

## Negative Output Low Drop Out voltage regulator

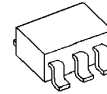
### ■ GENERAL DESCRIPTION

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. 1.0 $\mu$ F Output capacitor and small package can make NJM2828 suitable for portable items.

### ■ PACKAGE OUTLINE

SC88A

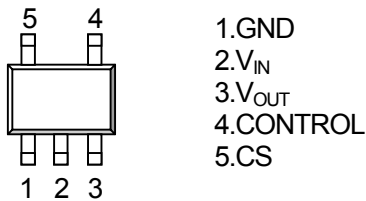


NJM2828F3

### ■ FEATURES

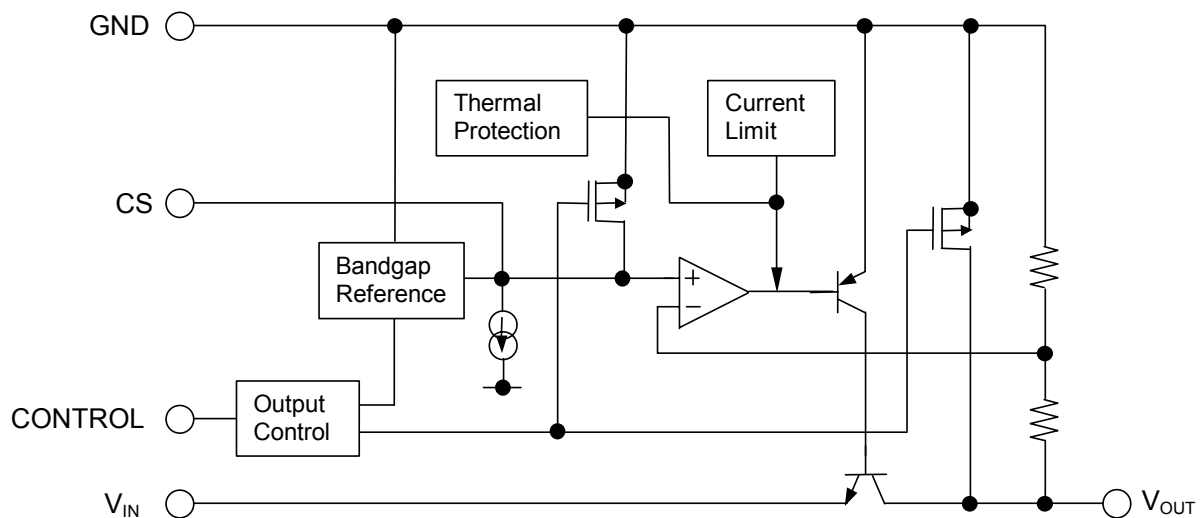
- Low Current Consumption    0.13V (typ.) @ $I_o=60\text{mA}$
- High Precision Output         $\pm 1.5\%$
- High Ripple Rejection       65dB(typ.) @ $f=1\text{kHz}$ ,  $V_o=-7\text{V}$  Version
- Output capacitor with 0.1F ceramic capacitor.
- Output Current                 $I_o(\text{max.})=100\text{mA}$
- 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



NJM2828F3-XX

### ■ EQUIVALENT CIRCUIT



# NJM2828

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## ■ OUTPUT VOLTAGE RANK LIST

Device Name	V <sub>OUT</sub>	Device Name	V <sub>OUT</sub>
NJM2828F3-14	-1.4V	NJM2828F3-06	-6.0V
NJM2828F3-15	-1.5V	NJM2828F3-63	-6.3V
NJM2828F3-02	-2.0V	NJM2828F3-65	-6.5V
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 <sub>IN</sub>	-14	V
Control Voltage	V <sub>CONT</sub>	+5	V
Power Dissipation	P <sub>D</sub>	250(*1)	mW
Operating Temperature	T <sub>opr</sub>	-40 ~ +85	°C
Storage Temperature	T <sub>stg</sub>	-40 ~ +125	°C
Output Sink Current at OFF-state	I <sub>SINK(OFF)</sub>	10	mA

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

■ Operating voltage

V<sub>IN</sub>=-3.2 ~ -12V (In case of Vo>-3.0V version)

■ ELECTRICAL CHARACTERISTICS

(Vo<-2.2V Version: V<sub>IN</sub>=Vo-1V, V<sub>CONT</sub>=3V, C<sub>IN</sub>=0.1μF, Co=1.0μF, Ta=25°C)

(Vo≥-2.2V Version: V<sub>IN</sub>=-3.2V, V<sub>CONT</sub>=3V, C<sub>IN</sub>=0.1μF, Co=2.2μF(Vo>-2.0V: Co=4.7μF), Ta=25°C)

