

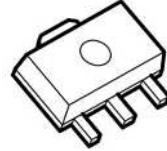
3-TERMINAL POSITIVE VOLTAGE REGULATOR

■ GENERAL DESCRIPTION

The NJM78L00S is a 100mA output 3-Terminal Positive Voltage regulator.

It has improvements in contrast with a conventional NJM78L00: an output voltage accuracy, an operating temperature range and MLCC correspondence. Moreover, the NJM78L00s has 3.3V output voltage version.

■ PACKAGE OUTLINE

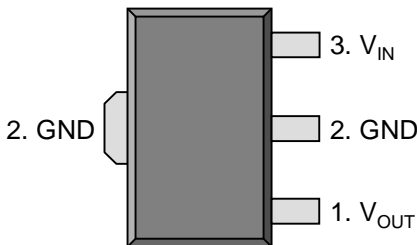


NJM78L00SU3
(SOT-89-3)

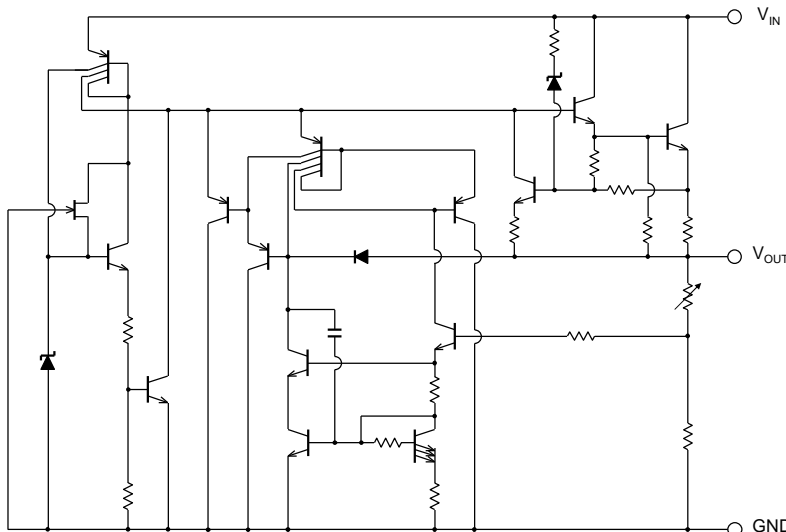
■ FEATURE

- Output Current 100 mA max.
- High Precision Output Voltage $V_O \pm 4.0\%$
- High Ripple Rejection
- Correspond to Low ESR Capacitor (MLCC)
- Over Current Protection Circuit
- Thermal Shutdown Circuit
- Output Voltage Lineup 3V, 3.3V, 5V, 6V, 8V, 10V, 12V, 15V
- Bipolar Technology
- Package SOT-89-3

■ PIN CONFIGURATION



■ EQUIVALENT CIRCUIT



NJM78L00S

■ ABSOLUTE MAXIMUM RATINGS

(Unless otherwise noted, $T_a = 25^\circ\text{C}$)

PARAMETER	SYMBOL	MAXIMUM RATINGS	UNIT
Input Voltage	V_{IN}	NJM78L03S to NJM78L08S : 30 NJM78L10S to NJM78L15S : 35	V
Power Dissipation	P_D	625 (*1) 2400 (*2)	mW
Junction Temperature Range	T_j	- 40 to + 150	$^\circ\text{C}$
Operating Temperature Range	T_{opr}	- 40 to + 125	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	- 50 to + 150	$^\circ\text{C}$

(*1) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 2Layers, copper area 100mm²)

(*2) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 4Layers)

(4Layers inner foil: 74.2 ×74.2mm applying a thermal via hole to a board based on JEDEC standard JESD51-5)

■ 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 is pulse testing.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L03SU3						
Output Voltage	V_O	$V_{IN}=9\text{V}$, $I_O=40\text{mA}$	2.88	3.0	3.12	V
Line Regulation 1	ΔV_O-V_{IN1}	$V_{IN}=5\text{V}$ to 20V, $I_O=40\text{mA}$	-	-	125	mV
Line Regulation 2	ΔV_O-V_{IN2}	$V_{IN}=6\text{V}$ to 20V, $I_O=40\text{mA}$	-	-	100	mV
Load Regulation 1	ΔV_O-I_{O1}	$V_{IN}=9\text{V}$, $I_O=1$ to 40 mA	-	-	25	mV
Load Regulation 2	ΔV_O-I_{O2}	$V_{IN}=9\text{V}$, $I_O=1$ to 100 mA	-	-	50	mV
Quiescent Current	I_Q	$V_{IN}=9\text{V}$, $I_O=0\text{mA}$	-	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=9\text{V}$, $I_O=1\text{mA}$	-	0.2	-	mV/ $^\circ\text{C}$
Ripple Rejection	RR	$6\text{V}<V_{IN}<16\text{V}$, $I_O=40\text{mA}$, $e_{in}=1V_{P-P}$, $f=120\text{Hz}$	43	72	-	dB
Output Noise Voltage	V_{NO}	$V_{IN}=9\text{V}$, $BW=10\text{Hz}$ to 100kHz, $I_O=40\text{mA}$	-	40	-	μVrms
Dropout Voltage	ΔV_{IO}	$I_O=100\text{mA}$	-	1.7	-	V

NJM78L33SU3

Output Voltage	V_O	$V_{IN}=9.3\text{V}$, $I_O=40\text{mA}$	3.17	3.3	3.43	V
Line Regulation 1	ΔV_O-V_{IN1}	$V_{IN}=5.3\text{V}$ to 20V, $I_O=40\text{mA}$	-	-	135	mV
Line Regulation 2	ΔV_O-V_{IN2}	$V_{IN}=6.3\text{V}$ to 20V, $I_O=40\text{mA}$	-	-	105	mV
Load Regulation 1	ΔV_O-I_{O1}	$V_{IN}=9.3\text{V}$, $I_O=1$ to 40mA	-	-	26	mV
Load Regulation 2	ΔV_O-I_{O2}	$V_{IN}=9.3\text{V}$, $I_O=1$ to 100mA	-	-	53	mV
Quiescent Current	I_Q	$V_{IN}=9.3\text{V}$, $I_O=0\text{mA}$	-	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	$V_{IN}=9.3\text{V}$, $I_O=1\text{mA}$	-	0.25	-	mV/ $^\circ\text{C}$
Ripple Rejection	RR	$6.3\text{V}<V_{IN}<16.3\text{V}$, $I_O=40\text{mA}$, $e_{in}=1V_{P-P}$, $f=120\text{Hz}$	42	71	-	dB
Output Noise Voltage	V_{NO}	$V_{IN}=9.3\text{V}$, $BW=10\text{Hz}$ to 100kHz, $I_O=40\text{mA}$	-	45	-	μVrms
Dropout Voltage	ΔV_{IO}	$I_O=100\text{mA}$	-	1.7	-	V

