Negative Output Low Drop Out voltage regulator

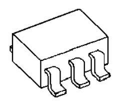
■ GENERAL DESCRIPTION

The NJM2828 is a negative output low dropout regulator. Advanced bipolar technology achieves low noise, high precision voltage and high ripple rejection.

It has soft-start and shunt SW function. 1.0µF Output capacitor and small package can make NJM2828 suitable for portable items.

■ PACKAGE OUTLINE

SC88A

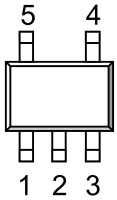


NJM2828F3

■ FEATURES

- Low Current Consumption 0.13V (typ.) @Io=60mA
- High Precision Output ±1.5%
- High Ripple Rejection 65dB(typ.) @f=1kHz, Vo=-7V Version
- Output capacitor with 0.1F ceramic capacitor.
- Output Current Io(max.)=100mA
- ON/OFF Control(Positive voltage control from 0 to +5V)
- Soft-start Function
- Shunt SW Function
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limit
- Bipolar Technology
- Package Outline SC88A

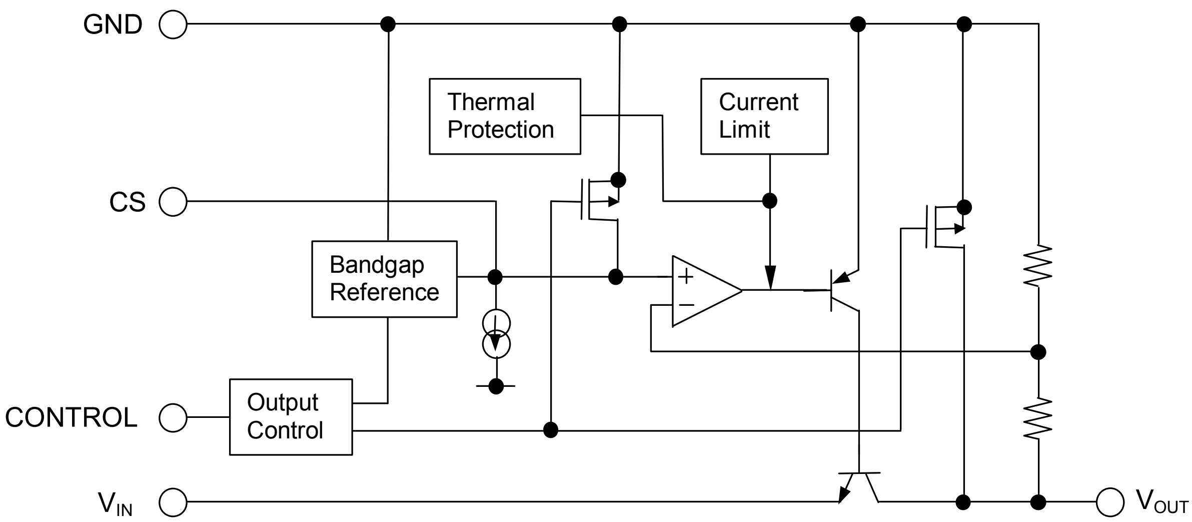
■ PIN CONFIGURATION



1.GND
2.V_{IN}
3.V_{OUT}
4.CONTROL
5.CS

NJM2828F3-XX

■ EQUIVALENT CIRCUIT



■ OUTPUT VOLTAGE RANK LIST

Device Name	V_{OUT}	Device Name	V_{OUT}
NJM2828F3-15	-1.5V	NJM2828F3-06	-6.0V
NJM2828F3-02	-2.0V	NJM2828F3-63	-6.3V
NJM2828F3-03	-3.0V	NJM2828F3-07	-7.0V
NJM2828F3-04	-4.0V	NJM2828F3-75	-7.5V
NJM2828F3-05	-5.0V	NJM2828F3-08	-8.0V
NJM2828F3-51	-5.1V	*NJM2828F3-85	-8.5V
NJM2828F3-55	-5.5V	NJM2828F3-10	-10.0V

Output voltage options available : -1.5 ~ -10.0V (0.1V step)

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Input Voltage	V_{IN}	-14	V
Control Voltage	V_{CONT}	+5	V
Power Dissipation	P_D	250(*1)	mW
Operating Temperature	Topr	–40 ~ +85	°C
Storage Temperature	Tstg	–40 ~ +125	°C
Output Sink Current at OFF-state	$I_{SINK(OFF)}$	10	mA

(*1): Mounted on glass epoxy board. (114.3×76.2×1.6mm : 2layer,FR-4)

■ Operating voltage

V_{IN}=-3.2 ~ -12V (In case of Vo>-3.0V version)