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

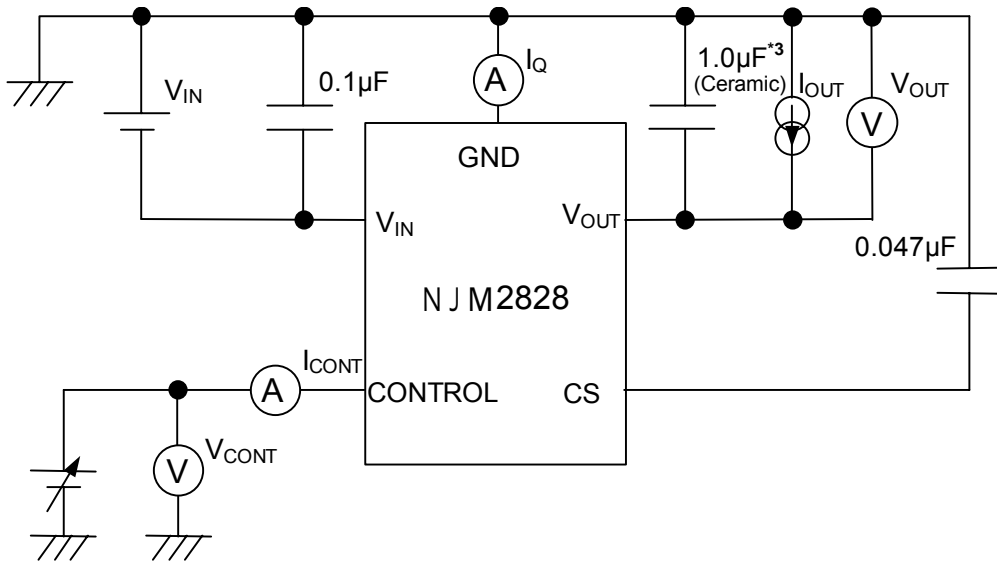
(\*2):Excludes Vo>-3.0V version.

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.

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## TEST CIRCUIT



\*3  $-2.2V \leq V_o < -2.0V$  version :  $C_o = 2.2\mu F$  (Ceramic)  
 $V_o \geq -2.0V$  version :  $C_o = 4.7\mu F$  (Ceramic)

## ■ TYPICAL APPLICATIONS

### \*ON/OFF control

ON/OFF control can be achieved by applying positive control voltage to CONTROL terminal.

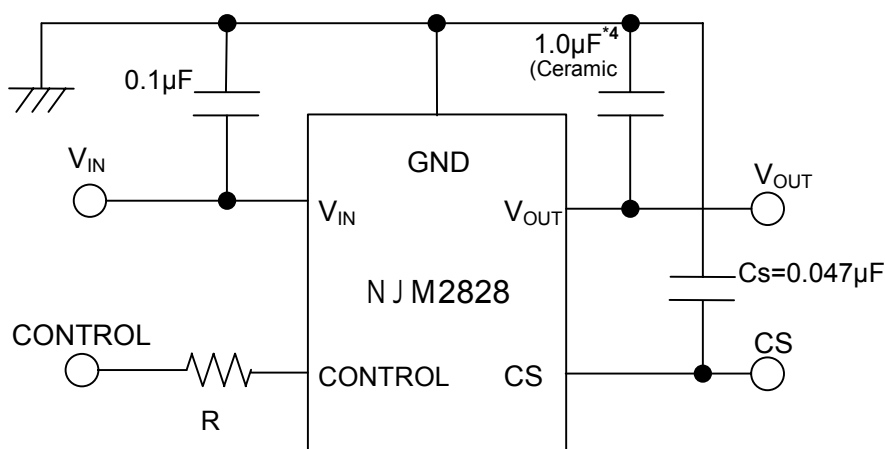
Apply positive  $V_{cont}$  ("H") to make chip to be ON (Enabled), and either  $V_{cont}$  is "L" or open (High Z) to make chip to be OFF (Disabled).

The relations between  $V_{cont}$  and the state is as follows:

$V_{cont} + 1.6V \leq V_{cont} \leq +5V$ ("H" level):	ON state
$V_{cont} 0V \leq V_{cont} \leq +0.6V$ ("L" level):	OFF state
$V_{cont} +0.6V < V_{cont} < +1.6V$ ("L" level):	Undefined

In case ON/OFF control is not used, keep applying positive  $V_{cont}$  to CONTROL terminal to make chip ON.

Note that negative  $V_{cont}$  does not make the chip enabled.



\*4  $-2.2V \leq V_o < -2.0V$  version :  $C_o = 2.2\mu F$   
 $V_o \geq -2.0V$  version :  $C_o = 4.7\mu F$

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  $0.1\mu F$  greater to avoid the problem.

$C_{IN}$  should connect between GND and  $V_{IN}$  as short as possible.

## \*Output Capacitance $C_o$

Output capacitor ( $C_o$ ) 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  $C_o$ ; however, use of recommended capacitance or greater value is essential for stable operation.

Use of a smaller  $C_o$  may cause excess output noise or oscillation of the regulator due to lack of the phase compensation.