■ ELECTRICAL CHARACTERISTICS

($C_{IN}=0.33\mu F$, $C_O=0.1\mu F$, $T_f=25^\circ C$) Measurement is to be conducted is pulse testing.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L05SU3						
Output Voltage	V_O	$V_{IN}=10V$, $I_O=40mA$	4.8	5.0	5.2	V
Line Regulation 1	ΔV_O-V_{IN1}	$V_{IN}=7V$ to $20V$, $I_O=40mA$	-	-	200	mV
Line Regulation 2	ΔV_O-V_{IN2}	$V_{IN}=8V$ 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_{rms}
Dropout Voltage	ΔV_{IO}	$I_O=100mA$	-	1.7	-	V

NJM78L06SU3						
Output Voltage	V_O	$V_{IN}=12V$, $I_O=40mA$	5.76	6.0	6.24	V
Line Regulation 1	ΔV_O-V_{IN1}	$V_{IN}=8.5V$ to $20V$, $I_O=40mA$	-	-	200	mV
Line Regulation 2	ΔV_O-V_{IN2}	$V_{IN}=9V$ 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_{rms}
Dropout Voltage	ΔV_{IO}	$I_O=100mA$	-	1.7	-	V

NJM78L08SU3						
Output Voltage	V_O	$V_{IN}=14V$, $I_O=40mA$	7.68	8.0	8.32	V
Line Regulation 1	ΔV_O-V_{IN1}	$V_{IN}=10.5V$ to $23V$, $I_O=40mA$	-	-	225	mV
Line Regulation 2	ΔV_O-V_{IN2}	$V_{IN}=11V$ 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_{rms}
Dropout Voltage	ΔV_{IO}	$I_O=100mA$	-	1.7	-	V

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■ ELECTRICAL CHARACTERISTICS

($C_{IN}=0.33\mu F$, $C_O=0.1\mu F$, $T_J=25^\circ C$) Measurement is to be conducted is pulse testing.

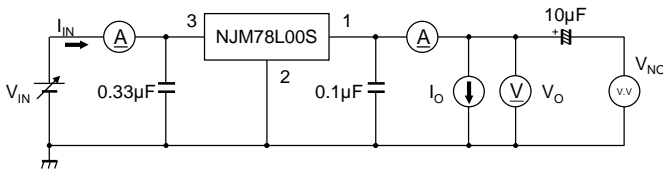
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L10SU3						
Output Voltage	V_O	$V_{IN}=16V, I_O=40mA$	9.6	10.0	10.4	V
Line Regulation 1	ΔV_O-V_{IN1}	$V_{IN}=13V \text{ to } 25V, I_O=40mA$	-	-	250	mV
Line Regulation 2	ΔV_O-V_{IN2}	$V_{IN}=14V \text{ to } 25V, I_O=40mA$	-	-	200	mV
Load Regulation 1	ΔV_O-I_{O1}	$V_{IN}=16V, I_O=1 \text{ to } 40mA$	-	-	50	mV
Load Regulation 2	ΔV_O-I_{O2}	$V_{IN}=16V, I_O=1 \text{ to } 100mA$	-	-	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}	$V_{IN}=16V, BW=10Hz \text{ to } 100kHz, I_O=40mA$	-	135	-	μV_{rms}
Dropout Voltage	ΔV_{IO}	$I_O=100mA$	-	1.7	-	V

NJM78L12SU3						
Output Voltage	V_O	$V_{IN}=19V, I_O=40mA$	11.52	12.0	12.48	V
Line Regulation 1	ΔV_O-V_{IN1}	$V_{IN}=14.5V \text{ to } 27V, I_O=40mA$	-	-	250	mV
Line Regulation 2	ΔV_O-V_{IN2}	$V_{IN}=16V \text{ to } 27V, I_O=40mA$	-	-	200	mV
Load Regulation 1	ΔV_O-I_{O1}	$V_{IN}=19V, I_O=1 \text{ to } 40mA$	-	-	50	mV
Load Regulation 2	ΔV_O-I_{O2}	$V_{IN}=19V, I_O=1 \text{ to } 100mA$	-	-	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}	$V_{IN}=19V, BW=10Hz \text{ to } 100kHz, I_O=40mA$	-	160	-	μV_{rms}
Dropout Voltage	ΔV_{IO}	$I_O=100mA$	-	1.7	-	V

NJM78L15SU3						
Output Voltage	V_O	$V_{IN}=23V, I_O=40mA$	14.4	15.0	15.6	V
Line Regulation 1	ΔV_O-V_{IN1}	$V_{IN}=17.5V \text{ to } 30V, I_O=40mA$	-	-	300	mV
Line Regulation 2	ΔV_O-V_{IN2}	$V_{IN}=20V \text{ to } 30V, I_O=40mA$	-	-	250	mV
Load Regulation 1	ΔV_O-I_{O1}	$V_{IN}=23V, I_O=1 \text{ to } 40mA$	-	-	75	mV
Load Regulation 2	ΔV_O-I_{O2}	$V_{IN}=23V, I_O=1 \text{ to } 100mA$	-	-	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}	$V_{IN}=23V, BW=10Hz \text{ to } 100kHz, I_O=40mA$	-	190	-	μV_{rms}
Dropout Voltage	ΔV_{IO}	$I_O=100mA$	-	1.7	-	V

■ TEST CIRCUIT

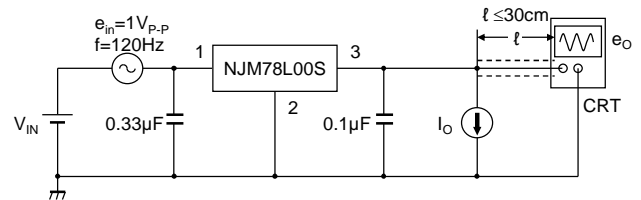
1. Output Voltage, Line Regulation, Load Regulation, Quiescent Current, Average, Output Noise Voltage, Temperature Coefficient of Output Voltage, Peak Output/Short Circuit Current



- Measurement is to be conducted in pulse testing

- $I_Q = I_{IN} - I_O$

2. Ripple Rejection



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

- 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.

