

## Buck DC/DC Converter for Energy Harvester with Adjustable Maximum Power Point Control, Adjustable Output Voltage and PG Function

No. EA-422-200722

### OVERVIEW

R1801K is a power-storing buck DC/DC converter for a photovoltaic and vibration energy harvester. The Power Good (PG) function can output PG signal according to the output voltage facilitating to build a system. A low operating quiescent current allows a harvester to be used under a low-illumination environment, and it is suitable for an equipment with low power supplied from a harvester.

### KEY BENEFITS

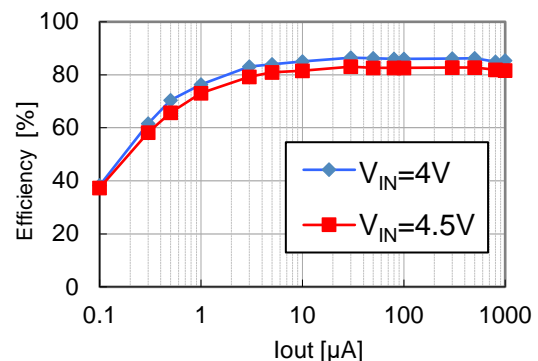
- Providing a low power supply ( $I_Q$  200 nA) and a high efficiency (approximately 80% @ 10  $\mu$ A).
- Monitoring the output voltage to output Power Good (PG) signal.
- Adjustable output voltage and maximum power point control voltage by pin setting.

### KEY SPECIFICATIONS

- Input Voltage Range: 2.3 V to 5.5 V
- Output Voltage Range: 2.3 V to 4.5 V
- Maximum Power Point Control Voltage Range :2.7 V to 5.3 V
- Output Voltage Accuracy:  $\pm 3.0\%$
- Operating Quiescent Current:  
Typ. 200 nA ( $T_a = 25^\circ\text{C}$ , at no load)  
under condition of  $V_{IN} = 4$  V,  $V_{OUT} = 3.0$  V
- Starting Power: 1  $\mu$ W ( $V_{IN} = 4$  V,  $V_{OUT} = 3.0$  V)
- Reverse Current Protection ( $V_{IN} \geq 2.0$  V)
- Adjustable Maximum Power Point Control, Adjustable Output Voltage
- PG Function

### TYPICAL CHARACTERISTICS

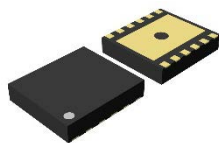
Efficiency vs. Output Current  $V_{OUT} = 3.0$  V



### APPLICATIONS

- Energy harvesting module of a photovoltaic and vibration energy harvester

### PACKAGE



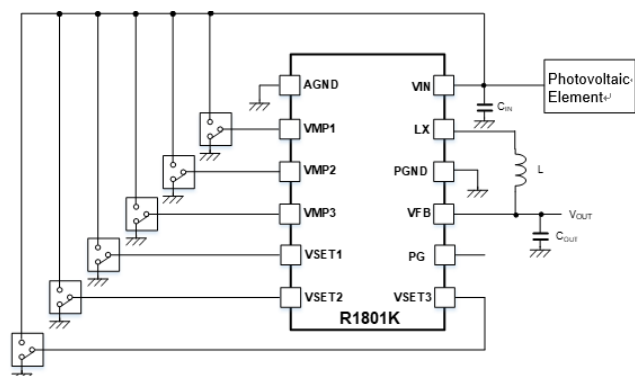
**DFN(PLP)2730-12**  
3.0 mm x 2.7 mm x 0.6 mm

### SELECTION GUIDE

Product Name	Package	Quantity per Reel
R1801KxxxA-TR	DFN(PLP)2730-12	5,000 pcs

xxx: Select the ideal combination of the set output voltage ( $V_{SET}$ ) and the set maximum power point control voltage ( $V_{MPSET}$ ) from the code number starting from 001.

### TYPICAL APPLICATION



$L = 22 \mu\text{H}$ ,  $C_{IN} = 10 \mu\text{F}$ ,  $C_{OUT} = 47 \mu\text{F}$

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## SELECTION GUIDE

The set output voltage and the set maximum power point control voltage are user-selectable options.

### Selection Guide

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1801KxxxA-TR	DFN(PLP)2730-12	5,000 pcs	Yes	Yes

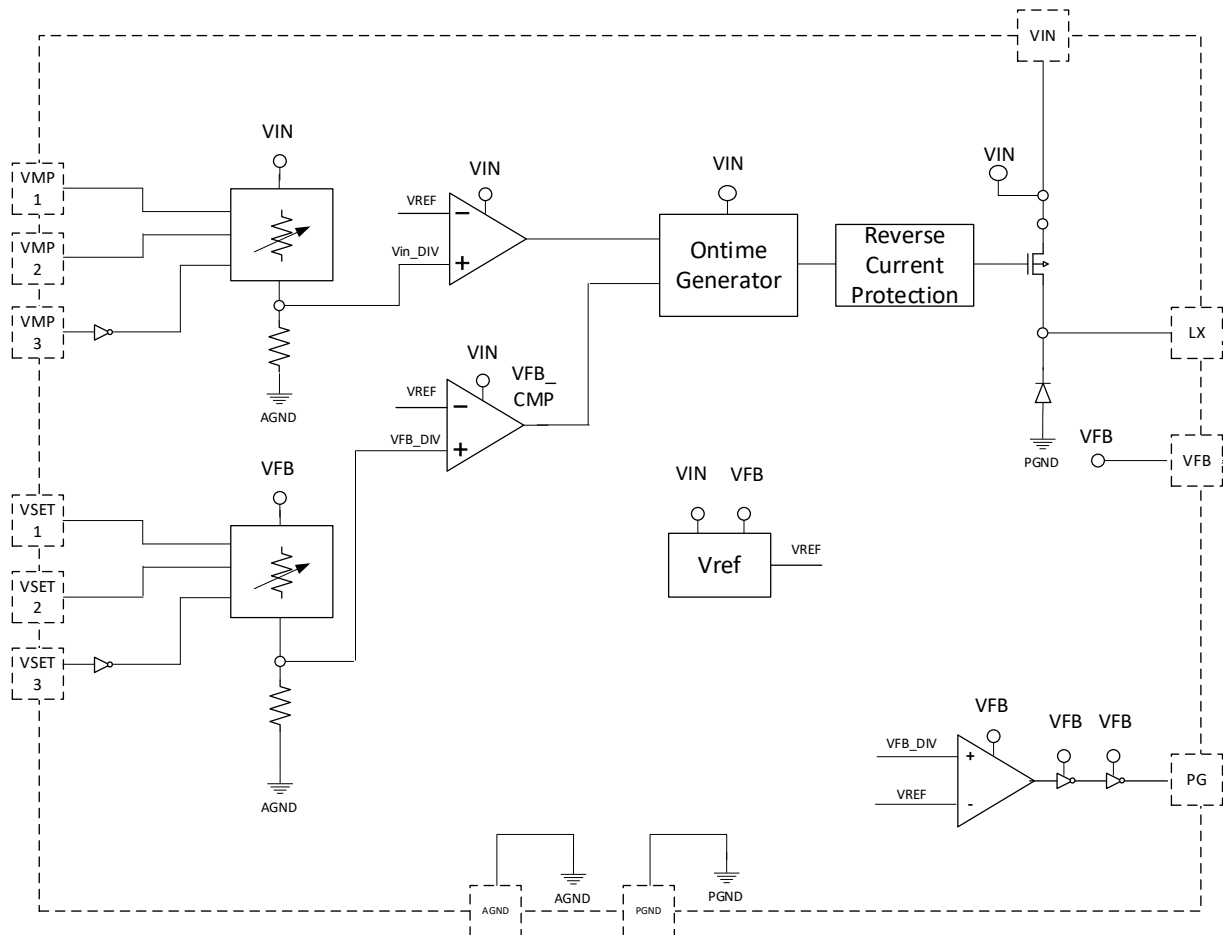
xxx: Select the ideal combination of the set output voltage ( $V_{SET}$ ) and the set maximum power point control voltage ( $V_{MPSET}$ ) from the code number starting from 001.

