

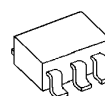
Negative Output Low Drop Out voltage regulator

■ 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 μ F Output capacitor and small package can make NJM2828 suitable for portable items.

■ PACKAGE OUTLINE

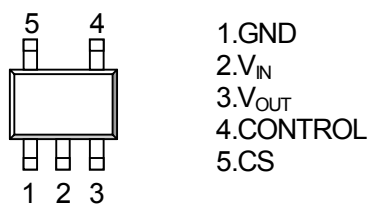


NJM2828F3

■ FEATURES

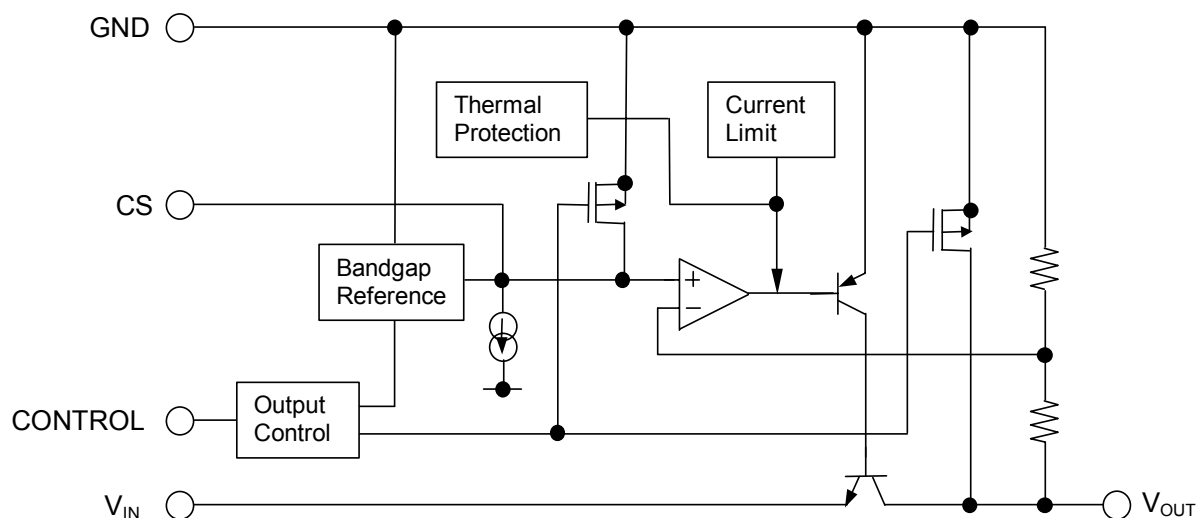
- Low Current Consumption 0.13V (typ.) @ $I_o=60\text{mA}$
- High Precision Output $\pm 1.5\%$
- High Ripple Rejection 65dB(typ.) @ $f=1\text{kHz}$, $V_o=-7\text{V}$ Version
- Output capacitor with 0.1F ceramic capacitor.
- Output Current $I_o(\text{max.})=100\text{mA}$
- ON/OFF Control(Positive voltage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

■ 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

■ 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	T_{opr}	-40 ~ +85	°C
Storage Temperature	T_{stg}	-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

$V_{IN} = -3.2 \sim -12V$ (In case of $V_O > -3.0V$ version)

■ ELECTRICAL CHARACTERISTICS

($V_O < -2.2V$ Version: $V_{IN} = V_O - 1V$, $V_{CONT} = 3V$, $C_{IN} = 0.1\mu F$, $C_O = 1.0\mu F$, $T_a = 25^\circ C$)

($V_O \geq -2.2V$ Version: $V_{IN} = -3.2V$, $V_{CONT} = 3V$, $C_{IN} = 0.1\mu F$, $C_O = 2.2\mu F$ ($V_O > -2.0V$: $C_O = 4.7\mu F$), $T_a = 25^\circ C$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	$I_O = 30mA$	+1.5%	-	-1.5%	V
Quiescent Current	I_Q	$I_O = 0mA$, except I_{cont}	-	130	200	μA
Quiescent Current at OFF-state	$I_{Q(OFF)}$	$V_{CONT} = 0V$	-	-	100	nA
Output Current	I_O	$V_O + 0.3V$	100	130	-	mA
Line Regulation	$\Delta V_O / \Delta V_{IN}$	$V_{IN} = V_O - 1V \sim -12V$, $I_O = 30mA$	-	-	0.10	%/V
Load Regulation	$\Delta V_O / \Delta I_O$	$I_O = 0 \sim 60mA$	-	-	0.03	%/mA
Dropout Voltage(*2)	ΔV_{I_O}	$I_O = 60mA$	-	0.13	0.23	V
Ripple Rejection	RR	$e_{in} = 200mV_{rms}$, $f = 1kHz$, $I_O = 10mA$ $V_O = -7V$ Version	-	65	-	dB
Average Temperature Coefficient of Output Voltage	$\Delta V_O / \Delta T_a$	$T_a = 0 \sim 85^\circ C$, $I_O = 10mA$	-	± 50	-	ppm/°C
Output Noise Voltage1	V_{NO}	$f = 10Hz \sim 80kHz$, $I_O = 10mA$, $V_O = -7V$ Version	-	100	-	μV_{rms}
CS Terminal Charge Current	I_{CS}	$V_{CS} = 0V$	4	5	6	μA
Output Resistance at OFF-state	$R_{O(OFF)}$	$V_{CONT} = 0V$, $V_O = -7V$ 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