■ ELECTRICAL CHARACTERISTICS

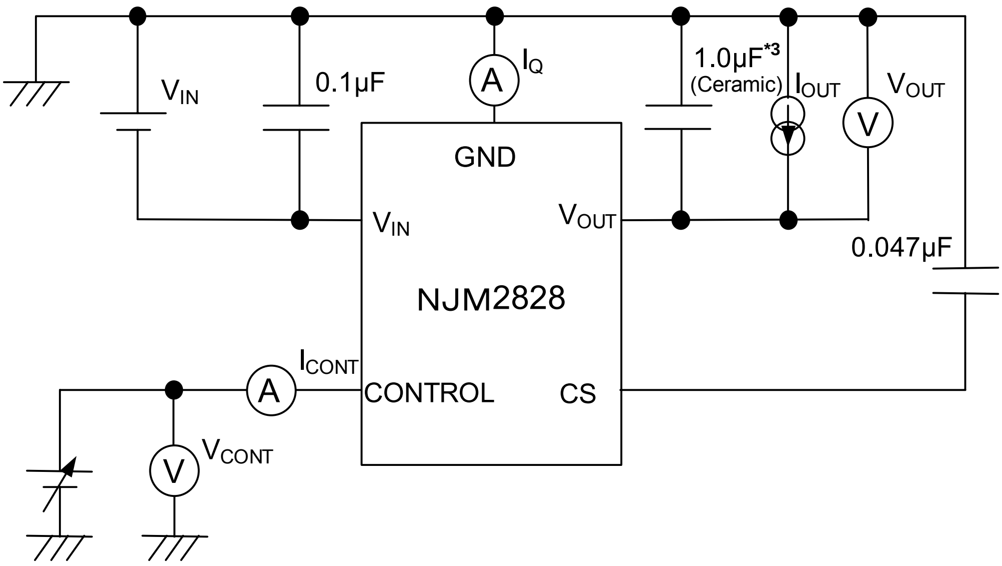
(Vo<-2.2V Version: V_{IN}=Vo-1V, V_{CONT}=3V, C_{IN}=0.1µF, Co=1.0µF, Ta=25°C)
(Vo≥-2.2V Version: V_{IN}=-3.2V, V_{CONT}=3V, C_{IN}=0.1µF, Co=2.2µF(Vo>-2.0V: Co=4.7µF), Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	Vo	Io=30mA	+1.5%	-	-1.5%	V
Quiescent Current	I_Q	Io=0mA, except Icont	-	130	200	µA
Quiescent Current at OFF-state	$I_{Q(OFF)}$	V_{CONT}=0V	-	-	100	nA
Output Current	Io	V_O+0.3V	100	130	-	mA
Line Regulation	$\Delta Vo/\Delta V_{IN}$	V_{IN}=Vo-1V~ -12V, Io=30mA	-	-	0.10	%/V
Load Regulation	ΔVo/ΔIo	Io=0~60mA	-	-	0.03	%/mA
Dropout Voltage(*2)	$\Delta V_{I\ O}$	Io=60mA	-	0.13	0.23	V
Ripple Rejection	RR	ein=200mVrms, f=1kHz, Io=10mA Vo=-7V Version	-	65	-	dB
Average Temperature Coefficient of Output Voltage	ΔVo/ΔTa	Ta=0~85°C, Io=10mA	-	±50	-	ppm/°C
Output Noise Voltage1	V_{NO}	f=10Hz~80kHz, Io=10mA, Vo=-7V Version	-	100	-	µVrms
CS Terminal Charge Current	Ics	V_{CS}=0V	4	5	6	µA
Output Resistance at OFF-state	$R_{O(OFF)}$	V_{CONT}=0V, Vo=-7V Version	-	360	-	Ω
Control Current	I_{CONT}	V_{CONT}=1.6V	-	2	4	µA
Control Voltage for ON-state	$V_{CONT(ON)}$		1.6	-	-	V
Control Voltage for OFF-state	$V_{CONT(OFF)}$		-	-	0.6	V
Input Voltage	V_{IN}		-12	-	-	V

(*2):Excludes Vo>-3.0V version.

The above specification is a common specification for all output voltages.
Therefore, it may be different from the individual specification for a specific output voltage.

■ TEST CIRCUIT



*3 -2.2V≤Vo< -2.0V version : Co=2.2μF(Ceramic)
Vo≥-2.0V version : Co=4.7μ F(Ceramic)

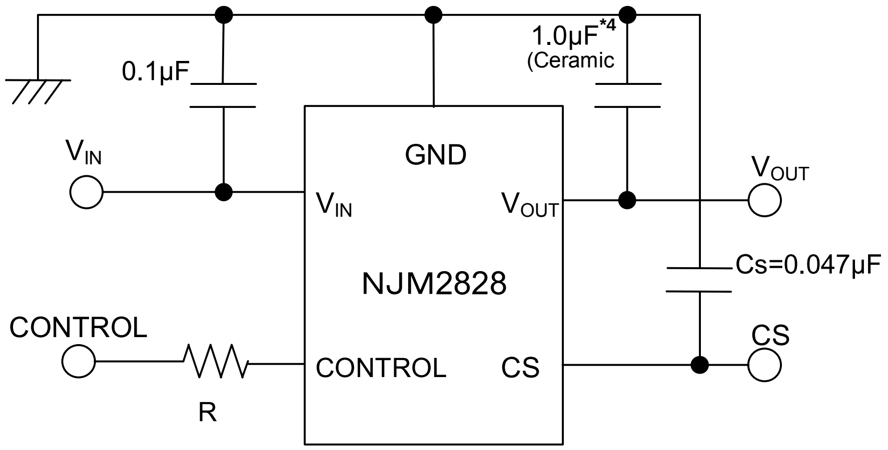
■ TYPICAL APPLICATIONS

∗ON/OFF control

ON/OFF control can be achieved by applying positive control voltage to CONTROL terminal.
Apply positive Vcont ("H") to make chip to be ON (Enabled), and either Vcont is "L" or open (High Z) to make chip to be OFF (Disabled).
The relations between Vcont and the state is as follows:

Vcont +1.6V ≤ Vcont ≤ +5V ("H" level):	ON state
Vcont 0V ≤ Vcont ≤ +0.6V ("L" level):	OFF state
Vcont +0.6V < Vcont < +1.6V ("L" level):	Undefined

In case ON/OFF control is not used, keep applying positive Vcont to CONTROL terminal to make chip ON.
Note that negative Vcont does not make the chip enabled.