Refer to PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS for lineup.

When use the PG function, put the  $V_{SET}$  voltage 2.5 V or higher.

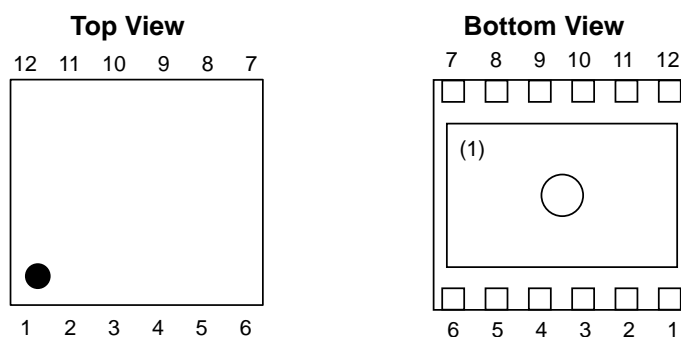
It is recommended to set as  $V_{MP} > V_{SET} + 0.5$  V or higher.

## BLOCK DIAGRAM



R1801K Block Diagram

## PIN DESCRIPTION



**DFN (PLP) 2730-12 Pin Configuration**

- <sup>(1)</sup> The tab on the bottom of the package enhances thermal performance and is electrically connected to GND (substrate level).  
It is recommended that the tab be connected to the ground plane on the board, or otherwise be left floating.

### DFN(PLP)2730-12 Pin Description

Pin No.	Symbol	Description
1	AGND	Analog Ground Pin
2	VMP1	Maximum Power Point Control Voltage Adjustment Pin 1
3	VMP2	Maximum Power Point Control Voltage Adjustment Pin 2
4	VMP3	Maximum Power Point Control Voltage Adjustment Pin 3
5	VSET1	Output Voltage Adjustment Pin 1
6	VSET2	Output Voltage Adjustment Pin 2
7	VSET3	Output Voltage Adjustment Pin 3
8	PG	Power Good Pin
9	VFB	Output Voltage Pin
10	PGND	Power Ground Pin
11	LX	DC/DC Switching Pin
12	VIN	Pin for Connecting Photovoltaic Element

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### ABSOLUTE MAXIMUM RATINGS

#### Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
$V_{IN}$	VIN Pin Voltage	-0.3 to 6.5	V
$V_{LX}$	LX Pin Voltage	-0.3 to $V_{IN} + 0.3$	V
$V_{VFB}$	VFB Pin Voltage	-0.3 to 6.5	V
$V_{VMP1}$	VMP1 Pin Voltage	-0.3 to 6.5	V
$V_{VMP2}$	VMP2 Pin Voltage	-0.3 to 6.5	V
$V_{VMP3}$	VMP3 Pin Voltage	-0.3 to 6.5	V
$V_{VSET1}$	VSET1 Pin Voltage	-0.3 to 6.5	V
$V_{VSET2}$	VSET2 Pin Voltage	-0.3 to 6.5	V
$V_{VSET3}$	VSET3 Pin Voltage	-0.3 to 6.5	V
$V_{PG}$	Power Good Pin	-0.3 to 6.5	V
$P_D$	Power Dissipation	Refer to Appendix "POWER DISSIPATION"	
$T_j$	Junction Temperature Range	-40 to 85	°C
$T_{stg}$	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 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.

### RECOMMENDED OPERATING CONDITIONS

#### Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
$V_{IN}$	Input Voltage	2.3 to 5.5	V
$T_a$	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.

## ELECTRICAL CHARACTERISTICS

The specifications surrounded by   are guaranteed by design engineering at  $-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$ .

### R1801K Electrical Characteristics

( $T_a = 25^{\circ}\text{C}$ )

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
$V_{\text{OUT}}$	Output Voltage	$V_{\text{IN}} \geq V_{\text{SET}} + 0.5 \text{ V}$ , $V_{\text{VSET1-3}} = \text{"L"}$ , at no load	$\frac{V_{\text{SET}}}{\times 0.97}$		$\frac{V_{\text{SET}}}{\times 1.03}$	V
$I_{\text{Q}}$	Operating Quiescent Current	$V_{\text{IN}} = 5.0 \text{ V}$ , $V_{\text{VFB}} = 3.0 \text{ V}$ , device not switching VFB pin current is converted by $V_{\text{IN}}$ current		200	<span style="border: 1px solid black; padding: 0 2px;">420</span>	nA
$V_{\text{MP}}$	Accuracy of Maximum Power Point Control Voltage	$V_{\text{VFB}} = 0 \text{ V}$	<span style="border: 1px solid black; padding: 0 2px;">-200</span>		<span style="border: 1px solid black; padding: 0 2px;">200</span>	mV
$I_{\text{VMP1 to 3}}$	VMP1 to 3 Pin H/L Leakage Current	$V_{\text{IN}} = 5.5 \text{ V}$ , $V_{\text{VMP1 to 3}} = 5.5 \text{ V} / 0 \text{ V}$			<span style="border: 1px solid black; padding: 0 2px;">0.1</span>	uA
$I_{\text{VSET1 to 3}}$	VSET1 to 3 Pin H/L Leakage Current	$V_{\text{IN}} = 5.5 \text{ V}$ , $V_{\text{VSET1 to 3}} = 5.5 \text{ V} / 0 \text{ V}$			<span style="border: 1px solid black; padding: 0 2px;">0.1</span>	uA
$I_{\text{LEAK}}$	Output Driver H/L Leakage Current	$V_{\text{IN}} = 5.5 \text{ V}$ , $V_{\text{LX}} = 5.5 \text{ V} / 0 \text{ V}$			<span style="border: 1px solid black; padding: 0 2px;">0.1</span>	uA
$\Delta V_{\text{MP}}$	VMP Adjustment Resolution			100		mV
$\Delta V_{\text{SET}}$	VSET Adjustment Resolution			100		mV

All test items listed under Electrical Characteristics are done under the pulse load condition ( $T_j \approx T_a = 25^{\circ}\text{C}$ ).  
Test circuit is operated with "Open Loop Control" (GND = 0 V), unless otherwise specified.

