

## 3-TERMINAL POSITIVE VOLTAGE REGULATOR

### ■ GENERAL DESCRIPTION

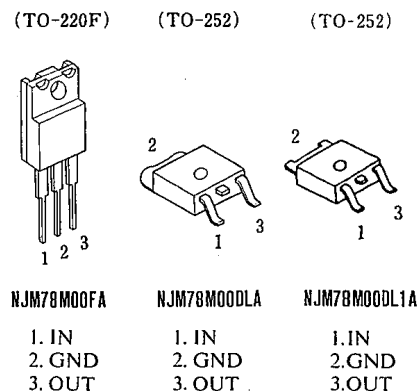
The NJM78M00 series of 3-Terminal Positive Voltage Regulators is constructed using the New JRC Planar epitaxial process. These regulators employ internal current-limiting, thermal-shutdown and safe-area compensation making them essentially indestructible. If adequate heat sinking is provided, they can deliver in excess of 500mA output current. They are intended as fixed voltage regulation 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 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
- Guarantee'd 500mA Output Current
- Package Outline
- Bipolar Technology

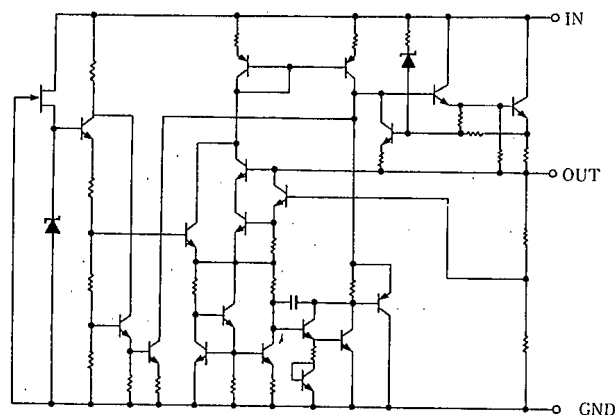
TO-220F, TO-252

### ■ PACKAGE OUTLINE



(note) The radiation fin is connected pin2.

### ■ EQUIVALENT CIRCUIT



## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

| PARAMETER                   | SYMBOL                         | MAXIMUM RATINGS |               | UNIT |
|-----------------------------|--------------------------------|-----------------|---------------|------|
| Input Voltage               | VIN                            | 78M05~78M09     | 35            | V    |
|                             |                                | 78M12~78M15     | 35            |      |
|                             |                                | 78M18~78M24     | 40            |      |
| Storage Temperature Range   | Tstg                           | -40 ~ +150      |               | °C   |
| Operating Temperature Range | Operating Junction Temperature | Tj              | -30~+150      | °C   |
|                             | Operating Junction Temperature | Topr            | -40~+85       |      |
| Power Dissipation           | Pd                             | TO220F          | 7.5 (Tc≤75°C) | W    |
|                             |                                | TO252           | 1.0 (Ta=25°C) |      |
|                             |                                |                 | 7.5 (Tc≤56°C) |      |

## ■ THERMAL CHARACTERISTICS

| Thermal Resistance | Junction-to-Ambient Temperature | $\theta_{ja}$ | TO220F | TO252 | °C/W |
|--------------------|---------------------------------|---------------|--------|-------|------|
|                    |                                 |               | 60     | 125   |      |
|                    | Junction-to-Case                | $\theta_{jc}$ | 7      | 12.5  |      |