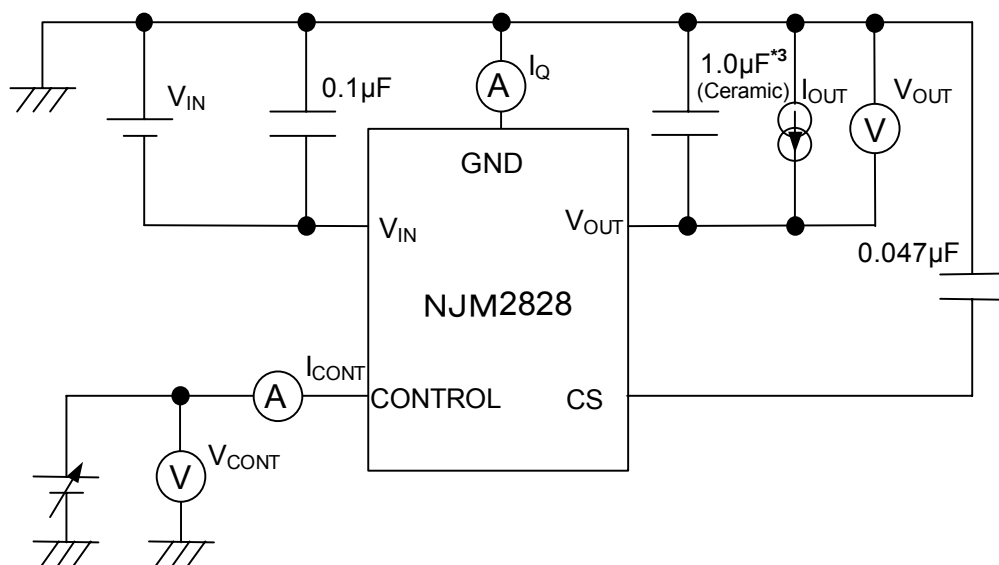
(*2): Excludes $V_O > -3.0V$ version.

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.

NJM2828

■ 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.

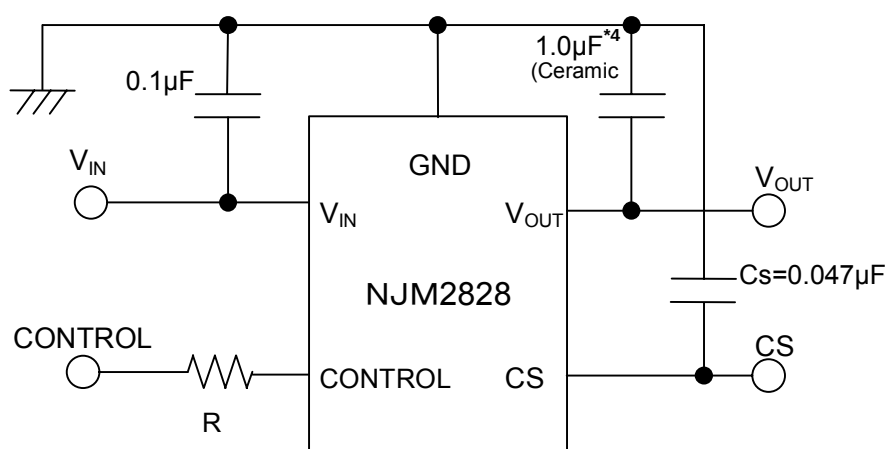
Apply positive V_{cont} ("H") to make chip to be ON (Enabled), and either V_{cont} is "L" or open (High Z) to make chip to be OFF (Disabled).