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## R1801K

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### PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS

The specifications surrounded by   are guaranteed by design engineering at  $-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$ .

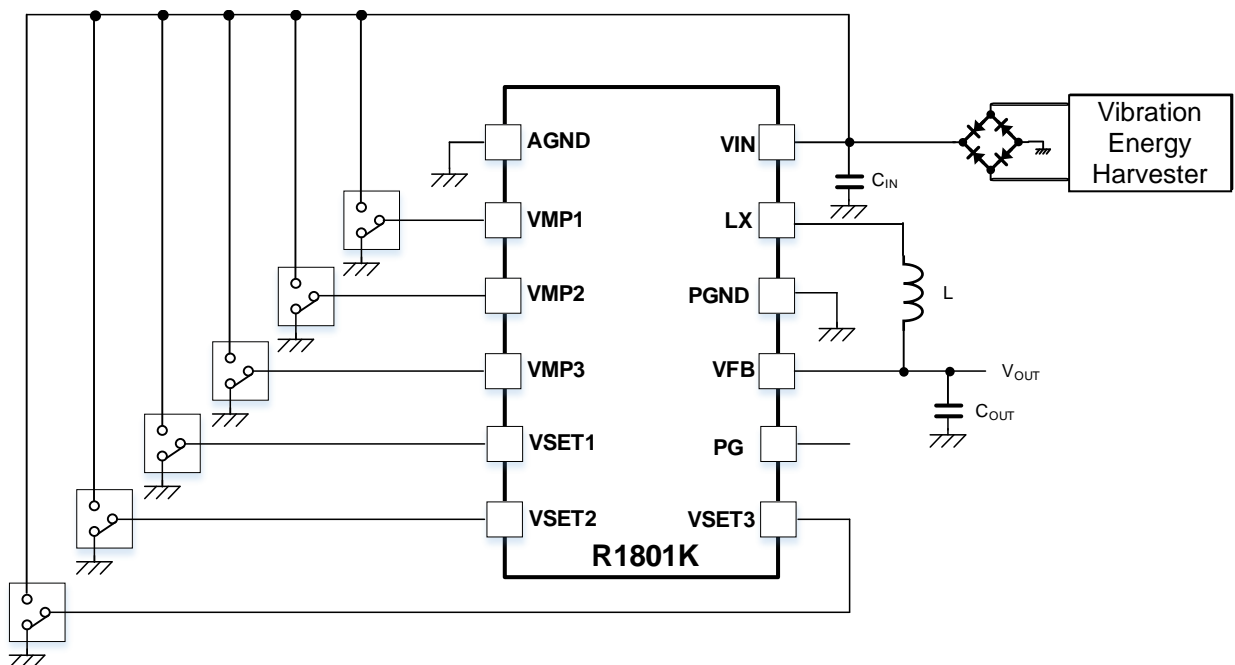
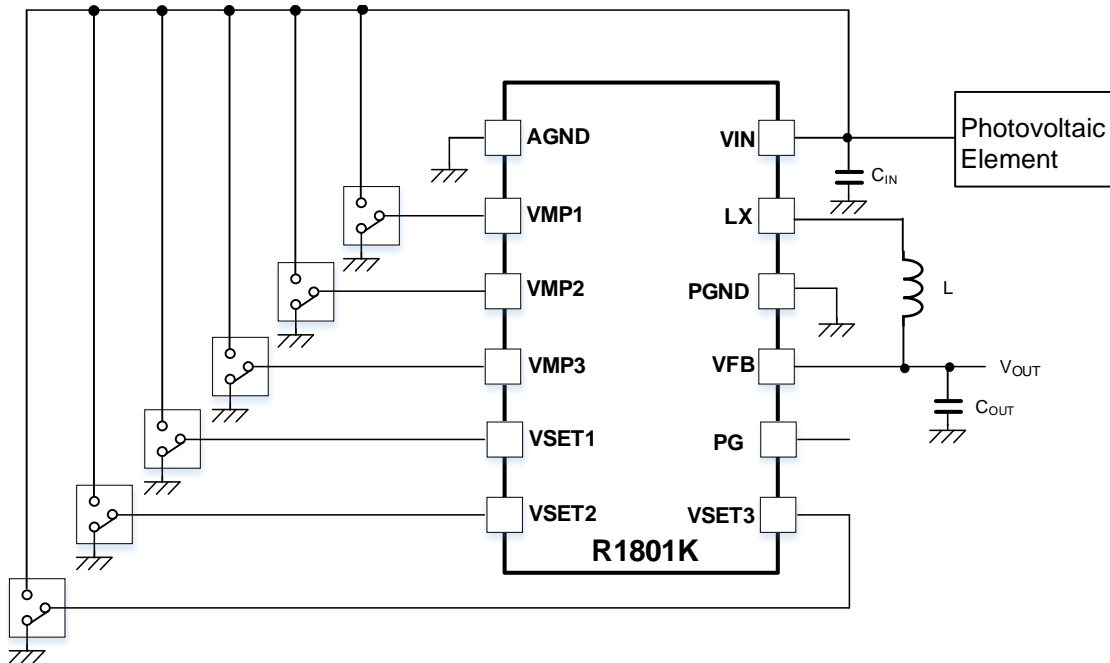
Product Name	$V_{\text{SET}}$ ( $V_{\text{SET}1-3}=\text{"L"}$ ) [V]			$V_{\text{MP}}$ ( $V_{\text{MP}1-3}=\text{"L"}$ ) [V]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
R1801K001A	<span style="border: 1px solid black; padding: 0 2px;">2.716</span>	2.8	<span style="border: 1px solid black; padding: 0 2px;">2.884</span>	<span style="border: 1px solid black; padding: 0 2px;">3.500</span>	3.7	<span style="border: 1px solid black; padding: 0 2px;">3.900</span>
R1801K002A	<span style="border: 1px solid black; padding: 0 2px;">2.716</span>	2.8	<span style="border: 1px solid black; padding: 0 2px;">2.884</span>	<span style="border: 1px solid black; padding: 0 2px;">3.900</span>	4.1	<span style="border: 1px solid black; padding: 0 2px;">4.300</span>
R1801K003A	<span style="border: 1px solid black; padding: 0 2px;">3.395</span>	3.5	<span style="border: 1px solid black; padding: 0 2px;">3.605</span>	<span style="border: 1px solid black; padding: 0 2px;">3.900</span>	4.1	<span style="border: 1px solid black; padding: 0 2px;">4.300</span>
R1801K004A	<span style="border: 1px solid black; padding: 0 2px;">2.716</span>	2.8	<span style="border: 1px solid black; padding: 0 2px;">2.884</span>	<span style="border: 1px solid black; padding: 0 2px;">4.300</span>	4.5	<span style="border: 1px solid black; padding: 0 2px;">4.700</span>
R1801K005A	<span style="border: 1px solid black; padding: 0 2px;">3.395</span>	3.5	<span style="border: 1px solid black; padding: 0 2px;">3.605</span>	<span style="border: 1px solid black; padding: 0 2px;">4.300</span>	4.5	<span style="border: 1px solid black; padding: 0 2px;">4.700</span>
R1801K006A	<span style="border: 1px solid black; padding: 0 2px;">2.522</span>	2.6	<span style="border: 1px solid black; padding: 0 2px;">2.678</span>	<span style="border: 1px solid black; padding: 0 2px;">2.900</span>	3.1	<span style="border: 1px solid black; padding: 0 2px;">3.300</span>
R1801K007A	<span style="border: 1px solid black; padding: 0 2px;">2.716</span>	2.8	<span style="border: 1px solid black; padding: 0 2px;">2.884</span>	<span style="border: 1px solid black; padding: 0 2px;">4.700</span>	4.9	<span style="border: 1px solid black; padding: 0 2px;">5.100</span>
R1801K008A	<span style="border: 1px solid black; padding: 0 2px;">3.395</span>	3.5	<span style="border: 1px solid black; padding: 0 2px;">3.605</span>	<span style="border: 1px solid black; padding: 0 2px;">4.700</span>	4.9	<span style="border: 1px solid black; padding: 0 2px;">5.100</span>

