NISSHINBO

RP604x Series

Ultra-low Quiescent Current (I_Q = 0.3 µA), 300 mA, Buck-Boost DC/DC Converter

No. EA-415-241022

OVERVIEW

The RP604x is a buck-boost converter featuring a minimum supply current and a high efficiency at low-load. The device operates at the low operating quiescent current (I_Q = 0.3 µA) to make the most of battery life for the battery driver operated intermittently.

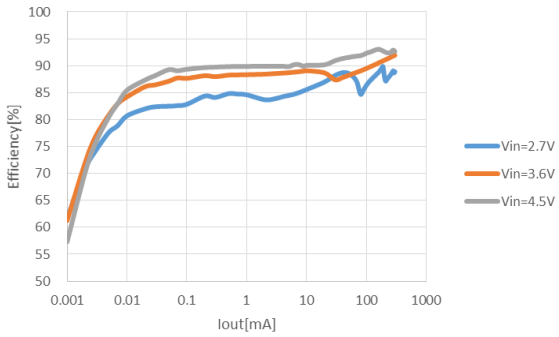
KEY BENEFITS

- The low supply current (I_Q = 0.3 µA) can achieve making battery life longer and battery's size-reduction.
- Wide range of input voltage (1.8 V to 5.5 V) can support for every battery from a coin-type battery to a USB port.
- Selectable package: WLCSP-20-P2 or DFN(PL)2730-12

KEY SPECIFICATIONS

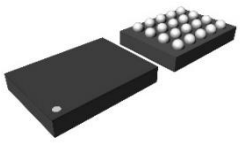
- Input Voltage: 1.8 V to 5.5 V
- Output Voltage: 1.6 V to 5.2 V, 0.1 V step
- Output Voltage Accuracy: ±1.5%
- Maximum Output Current: 300 mA at Buck
- Built-in Driver On-resistance (RP604Z, V_{IN} = 3.6 V): PMOS = Typ.0.12 Ω, NMOS = Typ. 0.12 Ω
- Operating Quiescent Current (I_Q): 0.3 µA
- Standby Current: 0.01 µA
- Protection Features: UVLO, OVP, LX Peak Current, and Thermal Shutdown

TYPICAL CHARACTERISTICS

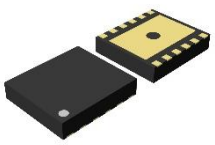


V_{OUT} = 3.3 V

PACKAGES



WLCSP-20-P2
1.71 x 2.315 x 0.40(1) mm
(1) maximum dimension



DFN(PL)2730-12
2.70 x 3.00 x 0.6(1) mm
(1) maximum dimension

OPTIONAL FUNCTIONS

The auto-discharge function and the set output voltage (V_{SET}) are user-selectable options.

Product Name	Auto-discharge Function	V_{SET}
RP604xxx1A	Disable	1.6 V to 5.2 V (0.1 V step)
RP604xxx1B	Enable	

APPLICATIONS

- Wearable Appliances: SmartWatch, SmartBand, Healthcare
- Li-ion/Coin Battery-used Equipment
- Low-power Wireless Communication Equipment: *Bluetooth*® Low Energy, ZigBee, WiSunm, ANT
- Low-power Devices for CPU, Memory, Sensor Device, Energy Harvesting

SELECTION GUIDE

The set output voltage, the auto-discharge function[1] and the package are user-selectable options.

Selection Guide

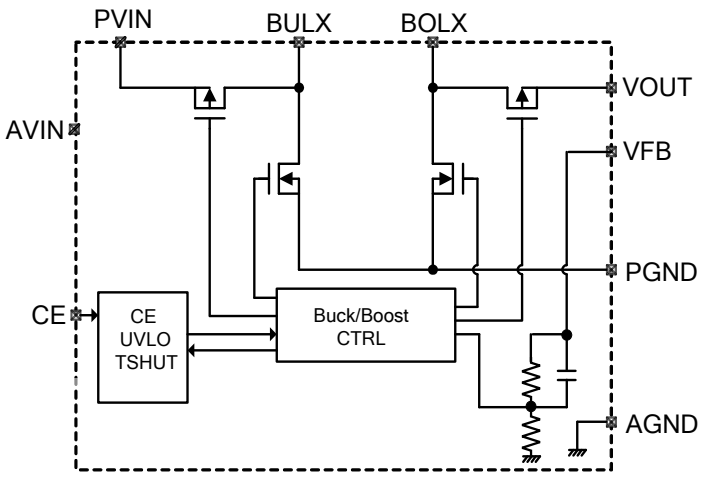
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP604Zxx1$-E2-F	WLCSP−20−P2	5,000 pcs	Yes	Yes
RP604Zxx1$-E2-T	WLCSP−20−P2	5,000 pcs	Yes	Yes
RP604Kxx1$-TR	DFN(PL)2730-12	5,000 pcs	Yes	Yes

xx: Specify the set output voltage (V_{SET}) within the range of 1.6 V (16) to 5.2 V (52) in 0.1 V steps.

$: Specify the auto-discharge function.

Version	Auto-discharge Function	V_{SET}
A	Disable	1.6 V to 5.2 V
B	Enable	

BLOCK DIAGRAM



RP604xxx1A/ RP604xxx1B Block Diagram

[1] Auto-discharge function quickly lowers the output voltage to 0 V, when the chip enable signal is switched from the active mode to the standby mode, by releasing the electrical charge accumulated in the external capacitor.

PIN DESCRIPTIONS

WLCSP-20-P2 Pin Configuration

WLCSP-20-P2 Pin Description

Pin No.	Pin Name	Description
A5, B5, C5	VOUT	Output Voltage Pin
A4, B4, C4	BOLX	Boost Switching Output Pin
A3, B3, C3, D3	PGND	Power GND Pin
A2, B2, C2	BULX	Buck Switching Output Pin
A1, B1, C1	PVIN	Power Input Voltage Pin
D1	AVIN	Analog Power Input Voltage Pin
D2	CE	Chip Enable Pin, Active-high
D4	AGND	Analog GND Pin
D5	VFB	Output Voltage Feedback Pin

DFN(PL)2730-12 Pin Configuration

DFN(PL)2730-12 Pin Description

Pin No.	Pin Name	Description
1	AVIN	Analog Power Input Voltage Pin
2	CE	Chip Enable Pin, Active-high
3	PGND	Power GND Pin
4	PGND	Power GND Pin
5	AGND	Analog GND Pin
6	VFB	Output Voltage Feedback Pin
7	VOUT	Output Voltage Pin
8	BOLX	Boost Switching Output Pin
9	PGND	Power GND Pin
10	PGND	Power GND Pin
11	BULX	Buck Switching Output Pin
12	PVIN	Power Input Voltage Pin

* The tab on the bottom of the package shown by blue circle is a substrate potential (GND). It is recommended that this tab be connected to the ground plane on the board but it is possible to leave the tab floating.

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings (GND = 0 V)

Symbol	Parameter			Rating	Unit
V_{IN}	A/PVIN Pin Voltage			−0.3 to 6.5	V
V_{BULX}	BULX Pin Voltage			−0.3 to V_{IN} + 0.3	V
V_{BOLX}	BOLX Pin Voltage			−0.3 to V_{OUT} + 0.3	V
V_{CE}	CE Pin Voltage			−0.3 to 6.5	V
V_{OUT}	VOUT Pin Voltage			−0.3 to 6.5	V
V_{FB}	VFB Pin Voltage			−0.3 to 6.5	V
I_{LX}	BULX/BOLX Pin Output Current			900	mA
P_D	Power Dissipation(1)	WLCSP-20-P2	JEDEC STD. 51-9	1490	mW
		DFN(PL)2730-12	JEDEC STD. 51-7	3100	mW
Tj	Junction Temperature Range			−40 to 125	°C
Tstg	Storage Temperature Range			−55 to 125	°C

ABSOLUTE MAXIMUM RATINGS

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

RECOMMENDED OPERATING CONDITIONS

Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{IN}	Input Voltage	1.8 to 5.5	V
Ta	Operating Temperature Range	−40 to 85	°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 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.