Therefore, use  $C_o$  with the recommended capacitance or greater value and connect between  $V_o$  terminal and GND terminal with minimal wiring. The recommended capacitance depends on the output voltage. Low voltage regulator requires greater value of the  $C_o$ . Thus, check the recommended capacitance for each output voltage.

Use of a greater  $C_o$  reduces output noise and ripple output, and also improves transient response of the output voltage against rapid load change.

## \*Soft-start function

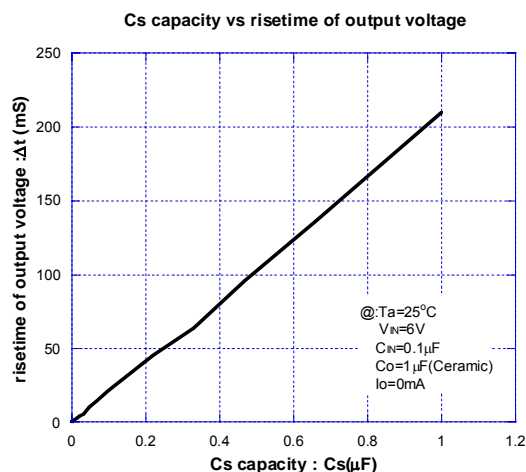
Capacitance  $C_s$  connect between CS pin and GND for the following.

- 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

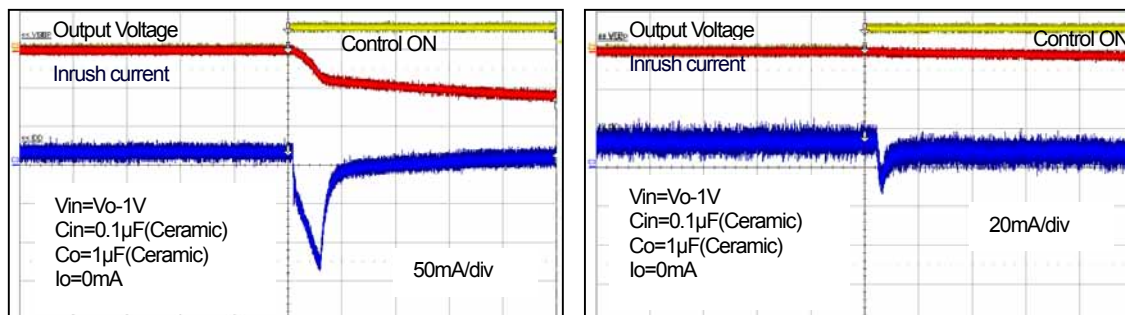
Calculation : risetime of output voltage  $\Delta t \cong 213 \times C_s(\mu F)$



### 2.Inrush current at control ON

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

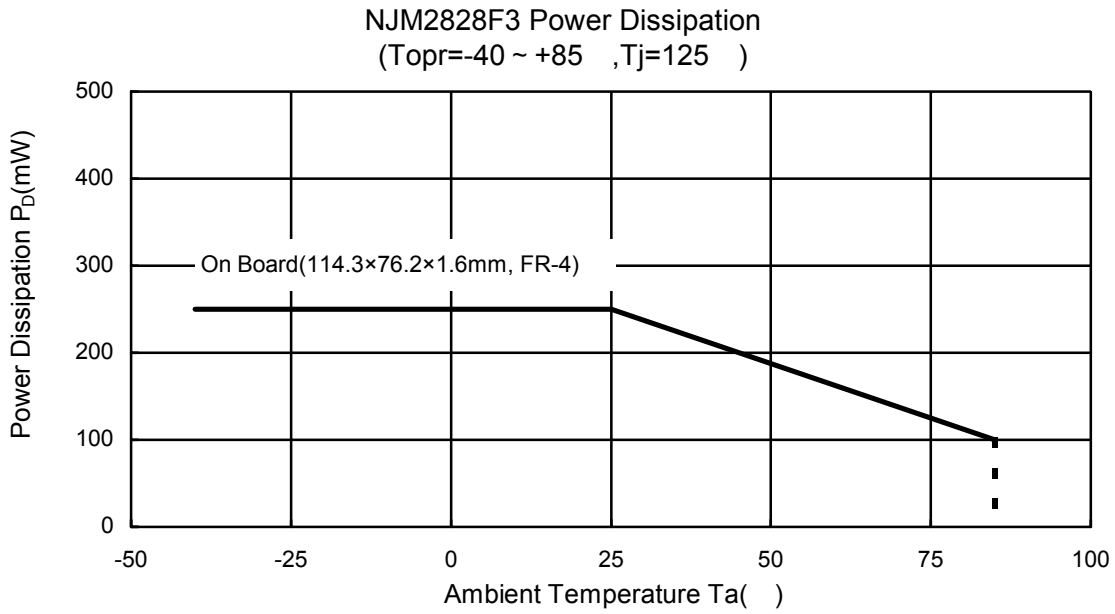
Inrush current wave :



\* 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.