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

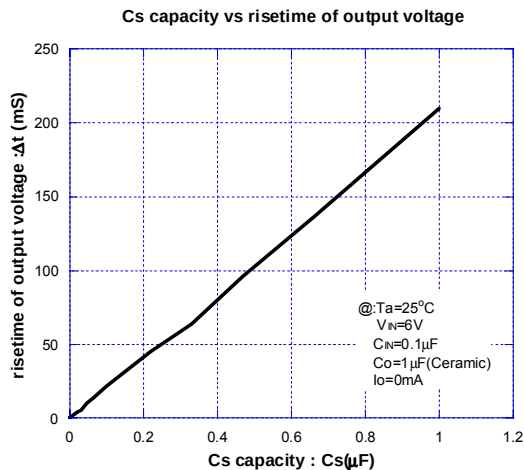
Capacitance C_s connect between CS pin and GND for the following.

- 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

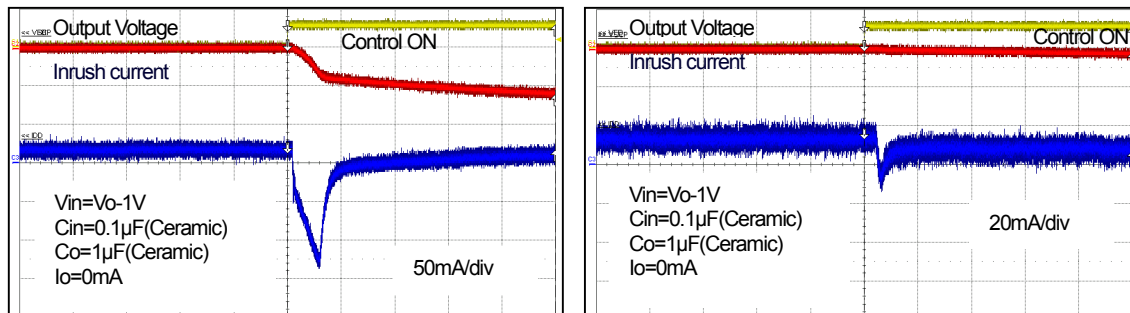
Calculation : risetime of output voltage $\Delta t \approx 213 \times C_s(\mu F)$



2.Inrush current at control ON

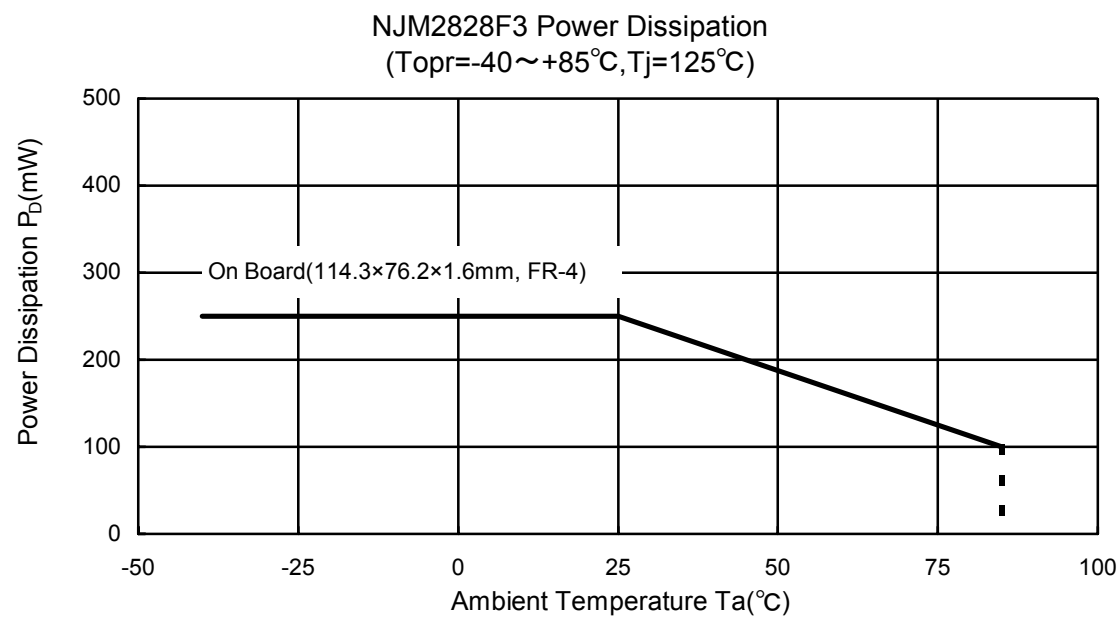
The peak value of the inrush current can be limited according to the capacitance of the C_s .

