NC2650ZA330A-EV

Ultra-low Quiescent Current (I_{QVIN} = 85nA) 1A Step-down Switching Regulator

FEATURES

- Input Voltage Range (Maximum Rating): 1.8 V to 5.5 V (6.5 V)
- Output Voltage Range: 0.8 V to 3.3 V (internally fixed)
- Output Voltage Accuracy: ±1 % (V_{SET} ≥ 1.2 V), ±1.5 % (V_{SET} < 1.2 V)
- Quiescent Current: Typ. 85 nA
- Efficiency: Typ. 80 % (V_{IN}=3.6V, V_{OUT}=1.8V, I_{OUT}=1uA)
- Ripple Voltage: Typ. 10mVpp (I_{OUT}=500mA)
- UVLO Detection Voltage: Typ. 1.45 V
- Soft-Start Time: Typ. 170 µs
- Thermal Shutdown Function: Detection Temperature: Typ. 150 °C, Release Temperature: Typ. 120 °C
- Auto Discharge Function

GENERAL DESCRIPTION

The NC2650 is a synchronous rectification step-down switching regulator using CMOS-based with PWM/PFM automatic alternating function.

This product achieves ultra-low power consumption of only 85 nA in quiescent current, so it is ideal for battery-powered portable devices such as wearable devices and IoT devices.

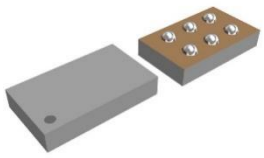
Because it exhibits high efficiency under light load conditions, it extends battery life in intermittent operation applications and allows the use of a small inductor (0.47µH), contributing to space savings.

It also achieves low ripple voltage and fast load transient response, providing stable power quality. Shutdown function is possible by switching the EN pin and auto-discharge can be selected, so that enables flexible power supply design.

APPLICATIONS

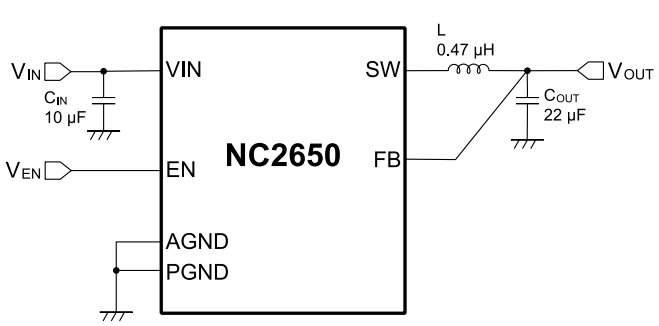
- IoT Edge Terminals
- Devices Powered by Coin/Button/Dry Batteries.
- Alarms, Smart Watches etc.

PACKAGE

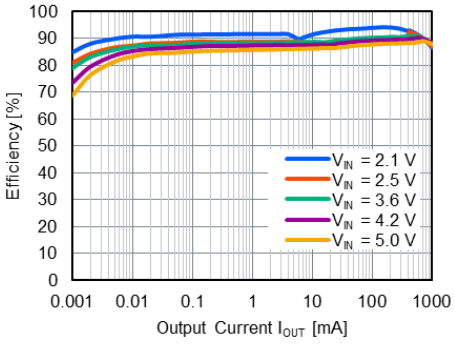


WLCSP-6-ZA2 1.47 x 0.87 x 0.4 (mm)