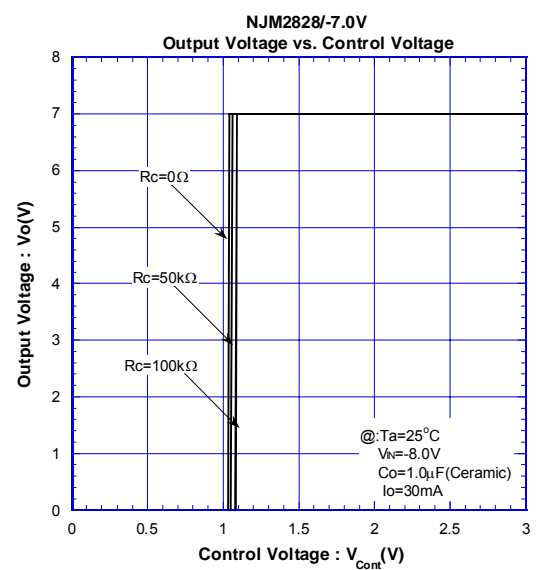
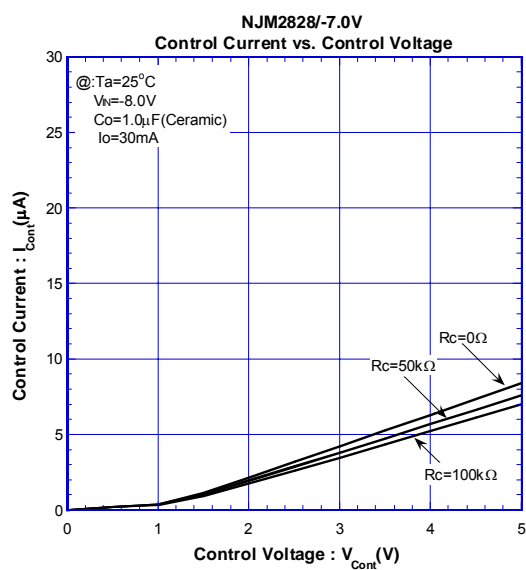
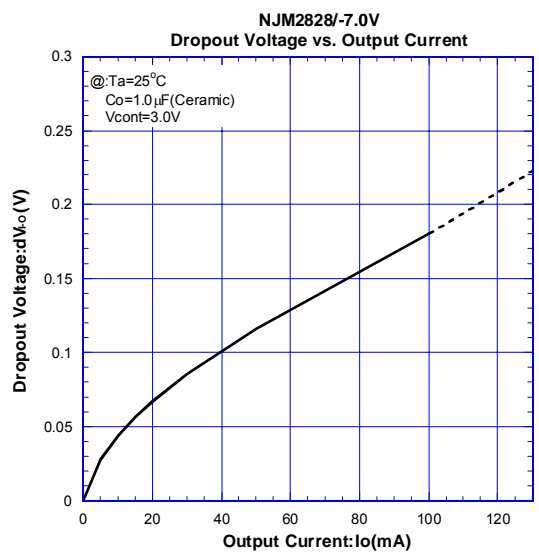
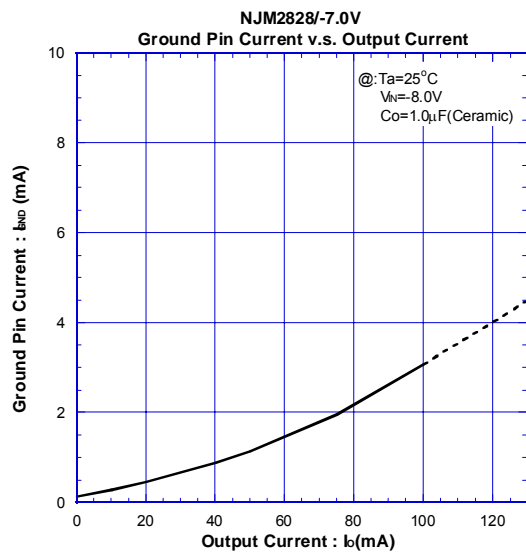
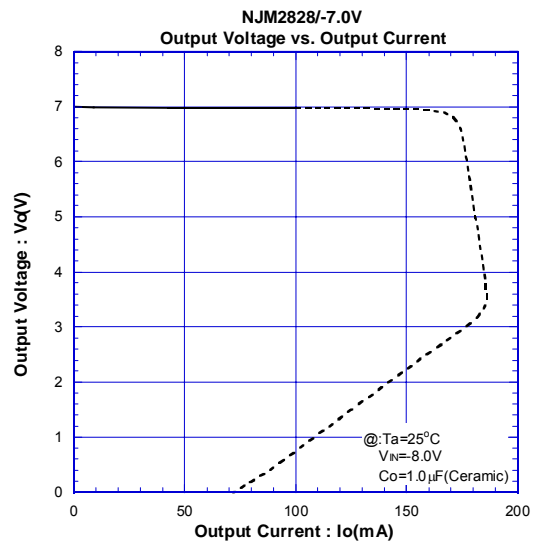
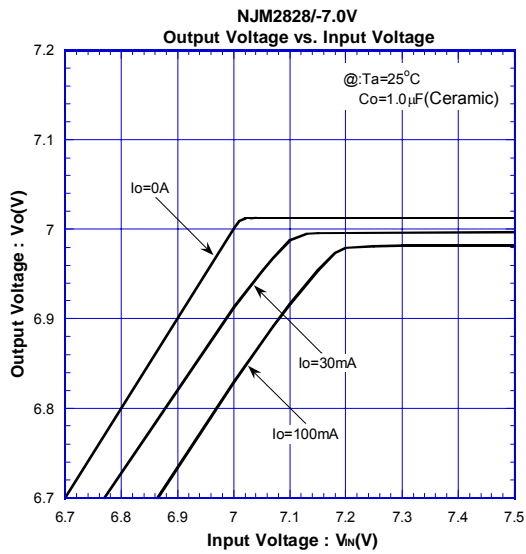
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## POWER DISSIPATION vs. AMBIENT TEMPERATURE