*4 -2.2V≤Vo< -2.0V version : Co=2.2µF
Vo≥-2.0V version : Co=4.7µ F

In the case of using a resistance "R" between V_{IN} and control.
The current flow into the control terminal while the IC is ON state (I_{CONT}) can be reduced when a pull up resistance "R" is inserted between V_{IN} and the control terminal.
The minimum control voltage for ON state ($V_{CONT (ON)}$) is increased due to the voltage drop caused by I_{CONT} and the resistance "R". The I_{CONT} is temperature dependence as shown in the "Control Current vs. Temperature" characteristics. Therefore, the resistance "R" should be carefully selected to ensure the control voltage exceeds the $V_{CONT (ON)}$ over the required temperature range.

∗Input Capacitance C_{IN}

Input capacitance C_{IN} is required to prevent oscillation and reduce power supply ripple for applications with high power supply impedance or a long power supply line.
Use the C_{IN} value of 0.1µF greater to avoid the problem.
C_{IN} should connect between GND and V_{IN} as short as possible.

∗Output Capacitance C_O

Output capacitor (Co) is required for a phase compensation of the internal error amplifier. The capacitance and the equivalent series resistance (ESR) influences stability of the regulator.
This product is designed to work with a low ESR capacitor for the Co; however, use of recommended capacitance or greater value is essential for stable operation.
Use of a smaller Co may cause excess output noise or oscillation of the regulator due to lack of the phase compensation.
Therefore, use Co with the recommended capacitance or greater value and connect between Vo terminal and GND terminal with minimal wiring. The recommended capacitance depends on the output voltage. Low voltage regulator requires greater value of the Co. Thus, check the recommended capacitance for each output voltage.
Use of a greater Co reduces output noise and ripple output, and also improves transient response of the output voltage against rapid load change.

∗Soft-start function

Capacitance Cs connect between CS pin and GND for the following.

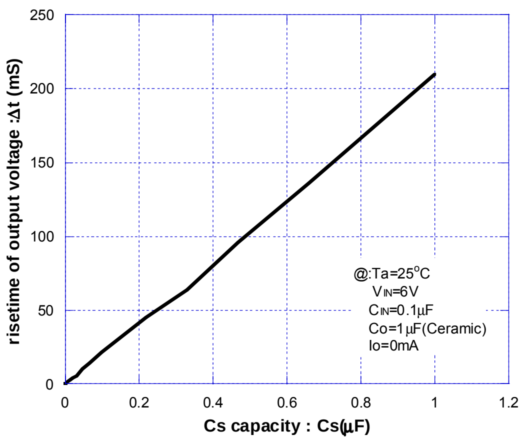
- Control at risetime of output voltage.
- Reduces inrush current at output ON.

When the soft start function is not used, CS pin should be open.

1.Cs capacitance vs risetime of output voltage

Calculation : risetime of output voltage $\Delta t \cong 213 \times Cs(\mu F)$

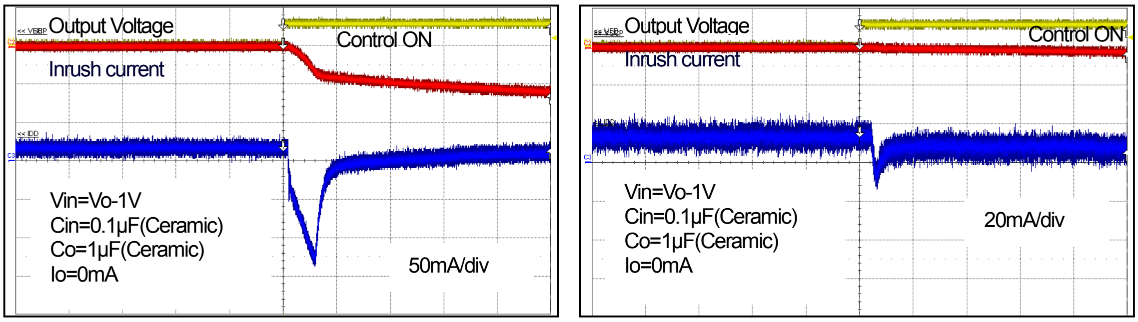
Cs capacity vs risetime of output voltage