(1) Refer to *POWER DISSIPATION* for detailed information.

ELECTRICAL CHARACTERISTICS

The specifications surrounded by [ ] are guaranteed by design engineering at −40°C ≤ Ta ≤ 85°C.

RP604Z/K Electrical Characteristics (Ta = 25°C)

Symbol	Parameter	Test Conditions/Comments		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN} = V_{CE} = 3.6 V		x 0.985		x 1.015	V
I_Q	Operating Quiescent Current	V_{IN} = V_{CE} = V_{OUT} = 3.6 V, V_{SET} = 3.3V at rest			0.3		µA
$I_{STANDBY}$	Standby Current	V_{IN} = 5.5 V, V_{CE} = 0 V			0.01	1	µA
I_{CEH}	CE Pin Input Current, High	V_{IN} = V_{CE} = 5.5 V		[−0.025]	0	[0.025]	µA
I_{CEL}	CE Pin Input Current, Low	V_{IN} = 5.5 V, V_{CE} = 0 V		[−0.025]	0	[0.025]	µA
I_{VOUTH}	VFB Pin Input Current, High	V_{IN} = V_{FB} = 5.5 V, V_{CE} = 0 V		[−0.025]	0	[0.025]	µA
I_{VOUTL}	VFB Pin Input Current, Low	V_{IN} = 5.5 V, V_{CE} = V_{FB} = 0 V		[−0.025]	0	[0.025]	µA
V_{OVP}	OVP Threshold Voltage	V_{IN} = 3.6 V, rising (detection)			6.0		V
		V_{IN} = 3.6 V, falling (release)			5.5		V
R_{DISN}	Auto-discharge NMOS On-resistance(1)	V_{IN} = 3.6 V, V_{CE} = 0 V			100		Ω
V_{CEH}	CE Pin Input Voltage, High	V_{IN} = 5.5 V		[1.0]			V
V_{CEL}	CE Pin Input Voltage, Low	V_{IN} = 2.0 V				[0.4]	V
R_{ONP}	PMOS On-resistance	RP604Z	V_{IN} = 3.6 V, I_{LX} = −100 mA		0.12		Ω
		RP604K	V_{IN} = 3.6 V, I_{LX} = −100 mA		0.15		Ω
R_{ONN}	NMOS On-resistance	RP604Z	V_{IN} = 3.6 V, I_{LX} = −100 mA		0.12		Ω
		RP604K	V_{IN} = 3.6 V, I_{LX} = −100 mA		0.15		Ω
T_{TSD}	Thermal Shutdown Threshold Temperature	Tj, rising (detection)			140		°C
T_{TSR}		Tj, falling (release)			100		°C
t_{START}	Soft-start Time	V_{IN} = V_{CE} = 3.6 V			20		ms
I_{LXLIM}	LX Current Limit	V_{IN} = V_{CE} = 3.6 V		[600]	900		mA
V_{UVLOF}	UVLO Threshold Voltage	V_{IN} = V_{CE}, falling (detection)		[1.40]	1.50	[1.65]	V
V_{UVLOR}		V_{IN} = V_{CE}, rising (release)		[1.55]	1.65	[1.80]	V

All test items listed under Electrical Characteristics are done under the pulse load condition (Tj ≈ Ta = 25°C). Unless otherwise noted, the test runs with “Open-loop Control” (GND = 0 V).

(8) RP604xxx1B only

Product-specific Electrical Characteristics (Ta = 25°C)

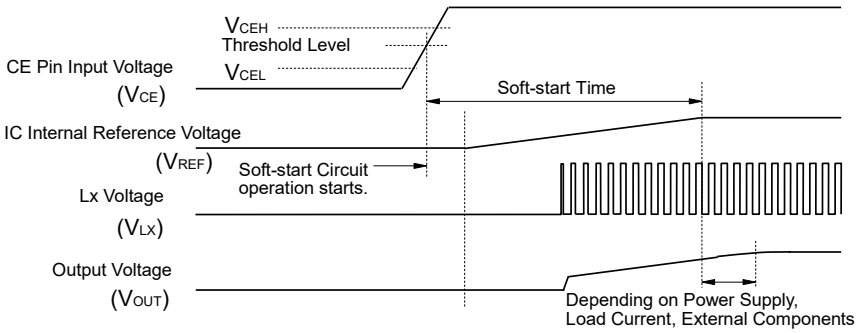
Product Name	V_{OUT} [V]		
	Min.	Typ.	Max.
RP604x161x	1.576	1.600	1.624
RP604x171x	1.675	1.700	1.725
RP604x181x	1.773	1.800	1.827
RP604x191x	1.872	1.900	1.928
RP604x201x	1.970	2.000	2.030
RP604x211x	2.069	2.100	2.131
RP604x221x	2.167	2.200	2.233
RP604x231x	2.266	2.300	2.334
RP604x241x	2.364	2.400	2.436
RP604x251x	2.463	2.500	2.537
RP604x261x	2.561	2.600	2.639
RP604x271x	2.660	2.700	2.740
RP604x281x	2.758	2.800	2.842
RP604x291x	2.857	2.900	2.943
RP604x301x	2.955	3.000	3.045
RP604x311x	3.054	3.100	3.146
RP604x321x	3.152	3.200	3.248
RP604x331x	3.251	3.300	3.349
RP604x341x	3.349	3.400	3.451
RP604x351x	3.448	3.500	3.552
RP604x361x	3.546	3.600	3.654
RP604x371x	3.645	3.700	3.755
RP604x381x	3.743	3.800	3.857
RP604x391x	3.842	3.900	3.958
RP604x401x	3.940	4.000	4.060
RP604x411x	4.039	4.100	4.161
RP604x421x	4.137	4.200	4.263
RP604x431x	4.236	4.300	4.364
RP604x441x	4.334	4.400	4.466
RP604x451x	4.433	4.500	4.567
RP604x461x	4.531	4.600	4.669
RP604x471x	4.630	4.700	4.770
RP604x481x	4.728	4.800	4.871
RP604x491x	4.827	4.900	4.973
RP604x501x	4.925	5.000	5.074
RP604x511x	5.024	5.100	5.176
RP604x521x	5.122	5.200	5.277

THEORY OF OPERATION

Soft-start Time

Starting-up with CE Pin

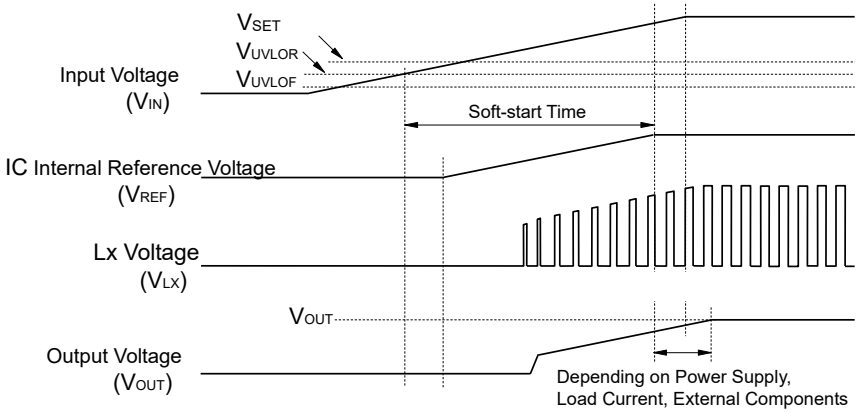
The IC starts to operate when the CE pin voltage (V_{CE}) exceeds the threshold voltage. The threshold voltage is preset between CE "H" input voltage (V_{CEH}) and CE "L" input voltage (V_{CEL}). After the start-up of the IC, soft-start circuit starts to operate. Then, after a certain period of time, the reference voltage (V_{REF}) in the IC gradually increases up to the specified value. Switching starts when V_{REF} reaches the preset voltage, and after that the output voltage rises accompanying V_{REF}'s increase. Soft-start time (t_{START}) starts when soft-start circuit is activated, and ends when the reference voltage reaches the specified voltage. Soft start time is not always equal to the turn-on speed of the DC/DC converter. Note that the turn-on speed could be affected by the power supply capacity, the output current, the inductance value and the C_{OUT} value.