TYPICAL APPLICATIONS



EFFICIENCY TYPICAL CHARACTERISTICS



NC2650ZA V_{OUT} = 1.8V

■PRODUCT NAME INFORMATION

Product Name	Package
NC2650ZA330A	WLCSP-6-ZA2

Description of configuration

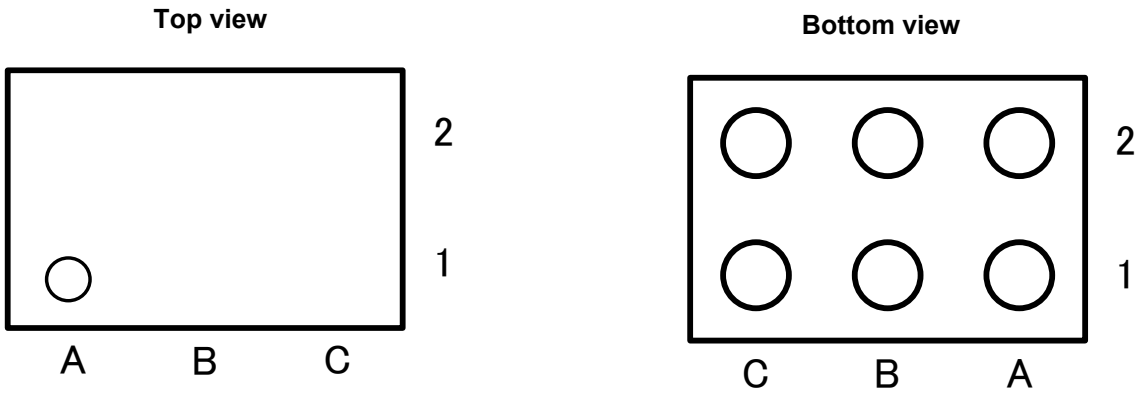
	Item	Description
330	Output Voltage	Set Output Voltage (V_{SET}): 3.3 V

Version

	Auto Discharge Function
A	Yes

- For more details on NC2650 IC, please refer to
https://www.nisshinbo-microdevices.co.jp/en/products/dc-dc-switching-regulator/spec/?product=nc2650

■PIN DESCRIPTIONS (NC2650ZA)



WLCSP-6-ZA2 Pin Configuration

NC2650ZA (WLCSP-6-ZA2) Pin Descriptions

Pin No.	Pin Name	I/O	Description
A1	FB	I	Feedback Pin Connect it to the VOUT node as an output voltage feedback pin.
B1	SW	O	Switching Output Pin Internal MOSFET Drain Connect an inductor between the VOUT node and the SW pin.
C1	VIN	Power	Power Supply Input Pin
A2	AGND	-	Analog GND Pin of Internal Circuit Be sure to connect to the GND pin on the board.
B2	EN	I	Enable Pin Can set the active state with the "High" input and the shutdown state with the "Low" input.
C2	PGND	-	Power Ground Pin of Internal Circuit Be sure to connect to the GND pin on the board.

■ABSOLUTE MAXIMUM RATINGS

	Symbol	Ratings	Unit
VIN pin Voltage	V_{IN}	-0.3 to 6.5	V
FB pin Voltage	V_{FB}	-0.3 to 6.5	V
SW pin Voltage	V_{SW}	-0.3 to 6.5	V
EN pin Voltage	V_{EN}	-0.3 to 6.5	V
Storage Temperature Range	T_{stg}	-55 to 125	°C
Junction Temperature *1	T_j	-40 to 125	°C

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

*1 Calculate the power consumption of the IC from the operating conditions, and calculate the junction temperature with the thermal resistance.

Please refer to "*THERMAL CHARACTERISTICS*" for the thermal resistance under our measurement board conditions

■RECOMMENDED OPERATING CONDITIONS

	Symbol	Ratings	unit
VIN pin Voltage	V_{IN}	1.8 to 5.5	V
Operating Temperature Range	T_a	-40 to 85	°C
Junction Temperature Range	T_j	-40 to 125	°C

RECOMMENDED OPERATING CONDITIONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

■ELECTRICAL CHARACTERISTICS

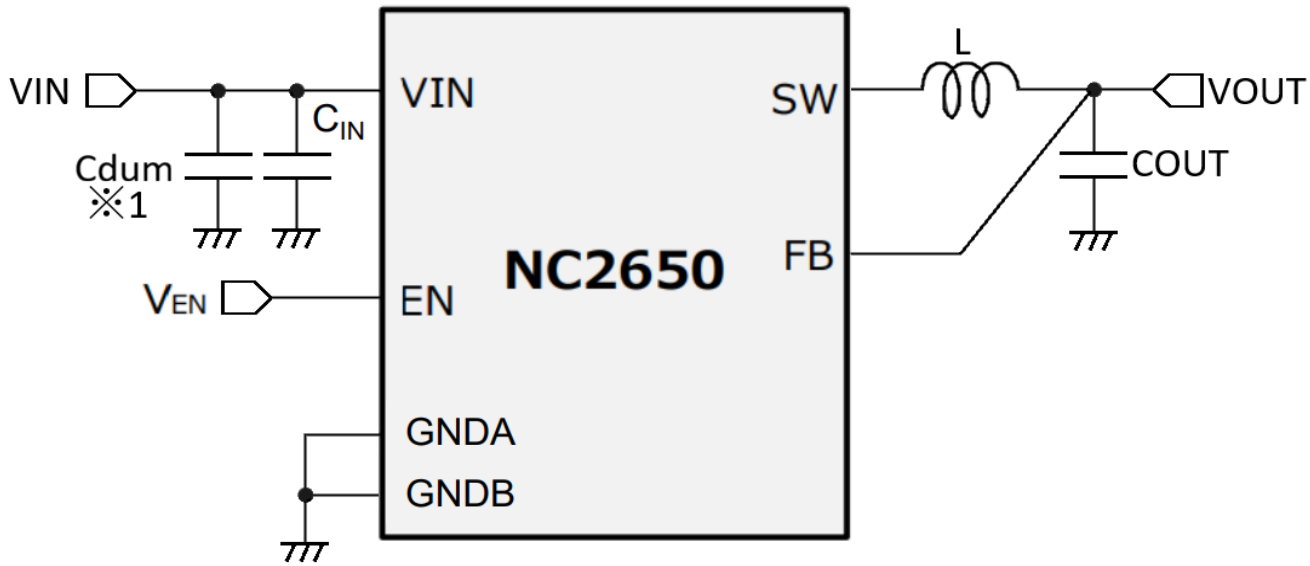
V_{IN} = 3.6 V unless otherwise specified.
For parameter that do not describe the temperature condition, the MIN / MAX value under the condition of −40 °C ≤ T_j ≤ 125 °C is described.