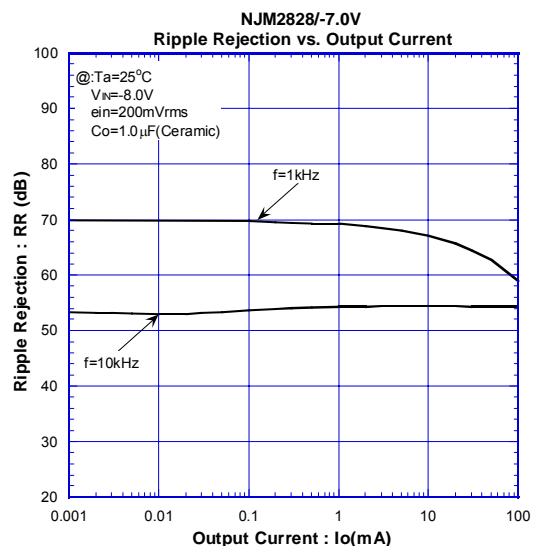
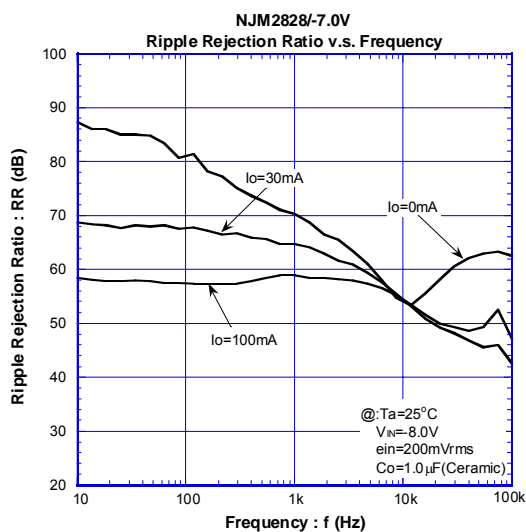
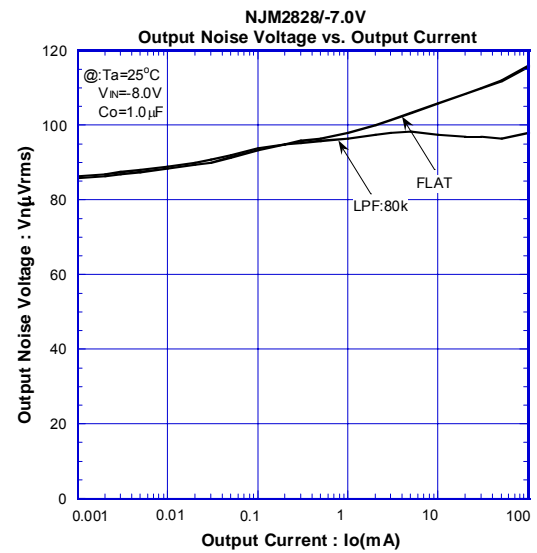
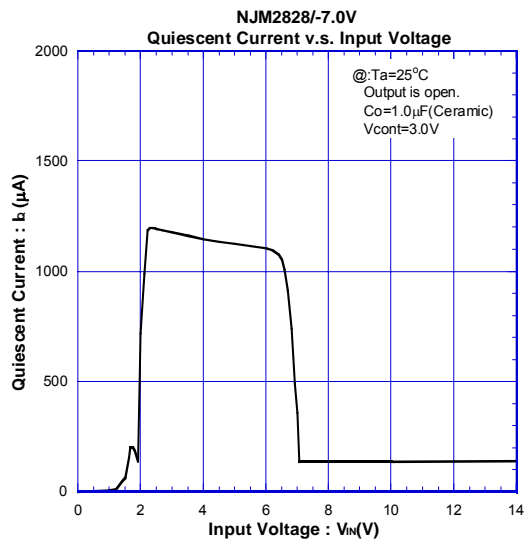
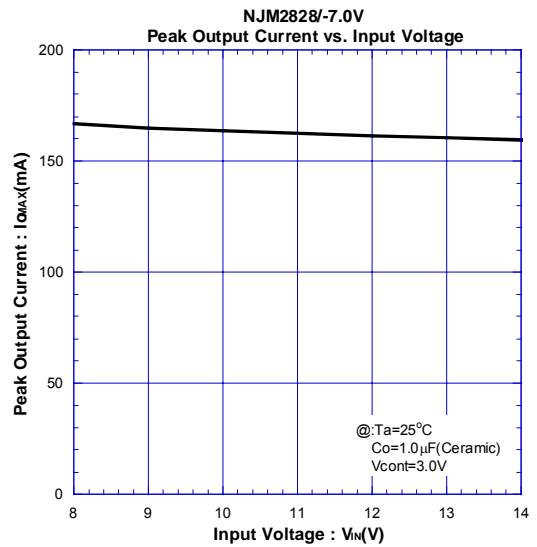
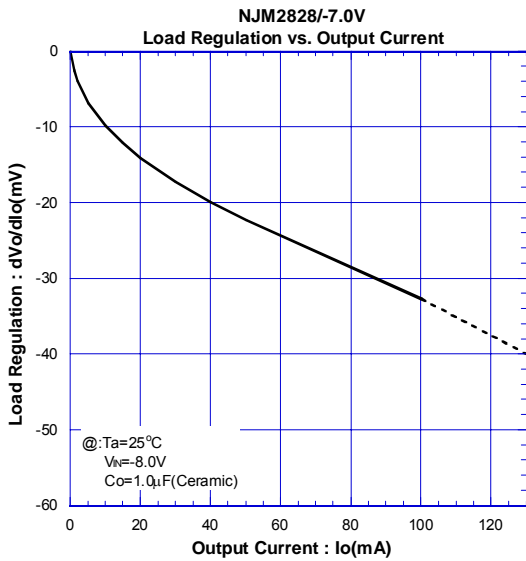


