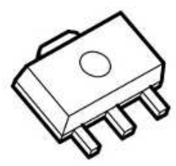
3-TERMINAL POSITIVE VOLTAGE REGULATOR

■ 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

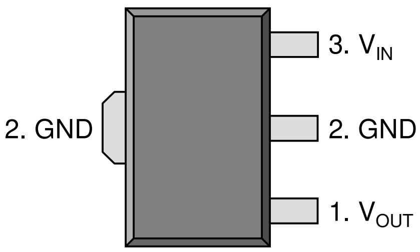


NJM78L00SU3
(SOT-89-3)

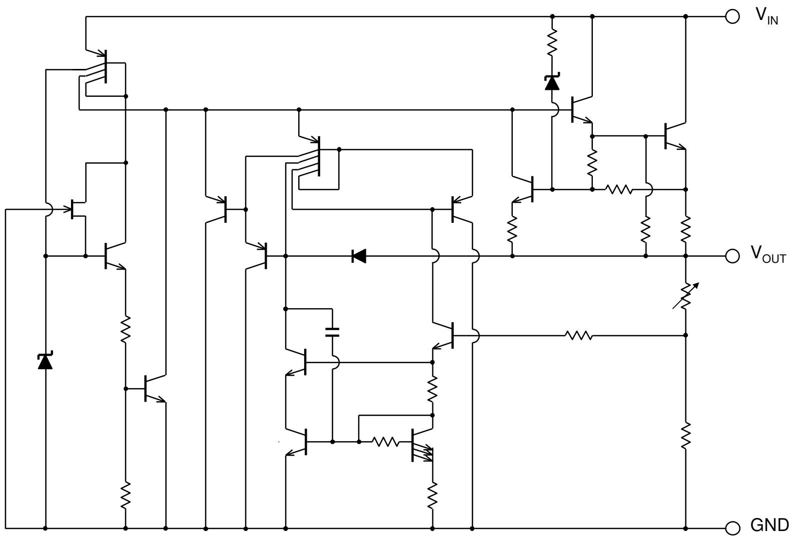
■ FEATURE

- Output Current 100 mA max.
- High Precision Output Voltage V_O±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



■ ABSOLUTE MAXIMUM RATINGS

(Unless otherwise noted, T_a = 25ºC)

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	°C
Operating Temperature Range	T_{opr}	- 40 to + 125	°C
Storage Temperature Range	T_{stg}	- 50 to + 150	°C

(*1) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 2Layers, copper area 100mm^2)
(*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}=0.33µF, C_O=0.1µF, T_j=25°C)Measurement is to be conducted is pulse testing.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L03SU3						
Output Voltage	V_O	V_{IN}=9V, I_O=40mA	2.88	3.0	3.12	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=5V to 20V, I_O=40mA	-	-	125	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=6V to 20V, I_O=40 mA	-	-	100	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=9V, I_O=1 to 40 mA	-	-	25	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=9V, I_O=1 to 100 mA	-	-	50	mV
Quiescent Current	I_Q	V_{IN}=9V, I_O=0 mA	-	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=9V, I_O=1 mA	-	0.2	-	mV/ºC
Ripple Rejection	RR	6V<V_{IN}<16V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	43	72	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=9V, BW=10Hz to 100kHz, I_O=40mA	-	40	-	µVrms
Dropout Voltage	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L33SU3						
Output Voltage	V_O	V_{IN}=9.3V, I_O=40mA	3.17	3.3	3.43	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=5.3V to 20V, I_O=40mA	-	-	135	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=6.3V to 20V, I_O=40mA	-	-	105	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=9.3V, I_O=1 to 40mA	-	-	26	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=9.3V, I_O=1 to 100mA	-	-	53	mV
Quiescent Current	I_Q	V_{IN}=9.3V, I_O=0mA	-	2.0	6	mA
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$	V_{IN}=9.3V, I_O=1mA	-	0.25	-	mV/ºC
Ripple Rejection	RR	6.3V<V_{IN}<16.3V, I_O=40mA, e_{in}=1V_{P-P}, f=120Hz	42	71	-	dB
Output Noise Voltage	V_{NO}	V_{IN}=9.3V, BW=10Hz to 100kHz, I_O=40mA	-	45	-	µVrms
Dropout Voltage	ΔV_{IO}	I_O=100mA	-	1.7	-	V

■ ELECTRICAL CHARACTERISTICS

(C_{IN}=0.33µF, C_O=0.1µF, T_j=25°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_{IN}1	V_{IN}=7V to 20V, I_O=40mA	-	-	200	mV
Line Regulation 2	ΔV_O-V_{IN}2	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/ºC
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	-	µVrms
Dropout Voltage	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L06SU3						
Output Voltage	V_O	V_{IN}=12V, I_O=40mA	5.76	6.0	6.24	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=8.5V to 20V, I_O=40mA	-	-	200	mV
Line Regulation 2	ΔV_O-V_{IN}2	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/ºC
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	-	µVrms
Dropout Voltage	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L08SU3						
Output Voltage	V_O	V_{IN}=14V, I_O=40mA	7.68	8.0	8.32	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=10.5V to 23V, I_O=40mA	-	-	225	mV
Line Regulation 2	ΔV_O-V_{IN}2	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/ºC
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	-	µVrms
Dropout Voltage	ΔV_{IO}	I_O=100mA	-	1.7	-	V

■ ELECTRICAL CHARACTERISTICS

(C_{IN}=0.33µF, C_O=0.1µF, T_j=25°C)Measurement is to be conducted is pulse testing.