2.Inrush current at control ON

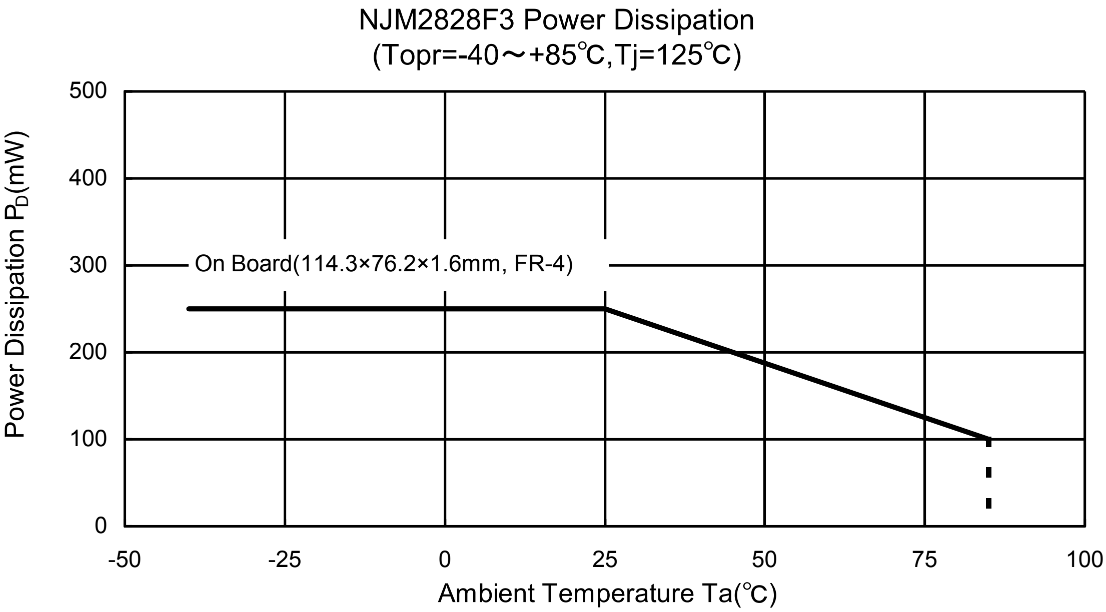
The peak value of the inrush current can be limited according to the capacitance of the Cs.

Inrush current wave :

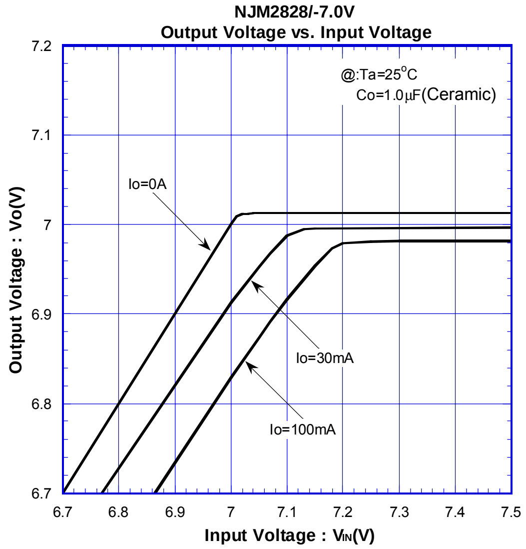


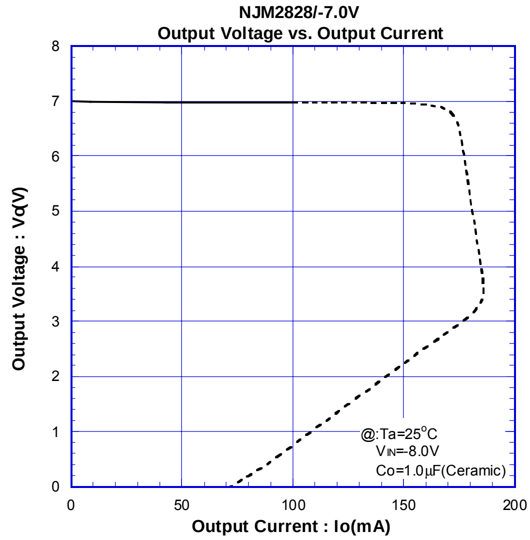
* This characteristic is one example. It is necessary to examine the characteristic with an actual circuit because there is an influence by the characteristic such as output voltage/output capacitor.

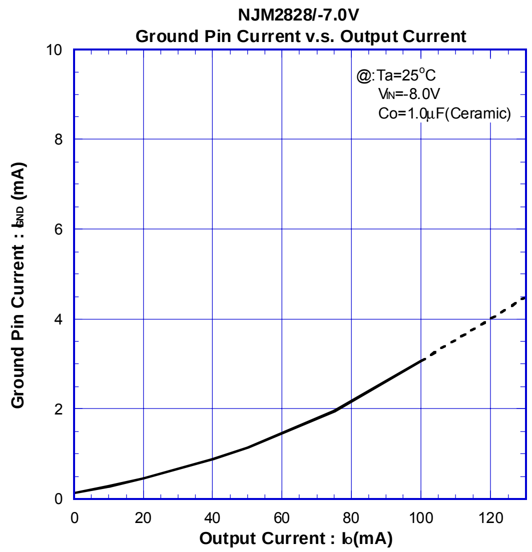
■ POWER DISSIPATION vs. AMBIENT TEMPERATURE

