CMOS LDO Regulator for Portable Equipments

Dual, Low-Dropout Linear Regulator

BD7003NUX, BD7004NUX

No.12020ECT09

●Descriptions

The BD7003NUX, BD7004NUX are dual channels, 300mA low-dropout voltage regulator output at each channel. The output voltage range is from 1.2V to 3.3V by operating range from 2.5V to 5.5V. The output voltages, VOUT1 and VOUT2, are determined at power up by the state of P1 and P2(see the table of “Output-Voltage Programming”). The BD7003NUX, BD7004NUX offer 1.8% accuracy and low-dropout. The shutdown current is near the zero current which is suitable for battery powered device. The BD7003NUX, BD7004NUX are mounted on VSON008X2020(2.0mmX2.0mmX0.6mm), which contributes to the space-saving design of set.

●Features

1) 2-channel 300mA, CMOS-type LDOs.
2) Pin-Programmable Output Voltage.
   (9 steps adjustable VO ; See the Table of “Output-Voltage Programming”.)
3) LDOs Power ON/OFF Enable Control.
4) 2.0mm×2.0mm Package.
5) Small Ceramic Output Capacitors(1μF).
6) Equipped with Over Current Limiter and Thermal Shutdown Circuit(TSD) .

●Applications

Battery-powered portable equipment, etc.

●Absolute Maximum Ratings (Ta = 25℃)

Parameter	Symbol	Ratings	Unit
Maximum Supply Voltage (VIN)	VIN	-0.3 ～ 7	V
Maximum Input Voltage 1 (P1,P2,EN1,EN2)	VINMAX1	-0.3 ～ 7	V
Maximum Input Voltage 2 (Vout1,Vout2)	VINMAX2	-0.3～Vin+0.3	V
Power Dissipation	Pd	1360*[1]	mW
Operating Temperature Range	Topr	-40 ～ +85	℃
Storage Temperature Range	Tstg	-55 ～ +150	℃

*[1] This is the allowable loss of when it is mounted on a ROHM specification board 40mm×40mm×1.5mmt
To use at temperature higher than 25°C , derate 10.9mW per 1℃

* This product is not especially designed to be protected from radioactivity.

●Recommended Operating Range (Ta=-40～+85℃)

Parameter	Symbol	Ratings	Unit
Input Power Supply Voltage Range	VIN	2.5～5.5	V

●Power Dissipation

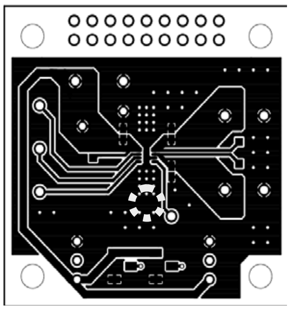
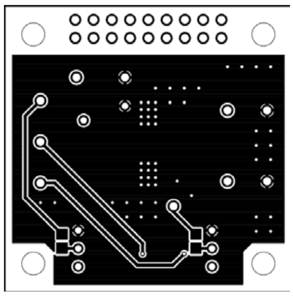
As for power dissipation, an approximate estimate of the heat reduction characteristics and internal power consumption of IC are shown, so please use these for reference. Since power dissipation changes substantially depending on the implementation conditions (board size, board thickness, metal wiring rate, number of layers and through holes, etc.), it is recommended to measure Pd on a set board. Exceeding the power dissipation of IC may lead to deterioration of the original IC performance, such as causing operation of the thermal shutdown circuit or reduction in current capability. Therefore, be sure to prepare sufficient margin within power dissipation for usage.

Calculation of the maximum internal power consumption of IC (PMAX)

$$PMAX=(VIN-VOUT)\times IOUT(MAX.)$$

(VIN: Input voltage VOUT: Output voltage IOUT(MAX): Maximum output current)

Measurement conditions

	Evaluation Board 1 (Double-side Board)
Layout of Board for Measurement (Unit: mm) IC Implementation Position	 Top Layer (Top View)  Bottom Layer (Top View)
Power Dissipation	1.36W
Thermal Resistance	θja=91.9℃/W

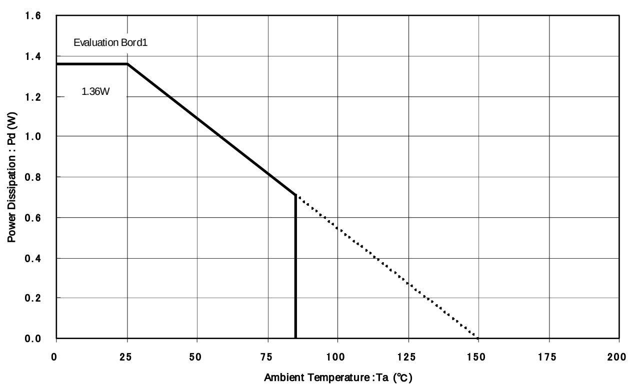


Fig.1. VSON008X2020 Power dissipation heat reduction characteristics (Reference)

* Please design the margin so that PMAX becomes is than Pd (PMAX<Pd) within the usage temperature range.

●Electrical Characteristics (Vin=3.7V, EN1=EN2=Vin,Ta =+25℃, unless otherwise noted.)