\* Please contact us for setting voltages other than those listed above.

\* When use the PG function, put the  $V_{\text{SET}}$  voltage 2.5 V or higher.

\* It is recommended to set as  $V_{\text{MP}} > V_{\text{SET}} + 0.5\text{V}$  or higher.

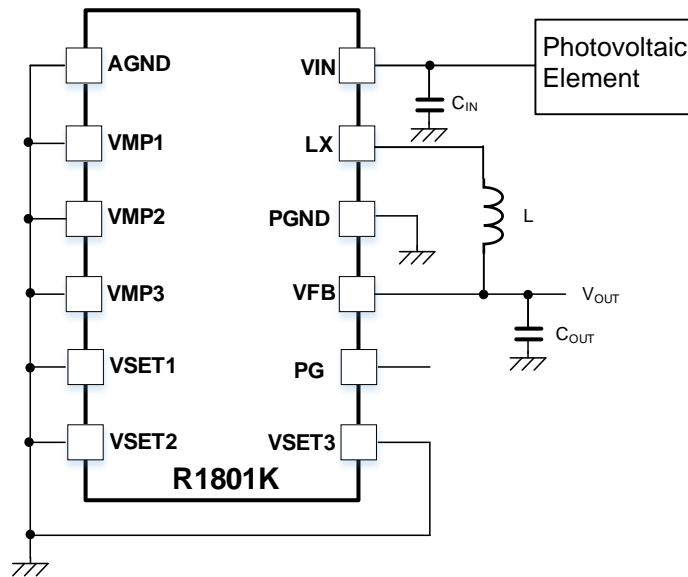
### TYPICAL APPLICATION CIRCUIT



R1801K Typical Application Circuit

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Typical Application Circuit

## Recommended External Components

Symbol	Descriptions
$C_{IN}$	Ceramic Capacitor 10 $\mu$ F or higher
$C_{OUT}$	Ceramic Capacitor 47 $\mu$ F or higher
	Large-capacity Electrical Storage Device
L	Inductor 22 $\mu$ H

## Recommended Large-capacity Electrical Storage Devices

Manufacturer	Product	Part #	Capacity	Type	Notes
TDK	CeraCharge™	BCT1812M101AG	100 $\mu$ Ah	All-solid-state Li-ion	CeraCharge™ is a trademark of TDK
Nichicon	SLB series	SLB03070LR35	350 $\mu$ Ah	Li-ion	
NGK	EnerCera®	ET1210C-R ET2016C-R ET271704P-H	5 mAh 25 mAh 5 mAh	Li-ion	EnerCera® is a trademark of NGK
Murata	CT series	CT04120	3 mAh	Li-ion	



## 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.

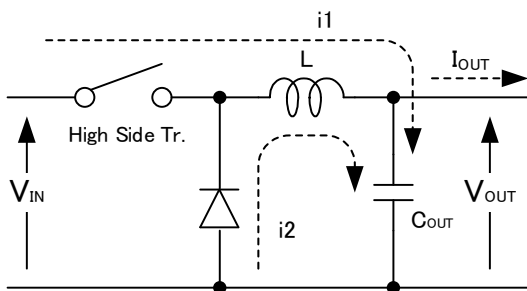
- Using a ceramic capacitor with a lower equivalent series resistance (ESR) is recommended; a capacitor of 10  $\mu\text{F}$  or higher for  $C_{\text{IN}}$  between VIN and GND pins, a capacitor of 47  $\mu\text{F}$  or higher for  $C_{\text{OUT}}$ . Using a mass-storage device for  $C_{\text{OUT}}$  also is recommended. Please choose capacitors depending on the bias characteristics,  $V_{\text{IN}}$  and  $V_{\text{OUT}}$ . (Refer to *Recommended External Components*)
- Please choose inductors which have low direct-current resistance, enough allowable current and low magnetic saturation.
- When an intermediate voltage other than VIN or GND is input to the VMP1 to 3 and VSET1 to 3 pins, the supply current may increase due to the cross-conduction current of the IC internal logic circuit. When the VMP1 to 3 and VSET1 to 3 pins are open, the maximum power point control voltage and VSET voltage may vary. When using the IC, connect the VMP1 to 3 and VSET1 to 3 pins to "VIN" or "GND".

## THEORY OF OPERATION

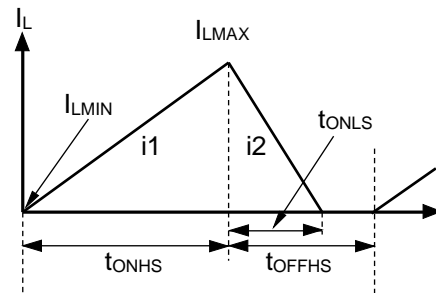
### BUCK CONVERTER OPERATION AND OUTPUT CURRENT

The basic buck DC / DC converter operation is illustrated in the following figures.