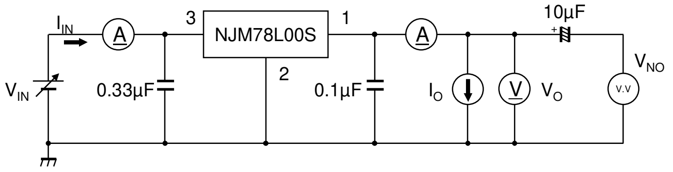
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L10SU3						
Output Voltage	V_O	V_{IN}=16V, I_O=40mA	9.6	10.0	10.4	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=13V to 25V, I_O=40mA	-	-	250	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=14V to 25V, I_O=40mA	-	-	200	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=16V, I_O=1 to 40mA	-	-	50	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=16V, I_O=1 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/ºC
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 to 100kHz, I_O=40mA	-	135	-	µVrms
Dropout Voltage	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L12SU3						
Output Voltage	V_O	V_{IN}=19V, I_O=40mA	11.52	12.0	12.48	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=14.5V to 27V, I_O=40mA	-	-	250	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=16V to 27V, I_O=40mA	-	-	200	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=19V, I_O=1 to 40mA	-	-	50	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=19V, I_O=1 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/ºC
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 to 100kHz,I_O=40mA	-	160	-	µVrms
Dropout Voltage	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L15SU3						
Output Voltage	V_O	V_{IN}=23V, I_O=40mA	14.4	15.0	15.6	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=17.5V to 30V, I_O=40mA	-	-	300	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=20V to 30V, I_O=40mA	-	-	250	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=23V, I_O=1 to 40mA	-	-	75	mV
Load Regulation 2	ΔV_O-I_O2	V_{IN}=23V, I_O=1 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/ºC
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 to 100kHz, I_O=40mA	-	190	-	µVrms
Dropout Voltage	ΔV_{IO}	I_O=100mA	-	1.7	-	V

■ TEST CIRCUIT

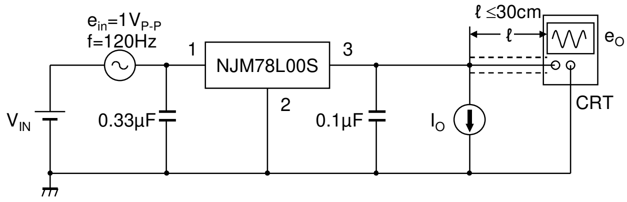
1. Output Voltage, Line Regulation, Load Regulation, Quiescent Current, Average, Output Noise Voltage, Temperature Coefficient of Output Voltage, Peak Output/Short Circuit Current



▪ Measurement is to be conducted in pulse testing

▪ $I_Q = I_{IN} - I_O$

2. Ripple Rejection



$$RR = 20\log_{10}\left(\frac{ein}{eo}\right)$$

・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.

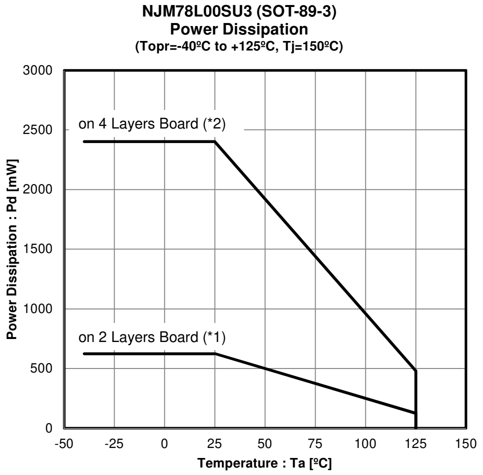
On the other hand, Use of a larger C_O reduces output noise and ripple output, and also improves output transient response when rapid load change.

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.

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE

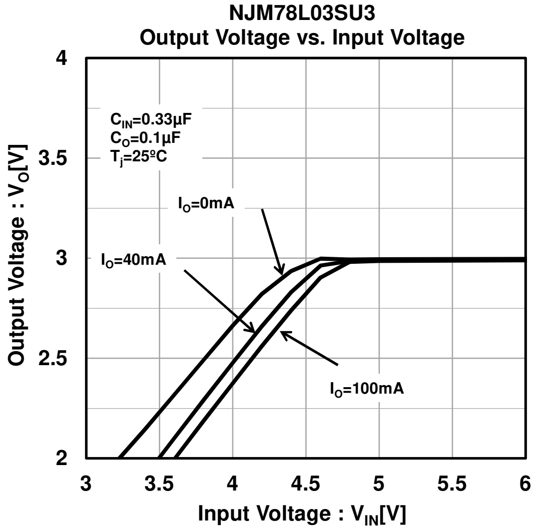


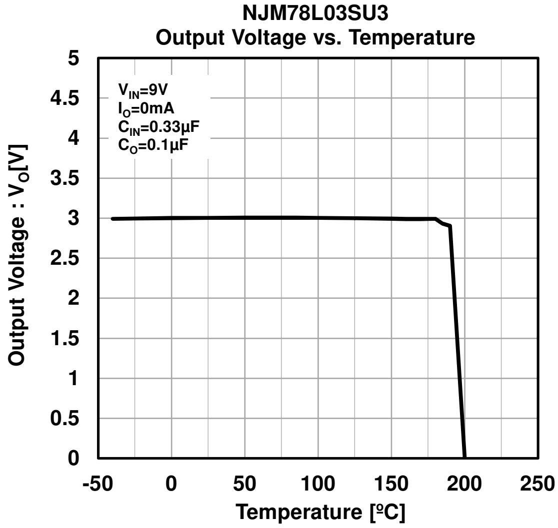
(*1) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 2Layers, copper area 100mm^2)