Parameter	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Output Voltage range	VOUT	1.2	-	3.3	V	
Input Voltage range	VIN	2.5	-	5.5	V	
Output Voltage Accuracy	Δvouta	-1.8	-	1.8	%	Iout=1mA, VOUT≧1.5V
	Δvoutb	-30	-	+30	mV	Iout=1mA, VOUT=1.2V
Maximum Output Current	Imax	300	-	-	mA	
Short Circuit Current	Isc	-	150	-	mA	VOUT = 0V
Ground Pin Current	Iq	-	55	95	μA	Iout=0mA
		-	35	65		One LDO shutdown, Iout=0mA
Dropout Voltage	Vdrop	-	120	170	mV	VIN=2.5V, VOUT=2.6V, Iout=100mA
		-	90	140		VIN=2.7V, VOUT=2.8V, Iout=100mA
			80	130		VIN=2.9V, VOUT=3.0V, Iout=100mA
		-	70	120		VIN=3.2V, VOUT=3.3V,Iout=100mA
		-	360	510		VIN=2.5V, VOUT=2.6V, Iout=300mA
		-	270	420		VIN=2.7V, VOUT=2.8V, Iout=300mA
			240	390		VIN=2.9V, VOUT=3.0V, Iout=300mA
		-	210	360		VIN=3.2V, VOUT=3.3V, Iout=300mA
Line Regulation	ΔVLNR	-	0.02	0.2	%/V	VIN=VOUT+1V to VIN=5.5V, Iout=10mA
Load Regulation	ΔVLDR	-	0.2	0.6	%	Iout=1mA to 300mA
Ripple Rejection	PSRR	-	66	-	dB	f=100Hz,Iout=10mA@VOUT=1.5V
Output Noise	en	-	150	-	μVrms	fBW=10Hz to 100kHz;Iout=10mA
●EN1, EN2						
Enable Input Threshold	ViH	1.2	-	-	V	Regulator enabled
	ViL	-	-	0.5		Regulator shutdown
Enable Input Leakage Current	Ien	-	0.1	1	μA	Ven=VIN , Ta=+25℃
Shutdown Supply Current	IQSHDN	-	0.1	1	μA	Vout=0V , Ta=+25℃

*This product is not especially designed to be protected from radioactivity.

Output-Voltage Programming

PIN Name	P1	P2	BD7003NUX		BD7004NUX	
			VOUT1	VOUT2	VOUT1	VOUT2
Set up	OPEN	OPEN	1.50	2.80	1.20	1.50
	OPEN	GND	1.80	2.60	1.20	1.80
	OPEN	VIN	1.80	2.70	1.80	1.50
	GND	OPEN	1.80	2.80	1.80	1.80
	GND	GND	1.80	2.90	1.80	3.00
	GND	VIN	2.60	2.80	1.80	3.30
	VIN	OPEN	2.80	2.80	2.80	3.00
	VIN	GND	2.90	2.90	3.00	3.00
	VIN	VIN	2.80	3.30	3.30	3.30

Output Voltage Programming Input (P1、P2)

Output voltages, VOUT1 and VOUT2, are determined at power up by the state of P1 and P2 (see the table of "Output-Voltage Programming"). Subsequent charges to P1 and P2 do not change the output voltages unless the supply power is cycled, or all EN inputs are simultaneously driven low to shutdown the device.

Shutdown (EN1, EN2)

The BD7003NUX, BD7004NUX have independent shutdown control inputs, EN1 and EN2. Driving both EN1 and EN2 low will shut down the entire device, reducing supply current to 1μA max. Connecting EN1 and EN2 to a logic-high or VIN will enable the corresponding output(s). It is prohibited to open EN1, EN2 switches.

●Typical Application Circuit

BD7003NUX, BD7004NUX

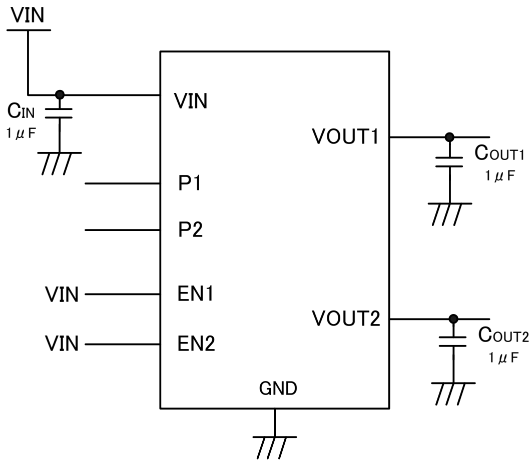
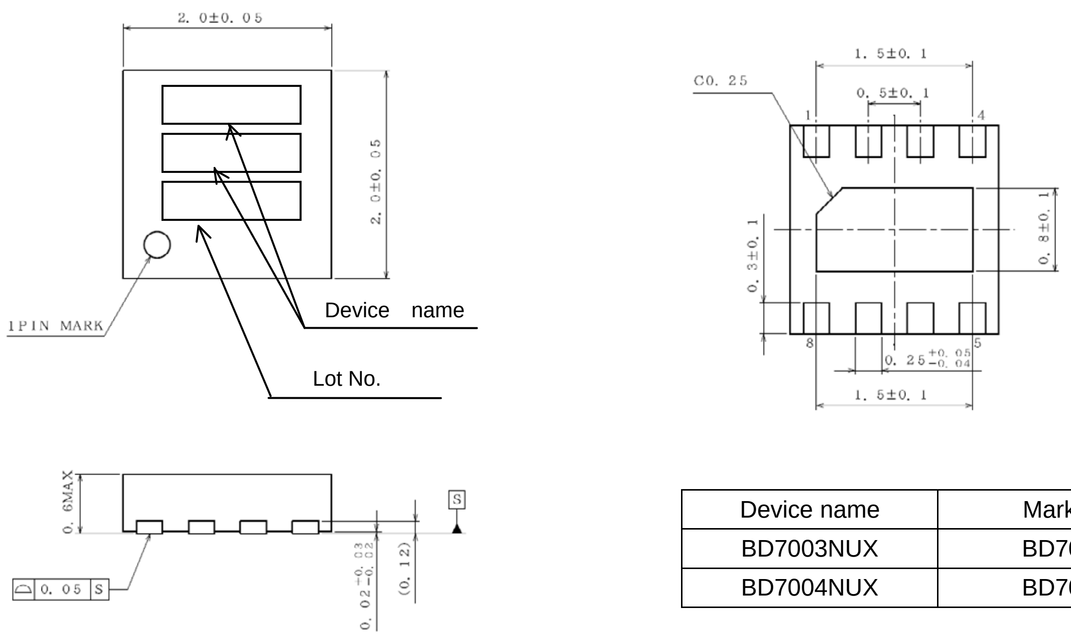