Timing Chart: Starting-up with CE Pin

Starting-up with Power Supply

After the power-on, when V_{IN} exceeds the UVLO released voltage (V_{UVLOR}), the IC starts to operate. Then, soft-start circuit starts to operate and after a certain period of time, V_{REF} gradually increases up to the specified value. Switching starts when V_{REF} reaches the preset voltage, and after that the output voltage rises accompanying V_{REF}'s increase. Soft-start time starts when soft-start circuit is activated, and ends when V_{REF} reaches the specified voltage. Note that the turn-on speed of V_{OUT} could be affected by the power supply capacity, the output current, the inductance value, the C_{OUT} value and the turn-on speed of V_{IN} determined by C_{IN}.



Timing Chart: Starting-up with Power Supply

Undervoltage Lockout (UVLO) Circuit

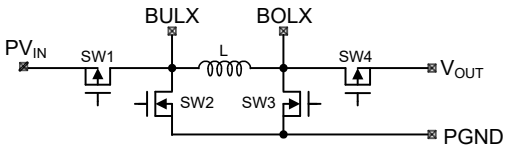
If the V_{IN} becomes lower than the UVLO detector threshold (V_{UVLOF}), the UVLO circuit starts to operate, V_{REF} stops, and P-channel and N-channel built-in switch transistors turn “OFF”. As a result, V_{OUT} drops according to the C_{OUT} capacitance value and the load. To restart the operation, V_{IN} needs to be higher than V_{UVLOR}.

Overvoltage Protection (OVP) Circuit

If the V_{OUT} becomes higher than the OVP detector threshold (V_{OVP}), the OVP circuit starts to operate, P-channel and N-channel built-in switch transistors turn “OFF”. As a result, V_{OUT} drops according to the C_{OUT} capacitance value and the load.

Overcurrent Protection Circuit

Overcurrent protection circuit supervises the inductor peak current (the peak current flowing through Pch Tr (SW1) in each switching cycle, and if the current exceeds the BULX current limit (I_{LXLIM}), it turns off Pch Tr (SW1). I_{LXLIM} of the RP604x is set to Typ. 0.9 A.



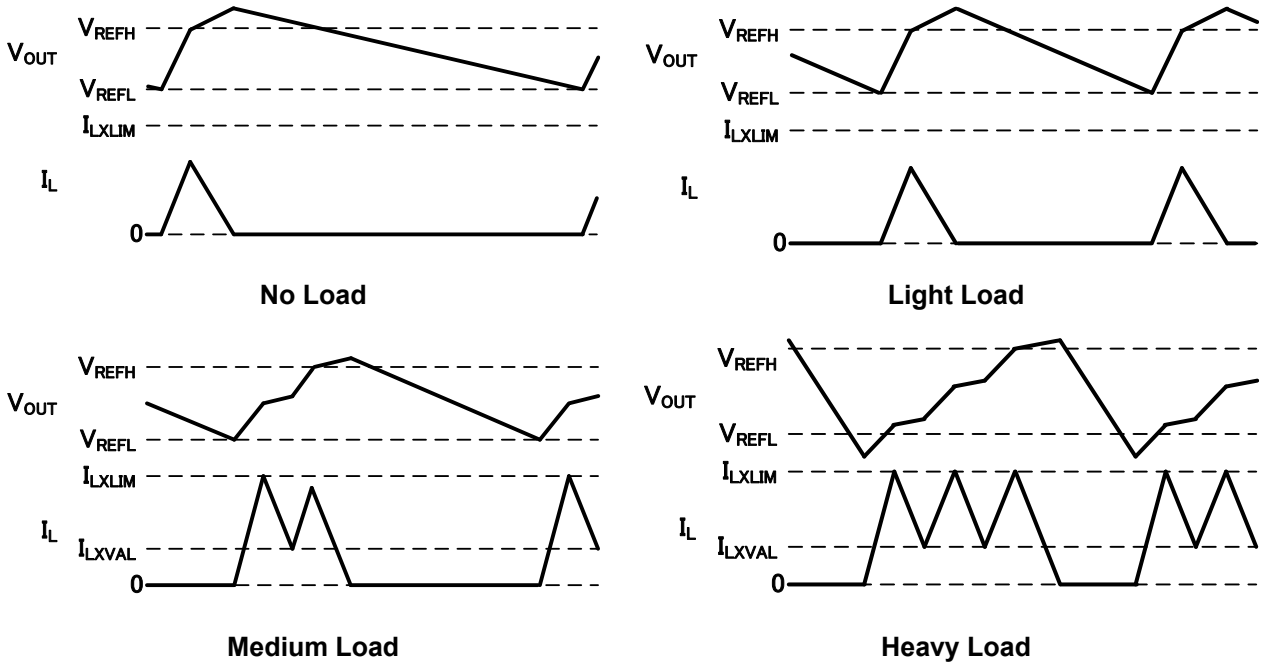
Simplified Diagram of Output Switches

VFM Mode

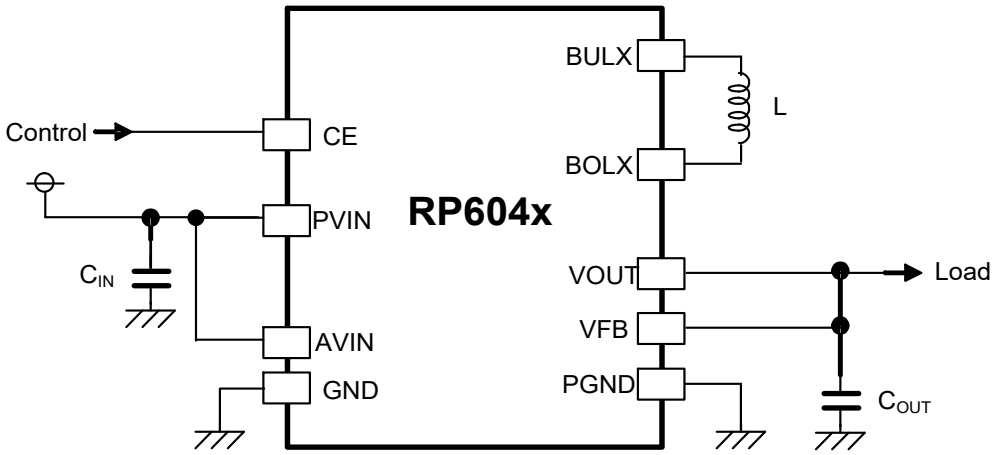
The VFM (Variable Frequency Modulation) mode is adopted as a switching method to achieve a high efficiency under light load conditions. A switching frequency varies depending on values of input voltage (V_{IN}), output voltage (V_{OUT}), and output current (I_{OUT}). Check the actual characteristics to avoid the switching noise.

A switching starts when V_{OUT} drops below the lower-limit reference voltage (V_{REFL}). When V_{OUT} exceeds the upper-limit reference voltage (V_{REFH}), a constant voltage is output by a hysteresis control which stops the switching.