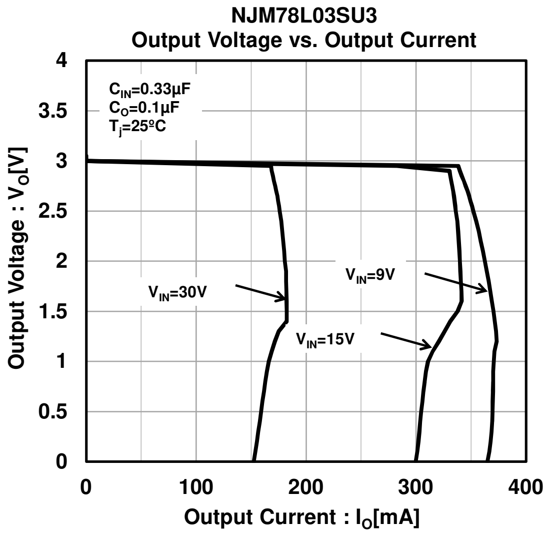
(*2) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 4Layers)

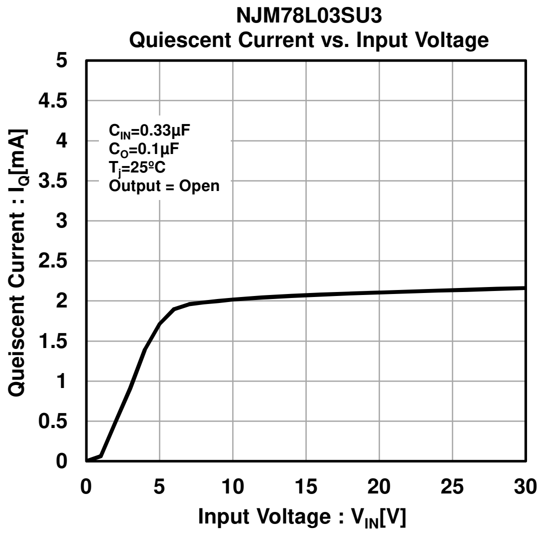
(4Layers inner foil: 74.2 ×74.2mm applying a thermal via hole to a board based on JEDEC standard JESD51-5)

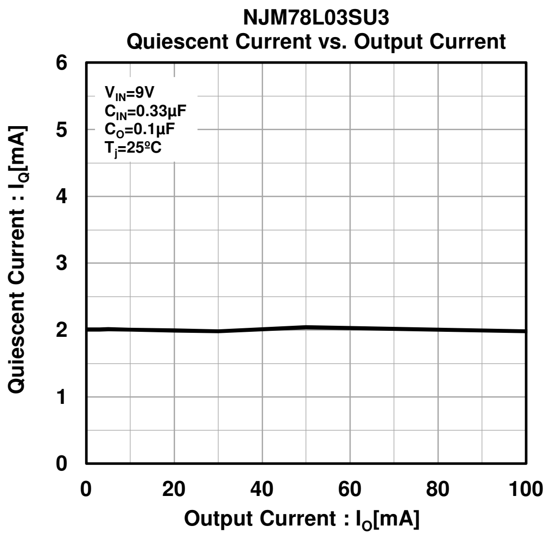
■ TYPICAL CHARACTERISTICS (3V)

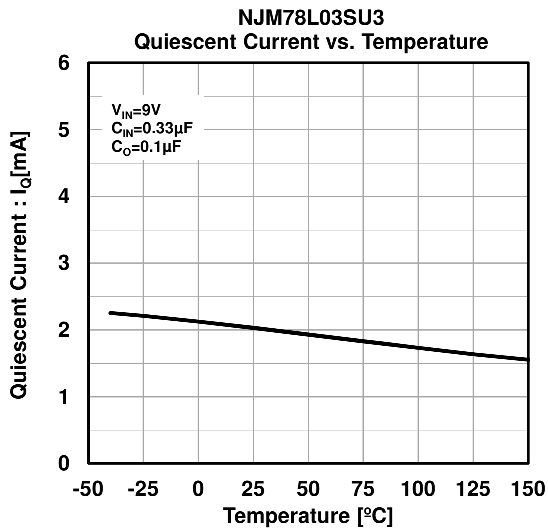






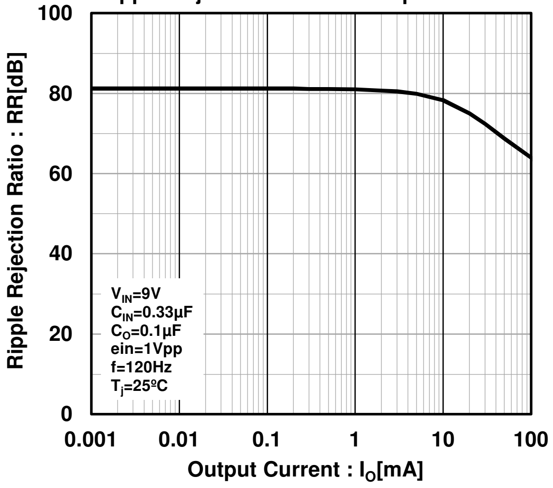




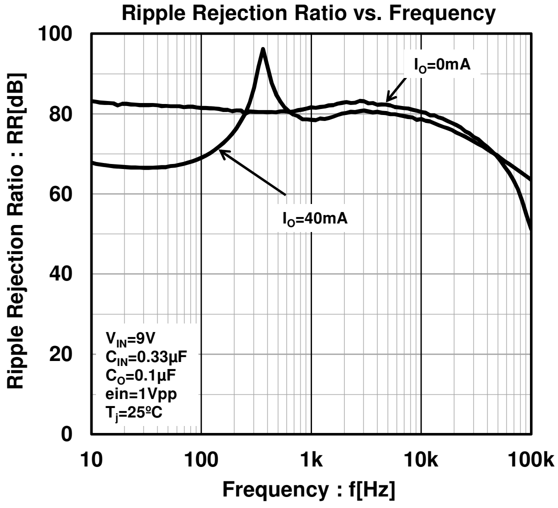


■ TYPICAL CHARACTERISTICS (3V)