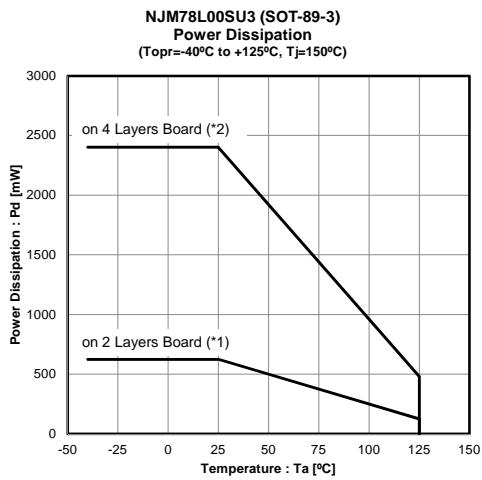
Therefore, use the recommended C_O value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and V_{OUT} as shortest path as possible for stable operation.

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 this product is designed stability works with wide range ESR of capacitor including low ESR products.

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■ POWER DISSIPATION vs. AMBIENT TEMPERATURE

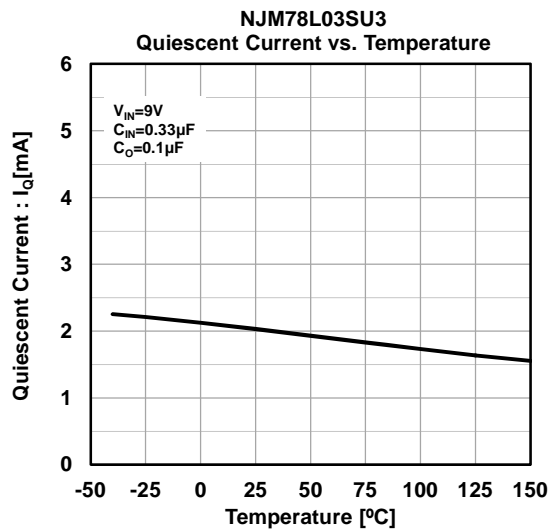
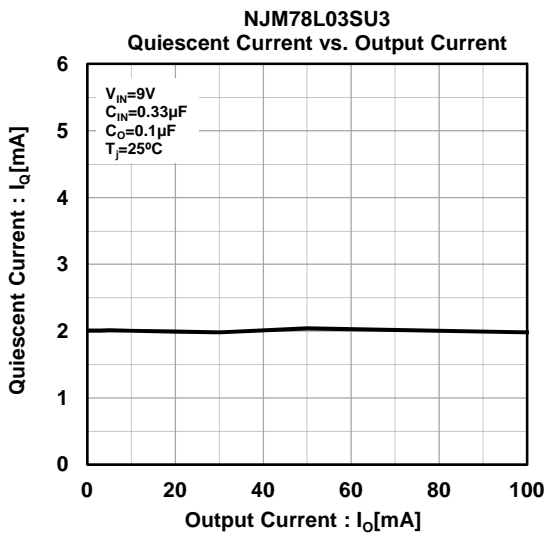
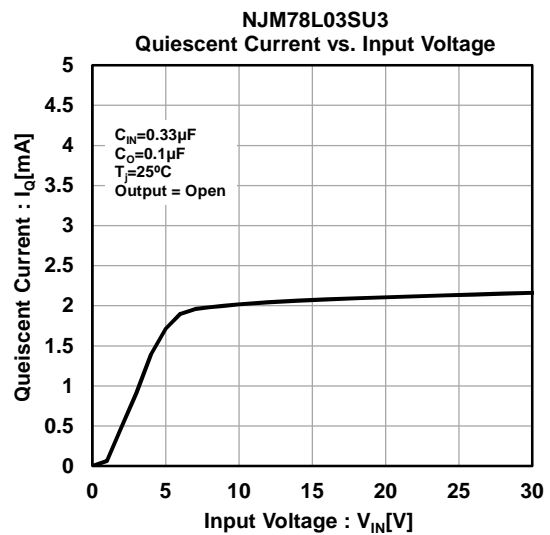
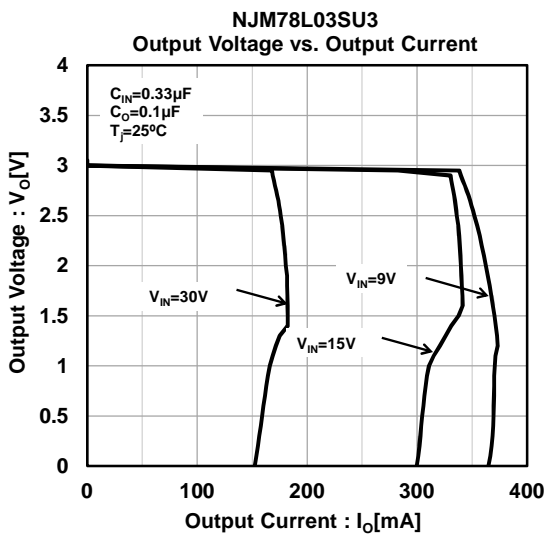
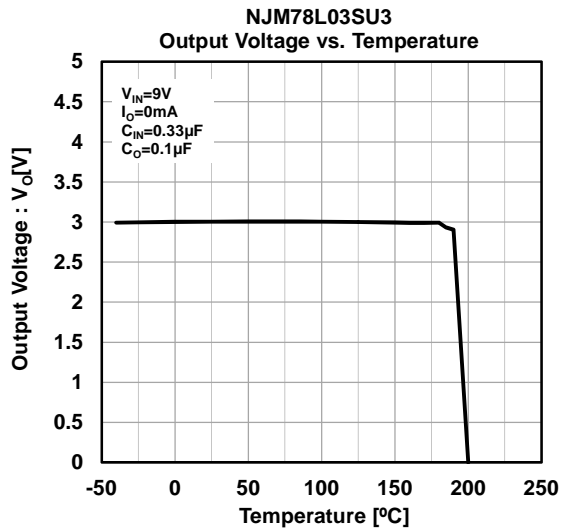
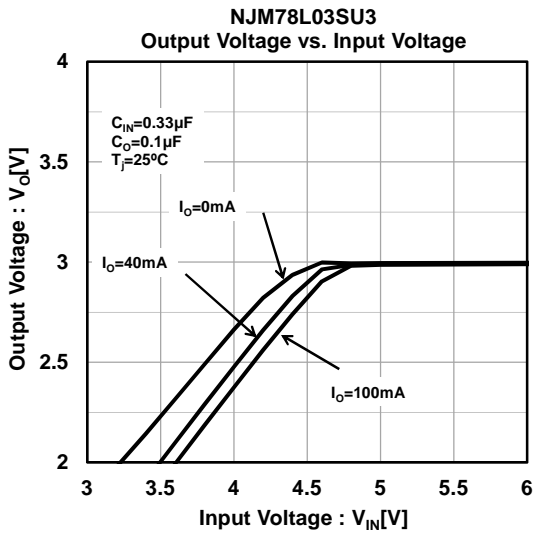