Figure2. Application Circuit

*It is prohibited to open EN1, EN2 switches.

●Package Dimensions (VSON008X2020)

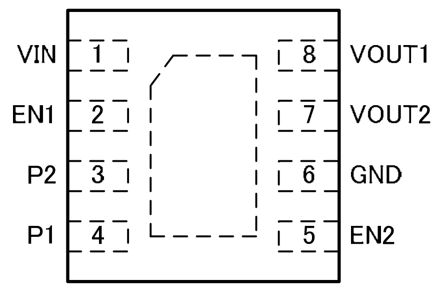


[Unit: mm]

Device name	Marking
BD7003NUX	BD7003
BD7004NUX	BD7004

●Pin Descriptions

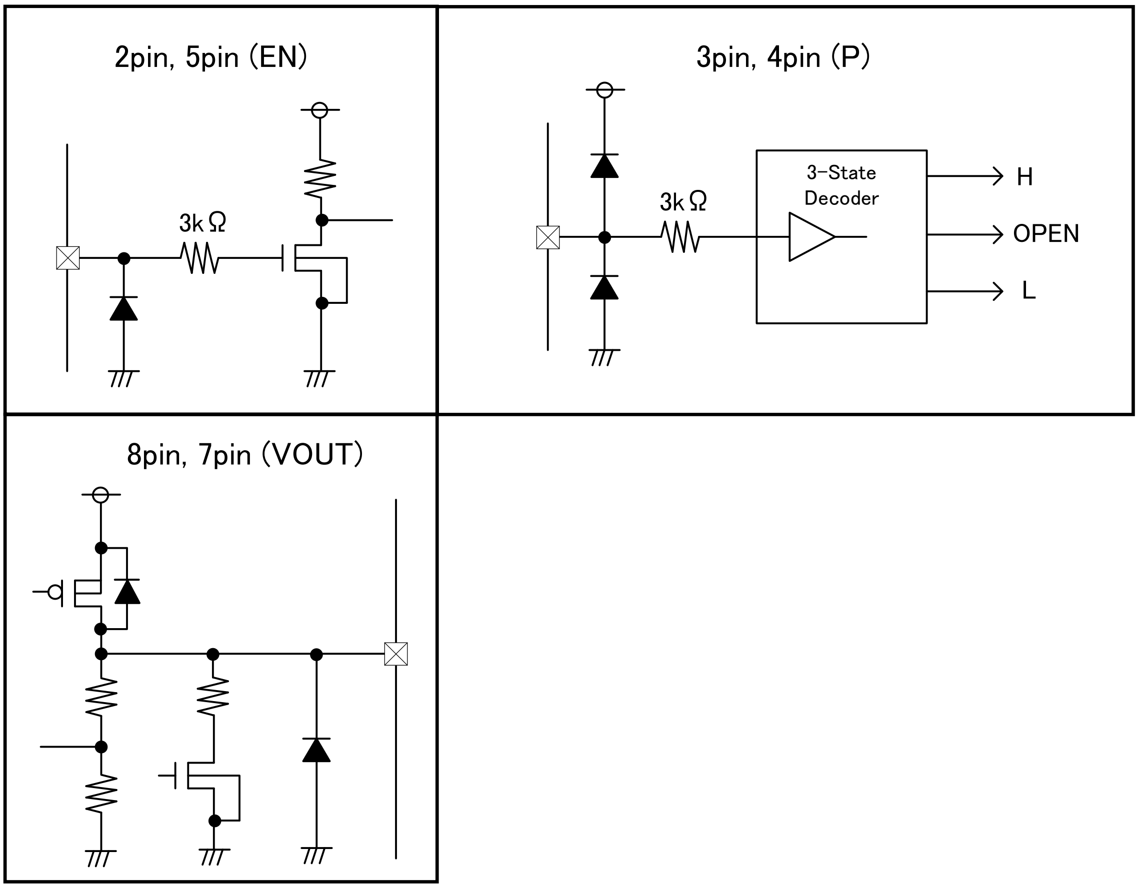
PIN description (Top View)



Note : Recommend connecting the Thermal Pad to the GND for excellent power dissipation.