In order to operate within the rated characteristic of inductor and avoid the deteriorated band frequency of DC superimposed characteristics, when the inductor current (I_L) exceeds LX current limit (I_{LXLIM}), the operation shifts to off-cycle. And when I_L drops below the valley current limit (I_{LXVAL}), the operation shifts to on-cycle.



APPLICATION INFORMATION



RP604x Typical Application Circuit

Recommended External Components

Symbol	Description
C_{IN}	10 µF or more, Ceramic Capacitor
C_{OUT}	22 µF, Ceramic Capacitor
L	2.2 µH, Inductor

TECHNICAL NOTES

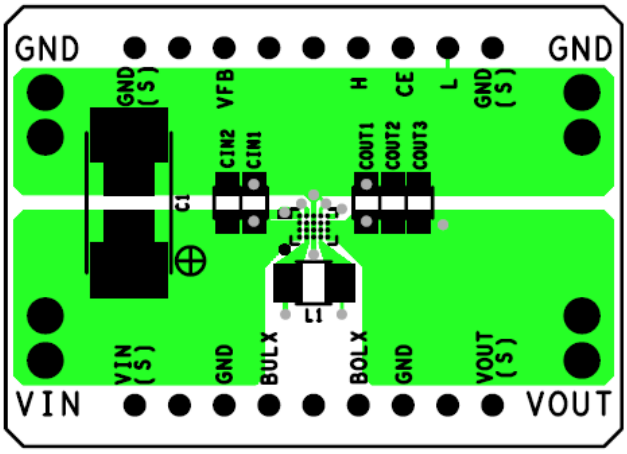
The performance of a power source circuit using this device is highly dependent on a peripheral circuit. A peripheral component or the device mounted on PCB should not exceed a rated voltage, a rated current or a rated power. When designing a peripheral circuit, please be fully aware of the following points. Refer to *PCB Layout* below.

- Use ceramic capacitors with a low equivalent series resistance (ESR), considering the bias characteristics and input/ output voltage.
- When the built-in switches are turned off, the inductor may generate a spike-shaped high voltage. Use the high-breakdown voltage capacitor (C_{OUT}) which output voltage is 1.5 times or more than the set output voltage.
- Use an inductor that has a low DC resistance, has an enough tolerable current and is less likely to cause magnetic saturation. If the inductance value is extremely small, the peak current of L_X may increase. When the peak current of L_X reaches to the L_X limit current (I_{LXLIM}), overcurrent protection circuit starts to operate. When selecting the inductor, consider the peak current of LX pin (I_{LXMAX}).
- When an intermediate voltage other than V_{IN} or GND is input to the CE pin, a supply current may be increased with a through current of a logic circuit in the IC. The CE pin is neither pulled up nor pulled down, therefore an operation is not stable at open.

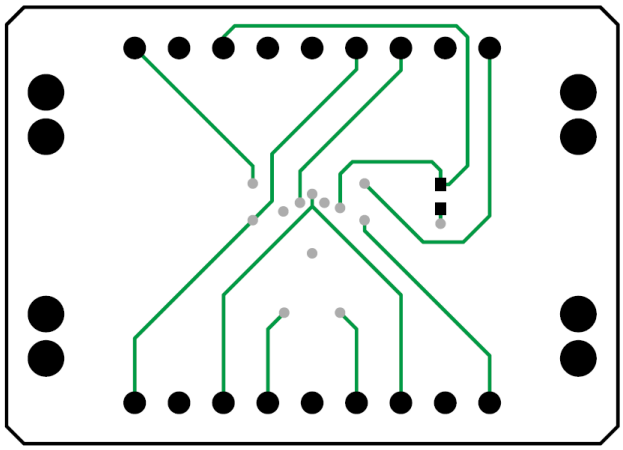
PCB Layout

RP604Z (Package: WLCSP-20-P2) PCB Layout

Topside

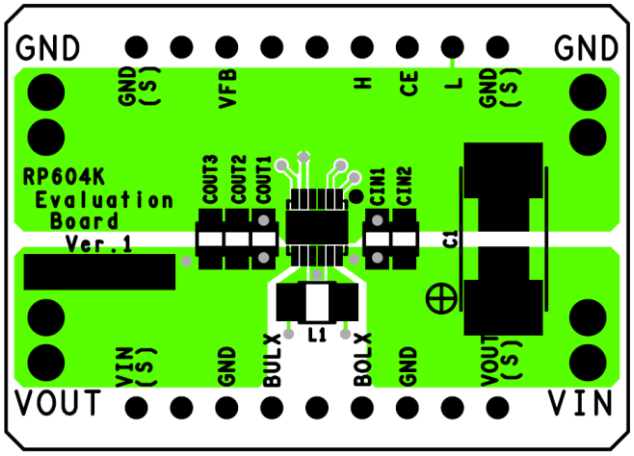


Backside

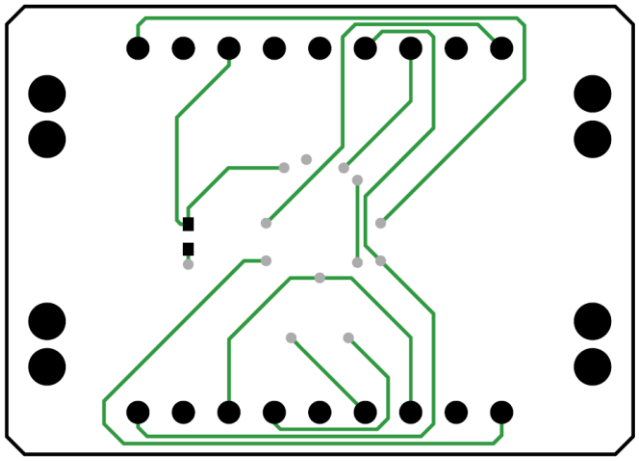


RP604K (Package: DFN(PL)2730-12) PCB Layout

Topside



Backside

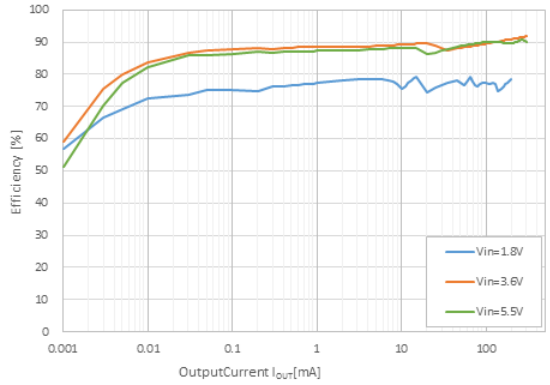


TYPICAL CHARACTERISTICS

Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

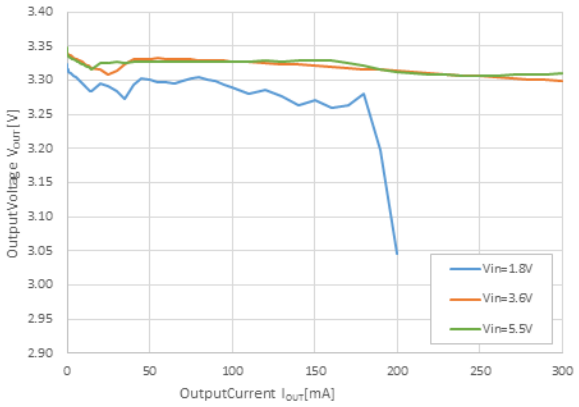
1) Output Current vs. Efficiency with Different Input Voltages