(*1) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 2Layers, copper area 100mm²)

(*2) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 4Layers)

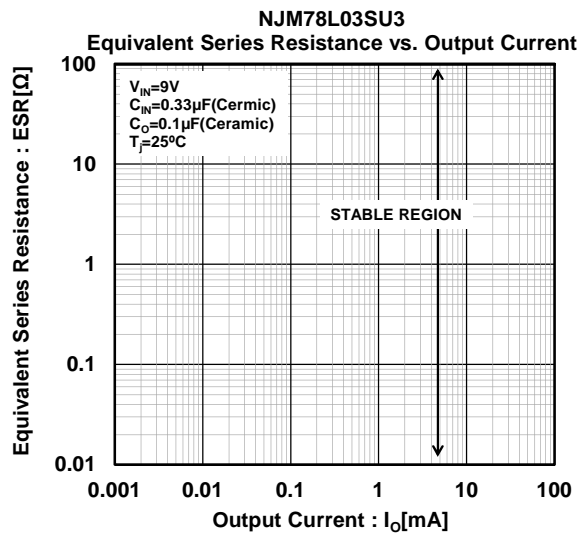
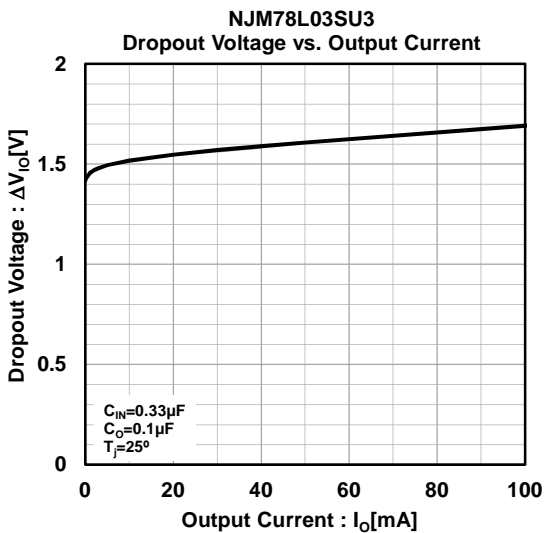
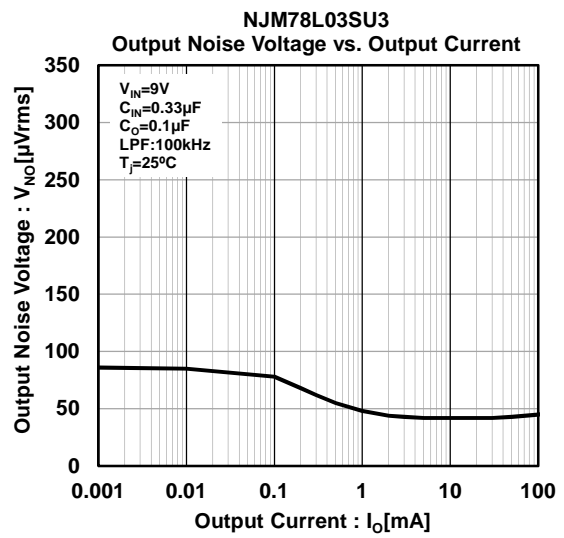
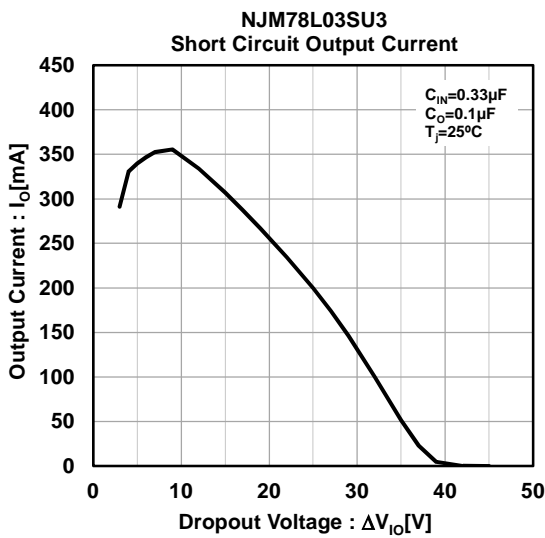
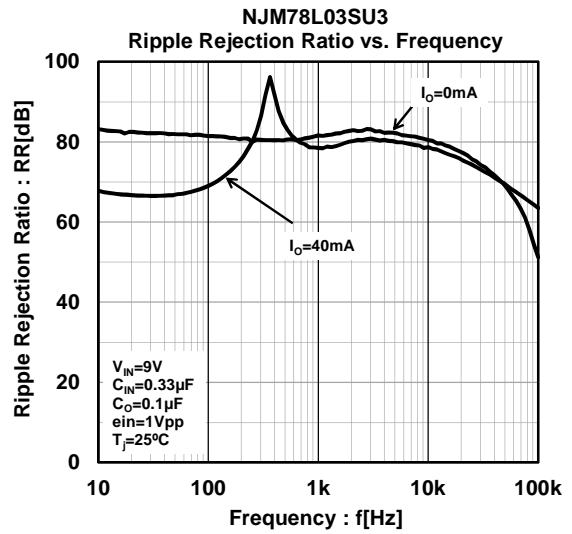
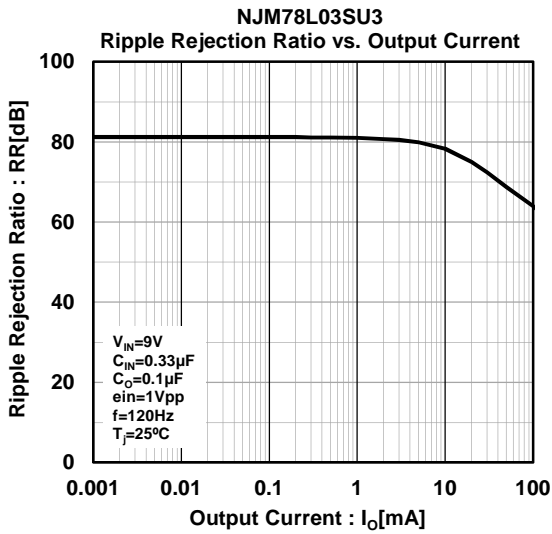
(4Layers inner foil: 74.2 ×74.2mm applying a thermal via hole to a board based on JEDEC standard JESD51-5)

