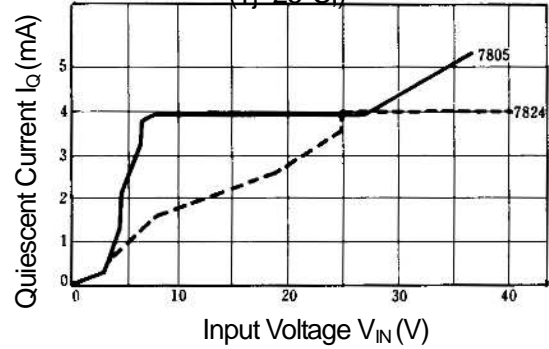
NJM7800 Series Short Circuit Output Current

($T_j=25^\circ\text{C}$, ∞ Heat Sink)

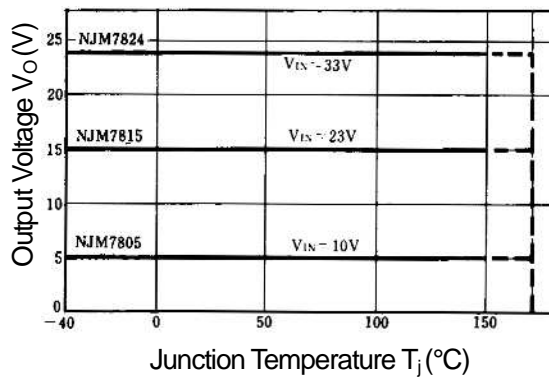


NJM7805/24 Quiescent Current vs. Input Voltage

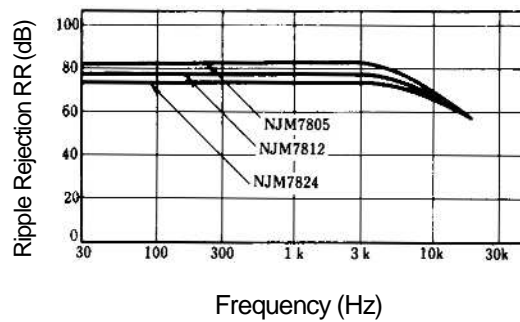
($T_j=25^\circ\text{C}$)



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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