RP604Z331x



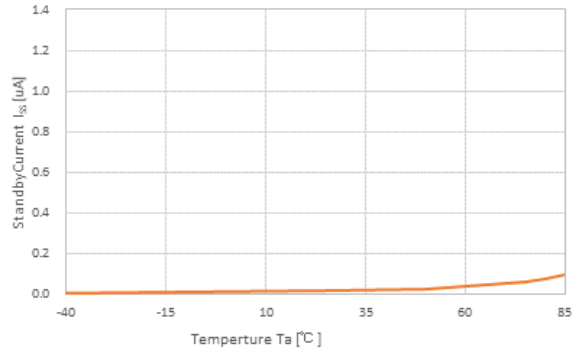
2) Output Current vs. Output Voltage with Different Input Voltages

RP604Z331x



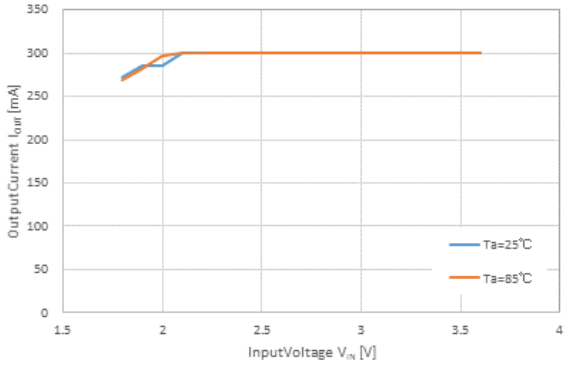
3) Temperature vs. Standby Current

RP604Z331x,V_{IN} = 5.5 V

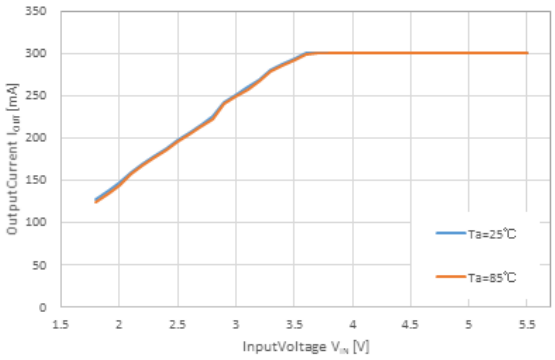


4) Input Voltage vs. Output Current

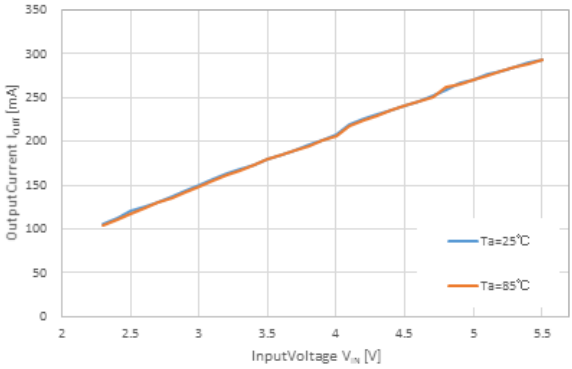
RP604Z161x, I_{OUT} = (I_{IN} = 300 mA)



RP604Z331x, I_{OUT} = (I_{IN} = 300 mA)

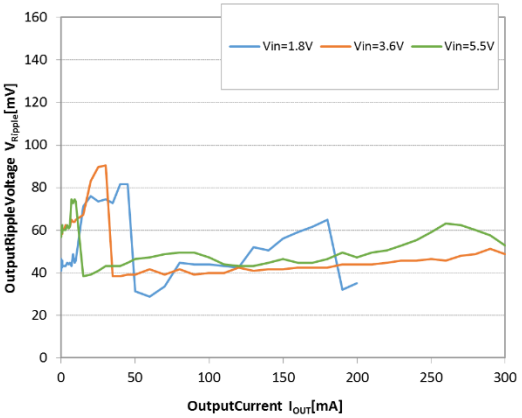


RP604Z521x, I_{OUT} = (I_{IN} = 300 mA)