Inrush current wave :

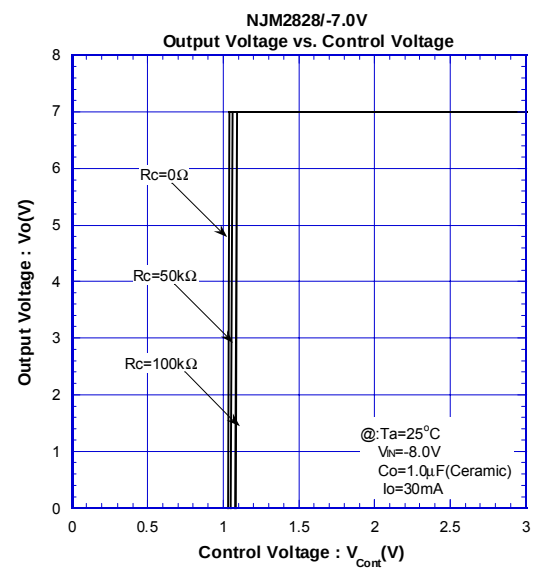
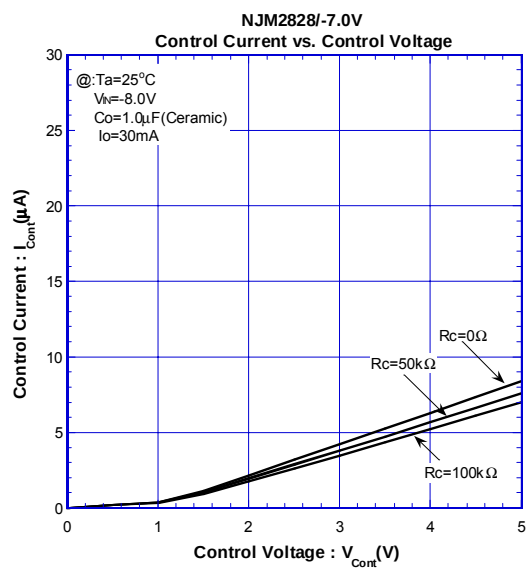
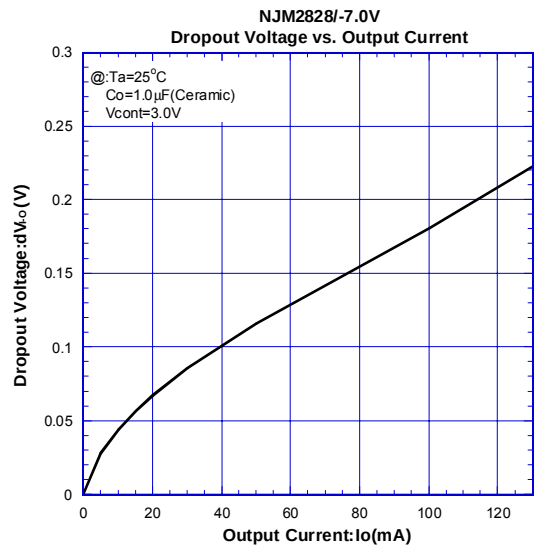
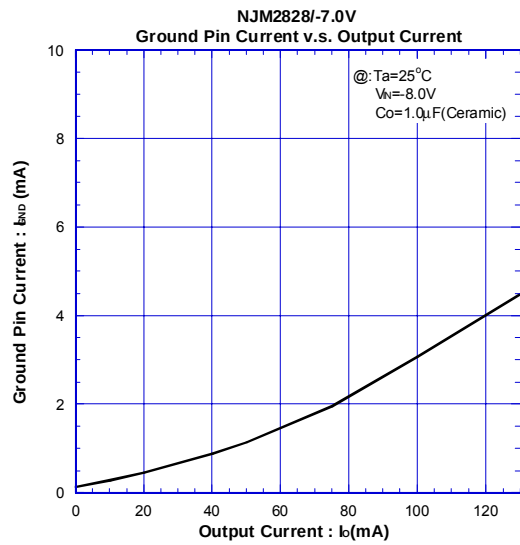
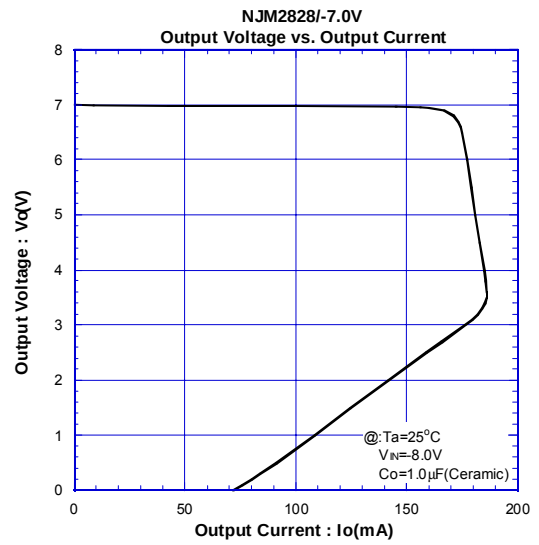
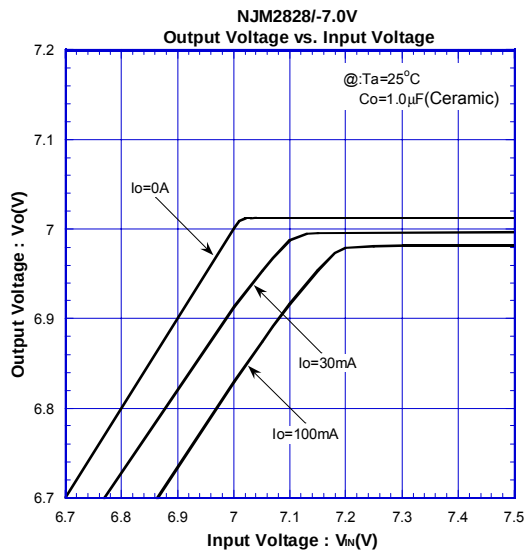