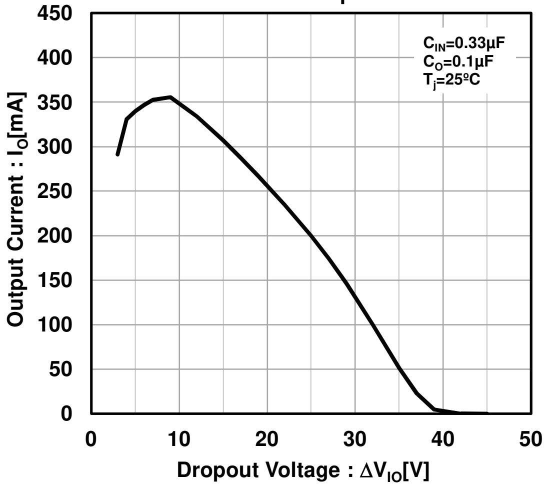
NJM78L03SU3
Ripple Rejection Ratio vs. Output Current



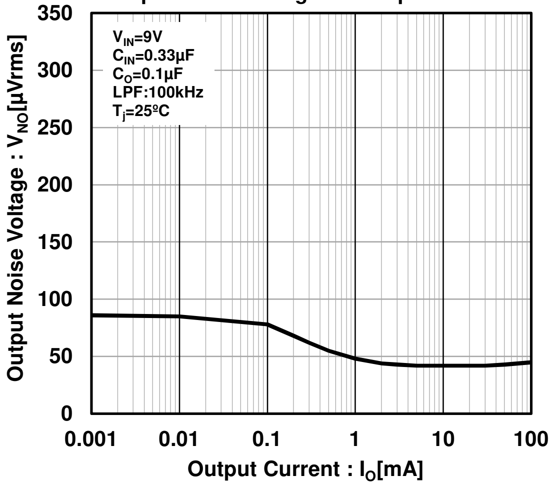
NJM78L03SU3
Ripple Rejection Ratio vs. Frequency



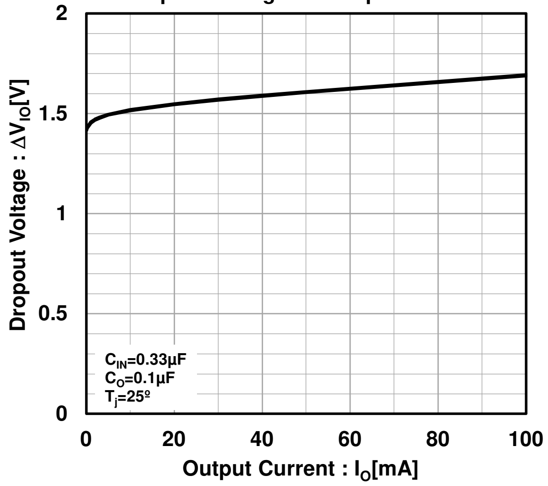
NJM78L03SU3
Short Circuit Output Current



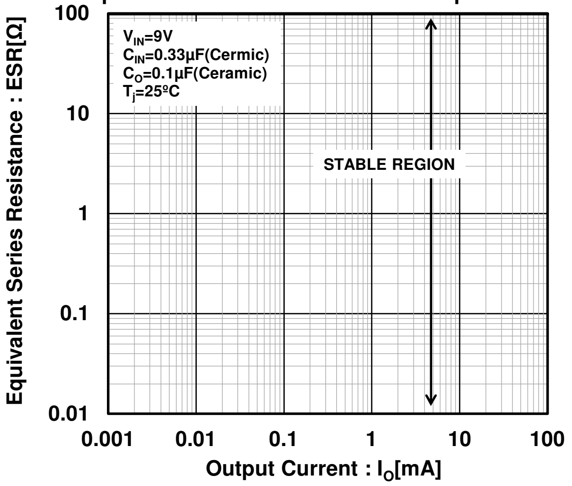
NJM78L03SU3
Output Noise Voltage vs. Output Current



NJM78L03SU3
Dropout Voltage vs. Output Current

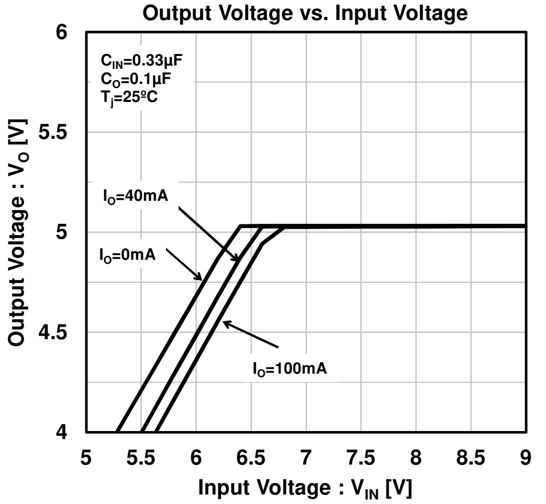


NJM78L03SU3
Equivalent Series Resistance vs. Output Current

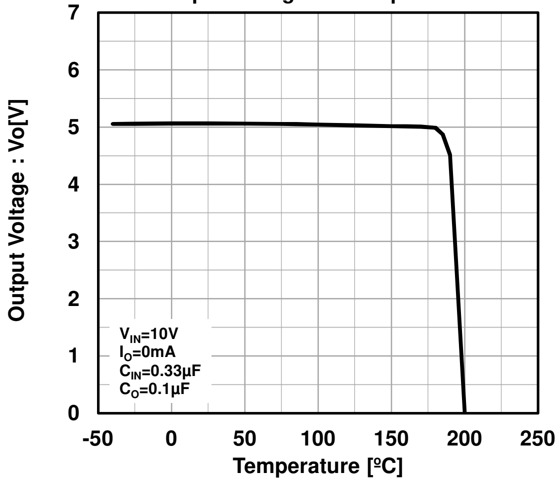


■ TYPICAL CHARACTERISTICS (5V)