## ELECTRICAL CHARACTERISTICS

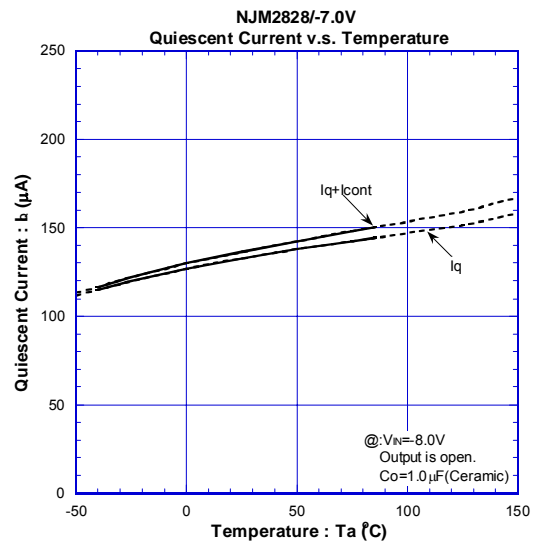
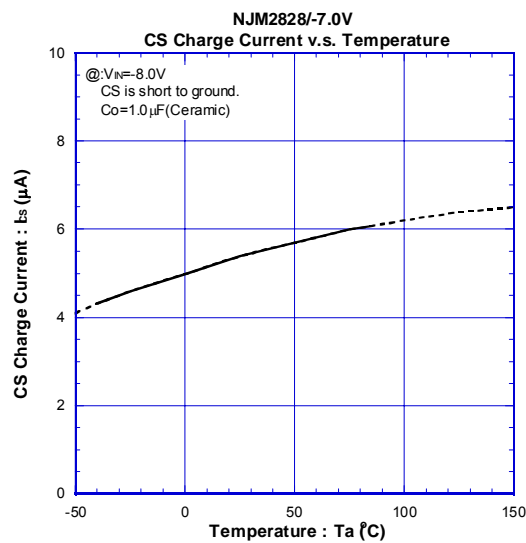
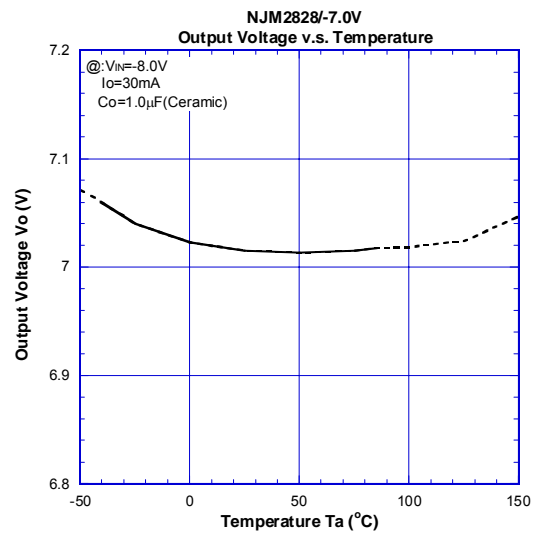
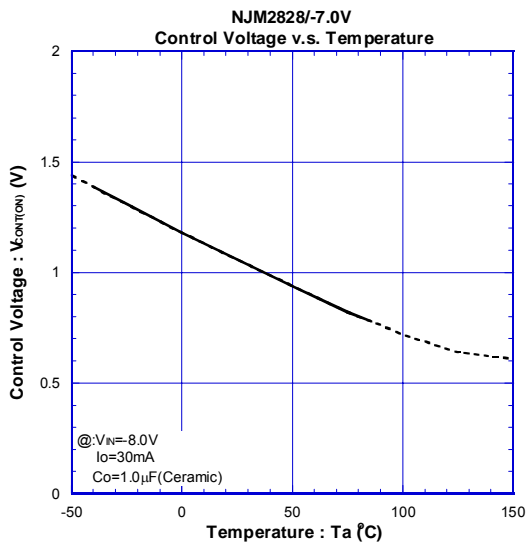
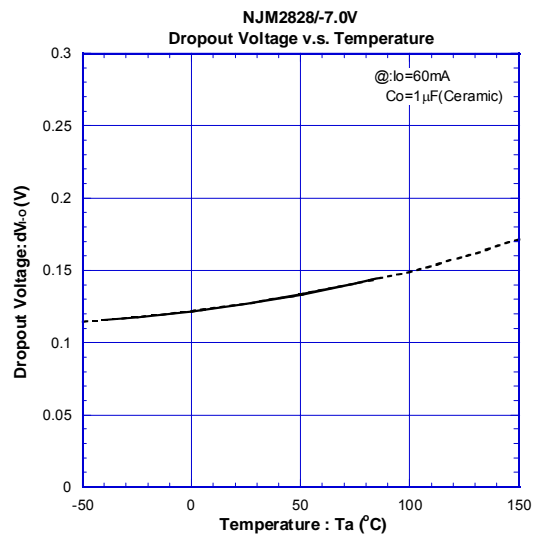
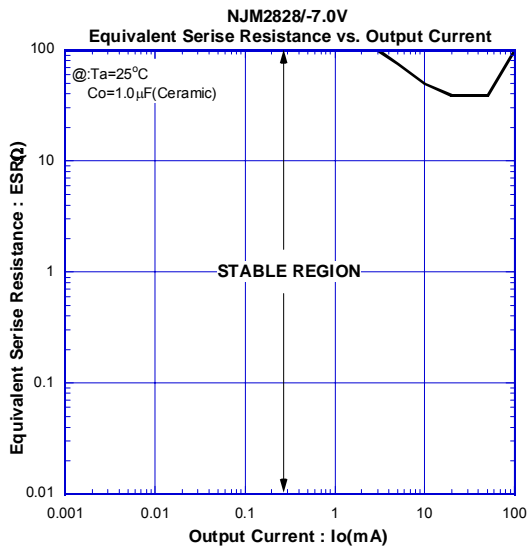