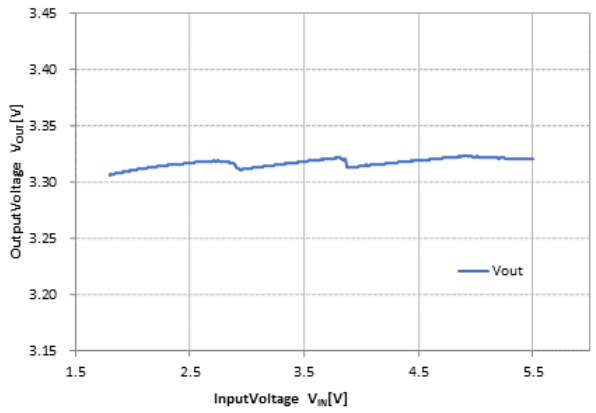
5) Output Ripple vs. Output Current

RP604Z331x

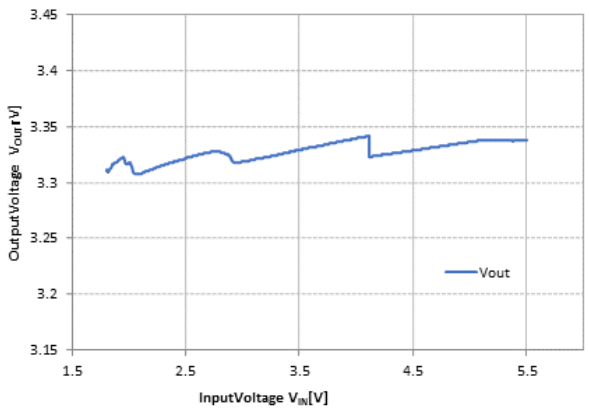


6) Input Voltage vs. Output Voltage

RP604Z331X, I_{OUT} = 1 mA

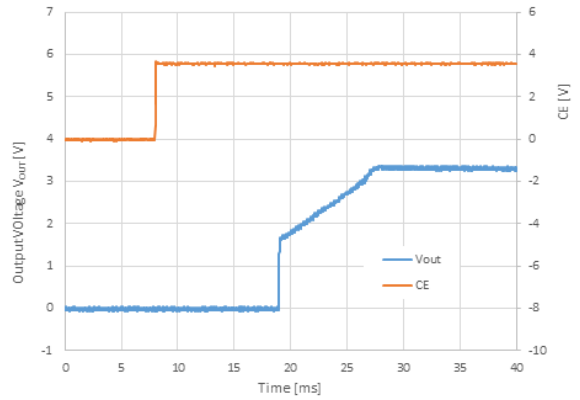


RP604Z331X, I_{OUT} = 100 mA

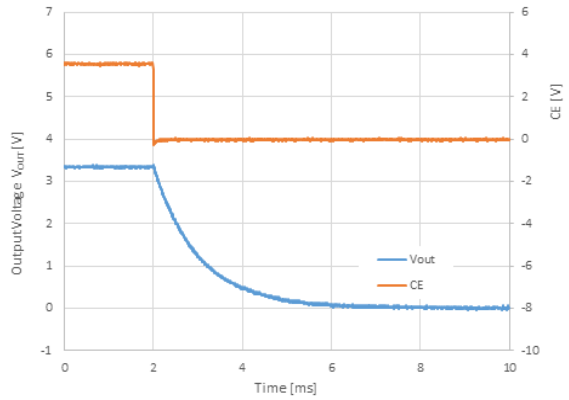


7) Starting-up/ Shutting-down Waveform with CE Pin

RP604Z331x, I_{OUT} = 0 mA

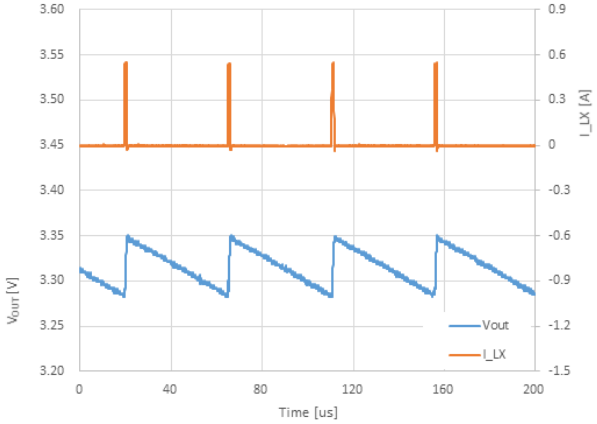


RP604Z331B, I_{OUT} = 0 mA

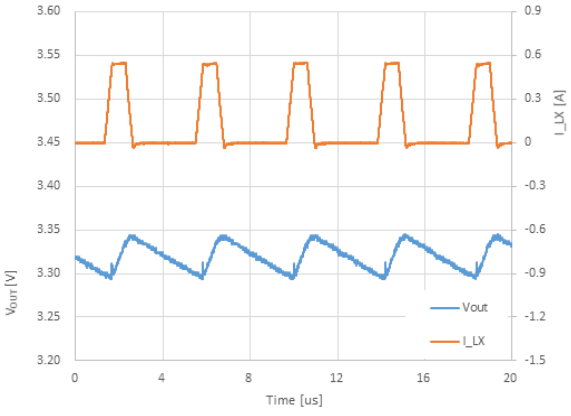


8) V_{OUT} Waveform

RP604Z331x, V_{IN} = 3.6 V, I_{OUT} = 10 mA

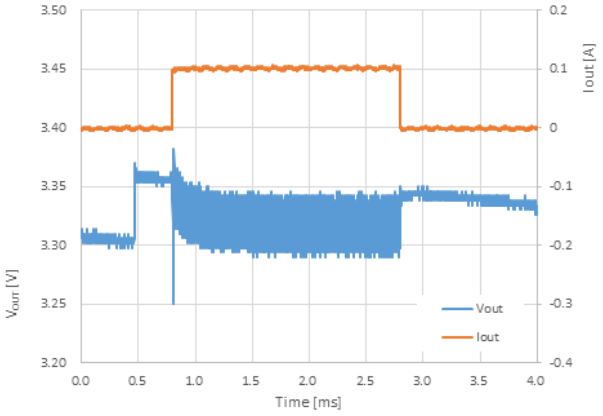


RP604Z331x, V_{IN} = 3.6 V, I_{OUT} = 100 mA



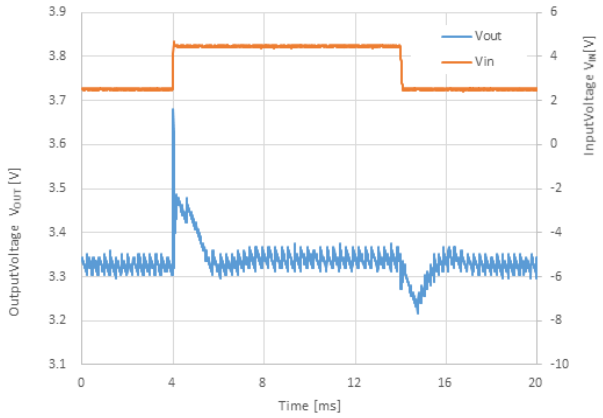
9) Load Transient Response

RP604Z331x, V_{IN} = 3.6 V, I_{OUT} = 0.01 mA ⟷ 100 mA

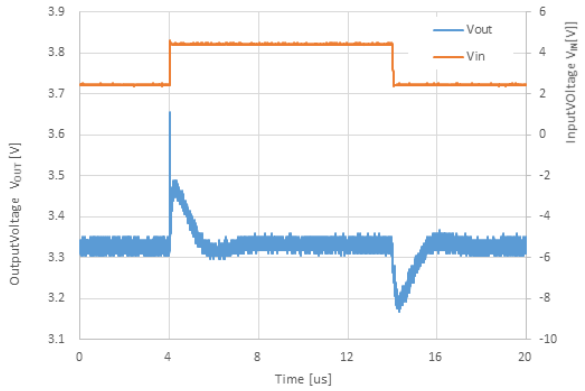


10) Input Transient Response

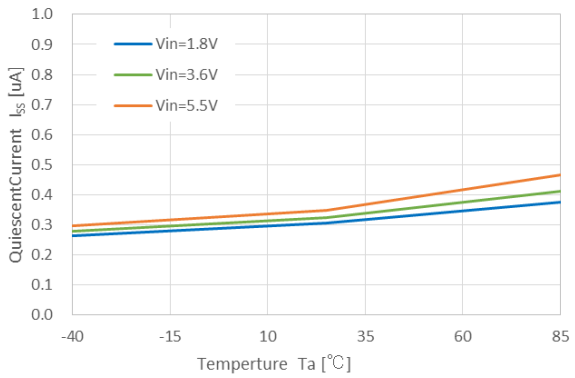
RP604Z331x, V_{IN} = 2.5 V ⟷ 4.5 V, I_{OUT} = 1 mA



RP604Z331x, V_{IN} = 2.5 V ⟷ 4.5 V, I_{OUT} = 100 mA



11) Temperature vs. Supply Current



POWER DISSIPATION WLCSP-20-P2

PD-WLCSP-20-P2-(85125)-JE-A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-9.

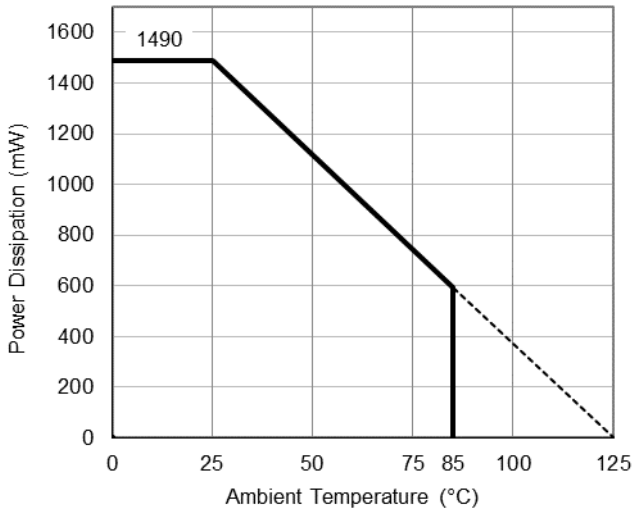
Measurement Conditions

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	101.5 mm x 114.5 mm x 1.6 mm
Copper Ratio	Outer Layers (First and Fourth Layers): 60% Inner Layers (Second and Third Layers): 100%

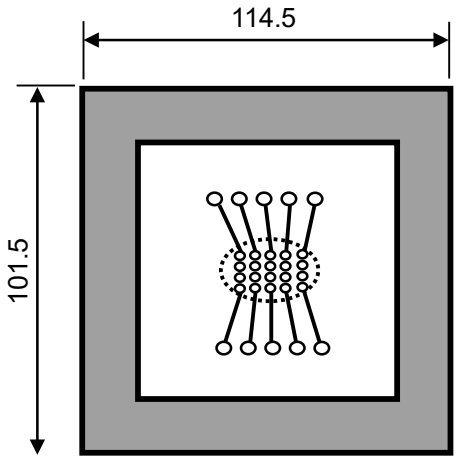
Measurement Result (Ta = 25°C, Tjmax = 125°C)

Item	Measurement Result
Power Dissipation	1490 mW
Thermal Resistance (θja)	θja = 67 °C/W