* This characteristic is one example. It is necessary to examine the characteristic with an actual circuit because there is an influence by the characteristic such as output voltage/output capacitor.

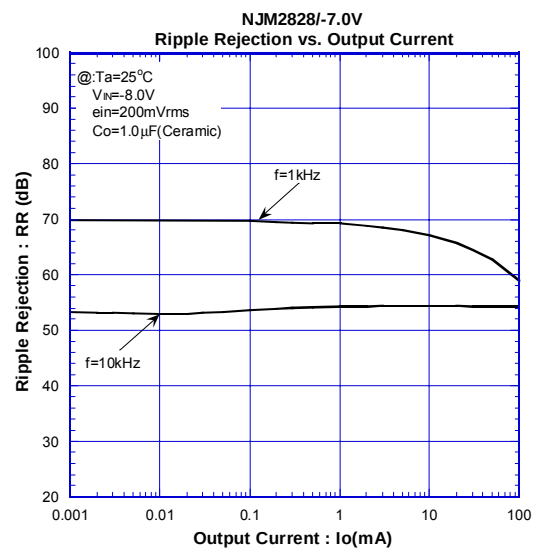
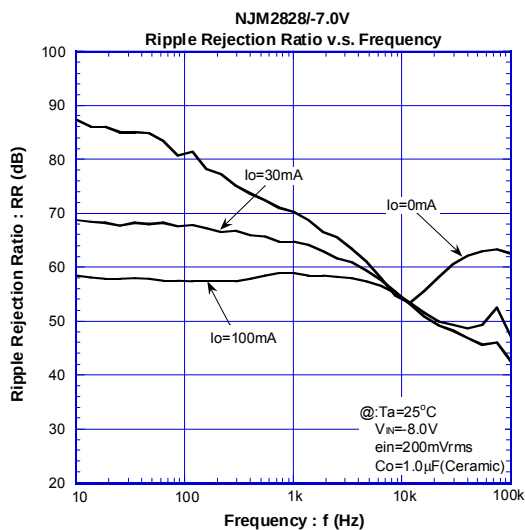
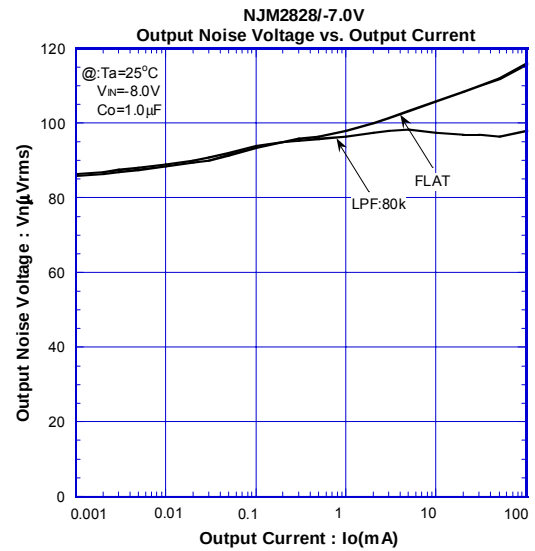
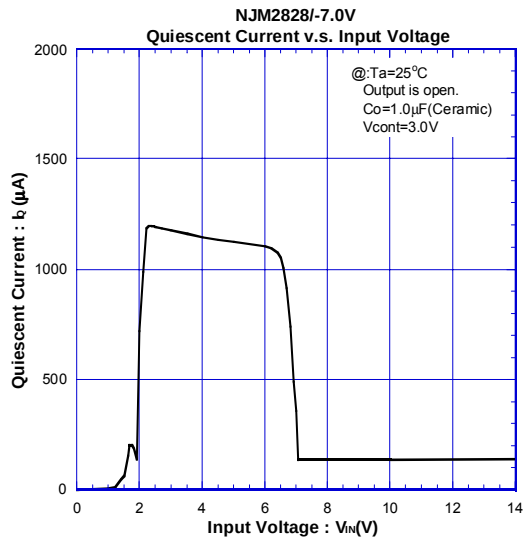
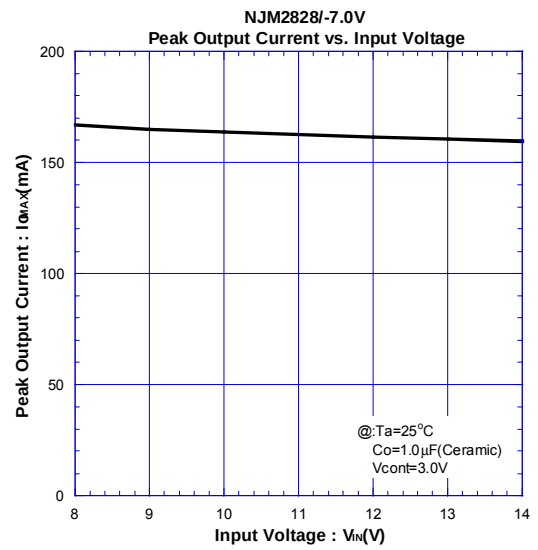
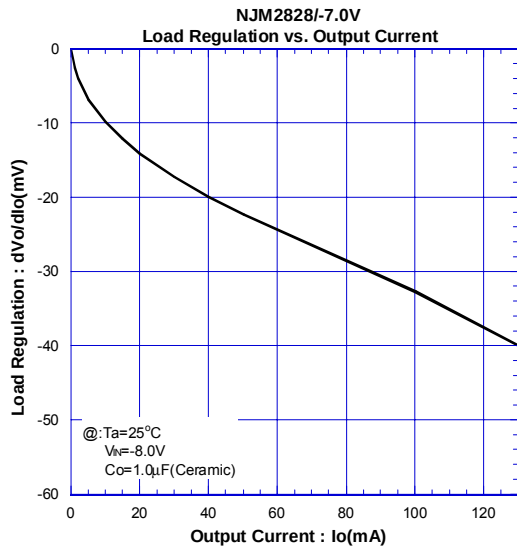
POWER DISSIPATION vs. AMBIENT TEMPERATURE