PIN No.	Name	I/O	ESD Diode		Function
			IN	GND	
1	VIN	I	-	O	Voltage Supply
2	EN1	I	-	O	Enable Input1
3	P2	I	O	O	Control Output-Voltage PIN2
4	P1	I	O	O	Control Output-Voltage PIN1
5	EN2	I	-	O	Enable Input2
6	GND	-	O	-	GND PIN
7	VOUT2	O	-	O	LDO1 Output1
8	VOUT1	O	-	O	LDO2 Output2

● Equivalent Circuit



● Block Diagram

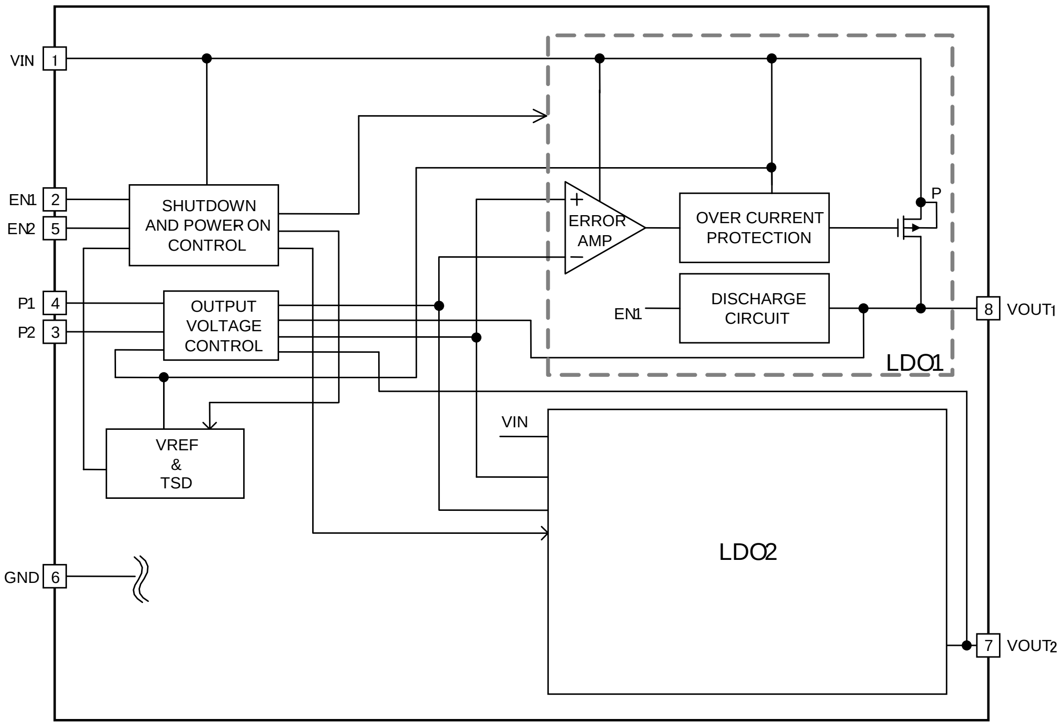


Fig.3. Block Diagram

●Typical Operating Characteristics

※The test conditions for the Typical Operating Characteristics are VIN=3.7V, CIN=1.0uF, COUT=1.0uF, Ta=25℃, Unless otherwise noted.

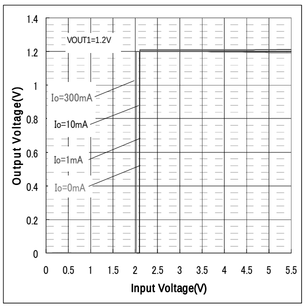


Fig.4. Output Voltage (VOUT1=1.2V)

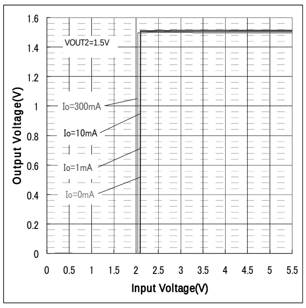


Fig.5. Output Voltage (VOUT2=1.5V)

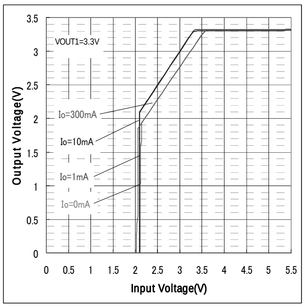


Fig.6. Output Voltage (VOUT1=3.3V)

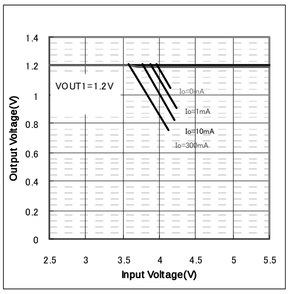


Fig.7. Line Regulation (VOUT1=1.2V)

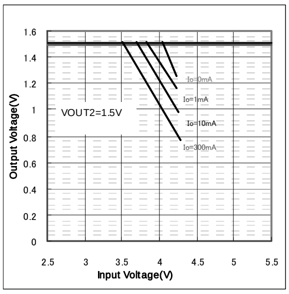


Fig.8. Line Regulation (VOUT2=1.5V)

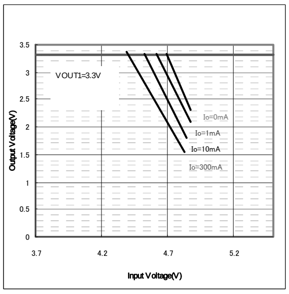


Fig.9. Line Regulation (VOUT1=3.3V)