θja: Junction-to-Ambient Thermal Resistance



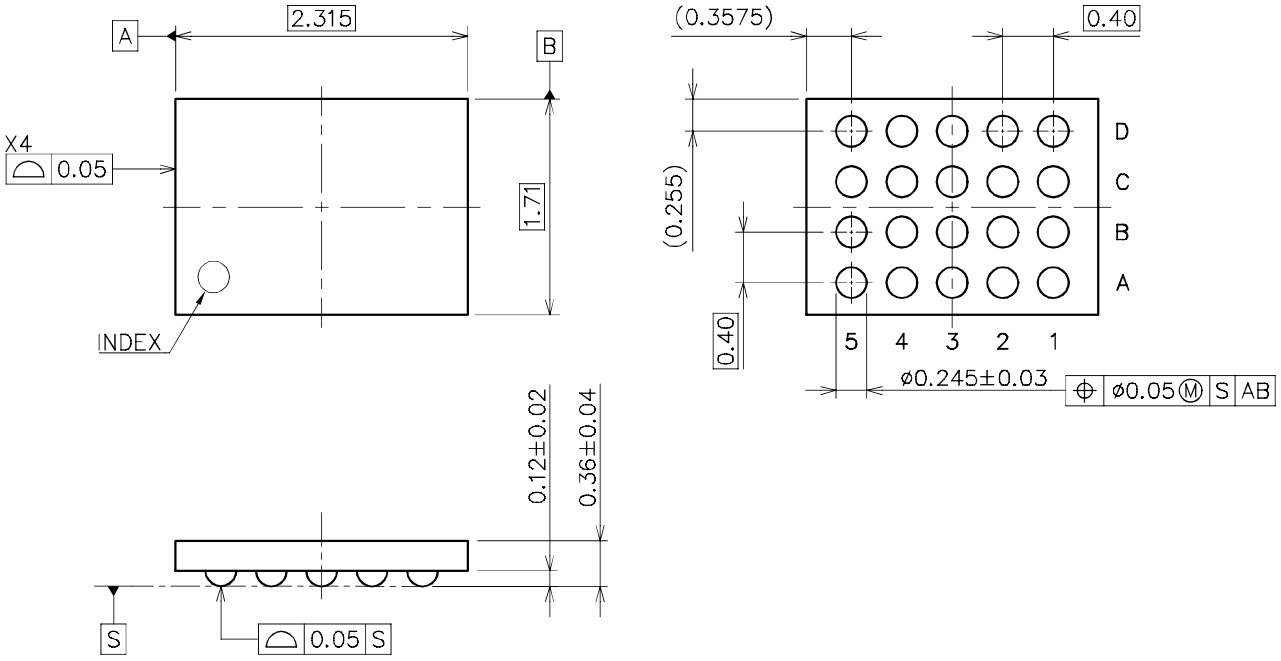
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS WLCSP-20-P2

DM-WLCSP-20-P2-JE-B

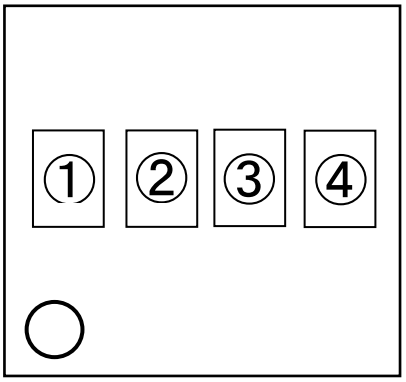


WLCSP-20-P2 Package Dimensions (Unit: mm)

PART MARKINGS RP604Z

MK-RP604Z-JE-A

①②: Product Code ⋯ Refer to *Part Marking List*
③④: Lot Number ⋯ Alphanumeric Serial Number

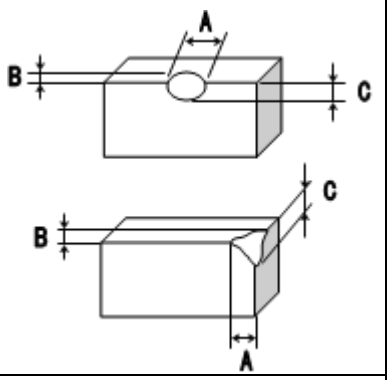


WLCSP-20-P2 Part Markings

NOTICE
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.

RP604Z Part Marking List

Product Name	①②	Product Name	①②
RP604Z161A	N0	RP604Z161B	U0
RP604Z171A	N1	RP604Z171B	U1
RP604Z181A	N2	RP604Z181B	U2
RP604Z191A	N3	RP604Z191B	U3
RP604Z201A	N4	RP604Z201B	U4
RP604Z211A	N5	RP604Z211B	U5
RP604Z221A	N6	RP604Z221B	U6
RP604Z231A	N7	RP604Z231B	U7
RP604Z241A	N8	RP604Z241B	U8
RP604Z251A	N9	RP604Z251B	U9
RP604Z261A	P0	RP604Z261B	V0
RP604Z271A	P1	RP604Z271B	V1
RP604Z281A	P2	RP604Z281B	V2
RP604Z291A	P3	RP604Z291B	V3
RP604Z301A	P4	RP604Z301B	V4
RP604Z311A	P5	RP604Z311B	V5
RP604Z321A	P6	RP604Z321B	V6
RP604Z331A	P7	RP604Z331B	V7
RP604Z341A	P8	RP604Z341B	V8
RP604Z351A	P9	RP604Z351B	V9
RP604Z361A	R0	RP604Z361B	X0
RP604Z371A	R1	RP604Z371B	X1
RP604Z381A	R2	RP604Z381B	X2
RP604Z391A	R3	RP604Z391B	X3
RP604Z401A	R4	RP604Z401B	X4
RP604Z411A	R5	RP604Z411B	X5
RP604Z421A	R6	RP604Z421B	X6
RP604Z431A	R7	RP604Z431B	X7
RP604Z441A	R8	RP604Z441B	X8
RP604Z451A	R9	RP604Z451B	X9
RP604Z461A	T0	RP604Z461B	Y0
RP604Z471A	T1	RP604Z471B	Y1
RP604Z481A	T2	RP604Z481B	Y2
RP604Z491A	T3	RP604Z491B	Y3
RP604Z501A	T4	RP604Z501B	Y4
RP604Z511A	T5	RP604Z511B	Y5
RP604Z521A	T6	RP604Z521B	Y6

No.	Inspection Items	Inspection Criteria	Figure
1	Package chipping	A≥0.2mm is rejected B≥0.2mm is rejected C≥0.2mm is rejected And, Package chipping to Si surface and to bump is rejected.	
2	Si surface chipping	A≥0.2mm is rejected B≥0.2mm is rejected C≥0.2mm is rejected But, even if A≥0.2mm, B≤0.1mm is acceptable.	
3	No bump	No bump is rejected.	
4	Marking miss	To reject incorrect marking, such as another product name marking or another lot No. marking.	
5	No marking	To reject no marking on the package.	
6	Reverse direction of marking	To reject reverse direction of marking character.	
7	Defective marking	To reject unreadable marking. (Microscope: X15/ White LED/ Viewed from vertical direction)	
8	Scratch	To reject unreadable marking character by scratch. (Microscope: X15/ White LED/ Viewed from vertical direction)	
9	Stain and Foreign material	To reject unreadable marking character by stain and foreign material. (Microscope: X15/ White LED/ Viewed from vertical direction)	

POWER DISSIPATION DFN(PL)2730-12

PD-DFN(PL)2730-12-(85125)-JE-B

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51.