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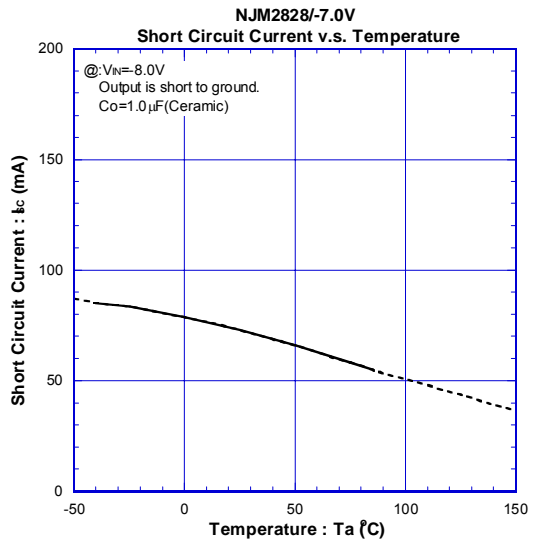
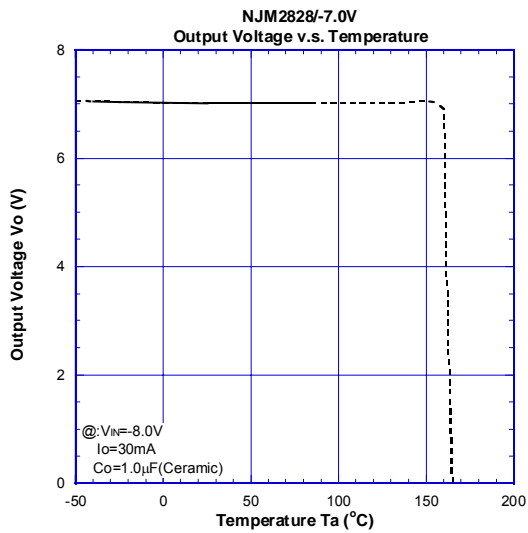
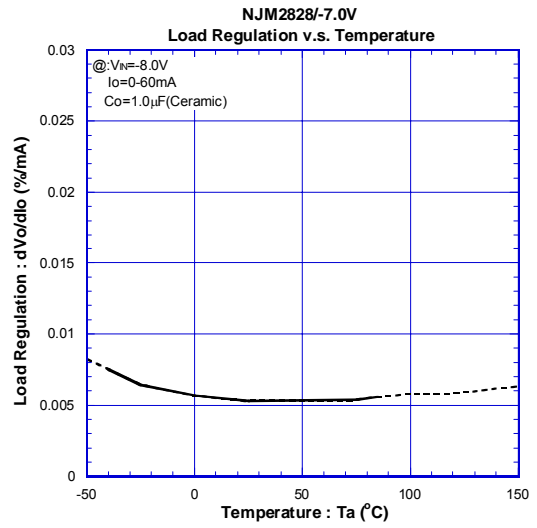
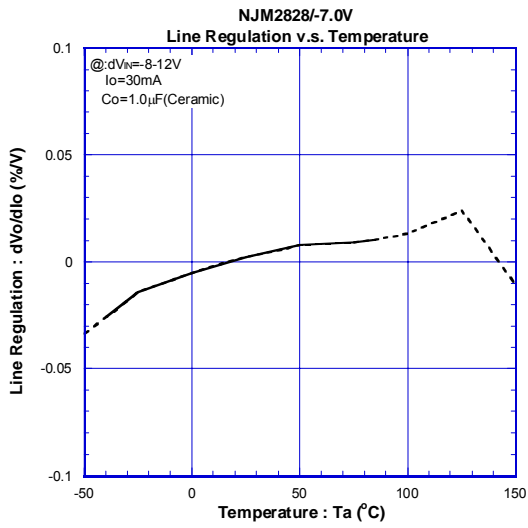