The buck DC / DC converter charges energy in the inductor when the high-side transistor turns ON, and discharges the energy from the inductor when the high-side transistor turns OFF and controls with less energy loss, so that a lower output voltage ( $V_{OUT}$ ) than the input voltage ( $V_{IN}$ ) is obtained.



**Basic Circuit**



**Current through Inductor**

- Step1.** The high-side transistor turns on,  $I_L = i1$  flows, the inductor is charged with energy, and  $C_{OUT}$  is charged to supply the output current ( $I_{OUT}$ ). At this moment,  $I_L = i1$  increases from  $I_L = I_{LMIN} = 0$  in proportion to the ON time of the high-side transistor ( $t_{ONHS}$ ), and reaches the maximum value of the current flowing through the inductor ( $I_{LMAX}$ ).
- Step2.** When the high-side transistor turns OFF, the inductor flows current  $I_L = i2$  from the diode to maintain  $I_L = I_{LMAX}$ .
- Step3.**  $I_L = i2$  decreases gradually, after the ON time of the low-side transistor ( $t_{ONLS}$ ), becomes  $I_L = I_{LMIN} = 0$ .

When the buck operation is stable, the maximum value ( $I_{LMAX}$ ) and minimum value ( $I_{LMIN}$ ) of the current through inductor will be the same whether the high-side transistor is ON or OFF, as shown above.

The difference between  $I_{LMAX}$  and  $I_{LMIN}$  of the current through inductor can be shown by the following equation (1).

$$\Delta I = I_{LMAX} - I_{LMIN} = V_{OUT} \times t_{ONLS} / L = (V_{IN} - V_{OUT}) \times t_{ONHS} / L \dots \dots \dots (1)$$

**ADJUSTABLE MAXIMUM POWER POINT CONTROL / OUTPUT VOLTAGE**

When the pin voltage of VMP1 to 3 and VSET1 to 3 is H, the maximum power voltage and VSET voltage are adjustable externally. 1 corresponds to +100 mV, 2 corresponds to +200 mV and 3 corresponds to -300 mV, and TYP.  $\pm 300$  mV is adjustable. However, setting all bits to H is a prohibited.

Due to the circuit configuration, the H / L level threshold voltage of each pin depends on the input voltage.

When using H voltage, it is recommended to pull up both of VMPPC / VSET to the input voltage.

Use the L voltage shorted to GND.

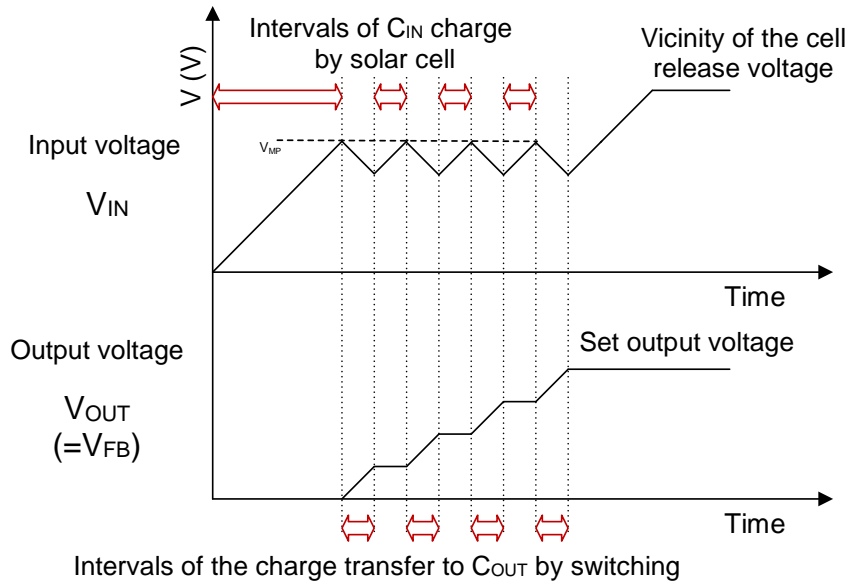
All adjustment pins should not be OPEN, use them as H / L levels.

Regulated Voltage Logic Table of Maximum Power Point Control Voltage

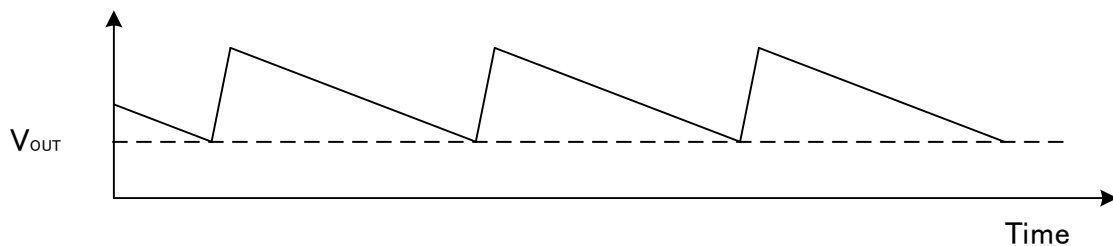
Regulated Voltage	VMP1	VMP2	VMP3
- 300 mV	H	H	L
- 200 mV	L	H	L
- 100 mV	H	L	L
0 mV	L	L	L
100 mV	L	H	H
200 mV	H	L	H
300 mV	L	L	H
Prohibited	H	H	H

Regulated Voltage Logic Table of Output Voltage

Regulated Voltage	VSET1	VSET2	VSET3
- 300 mV	H	H	L
- 200 mV	L	H	L
- 100 mV	H	L	L
0 mV	L	L	L
100 mV	L	H	H
200 mV	H	L	H
300 mV	L	L	H
Prohibited	H	H	H

**MAXIMUM POWER POINT CONTROL**

R1801K transfers power to a secondary side at the maximum power voltage ( $V_{MP}$ ), which is the operating point of the maximum amount of power generation of a solar cell. After R1801K receives power from the solar cell, the input voltage increases and when it reaches the  $V_{MP}$ , a switching starts and the R1801K transfers power to the secondary side. When a power transfer amount exceeds the supplied power from the solar cell, the input voltage decreases by the switching. At a certain point, the switching stops and a state changes to a charging mode. When the input voltage reaches the  $V_{MP}$  again, the R1801K transfers power to the secondary side. By repeating this operation enables transferring power to the secondary side while maintaining the operating point of the maximum amount of power generation of the solar cell.