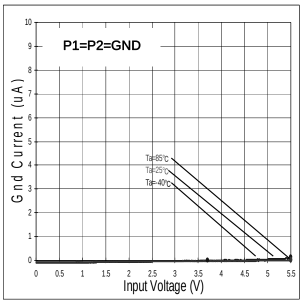


Fig.10. Circuit Current (VOUT1=1.8V,VOUT2=2.9V) EN1=EN2=GND

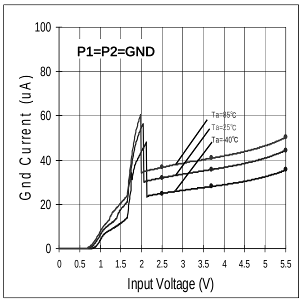


Fig.11. Circuit Current (VOUT1=1.8V,VOUT2=2.9 V) EN1=VIN, EN2=GND

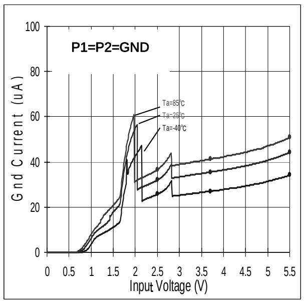


Fig.12. Circuit Current (VOUT1=1.8V,VOUT2=2.9V) EN1=GND, EN2=VIN

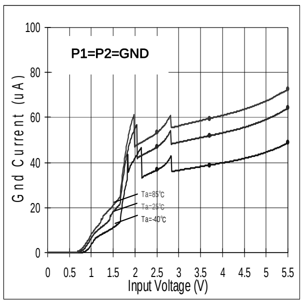


Fig.13. Circuit Current (VOUT1=1.8V,VOUT2=2.9V) EN1=EN2=VIN

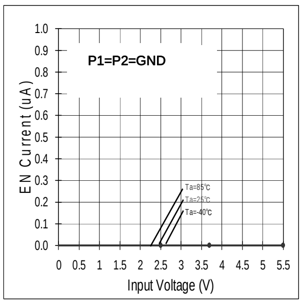


Fig.14. EN1 Input Current

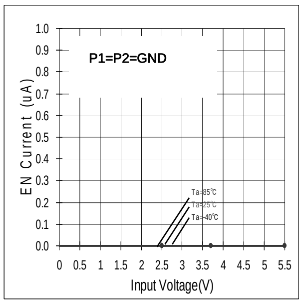


Fig.15. EN2 Input Current

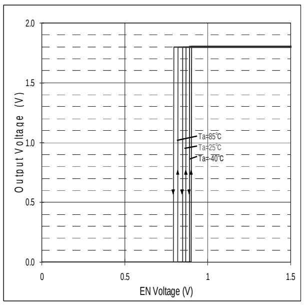


Fig.16. EN1 Threshold
(VOUT1=1.8V)

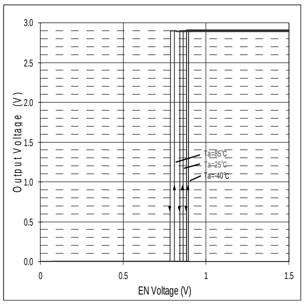


Fig.17. EN2 Threshold
(VOUT2=2.9V)

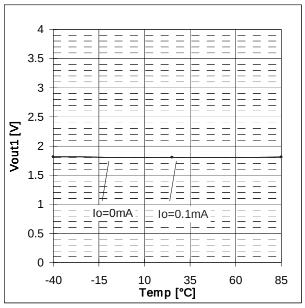


Fig.18. VOUT - Temp
(VOUT1=1.8V)

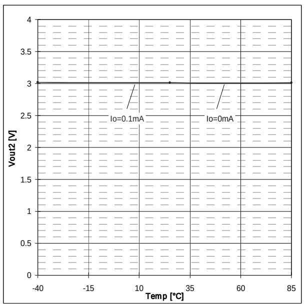


Fig.19. VOUT – Temp
(VOUT2=3.0V)

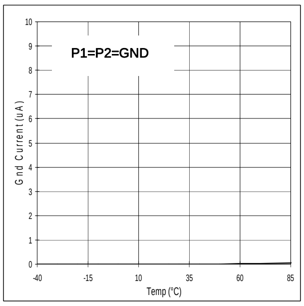


Fig.20. Icc - Temp
(VOUT1=1.8V,VOUT2=2.9V)
EN1=EN2=GND

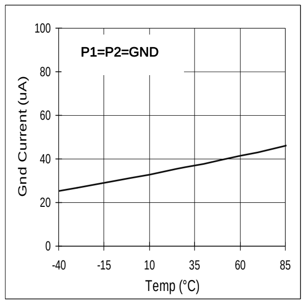


Fig.21.Icc- Temp
(VOUT1=1.8V,VOUT2=2.9V)
EN1=VIN, EN2=GND

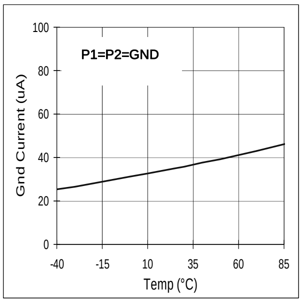


Fig.22. Icc - Temp
(VOUT1=1.8V,VOUT2=2.9V)
EN1=GND, EN2=VIN

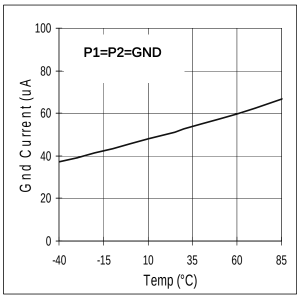


Fig.23. Icc - Temp
(VOUT1=1.8V,VOUT2=2.9V)
EN1=EN2=VIN

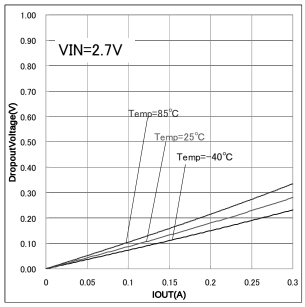


Fig.24. Drop Out Voltage
(VOUT1=2.8V)

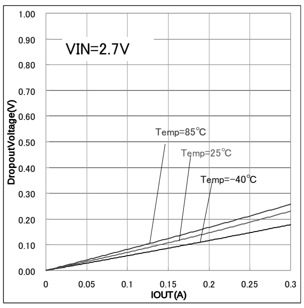


Fig.25. Drop Out Voltage
(VOUT2=2.8V)