■ TYPICAL CHARACTERISTICS (3V)

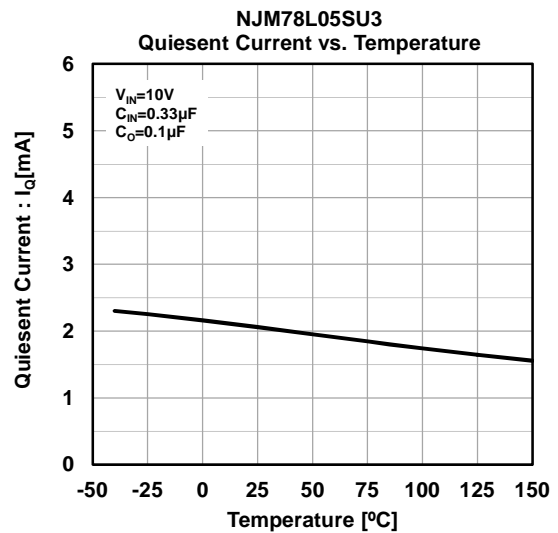
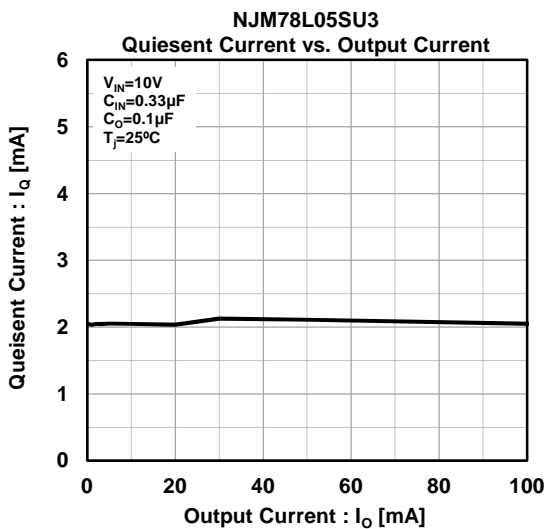
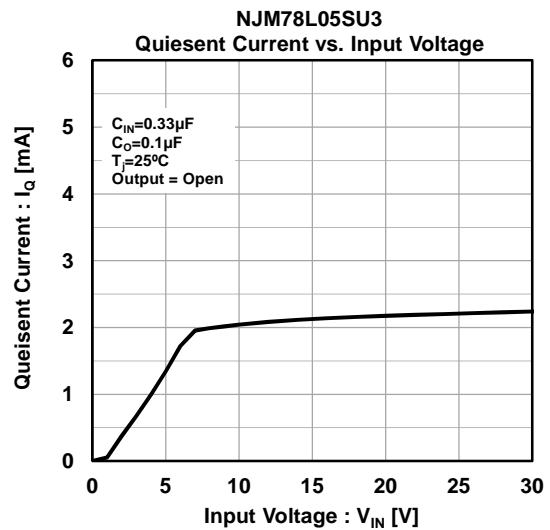
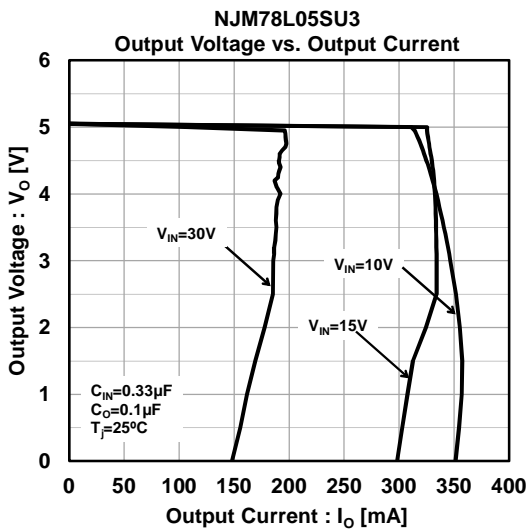
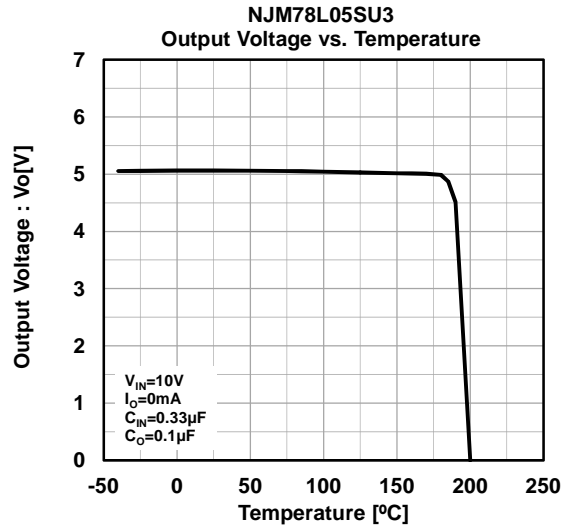
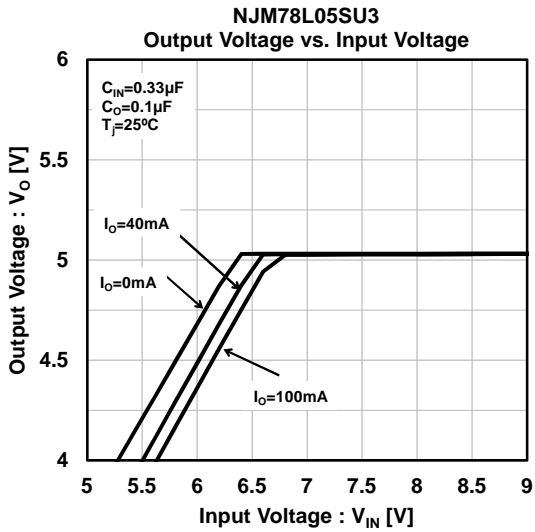