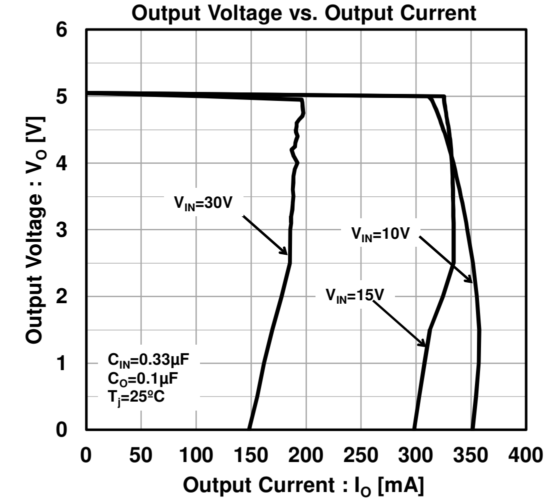
NJM78L05SU3
Output Voltage vs. Input Voltage



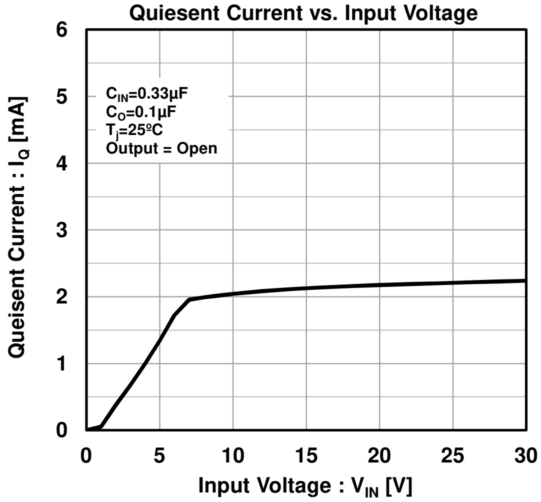
NJM78L05SU3
Output Voltage vs. Temperature



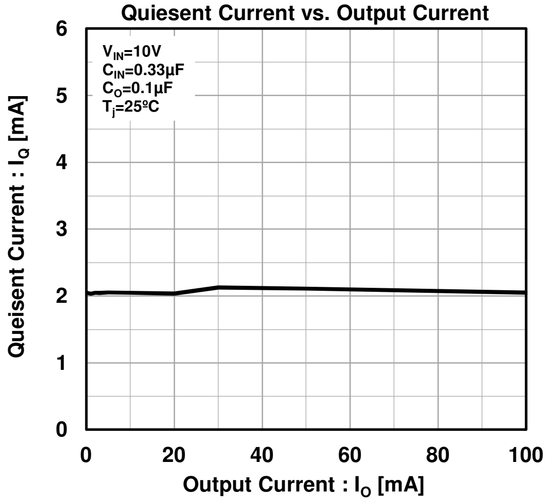
NJM78L05SU3
Output Voltage vs. Output Current



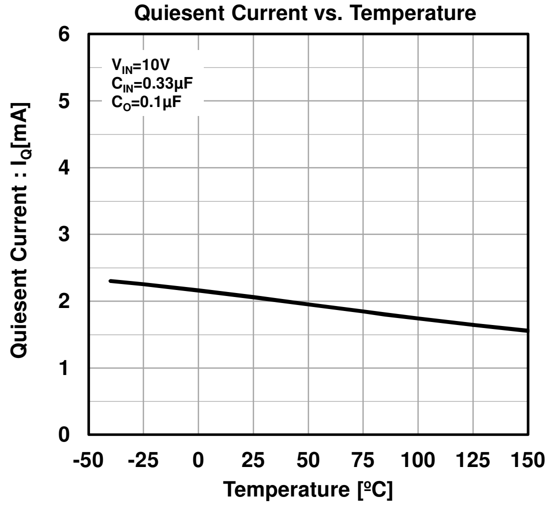
NJM78L05SU3
Quiesent Current vs. Input Voltage



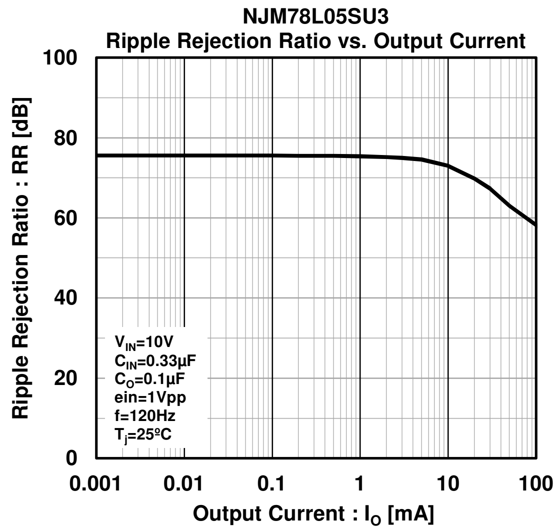
NJM78L05SU3
Quiesent Current vs. Output Current