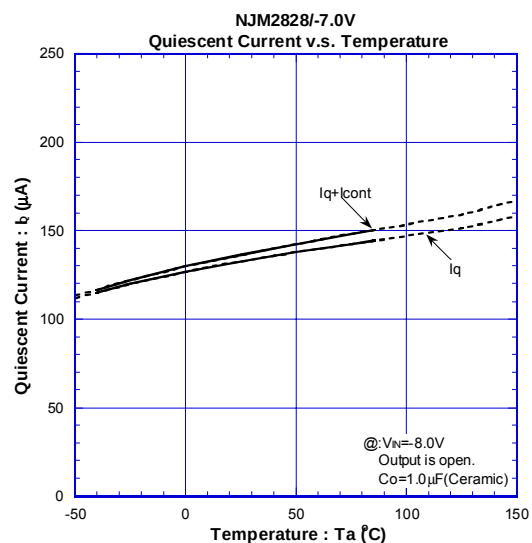
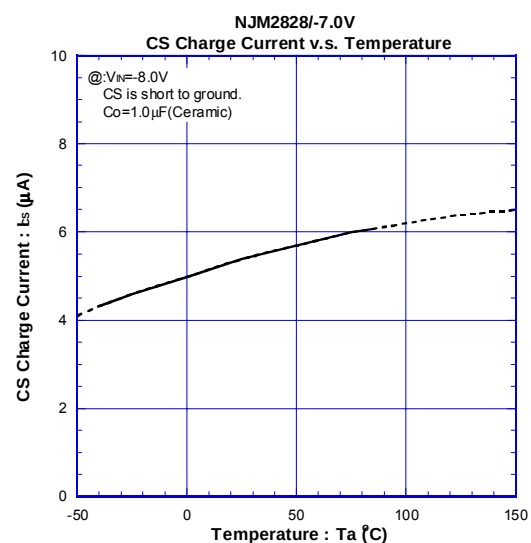
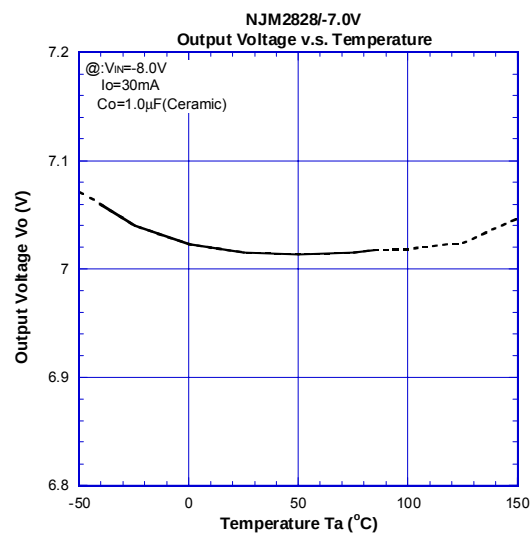
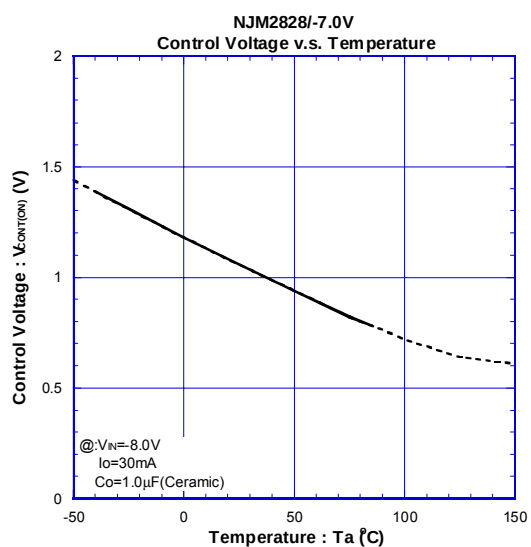
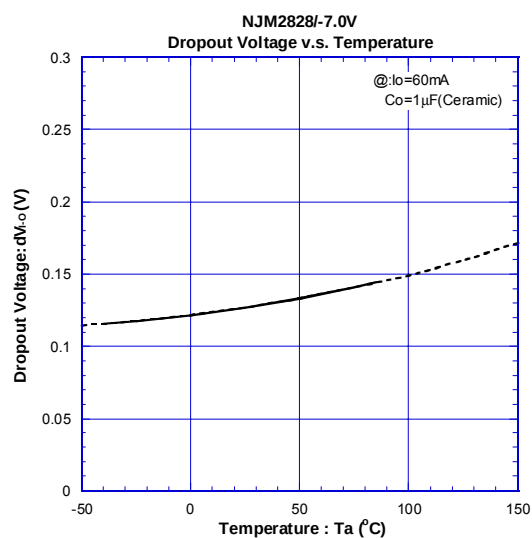
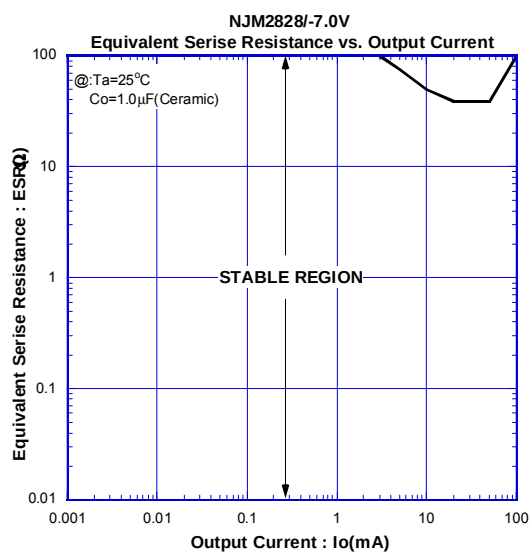
■ ELECTRICAL CHARACTERISTICS