## ■ ELECTRICAL CHARACTERISTICS (CIN=0.33 μF, Co=0.1 μF, Tj=25°C) Measurement is to be conducted in pulse testing.

| PARAMETER                                         | SYMBOL                  | TEST CONDITION                        | MIN. | TYP. | MAX. | UNIT  |
|---------------------------------------------------|-------------------------|---------------------------------------|------|------|------|-------|
| <b>NJM78M05A</b>                                  |                         |                                       |      |      |      |       |
| Output Voltage                                    | VO                      | VIN=10V, IO=350mA                     | 4.8  | 5.0  | 5.2  | V     |
| Line Regulation                                   | $\Delta V_O - V_{IN}$   | VIN=7~25V, IO=200mA                   | —    | 3    | 50   | mV    |
| Load Regulation                                   | $\Delta V_O - I_O$      | VIN=10V, IO=5~500mA                   | —    | 5    | 50   | mV    |
| Quiescent Current                                 | IQ                      | VIN=10V, IO=0mA                       | —    | 4    | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O / \Delta T$ | VIN=10V, IO=5mA                       | —    | -1   | —    | mV/°C |
| Ripple Rejection                                  | RR                      | VIN=10V, IO=350mA, ein=1Vp-p, f=120Hz | 60   | 80   | —    | dB    |
| Output Noise Voltage                              | VNO                     | VIN=10V, BW=10Hz~100kHz, IO=350mA     | —    | 60   | —    | μV    |

■ 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.