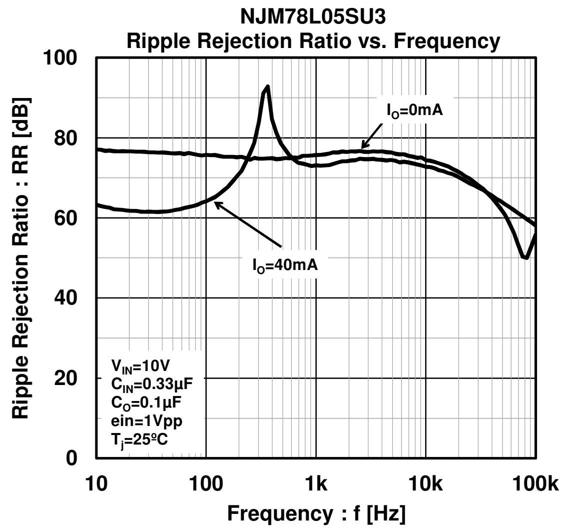


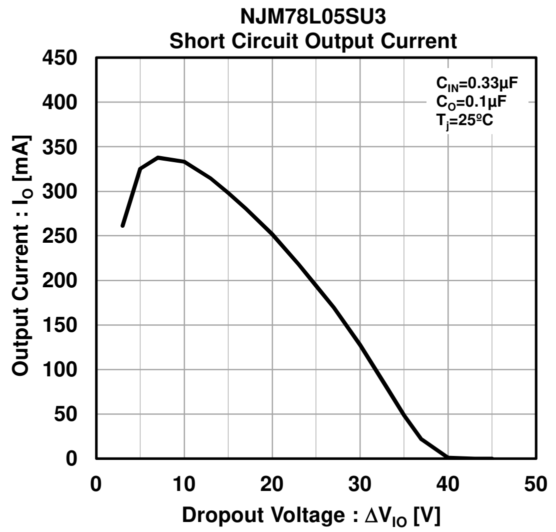
NJM78L05SU3
Quiesent Current vs. Temperature

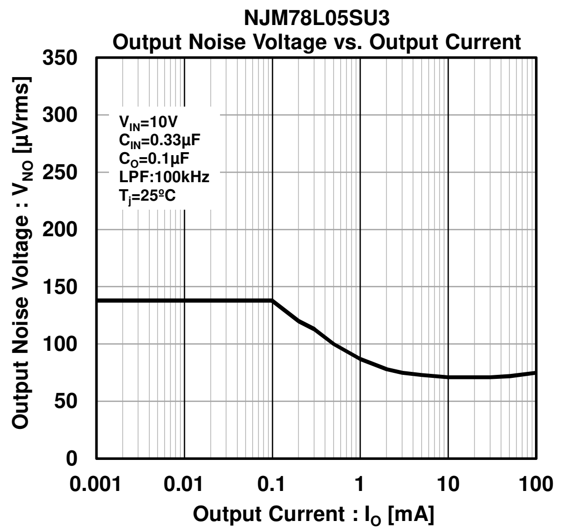


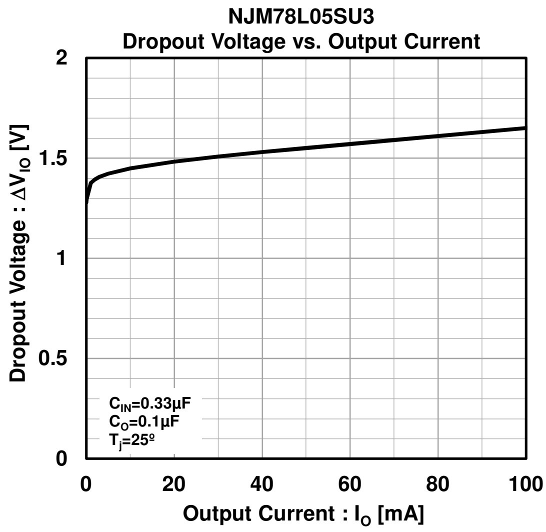
■ TYPICAL CHARACTERISTICS (5V)