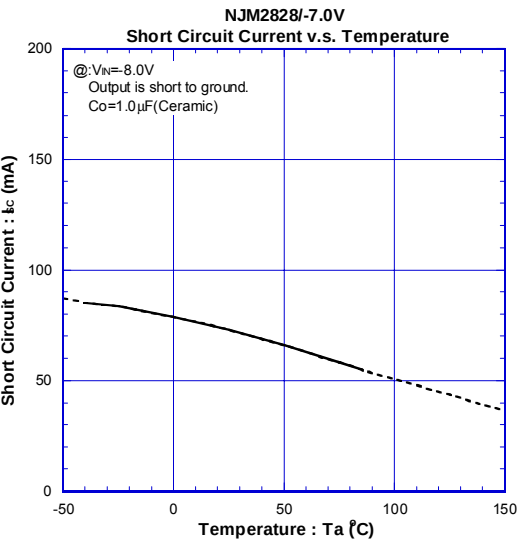
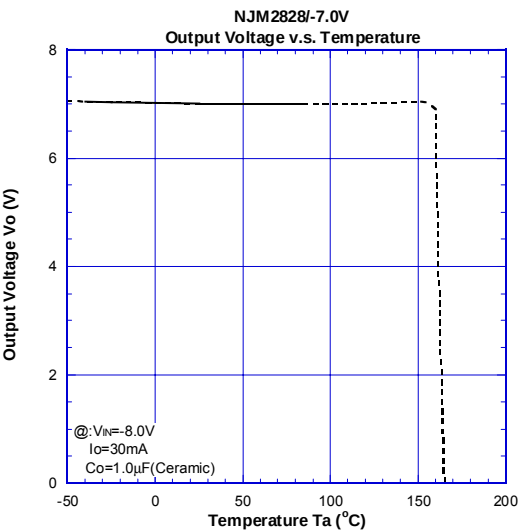
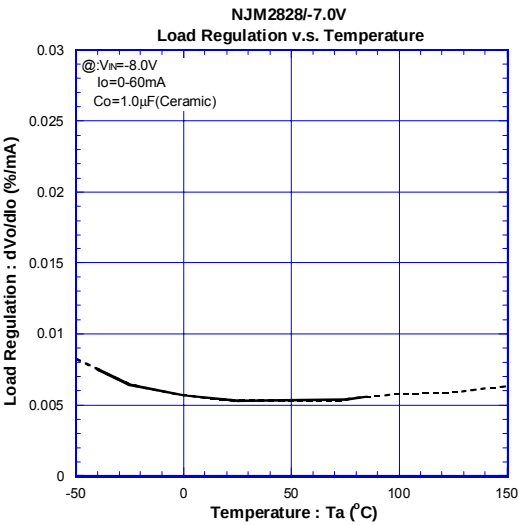
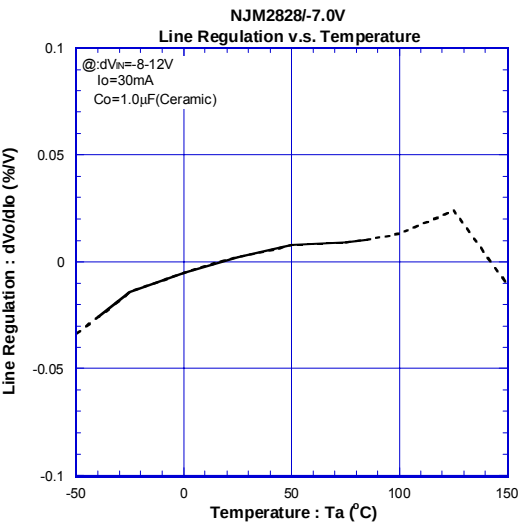
ELECTRICAL CHARACTERISTICS