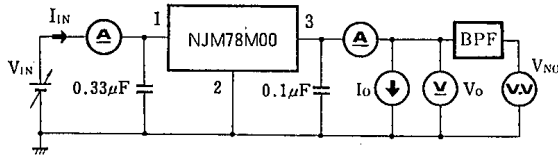
| PARAMETER                                         | SYMBOL                           | TEST CONDITION                                                                            | MIN. | TYP. | MAX. | UNIT  |
|---------------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------|------|------|------|-------|
| <b>NJM78M06A</b>                                  |                                  |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                   | V <sub>IN</sub> =11V, I <sub>O</sub> =350mA                                               | 5.75 | 6.0  | 6.25 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> -V <sub>IN</sub> | V <sub>IN</sub> =8~25V, I <sub>O</sub> =200mA                                             | —    | 5    | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> -I <sub>O</sub>  | V <sub>IN</sub> =11V, I <sub>O</sub> =5~500mA                                             | —    | 5    | 60   | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                   | V <sub>IN</sub> =11V, I <sub>O</sub> =0mA                                                 | —    | 4    | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT              | V <sub>IN</sub> =11V, I <sub>O</sub> =5mA                                                 | —    | -1   | —    | mV/°C |
| Ripple Rejection                                  | RR                               | V <sub>IN</sub> =11V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 59   | 75   | —    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                  | V <sub>IN</sub> =11V, BW=10Hz~100kHz, I <sub>O</sub> =350mA                               | —    | 70   | —    | μV    |
| <b>NJM78M08A</b>                                  |                                  |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                   | V <sub>IN</sub> =14V, I <sub>O</sub> =350mA                                               | 7.7  | 8.0  | 8.3  | V     |
| Line Regulation                                   | ΔV <sub>O</sub> -V <sub>IN</sub> | V <sub>IN</sub> =10.5~25V, I <sub>O</sub> =200mA                                          | —    | 6    | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> -I <sub>O</sub>  | V <sub>IN</sub> =14V, I <sub>O</sub> =5~500mA                                             | —    | 8    | 80   | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                   | V <sub>IN</sub> =14V, I <sub>O</sub> =0mA                                                 | —    | 4    | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT              | V <sub>IN</sub> =14V, I <sub>O</sub> =5mA                                                 | —    | -1   | —    | mV/°C |
| Ripple Rejection                                  | RR                               | V <sub>IN</sub> =14V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 56   | 75   | —    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                  | V <sub>IN</sub> =14V, BW=10Hz~100kHz, I <sub>O</sub> =350mA                               | —    | 80   | —    | μV    |
| <b>NJM78M09A</b>                                  |                                  |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                   | V <sub>IN</sub> =15V, I <sub>O</sub> =350mA                                               | 8.65 | 9.0  | 9.35 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> -V <sub>IN</sub> | V <sub>IN</sub> =11.5~25V, I <sub>O</sub> =200mA                                          | —    | 6    | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> -I <sub>O</sub>  | V <sub>IN</sub> =15V, I <sub>O</sub> =5~500mA                                             | —    | 8    | 90   | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                   | V <sub>IN</sub> =15V, I <sub>O</sub> =0mA                                                 | —    | 4.1  | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT              | V <sub>IN</sub> =15V, I <sub>O</sub> =5mA                                                 | —    | -1   | —    | mV/°C |
| Ripple Rejection                                  | RR                               | V <sub>IN</sub> =15V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 56   | 70   | —    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                  | V <sub>IN</sub> =15V, BW=10Hz~100kHz, I <sub>O</sub> =350mA                               | —    | 90   | —    | μV    |
| <b>NJM78M12A</b>                                  |                                  |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                   | V <sub>IN</sub> =19V, I <sub>O</sub> =350mA                                               | 11.5 | 12.0 | 12.5 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> -V <sub>IN</sub> | V <sub>IN</sub> =14.5~30V, I <sub>O</sub> =200mA                                          | —    | 8    | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> -I <sub>O</sub>  | V <sub>IN</sub> =19V, I <sub>O</sub> =5~500mA                                             | —    | 8    | 120  | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                   | V <sub>IN</sub> =19V, I <sub>O</sub> =0mA                                                 | —    | 4.1  | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT              | V <sub>IN</sub> =19V, I <sub>O</sub> =5mA                                                 | —    | -1   | —    | mV/°C |
| Ripple Rejection                                  | RR                               | V <sub>IN</sub> =19V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 55   | 70   | —    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                  | V <sub>IN</sub> =19V, BW=10Hz~100kHz, I <sub>O</sub> =350mA                               | —    | 100  | —    | 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>NJM78M15A</b>                                  |                       |                                                                                        |      |      |      |                      |
| Output Voltage                                    | $V_O$                 | $V_{IN}=23\text{V}$ , $I_O=350\text{mA}$                                               | 14.4 | 15.0 | 15.6 | V                    |