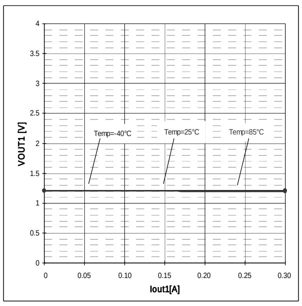


Fig.26. Load Regulation
(VOUT1=1.2V)

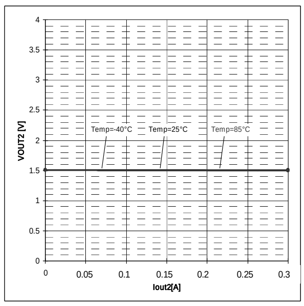


Fig.27. Load Regulation
(VOUT2=1.5V)

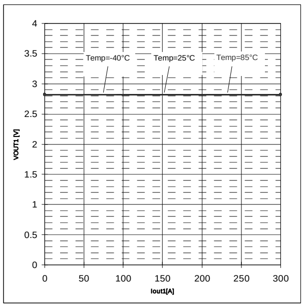


Fig.28. Load Regulation (VOUT1=2.8V)

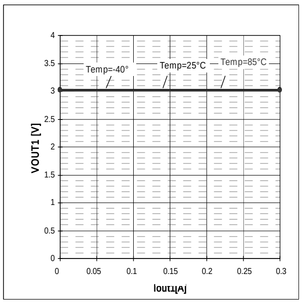


Fig.29. Load Regulation (VOUT2=3.0V)

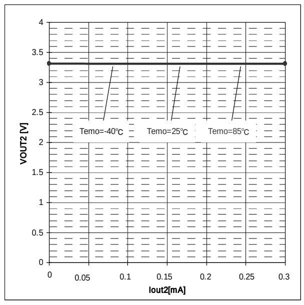


Fig.30. Load Regulation (VOUT2=3.3V)