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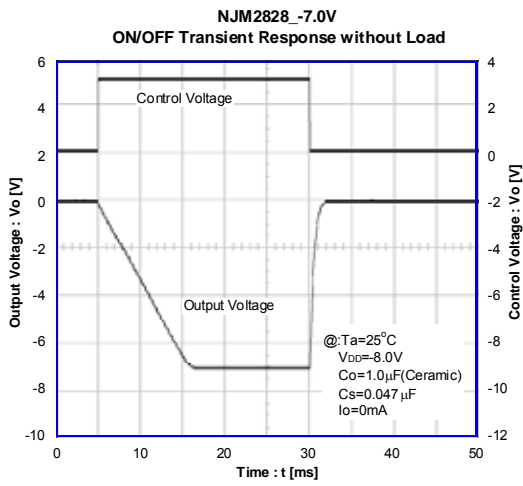
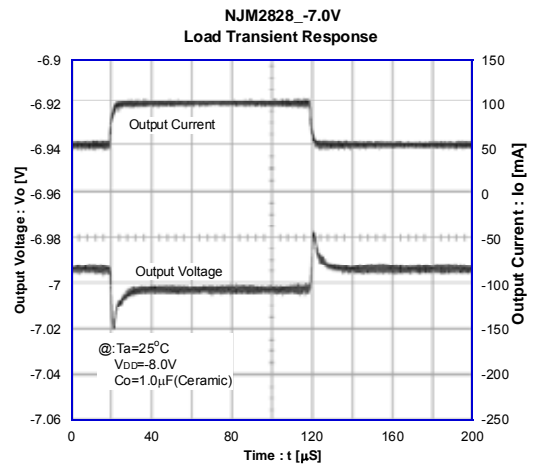
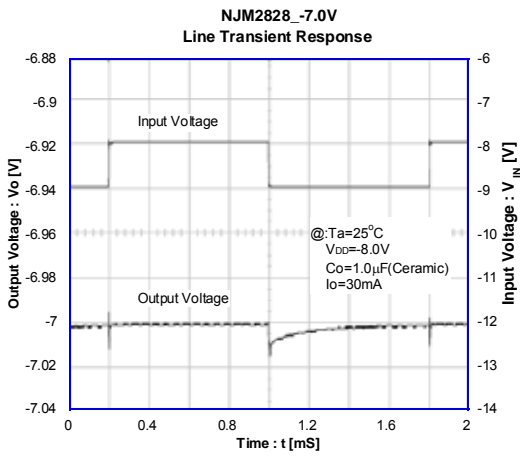
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