| Line Regulation                                   | $\Delta V_O/V_{IN}$   | $V_{IN}=17.5\sim 30\text{V}$ , $I_O=200\text{mA}$                                      | —    | 10   | 60   | mV                   |
| Load Regulation                                   | $\Delta V_O/I_O$      | $V_{IN}=23\text{V}$ , $I_O=5\sim 500\text{mA}$                                         | —    | 10   | 150  | mV                   |
| Quiescent Current                                 | $I_Q$                 | $V_{IN}=23\text{V}$ , $I_O=0\text{mA}$                                                 | —    | 4.1  | 6    | mA                   |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}=25\text{V}$ , $I_O=5\text{mA}$                                                 | —    | -1   | —    | mV/ $^\circ\text{C}$ |
| Ripple Rejection                                  | RR                    | $V_{IN}=23\text{V}$ , $I_O=350\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$ | 54   | 70   | —    | dB                   |
| Output Noise Voltage                              | $V_{NO}$              | $V_{IN}=23\text{V}$ , $BW=10\text{Hz}\sim 100\text{kHz}$ , $I_O=350\text{mA}$          | —    | 120  | —    | $\mu\text{V}$        |
| <b>NJM78M18A</b>                                  |                       |                                                                                        |      |      |      |                      |
| Output Voltage                                    | $V_O$                 | $V_{IN}=27\text{V}$ , $I_O=350\text{mA}$                                               | 17.3 | 18.0 | 18.7 | V                    |
| Line Regulation                                   | $\Delta V_O/V_{IN}$   | $V_{IN}=21\sim 33\text{V}$ , $I_O=200\text{mA}$                                        | —    | 10   | 60   | mV                   |
| Load Regulation                                   | $\Delta V_O/I_O$      | $V_{IN}=27\text{V}$ , $I_O=5\sim 500\text{mA}$                                         | —    | 15   | 180  | mV                   |
| Quiescent Current                                 | $I_Q$                 | $V_{IN}=27\text{V}$ , $I_O=0\text{mA}$                                                 | —    | 4.2  | 6    | mA                   |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}=27\text{V}$ , $I_O=5\text{mA}$                                                 | —    | -1.1 | —    | mV/ $^\circ\text{C}$ |
| Ripple Rejection                                  | RR                    | $V_{IN}=27\text{V}$ , $I_O=350\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$ | 53   | 65   | —    | dB                   |
| Output Noise Voltage                              | $V_{NO}$              | $V_{IN}=27\text{V}$ , $BW=10\text{Hz}\sim 100\text{kHz}$ , $I_O=350\text{mA}$          | —    | 140  | —    | $\mu\text{V}$        |
| <b>NJM78M20A</b>                                  |                       |                                                                                        |      |      |      |                      |
| Output Voltage                                    | $V_O$                 | $V_{IN}=29\text{V}$ , $I_O=350\text{mA}$                                               | 19.2 | 20.0 | 20.8 | V                    |
| Line Regulation                                   | $\Delta V_O/V_{IN}$   | $V_{IN}=23\sim 35\text{V}$ , $I_O=200\text{mA}$                                        | —    | 10   | 60   | mV                   |
| Load Regulation                                   | $\Delta V_O/I_O$      | $V_{IN}=29\text{V}$ , $I_O=5\sim 500\text{mA}$                                         | —    | 20   | 200  | mV                   |
| Quiescent Current                                 | $I_Q$                 | $V_{IN}=29\text{V}$ , $I_O=0\text{mA}$                                                 | —    | 4    | 6    | mA                   |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}=29\text{V}$ , $I_O=5\text{mA}$                                                 | —    | -1.1 | —    | mV/ $^\circ\text{C}$ |
| Ripple Rejection                                  | RR                    | $V_{IN}=29\text{V}$ , $I_O=350\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$ | 53   | 65   | —    | dB                   |
| Output Noise Voltage                              | $V_{NO}$              | $V_{IN}=29\text{V}$ , $BW=10\text{Hz}\sim 100\text{kHz}$ , $I_O=350\text{mA}$          | —    | 150  | —    | $\mu\text{V}$        |
| <b>NJM78M24A</b>                                  |                       |                                                                                        |      |      |      |                      |
| Output Voltage                                    | $V_O$                 | $V_{IN}=33\text{V}$ , $I_O=350\text{mA}$                                               | 23.0 | 24.0 | 25.0 | V                    |
| Line Regulation                                   | $\Delta V_O/V_{IN}$   | $V_{IN}=27\sim 38\text{V}$ , $I_O=200\text{mA}$                                        | —    | 10   | 60   | mV                   |
| Load Regulation                                   | $\Delta V_O/I_O$      | $V_{IN}=33\text{V}$ , $I_O=5\sim 500\text{mA}$                                         | —    | 20   | 240  | mV                   |
| Quiescent Current                                 | $I_Q$                 | $V_{IN}=33\text{V}$ , $I_O=0\text{mA}$                                                 | —    | 4.2  | 6    | mA                   |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}=33\text{V}$ , $I_O=5\text{mA}$                                                 | —    | -1.2 | —    | mV/ $^\circ\text{C}$ |
| Ripple Rejection                                  | RR                    | $V_{IN}=33\text{V}$ , $I_O=350\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$ | 50   | 60   | —    | dB                   |
| Output Noise Voltage                              | $V_{NO}$              | $V_{IN}=33\text{V}$ , $BW=10\text{Hz}\sim 100\text{kHz}$ , $I_O=350\text{mA}$          | —    | 160  | —    | $\mu\text{V}$        |