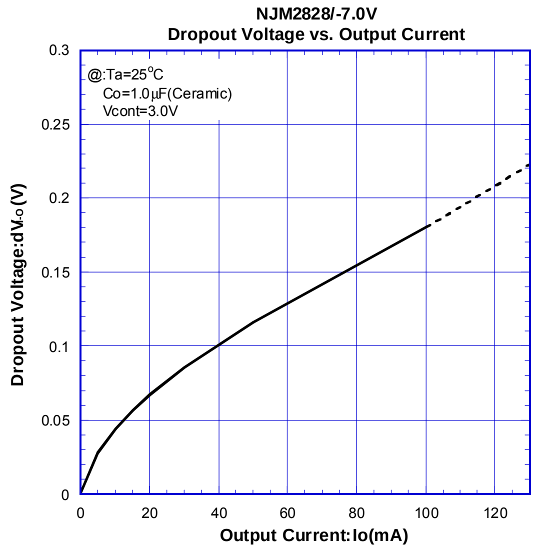


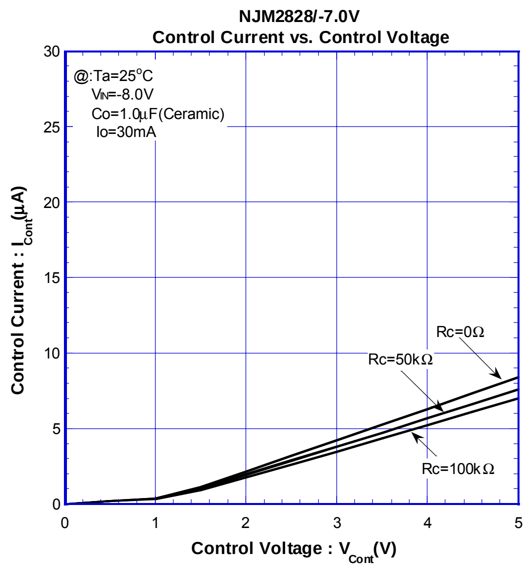
■ ELECTRICAL CHARACTERISTICS

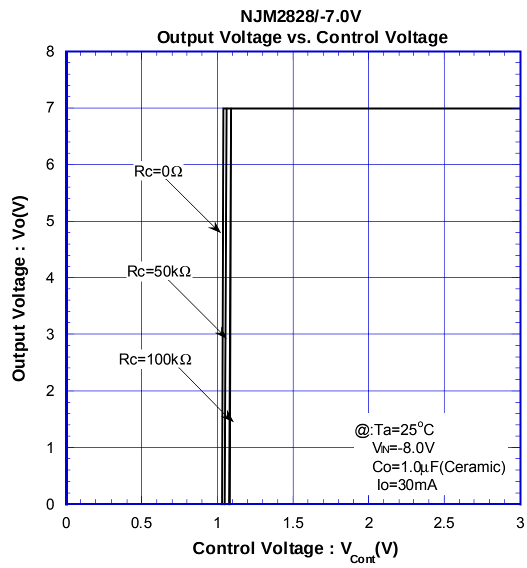






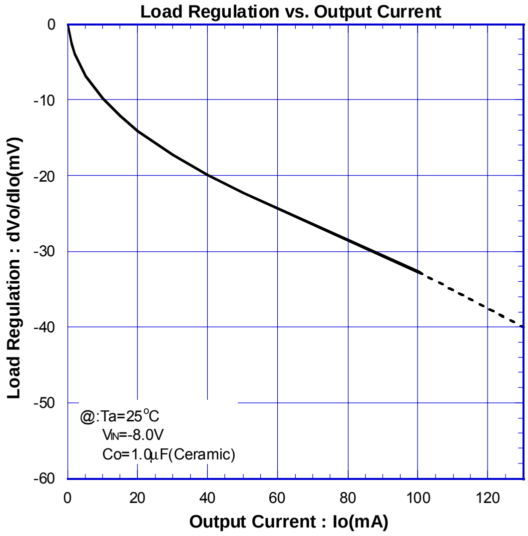




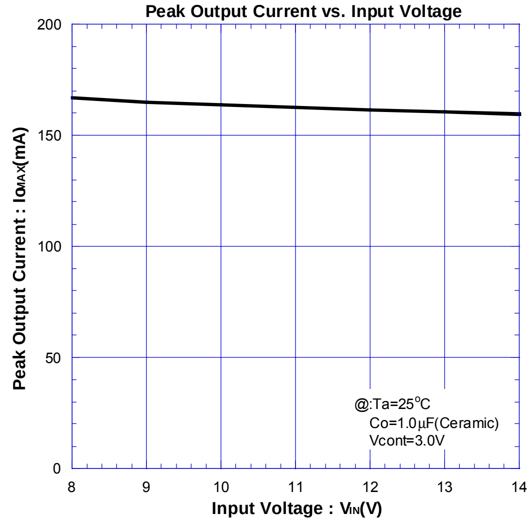


■ ELECTRICAL CHARACTERISTICS

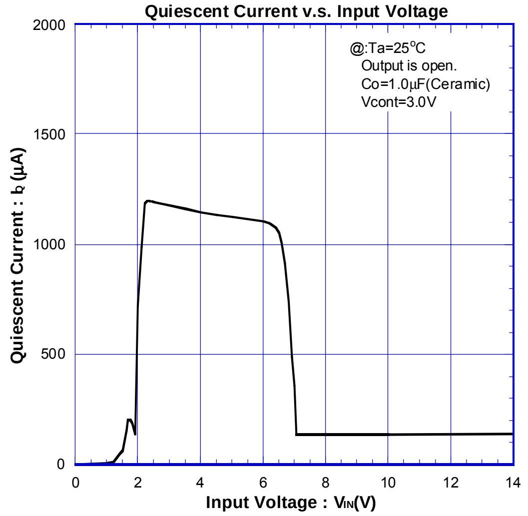
NJM2828/-7.0V
Load Regulation vs. Output Current