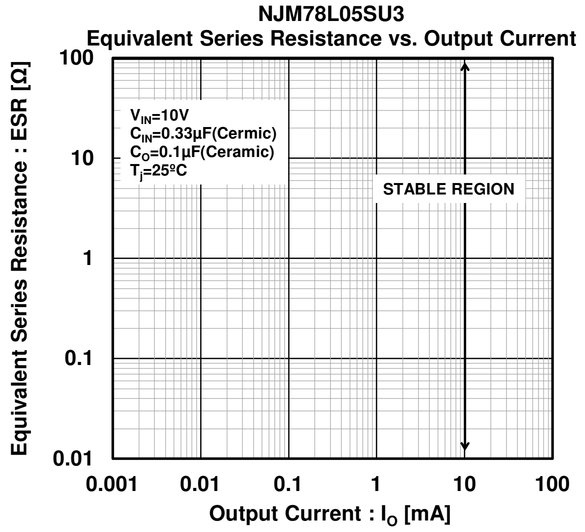




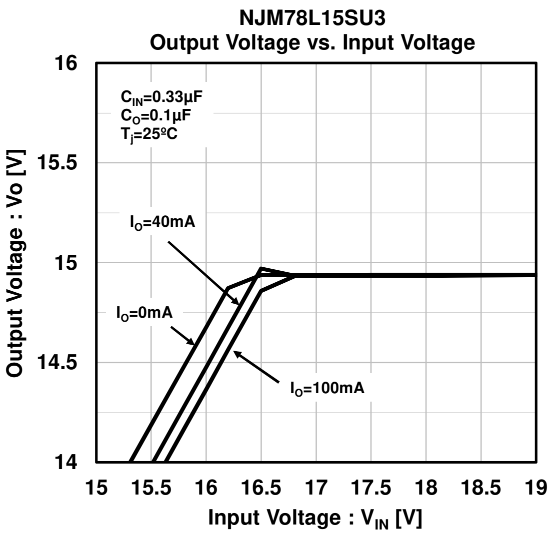


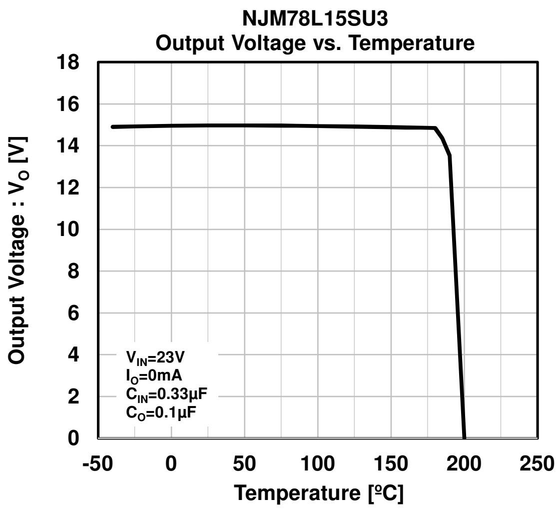


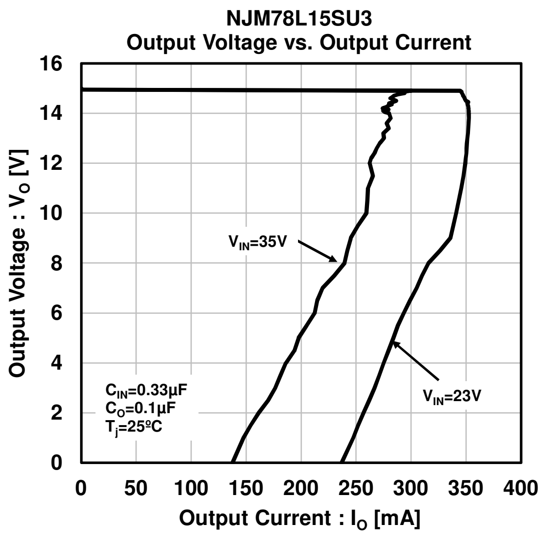


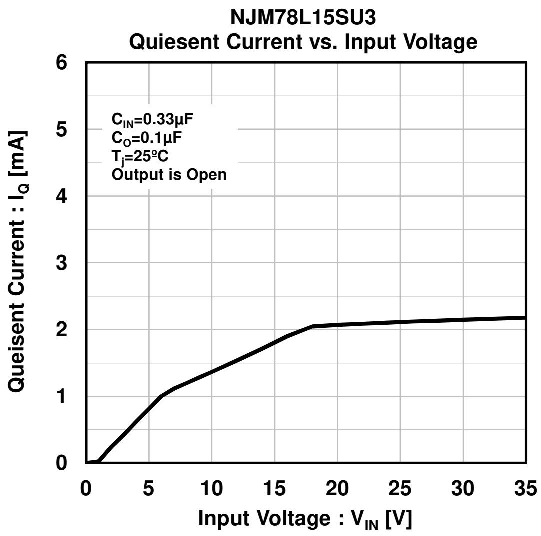


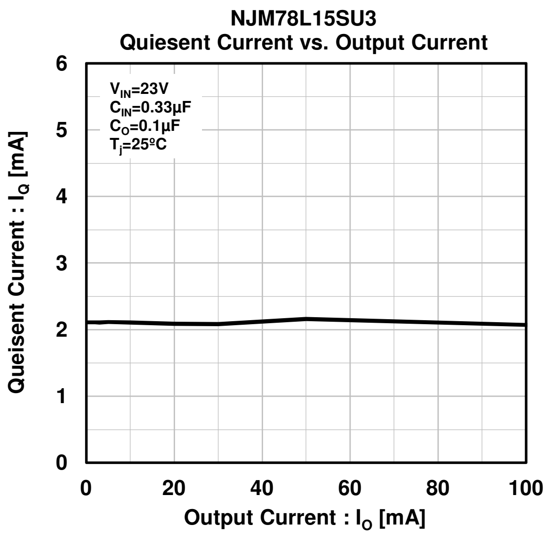
■ TYPICAL CHARACTERISTICS (15V)