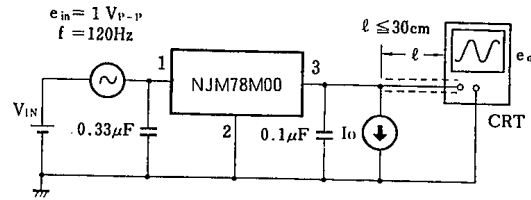
## ■ TEST CIRCUIT

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



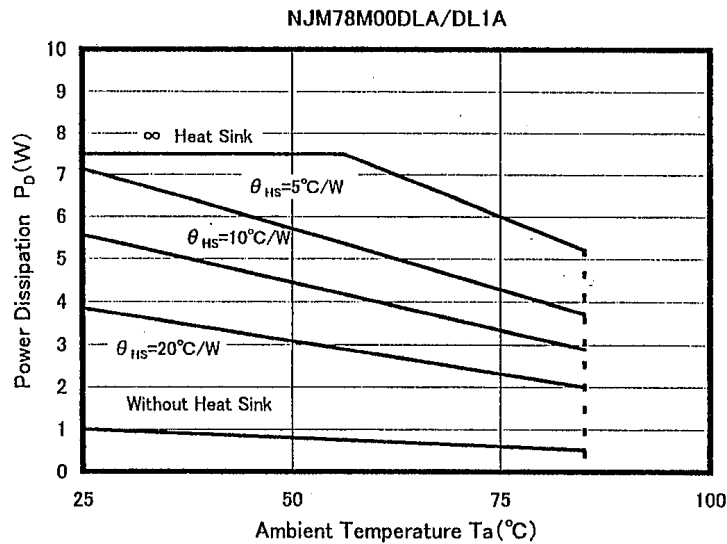
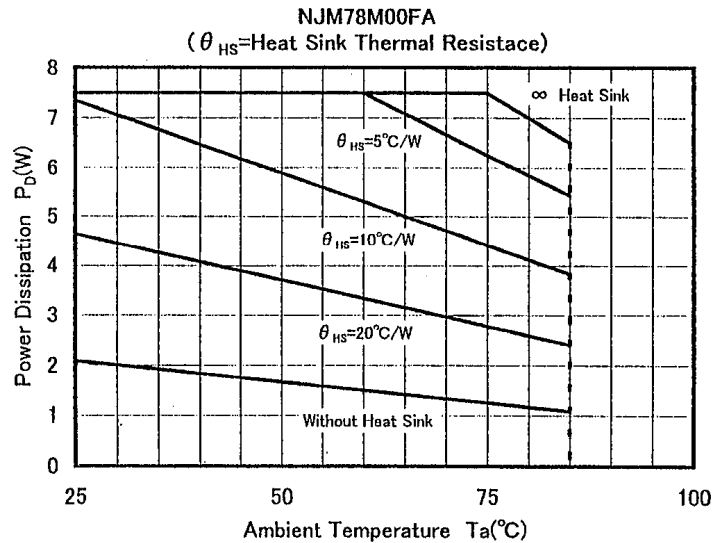
- Measurement is to be conducted
- $I_O = I_{IN} - I_0$  in pulse testing