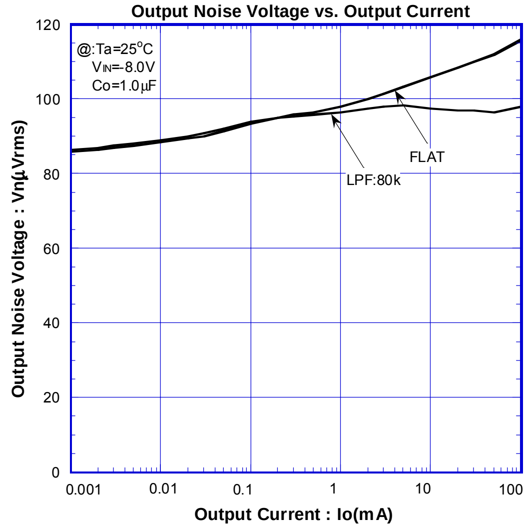
NJM2828/-7.0V
Peak Output Current vs. Input Voltage



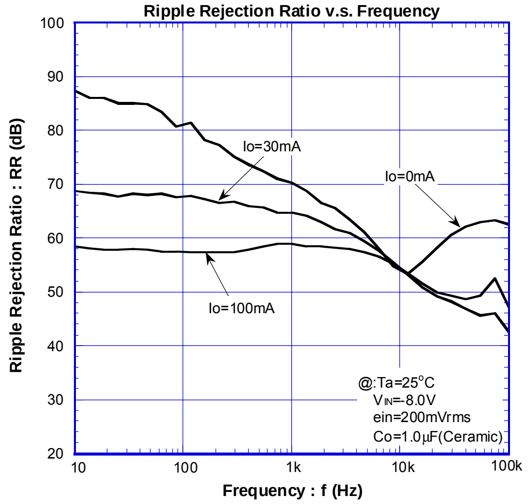
NJM2828/-7.0V
Quiescent Current v.s. Input Voltage



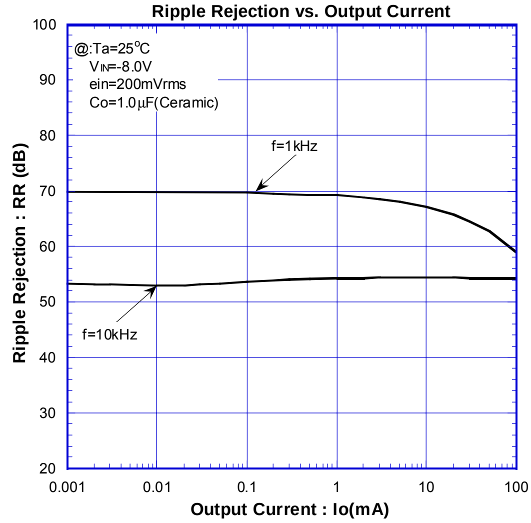
NJM2828/-7.0V
Output Noise Voltage vs. Output Current



NJM2828/-7.0V
Ripple Rejection Ratio v.s. Frequency



NJM2828/-7.0V
Ripple Rejection vs. Output Current



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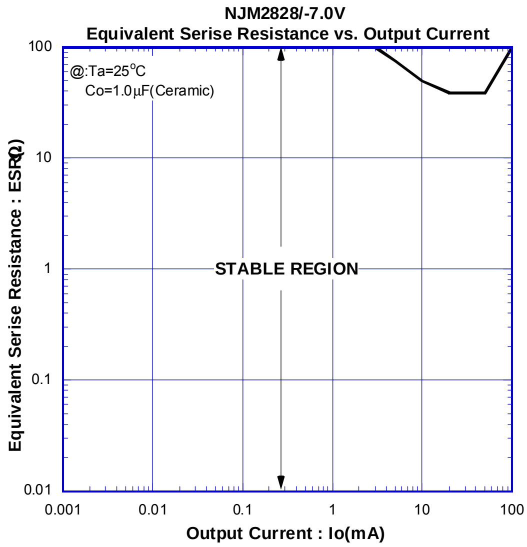