Measurement Conditions

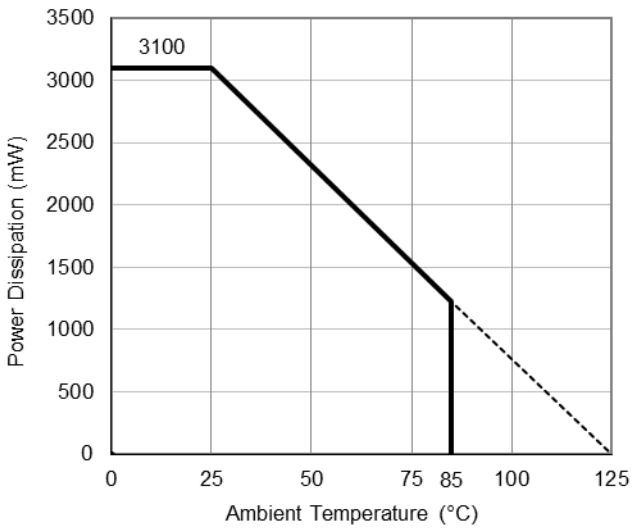
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 32 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

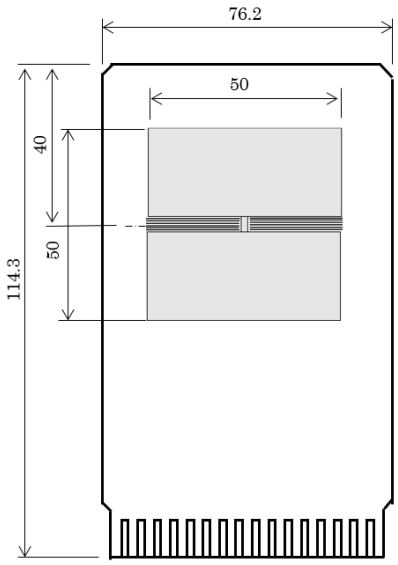
Item	Measurement Result
Power Dissipation	3100 mW
Thermal Resistance (θja)	θja = 32°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 8°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



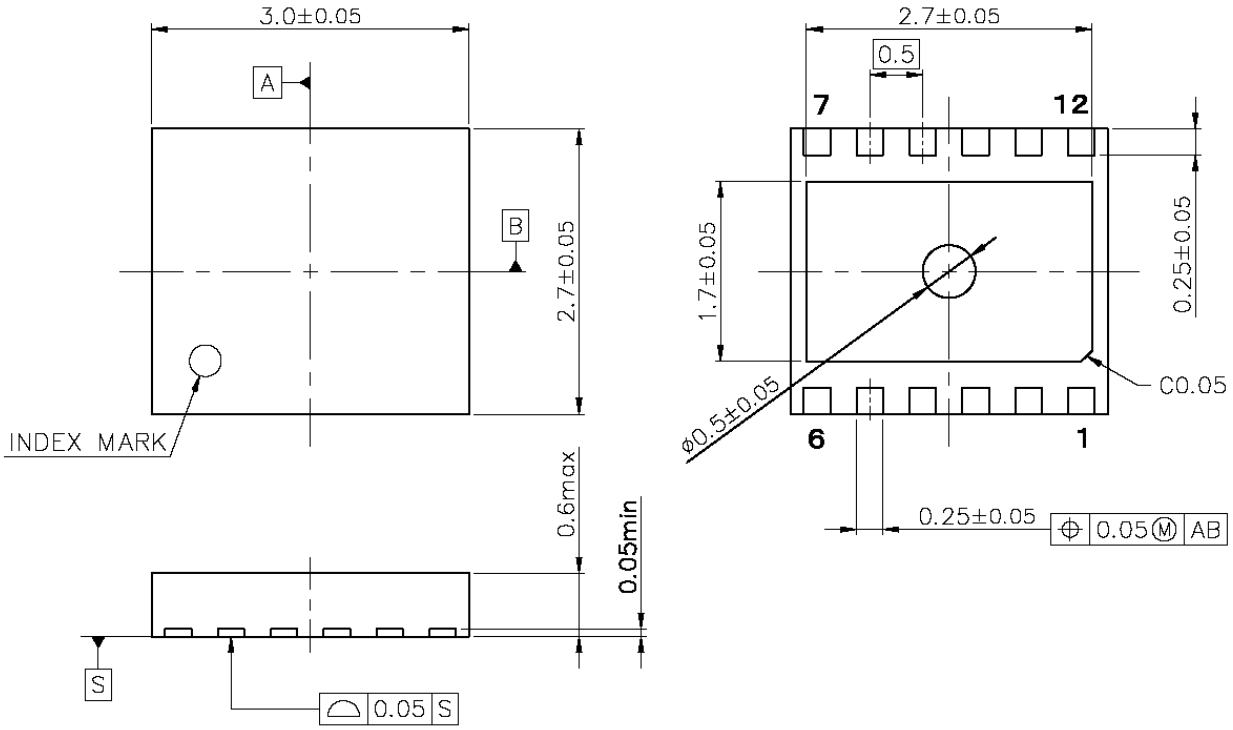
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS DFN(PL)2730-12

DM-DFN(PL)2730-12-JE-B



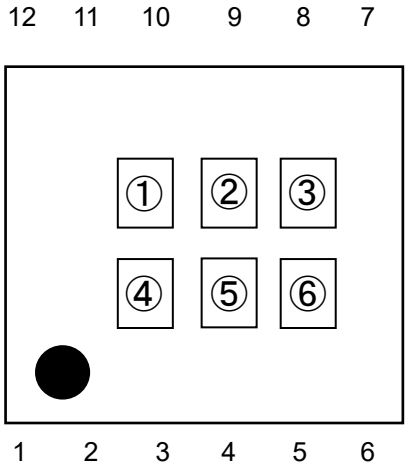
DFN(PL)2730-12 Package Dimensions (Unit: mm)

PART MARKINGS RP604K

MK-RP604K-JE-B

①②③④: Product Code ⋯ Refer to *Part Marking List*

⑤⑥: Lot Number ⋯ Alphanumeric Serial Number



DFN(PL)2730-12 Part Markings

NOTICE
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.

RP604K Part Marking List

Product Name	①②③④	Product Name	①②③④
RP604K161A	FR00	RP604K161B	FS00
RP604K171A	FR01	RP604K171B	FS01
RP604K181A	FR02	RP604K181B	FS02
RP604K191A	FR03	RP604K191B	FS03
RP604K201A	FR04	RP604K201B	FS04
RP604K211A	FR05	RP604K211B	FS05
RP604K221A	FR06	RP604K221B	FS06
RP604K231A	FR07	RP604K231B	FS07
RP604K241A	FR08	RP604K241B	FS08
RP604K251A	FR09	RP604K251B	FS09
RP604K261A	FR10	RP604K261B	FS10
RP604K271A	FR11	RP604K271B	FS11
RP604K281A	FR12	RP604K281B	FS12
RP604K291A	FR13	RP604K291B	FS13
RP604K301A	FR14	RP604K301B	FS14
RP604K311A	FR15	RP604K311B	FS15
RP604K321A	FR16	RP604K321B	FS16
RP604K331A	FR17	RP604K331B	FS17
RP604K341A	FR18	RP604K341B	FS18
RP604K351A	FR19	RP604K351B	FS19
RP604K361A	FR20	RP604K361B	FS20
RP604K371A	FR21	RP604K371B	FS21
RP604K381A	FR22	RP604K381B	FS22
RP604K391A	FR23	RP604K391B	FS23
RP604K401A	FR24	RP604K401B	FS24
RP604K411A	FR25	RP604K411B	FS25
RP604K421A	FR26	RP604K421B	FS26
RP604K431A	FR27	RP604K431B	FS27
RP604K441A	FR28	RP604K441B	FS28
RP604K451A	FR29	RP604K451B	FS29
RP604K461A	FR30	RP604K461B	FS30
RP604K471A	FR31	RP604K471B	FS31
RP604K481A	FR32	RP604K481B	FS32
RP604K491A	FR33	RP604K491B	FS33
RP604K501A	FR34	RP604K501B	FS34
RP604K511A	FR35	RP604K511B	FS35
RP604K521A	FR36	RP604K521B	FS36

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    - Various Safety Devices
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8. Quality Warranty
    8-1. Quality Warranty Period
    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
    8-2. Quality Warranty Remedies
    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
    8-3. Remedies after Quality Warranty Period
    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

NISSHINBO

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