2. Ripple Rejection



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

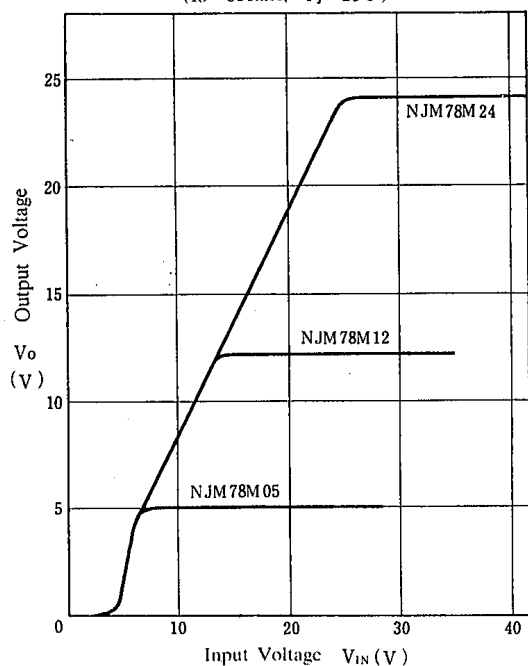
## ■ POWER DISSIPATION VS. AMBIENT TEMPERATURE



## ■ TYPICAL CHARACTERISTICS

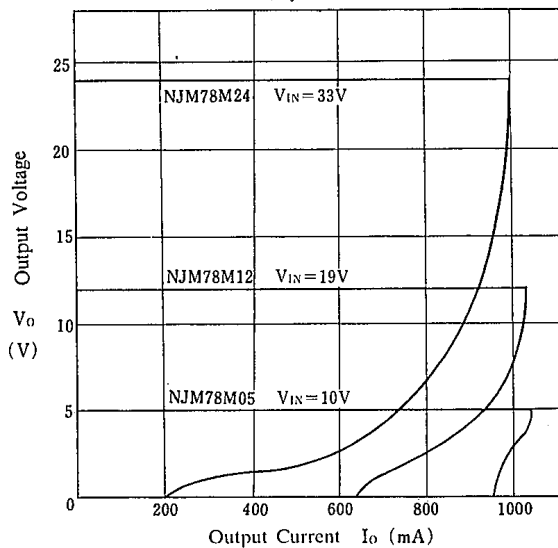
### NJM78M05/M12/M24 Output Characteristics

( $I_O = 350\text{mA}$ ,  $T_J = 25^\circ\text{C}$ )



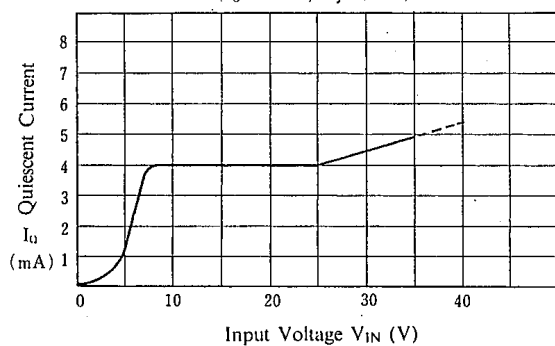
### NJM78M05/M12/M24 Load Characteristics