**OPERATION IN STABLE STATE**

Output Voltage Waveforms Near the Set Voltage

This section explains the R1801K's operation when the output voltage rises to the set voltage. When the output voltage exceeds the set voltage, the R1801K stops switching even if the  $V_{IN}$  voltage exceeds the  $V_{MP}$  voltage. After that, switching resumes when the output voltage decreases below the  $V_{OUT}$  voltage due to the load etc. R1801K repeats the above operation to keep the output voltage at the set voltage.

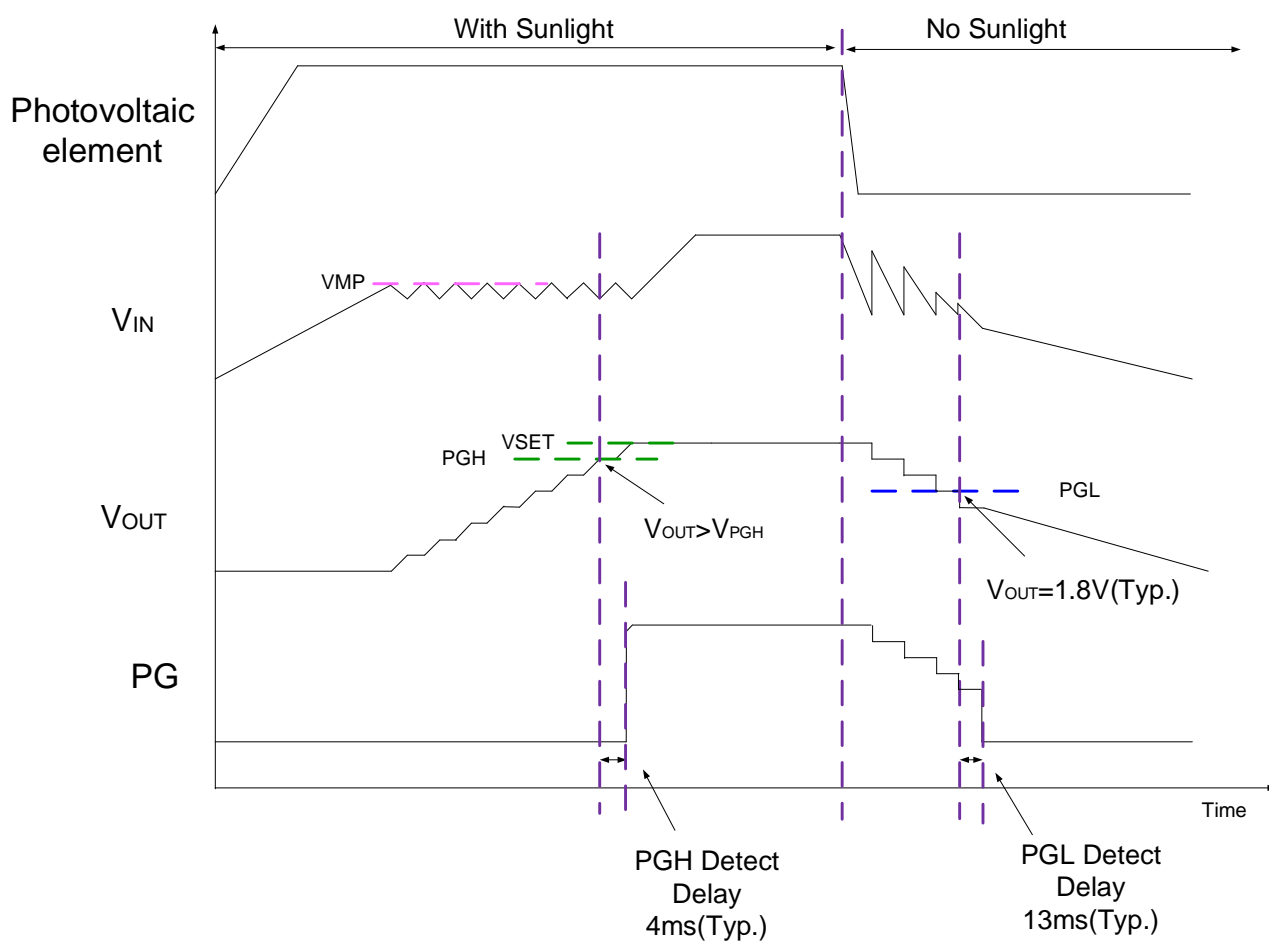
### POWER GOOD (PG) FUNCTION

When switching starts and the  $V_{OUT}$  voltage exceeds the PGH voltage ( $V_{OUT} \times 90\%$ ), after 4 ms (Typ.), the H signal is output from the PG pin. The output status can be determined by the PG pin voltage, enabling sequence control.

Once the PG pin voltage has risen, the L signal is not output until the  $V_{OUT}$  voltage decreases below 1.8 V (Typ.) or lower.

The PG function works regardless whether  $V_{IN}$  is supplied or not. For example, when connecting a large-capacity electrical storage device to  $C_{OUT}$  in a system with intermittent operation several times a day, the PG function continues to keep the H voltage powering from  $V_{OUT}$  even if  $V_{IN}$  runs out at night.

When use the PG function, put the  $V_{SET}$  voltage 2.5 V or higher.