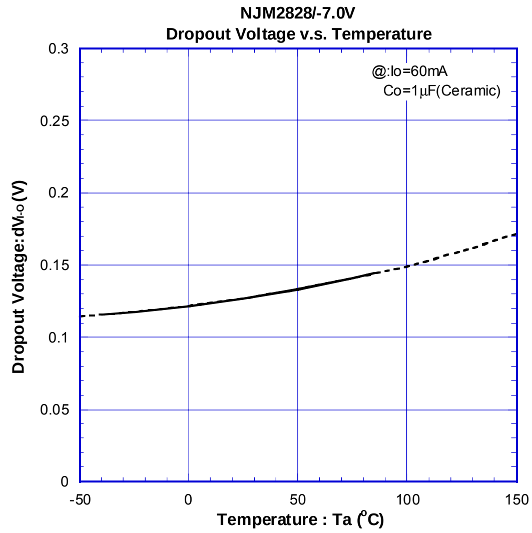

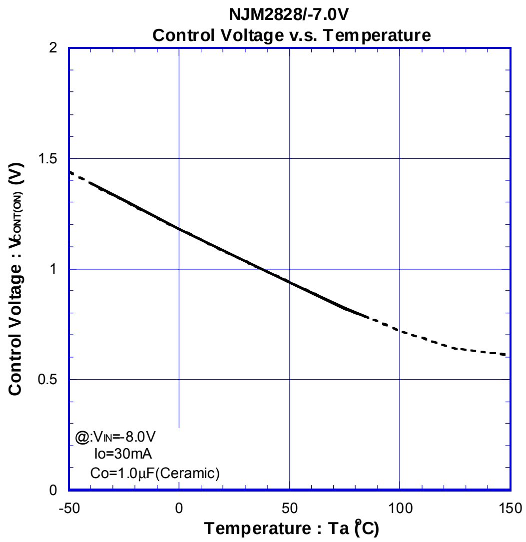

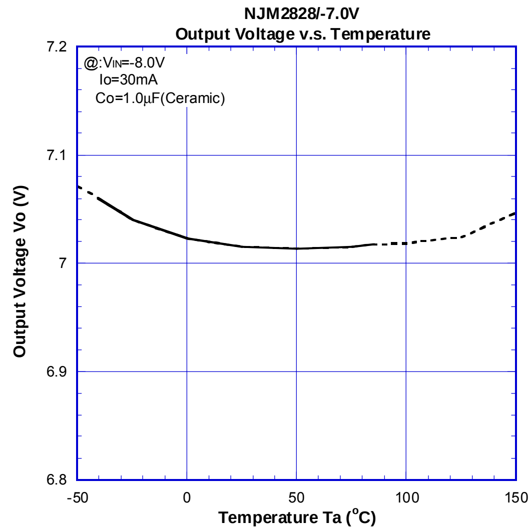

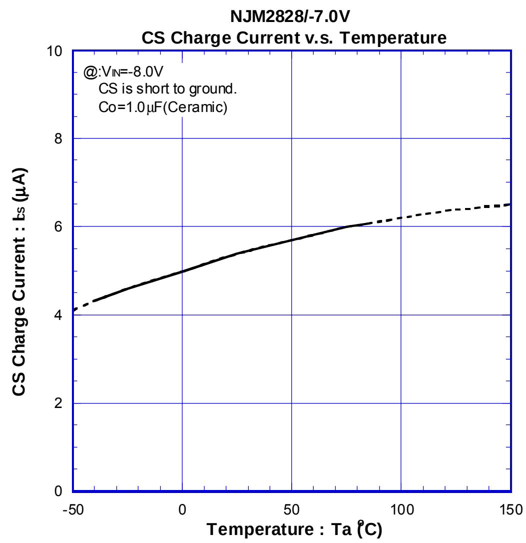

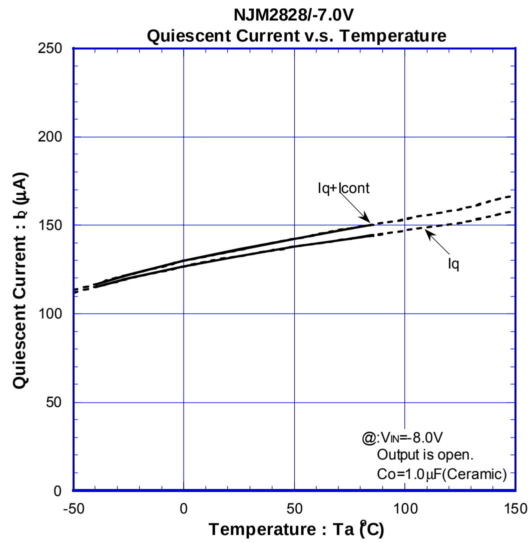

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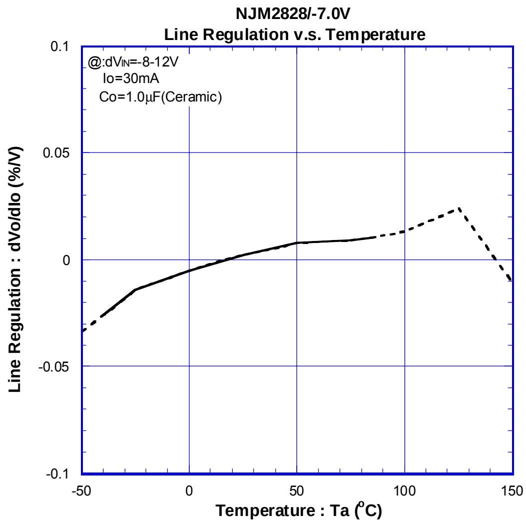