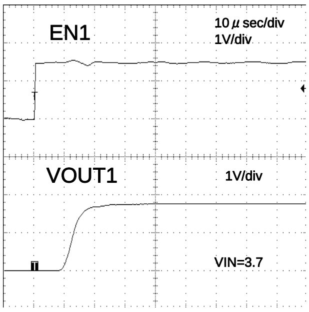


Fig.31. Start Up Time (VOUT1=1.8V) IOUT=0mA

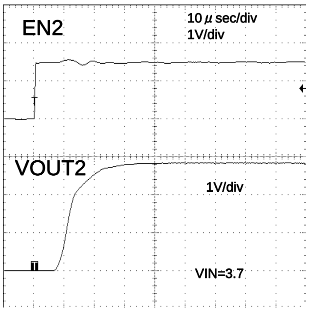


Fig.32. Start Up Time (VOUT2=2.9V) IOUT=0mA

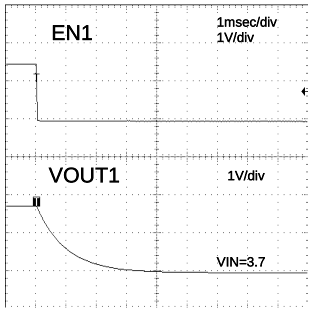


Fig.33. Discharge Time (VOUT1=1.8V) IOUT=0mA

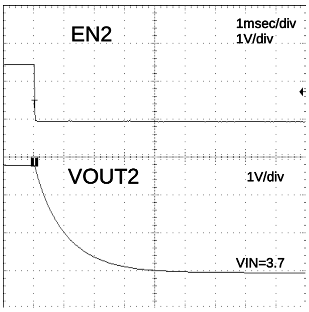


Fig.34. Discharge Time (VOUT2=2.9V) IOUT=0mA

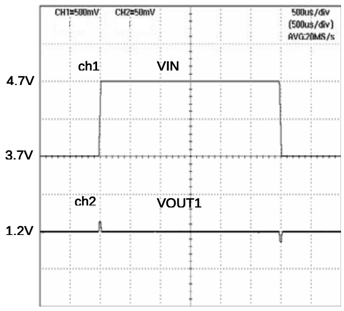


Fig.35. VIN Response (VOUT1=1.2V) IOUT=50mA

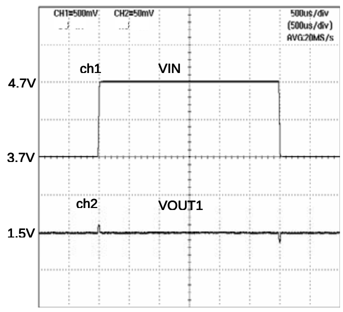


Fig.36. VIN Response (VOUT1=1.5V) IOUT=50mA

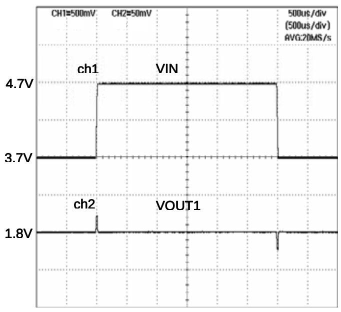


Fig.37. VIN Response (VOUT1=1.8V) IOUT=50mA

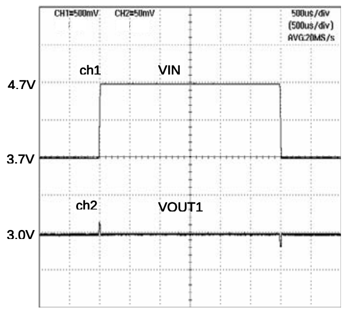


Fig.38. VIN Response (VOUT2=3.0V) IOUT=50mA

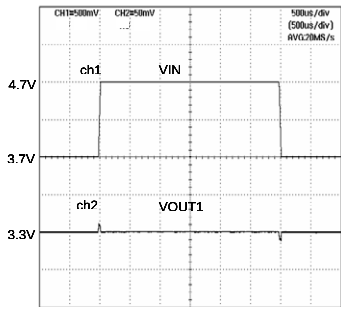


Fig.39. VIN Response (VOUT2=3.3V) IOUT=50mA

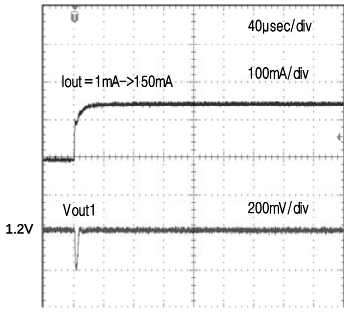


Fig.40. Load Response
(VOUT1=1.2V)
IOUT=1mA→150mA

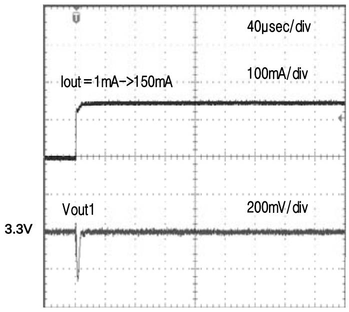


Fig.41. Load Response
(VOUT1=3.3V)
IOUT=1mA→150mA

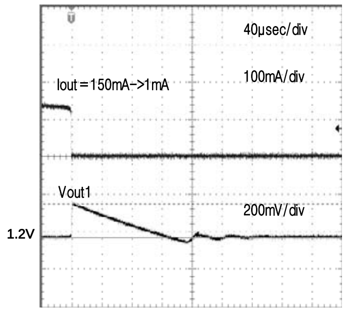


Fig.42. Load Response
(VOUT1=1.2V)
IOUT=150mA→1mA

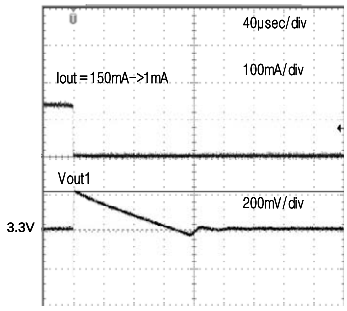


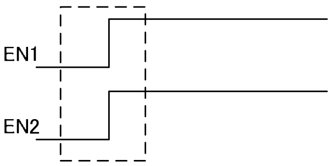
Fig.43. Load Response
(VOUT1=3.3V)
IOUT=150mA→1mA

●**Example of EN1&EN2 used** (P1=GND,P2=OPEN, VOUT1=1.8V, VOUT2=2.8V)

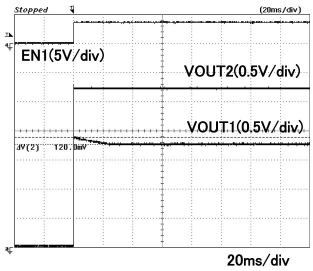
Output overshoot conditions

Whenever the LDO is turned ON, LDO1 output overshoot occurs in certain boot conditions.
In CASE2, the overshoot value is minimum, which boot order is EN1→EN2.
The maximum over shoot occurs in CASE3, which boot order is EN2→EN1.
The overshoot value differs between input voltages(VIN), output voltage setting and EN1, EN2 input timing interval.

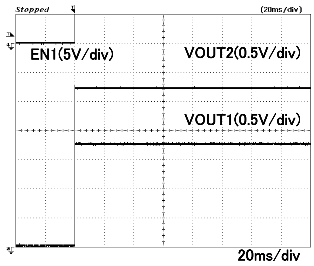
CASE1: EN1 & EN2 Pins are shorted



VIN=3.7V,EN2=EN1

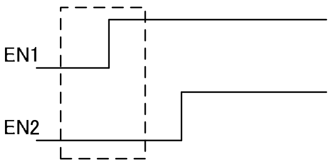


VIN=5.5V,EN2=EN1

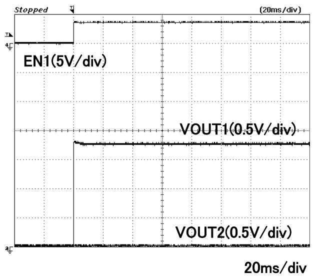


EN1 & EN2 Pins are independent

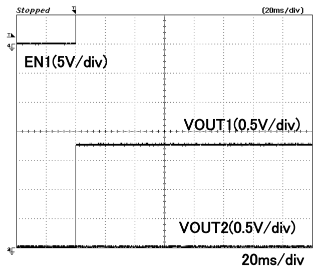
CASE2: EN1→EN2 operation(L→H)



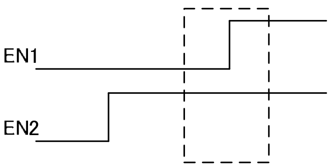
VIN=3.7V,EN2=L(OFF)



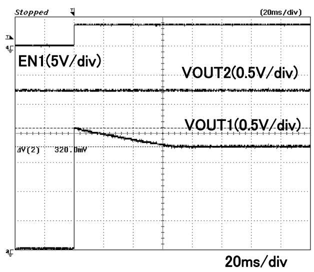
VIN=5.5V,EN2=L(OFF)



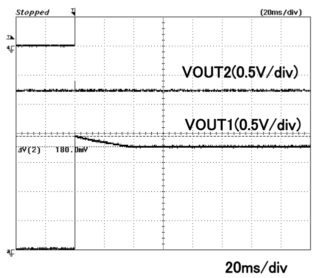
CASE3: EN2→EN1 operation(L→H)



VIN=3.7V,EN2=H(ON)



VIN=5.5V,EN2=H(ON)



●Notes for use

(1) Absolute maximum ratings
If applied voltage (VIN), operating temperature range (Topr), or other absolute maximum ratings are exceeded, there is a risk of damage. Since it is not possible to identify short, open, or other damage modes, if special modes in which absolute maximum ratings are exceeded are assumed, consider applying fuses or other physical safety measures.