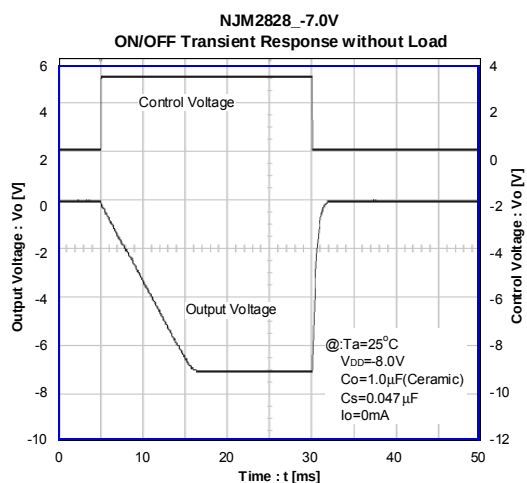
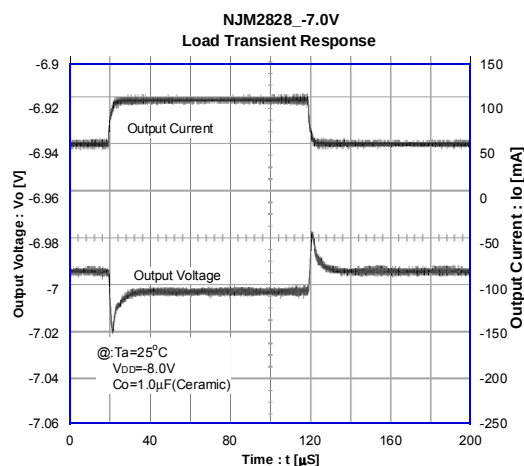
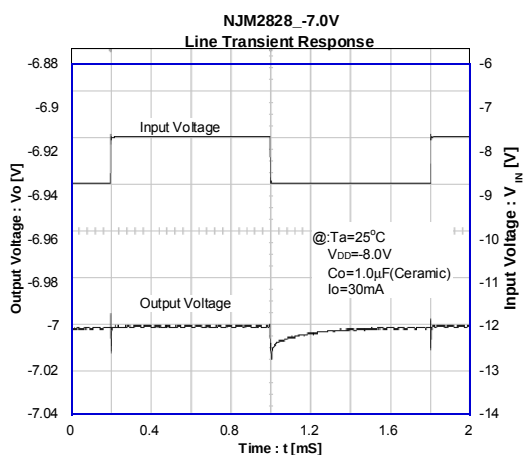
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