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

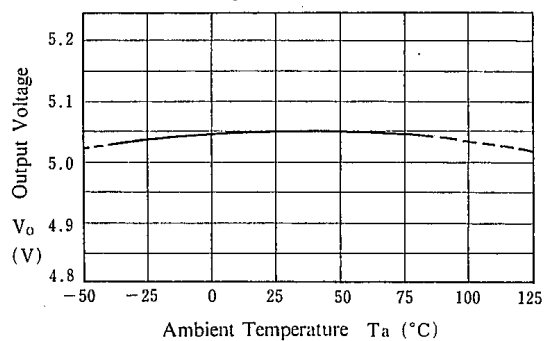


### NJM78M05 Quiescent Current vs. Input Voltage

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

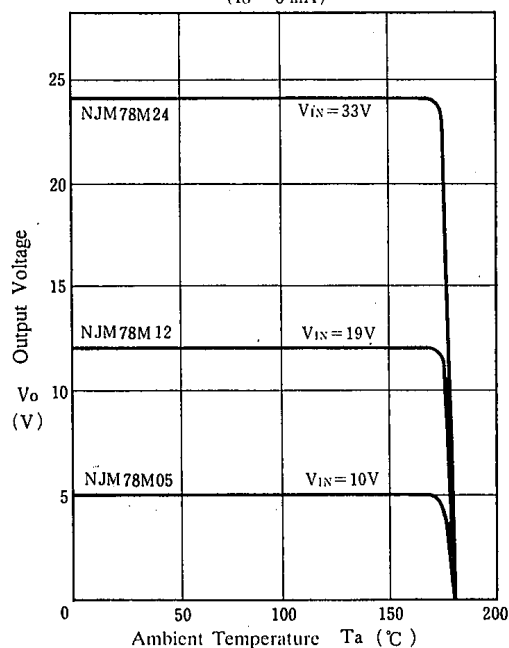


### NJM78M05 Output Voltage vs. Temperature



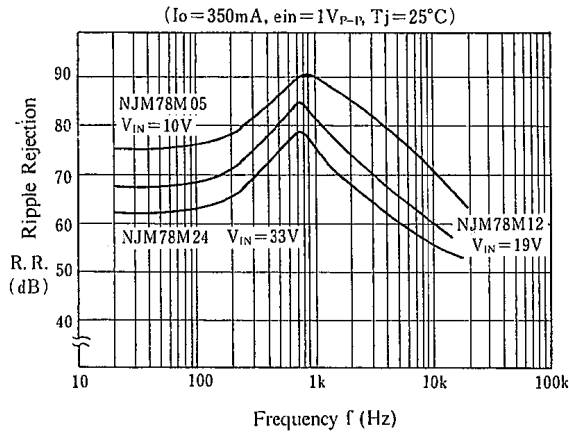
### NJM78M05/M12/M24 Thermal Shutdown Characteristics

( $I_O = 0\text{mA}$ )

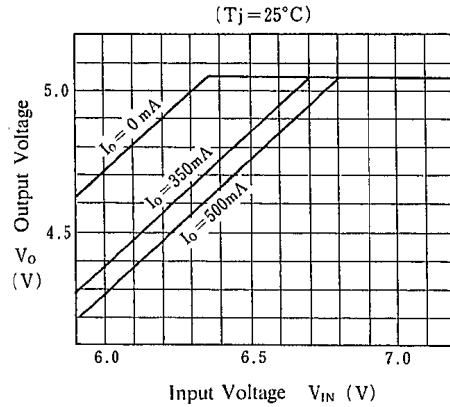


## ■ TYPICAL CHARACTERISTICS

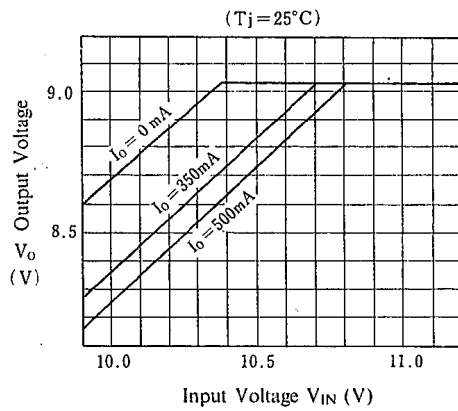
### NJM78M05/12/24 Ripple Rejection



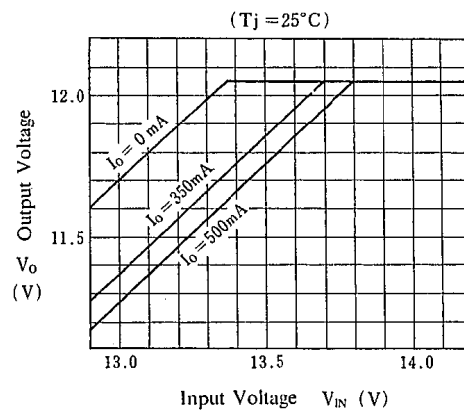
### NJM78M05 Dropout Characteristics



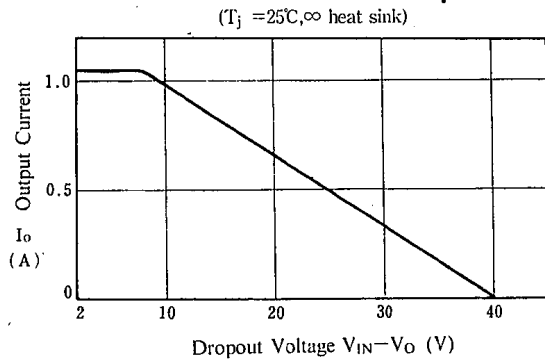
### NJM78M09 Dropout Characteristics



### NJM78M12 Dropout Characteristics



### NJM78M00 Series Short Circuit Output Current



## MEMO

[CAUTION]  
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