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■ TYPICAL CHARACTERISTICS (3V)

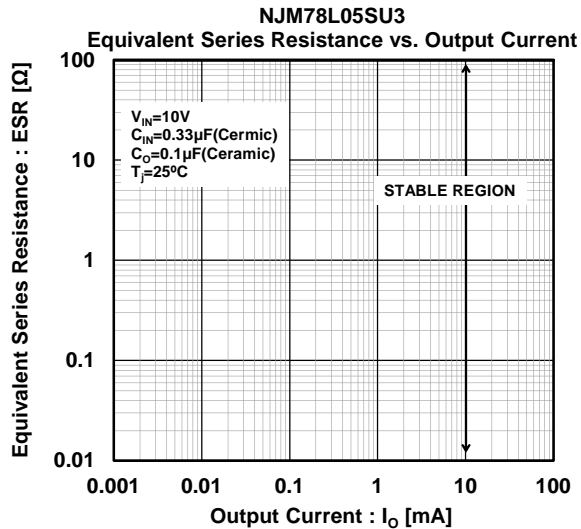
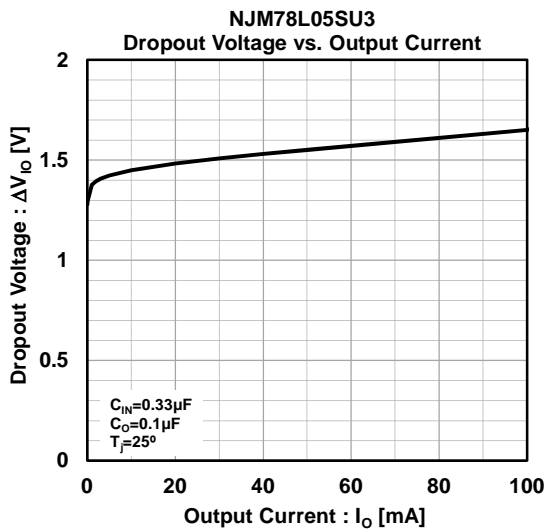
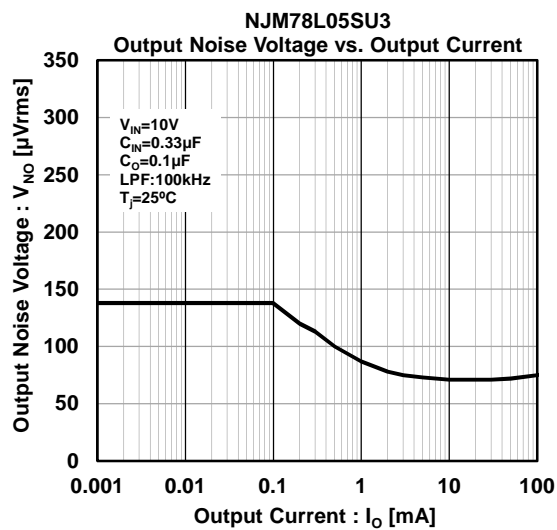
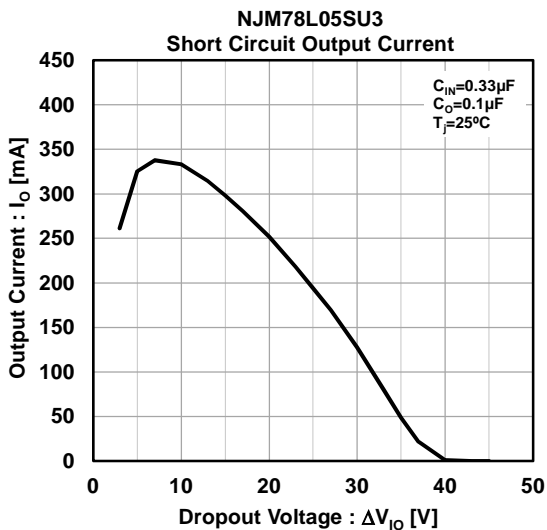
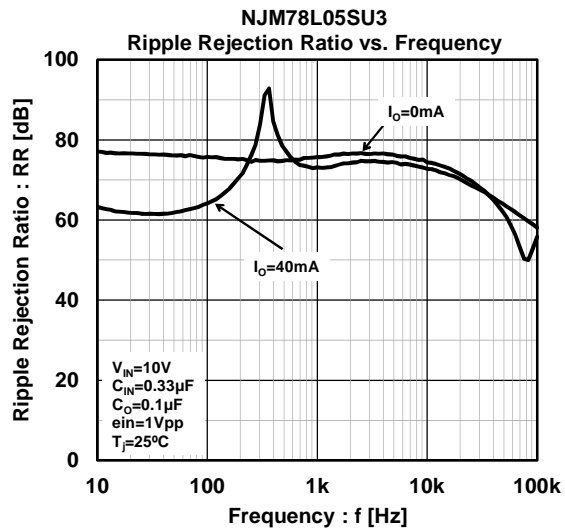
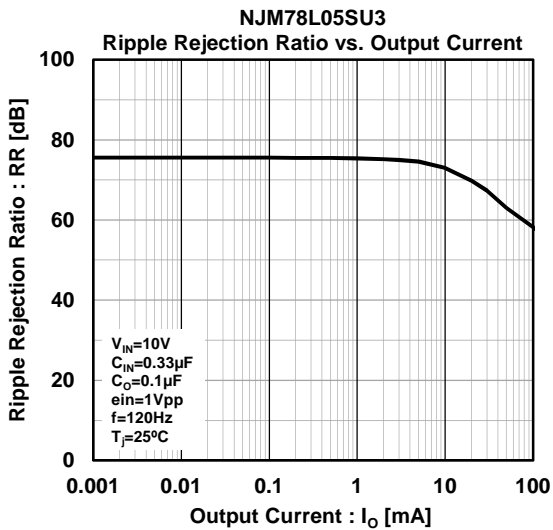