(2) Recommended operating range
This is the range within which it is possible to obtain roughly the expected characteristics. For electrical characteristics, it is those that are guaranteed under the conditions for each parameter. Even when these are within the recommended operating range, voltage and temperature characteristics are indicated.

(3) Reverse connection of power supply connector
There is a risk of damaging the IC by reverse connection of the power supply connector. For protection from reverse connection, take measures such as externally placing a diode between the power supply and the power supply pin of the IC.

(4) Power supply lines
In the design of the board pattern, make power supply and GND line wiring low impedance.
When doing so, although the digital power supply and analog power supply are the same potential, separate the digital power supply pattern and analog power supply pattern to deter digital noise from entering the analog power supply due to the common impedance of the wiring patterns. Similarly take pattern design into account for GND lines as well.
Furthermore, for all power supply pins of the IC, in conjunction with inserting capacitors between power supply and GND pins, when using electrolytic capacitors, determine constants upon adequately confirming that capacitance loss occurring at low temperatures is not a problem for various characteristics of the capacitors used.

(5) GND voltage
Make the potential of a GND pin such that it will be the lowest potential even if operating below that. In addition, confirm that there are no pins for which the potential becomes less than a GND by actually including transition phenomena.

(6) Shorts between pins and misinstallation
When installing in the set board, pay adequate attention to orientation and placement discrepancies of the IC. If it is installed erroneously, there is a risk of IC damage. There also is a risk of damage if it is shorted by a foreign substance getting between pins , between a pin and a power supply or GND.

(7) Operation in strong magnetic fields
Be careful when using the IC in a strong magnetic field, since it may malfunction.

(8) Inspection in set board
When inspecting the IC in the set board, since there is a risk of stress to the IC when capacitors are connected to low impedance IC pins, be sure to discharge for each process. Moreover, when getting it on and off of a jig in the inspection process, always connect it after turning off the power supply, perform the inspection, and remove it after turning off the power supply. Furthermore, as countermeasures against static electricity, use grounding in the assembly process and take appropriate care in transport and storage.

(9) Input pins
Parasitic elements inevitably are formed on an IC structure due to potential relationships. Because parasitic elements operate, they give rise to interference with circuit operation and may be the cause of malfunctions as well as damage. Accordingly, take care not to apply a lower voltage than GND to an input pin or use the IC in other ways such that parasitic elements operate. Moreover, do not apply a voltage to an input pin when the power supply voltage is not being applied to the IC. Furthermore, when the power supply voltage is being applied, make each input pin a voltage less than the power supply voltage as well as within the guaranteed values of electrical characteristics.

(10) Ground wiring pattern
When there is a small signal GND and a large current GND, it is recommended that you separate the large current GND pattern and small signal GND pattern and provide single point grounding at the reference point of the set so that voltage variation due to resistance components of the pattern wiring and large currents do not cause the small signal GND voltage to change. Take care that the GND wiring pattern of externally attached components also does not change.

(11) Externally attached capacitors
When using ceramic capacitors for externally attached capacitors, determine constants upon taking into account a lowering of the rated capacitance due to DC bias and capacitance change due to factors such as temperature.

(12) Thermal shutdown circuit (TSD)
When the junction temperature becomes 180℃ (typ) or higher, the thermal shutdown circuit operates and turns the switch OFF. The thermal shutdown circuit, which is aimed at isolating the IC from thermal runaway as much as possible, is not aimed at the protection or guarantee of the IC. Therefore, do not continuously use the IC with this circuit operating or use the IC assuming its operation.

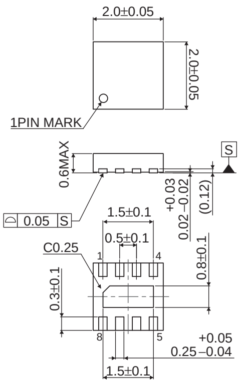
(13) Thermal design
Perform thermal design in which there are adequate margins by taking into account the permissible dissipation (Pd) in actual states of use.

●Ordering part number

B	D		7	0	0	3		N	U	X	-	E	2

- Part No.
- Part No. 7003 / 7004
- Package: NUX: VSON008X2020
- Packaging and forming specification: E2: Embossed tape and reel

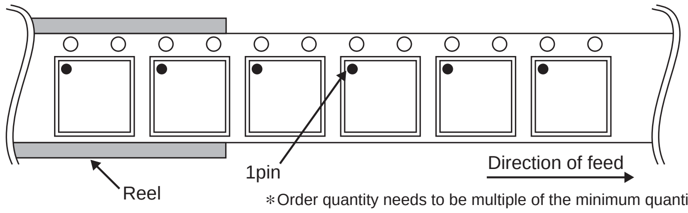
VSON008X2020



(Unit : mm)

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	4000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



*Order quantity needs to be multiple of the minimum quantity.

Notes

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