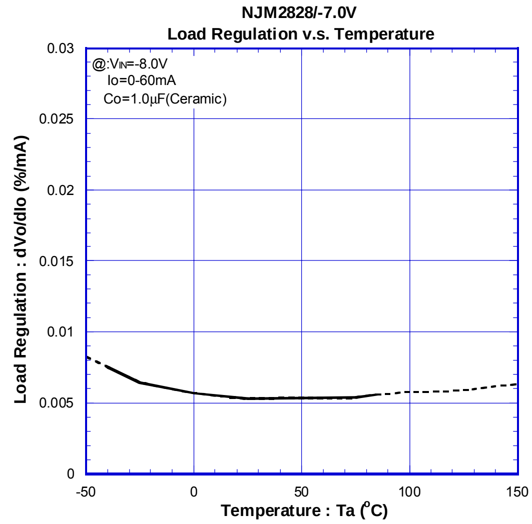

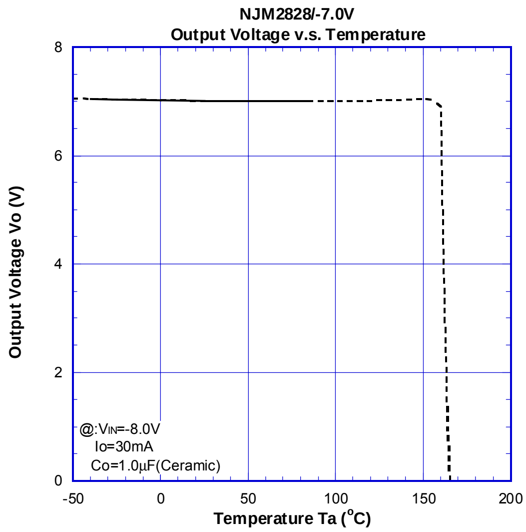

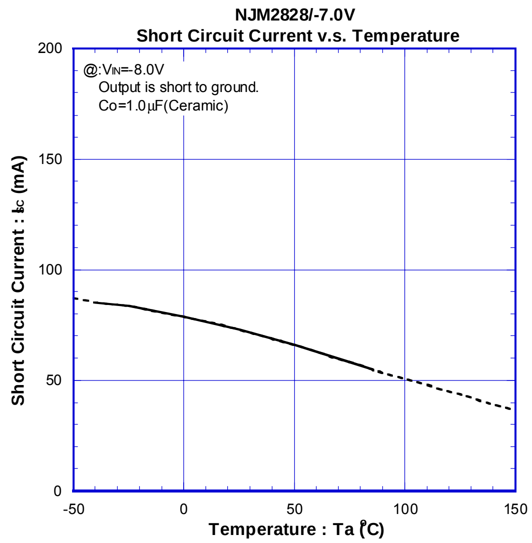

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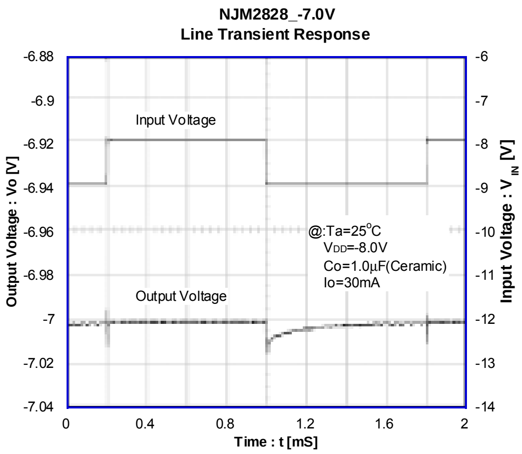

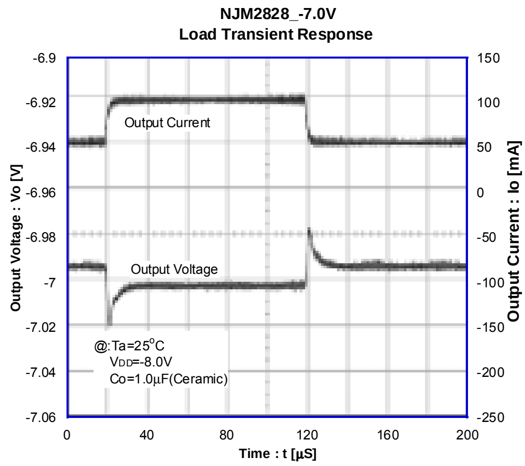

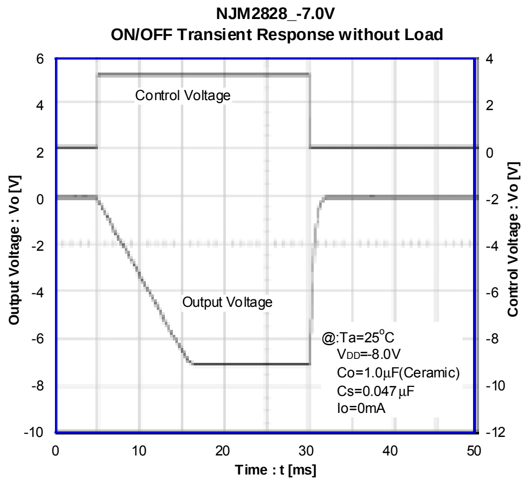

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