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Output Voltage	V_{OUTCCM}	PWM, V_{SET} ≥ 1.2V, T_j = 25 °C	× 0.99	-	× 1.01	V
		PWM, V_{SET} ≥ 1.2V, -40°C ≤ T_j ≤ 125°C	× 0.98	-	× 1.02	V
		PWM, V_{SET} < 1.2V, T_j = 25 °C	× 0.985	-	× 1.015	V
		PWM, V_{SET} < 1.2V, -40°C ≤ T_j ≤ 125°C	× 0.975	-	× 1.025	V
VIN pin Quiescent Current	I_{QVIN}	V_{OUT} = V_{SET}, no switching T_j = 25 °C	-	85	170	nA
Shutdown Current	I_{SD}	V_{IN} = 1.8~5.5V, V_{EN} = 0V T_j = 25 °C	-	4	100	nA
EN "H" Input Current	I_{ENH}	V_{IN} = V_{EN} = 5.5V -40°C ≤ T_j ≤ 85°C	-40	0	40	nA
EN "L" Input Current	I_{ENL}	V_{IN} = 5.5V, V_{EN} = 0V -40°C ≤ T_j ≤ 85°C	-40	0	40	nA
On-resistance for Discharger	R_{ONDIS}	NC2650xxxxxA	-	60	-	Ω
EN pin "H" Input Voltage	V_{ENH}	V_{IN} = 5.5 V	0.8	-	5.5	V
EN pin "L" Input Voltage	V_{ENL}	V_{IN} = 1.8 V	0	-	0.3	V
On-resistance of High Side MOSFET	R_{ONH}	I_{sw} = 100mA	-	150	-	mΩ
On-resistance of Low Side MOSFET	R_{ONL}	I_{sw} = 100mA	-	125	-	mΩ
Thermal Shutdown Detection Temperature	T_{SDDET}		-	150	-	°C
Thermal Shutdown Release Temperature	T_{SDREL}		-	120	-	°C
High Side Current Limit	I_{LIMHS}		1.4	1.8	2.2	A
High Side Current Limit at Soft-Start	I_{LIMHS_SS}	V_{SET} = 1.8V	0.26	0.5	0.76	A
Start-up Delay Time	$t_{STARTUP}$	from EN = low to high until device starts switching -40°C ≤ T_j ≤ 85°C	-	100	250	μs
Soft-Start Time	t_{SS}	I_{OUT} = 0mA, Vset = 1.8V	-	170	-	μs
UVLO Detection Voltage *1	$V_{UVLODET}$	V_{IN} = Falling	1.35	1.45	1.55	V
UVLO Release Voltage *1	$V_{UVLOREL}$	V_{IN} = Rising	1.4	1.5	1.6	V

All electrical characteristic parameters that specify the minimum and maximum specifications are tested under the condition of T_j ≈ T_a = 25 °C.

*1 Due to the circuit configuration, $V_{UVLODET}$ ≥ $V_{UVLOREL}$ does not hold. The hysteresis is Typ.50 mV.