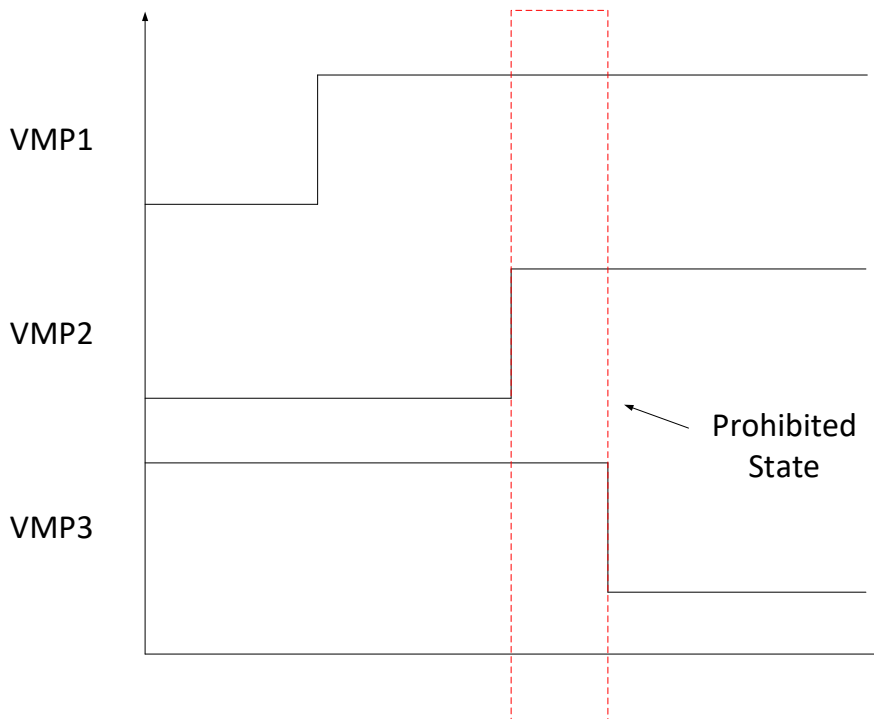
Sequence of PG function

**SWITCHING SEQUENCE OF VMP/VSET PINS**

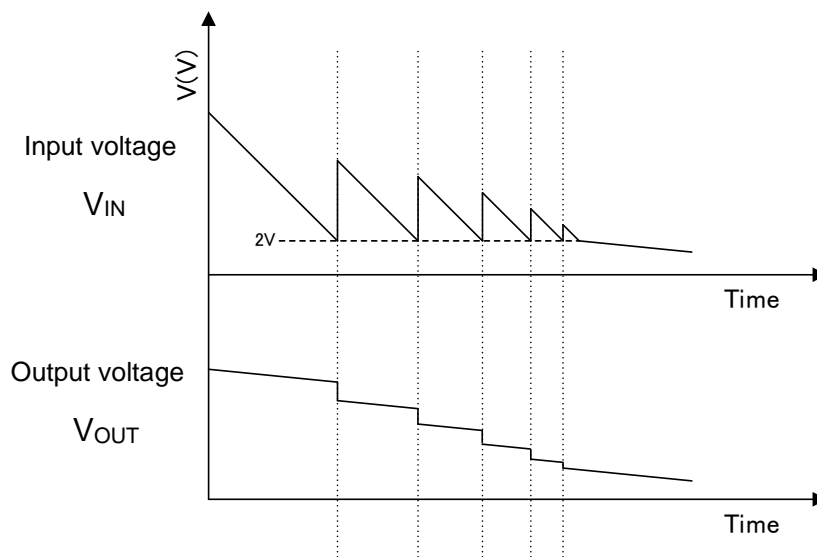
In case that the IC is switching or  $V_{OUT}$  is outputting when switching the maximum power point control voltage or the output set voltage, depending on the switching sequence, the output may cause overshooting or undershooting by recognizing a voltage different from the set voltage.

Consider the above mentioned, especially when switching multiple pins of VMP / VSET during operation.

Avoid a sequence to be in a prohibited state (all the bit is H) during the switching sequence.



## REVERSE CURRENT PROTECTION



R1801K has a reverse current protection to maintain the electric charge which is stored in the large-capacity electrical storage device or  $C_{OUT}$  connected to VFB pin when the light is cut off. When the light is cut off after a normal operation and a power supply from the solar cell is discontinued, the charge of supply current of a circuit connected respectively to the input and output sides is drawn.

When the input voltage drops below the output voltage, the reverse current protection operates to prevent the electric charge which is stored in the large-capacity electrical storage device or  $C_{OUT}$  from backflowing.

As shown in the figure above, this protection operates at 2 V or higher, when the input voltage drops below 2 V, the charge of the output side flows back to the input side. The drawn charge increases for a moment, but the R1801K returns to the reverse current protection state. The average amount of backflowed electric charge is minute.

Since the reverse current protection has hysteresis, there is a possibility to be detected as the reverse current even when  $V_{IN} = V_{OUT}$ . It is recommended to set as  $V_{MP} > V_{SET} + 0.5$  V.

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# R1801K

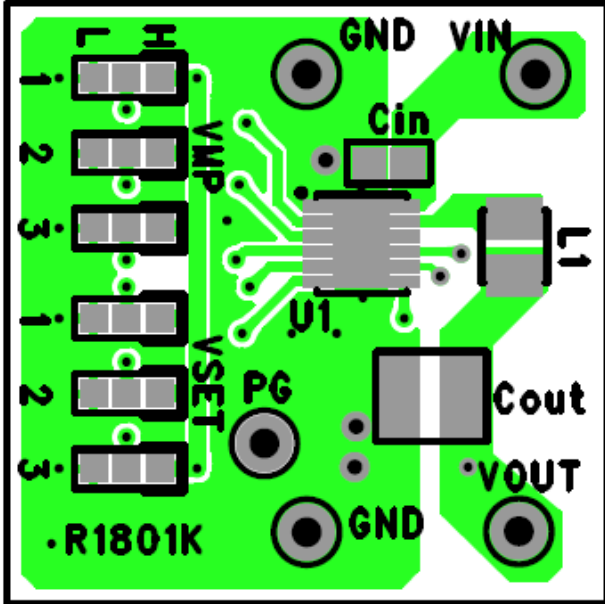
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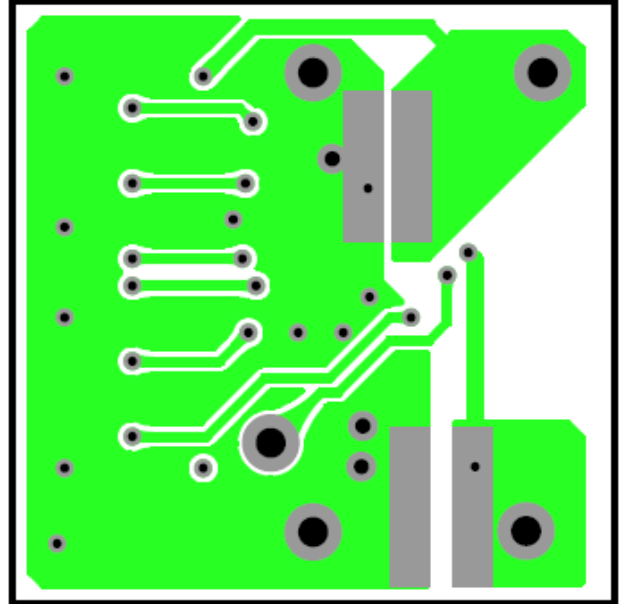
## APPLICATION INFORMATION