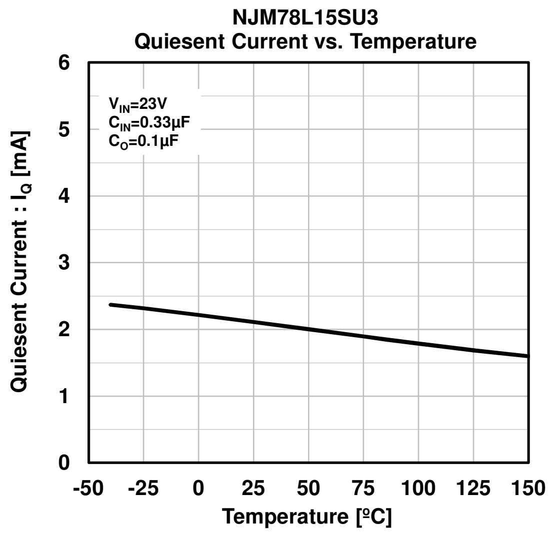




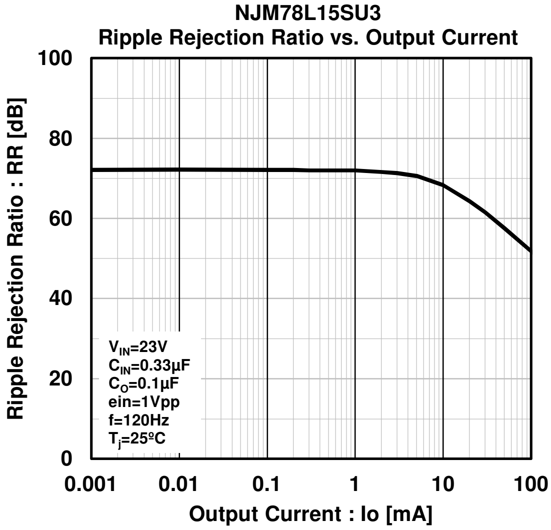


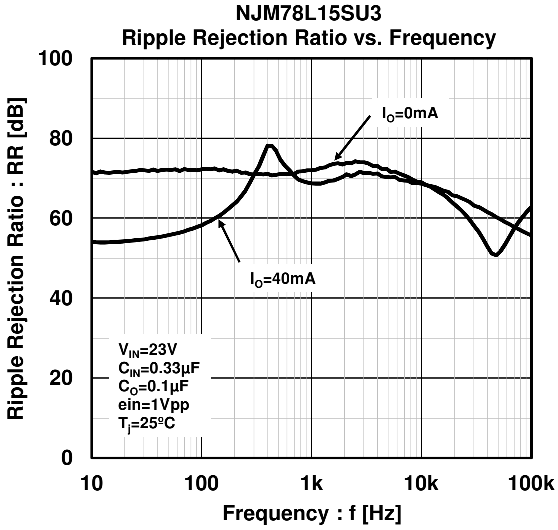


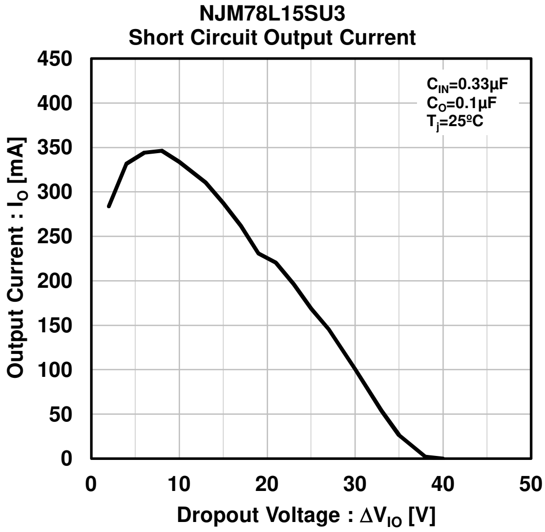


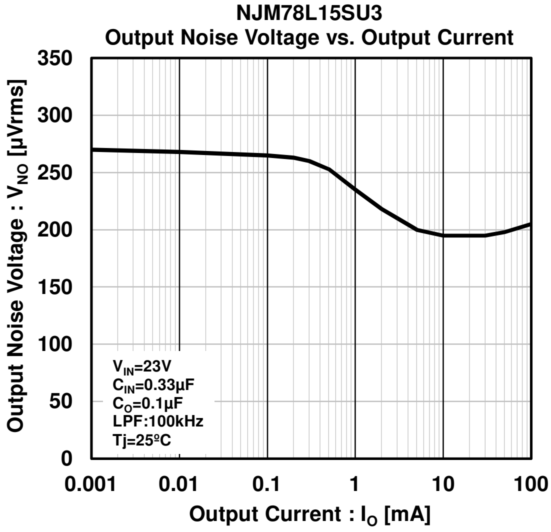


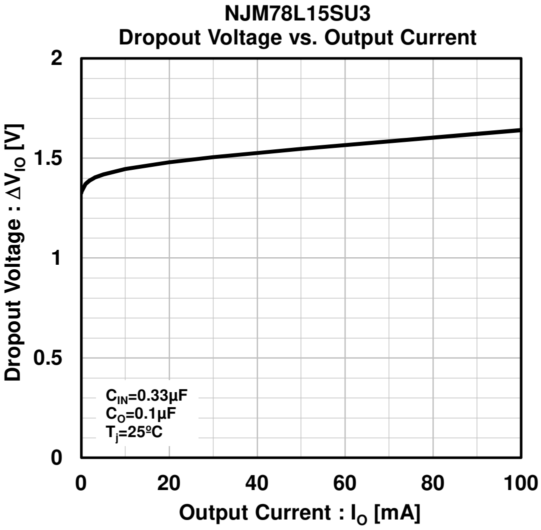
■ TYPICAL CHARACTERISTICS (15V)

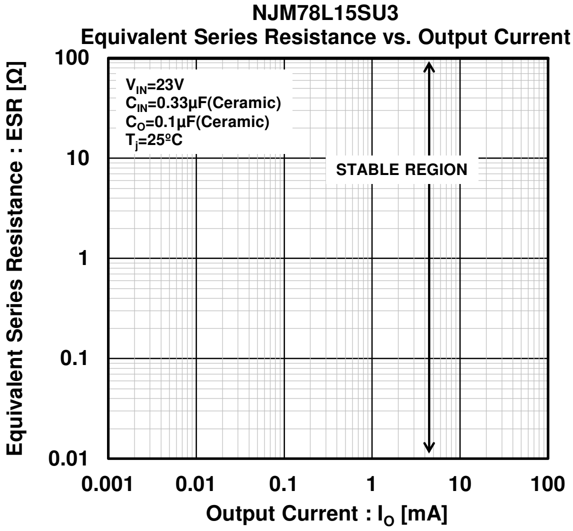












MEMO

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