■ TYPICAL CHARACTERISTICS (5V)

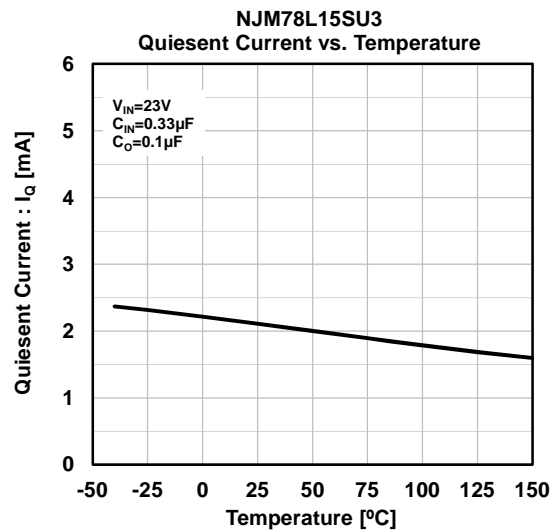
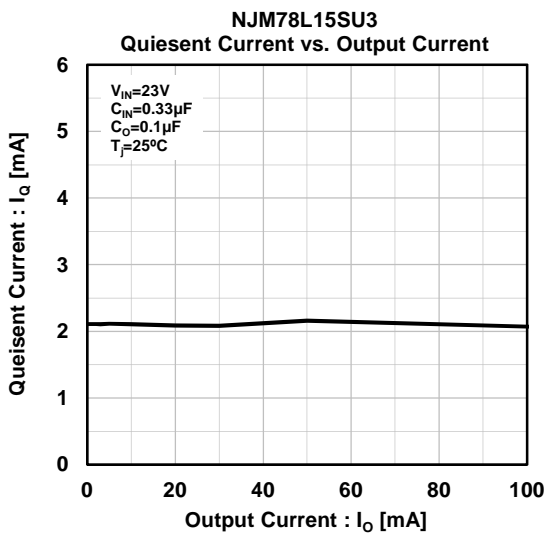
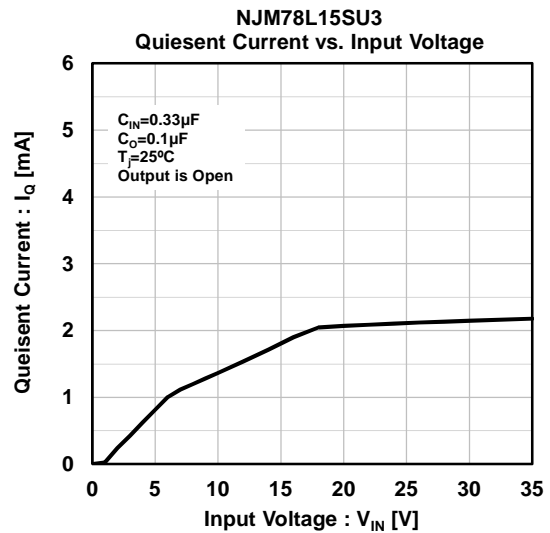
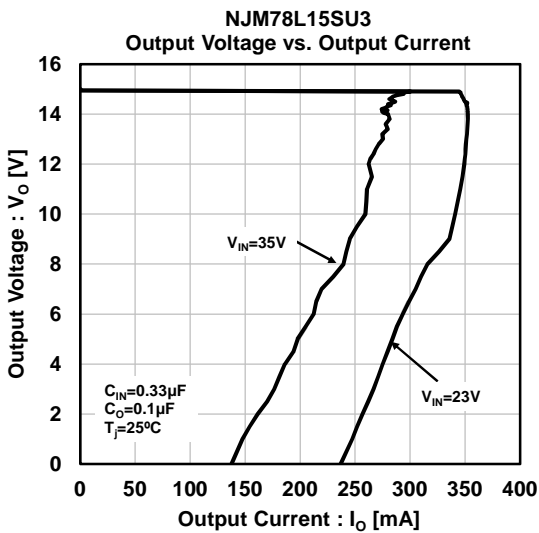
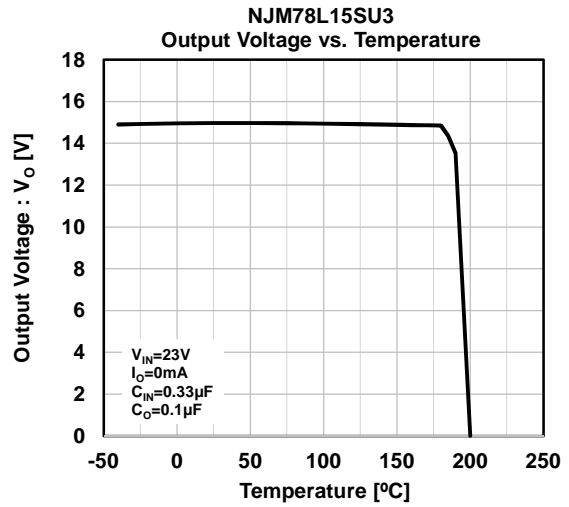
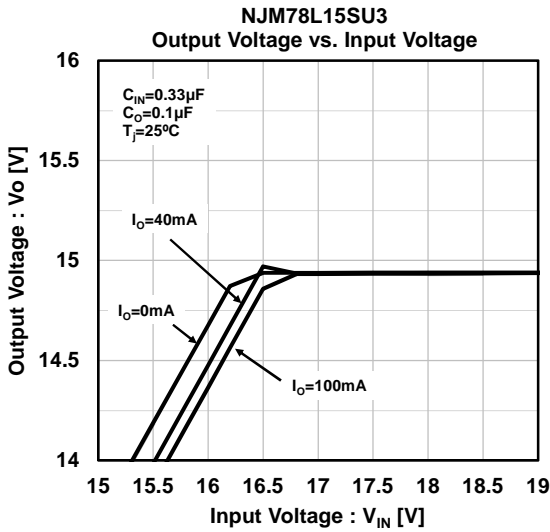


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■ TYPICAL CHARACTERISTICS (5V)