■TYPICAL APPLICATION CIRCUIT



※1 Testing with this EV board, an external attachment might be necessary for evaluation of the correct performance of the NC2650 and already has been attached as Cdum.
For evaluation, wiring for power supply or GND will be used. Considering the voltage drop or noise by the wiring, Cdum has been mounted on the EV board to obtain the right performance of the NC2650 in the actual PCB layout or measurement unit's wire is very short, and Cdum will be unnecessary.

Recommended external parts

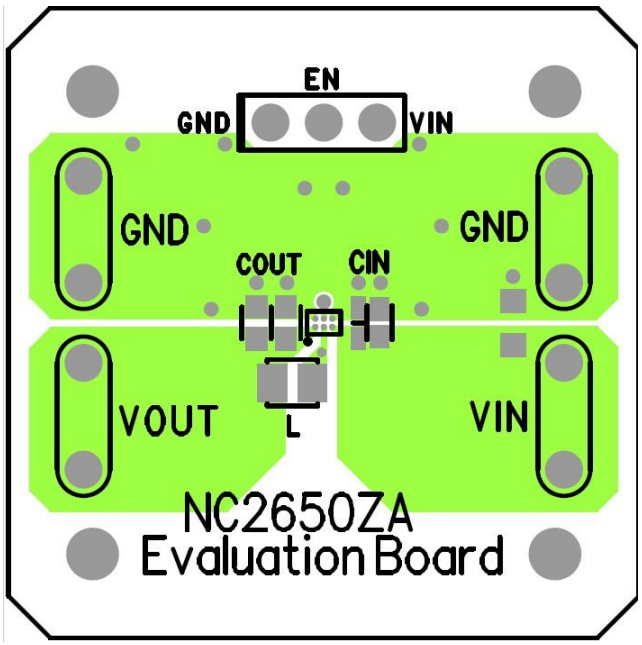
Symbol	Capacitance
CIN	10 µF
COUT	22 µF
L	0.47 µH
Cdum(※1)	22 µF

The bill of materials will be attached on the shipment of each purchased evaluation board.

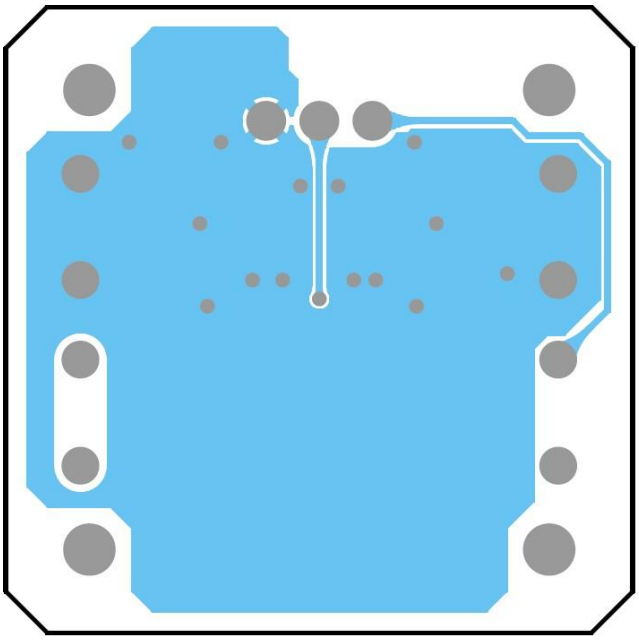
■Evaluation Board / PCB Layout Pattern Example

NC2650ZA（WLCSP-6-ZA2）

Top Layer



Bottom Layer



When designing PCB layout patterns, pay close attention to the following items.

External components should be placed as close as possible to the IC and on the same side, and the wiring from the IC to the components should be short. In particular, the capacitor CIN connected between VIN and PGND and the capacitor COUT connected between FB and AGND should be placed at the shortest possible distance from the terminals.

Current due to switching flows through the power supply wiring, ground wiring and SW pins. If the impedance of the power and ground wiring is high, the potential inside the IC may fluctuate due to the switching current, causing the IC to operate unstable. Therefore, the power and ground wiring should be short and thick.

The wiring from the SW pin to the inductor is a noise source, so ensure that the current capacity is sufficient to prevent the noise from increasing and that the wiring is not thicker and longer than necessary.

1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to our sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of our company.
3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.
4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under our company's or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.
11. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

NISSHINBO

Nisshinbo Micro Devices Inc.

Official website
https://www.nisshinbo-microdevices.co.jp/en/
Purchase information
https://www.nisshinbo-microdevices.co.jp/en/buy/