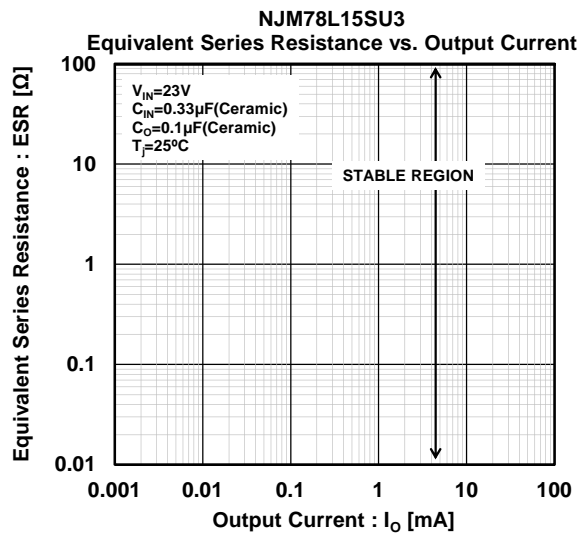
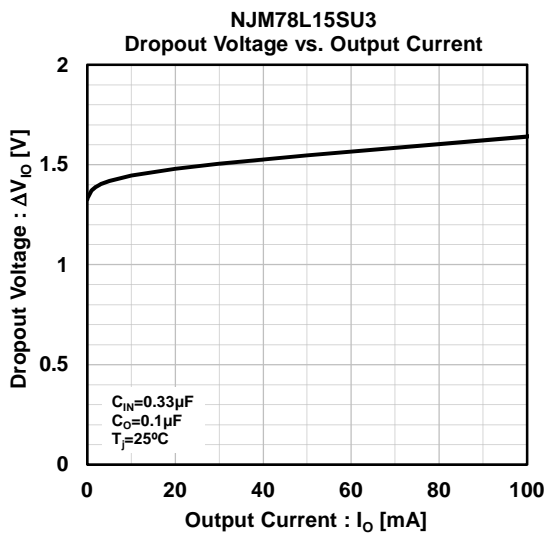
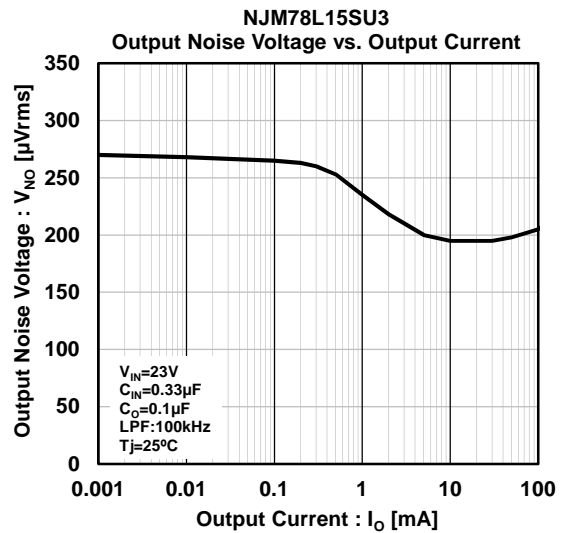
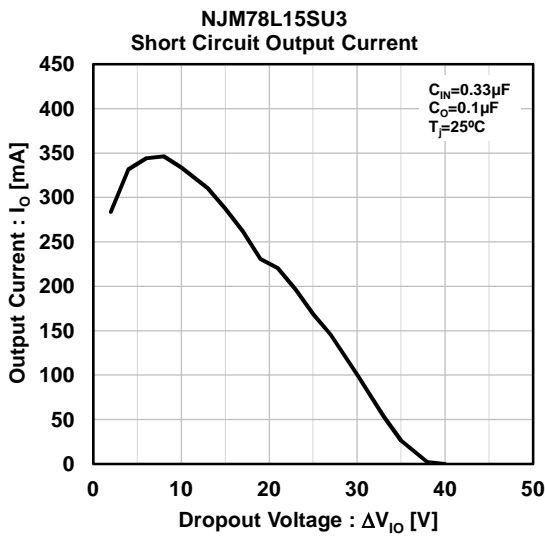
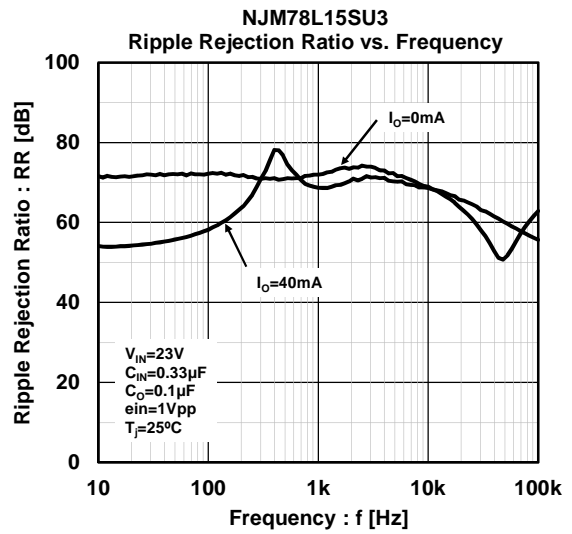
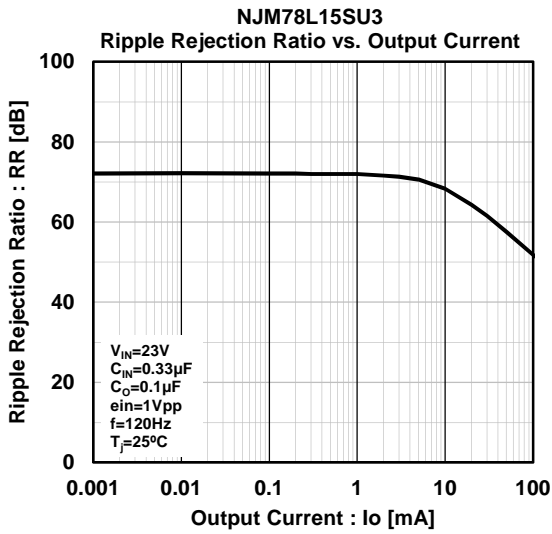


■ TYPICAL CHARACTERISTICS (15V)



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■ TYPICAL CHARACTERISTICS (15V)



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