### PCB LAYOUT

R1801K



Top Layer



Bottom Layer

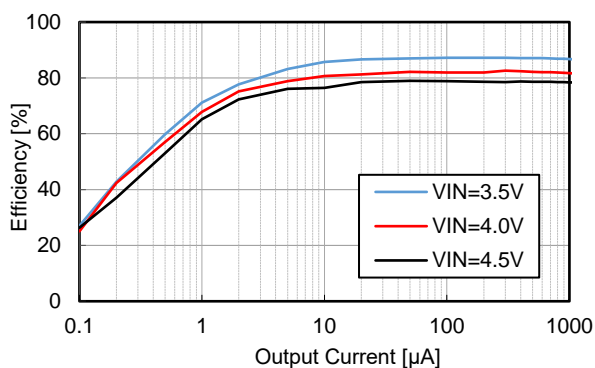


## TYPICAL CHARACTERISTICS

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

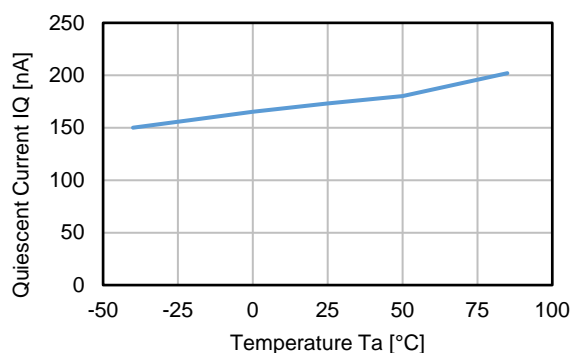
### 1) Efficiency vs. Output Current

$V_{SET} = 2.8\text{ V}$



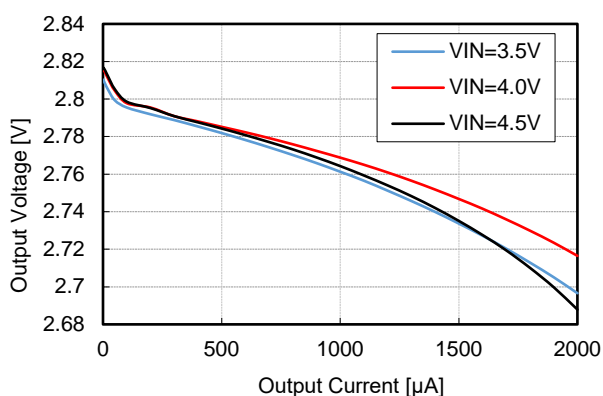
### 2) Quiescent Current vs. Temperature

$V_{IN} = 5.0\text{ V}, V_{FB} = 3.0\text{ V}$



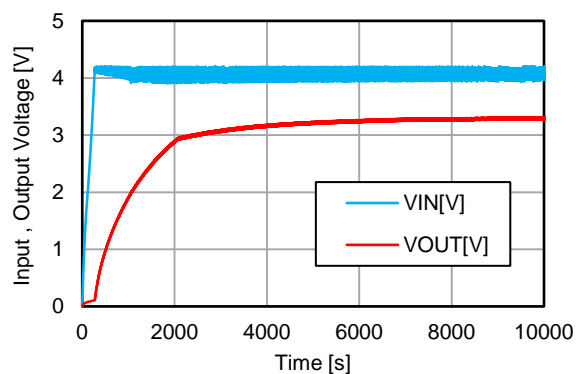
### 3) Output Voltage vs. Output Current

$V_{SET} = 2.8\text{ V}$



### 4) Minimum Starting Power

$V_{SET} = 3.3\text{ V}, I_{IN} = 222\text{ nA}$

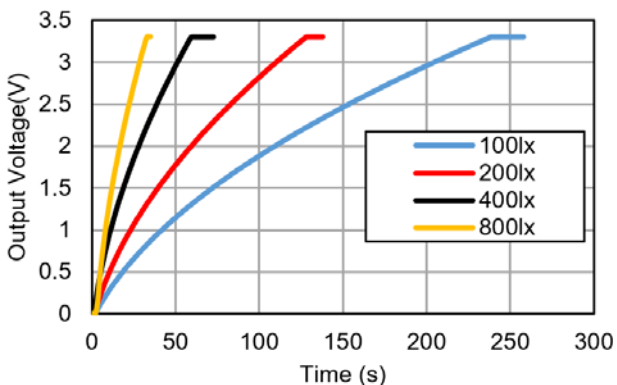


### 5) Start with Power Generation Element

Using R1801K003A,

Power Generation Element= AM-1801

$V_{MP} = 4.0\text{ V}, V_{SET} = 3.3\text{ V}$



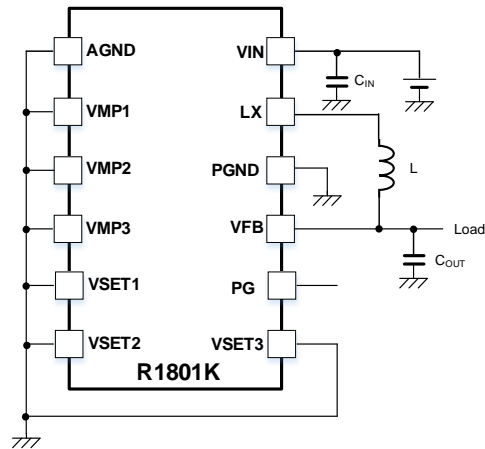
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## R1801K

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No. EA-422-200722

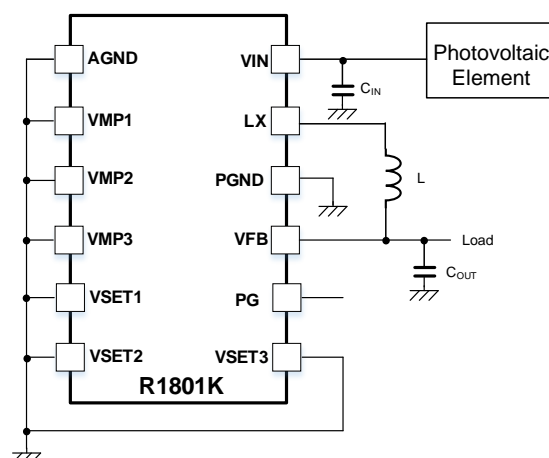
### Test Circuit and Components for Measurement



Test Circuit for Typical Characteristics 1) to 4)

#### Measurement Components for Typical Characteristics

Symbol	Specification	Manufacturer	Parts number
C <sub>IN</sub>	10 $\mu$ F	TDK	C1608X5R1E106M
C <sub>OUT</sub>	47 $\mu$ F	TDK	C3216X6S1A476M160AC
L	22 $\mu$ H	TDK	VLS201612CX-220M



**Test Circuit for Typical Characteristics 5)**  
**(When connecting to photovoltaic element, large-capacity capacitor)**

#### Measurement Components for Typical Characteristics

Symbol	Specification	Manufacturer	Parts number
Photovoltaic Element	Open Circuit Voltage 5.0V (at White Fluorescent Lighting 200lx)	Panasonic	AM-1801
$C_{IN}$	10 $\mu$ F	TDK	C1608X5R1E106M
$C_{OUT}$ *1	1mF	Rubycon	10ZLH1000MEFC8X16
L	22 $\mu$ H	TDK	VLS201612CX-220M

\*1 Used as an alternative of a large-capacity electrical storage device.

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

**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 × 23 pcs

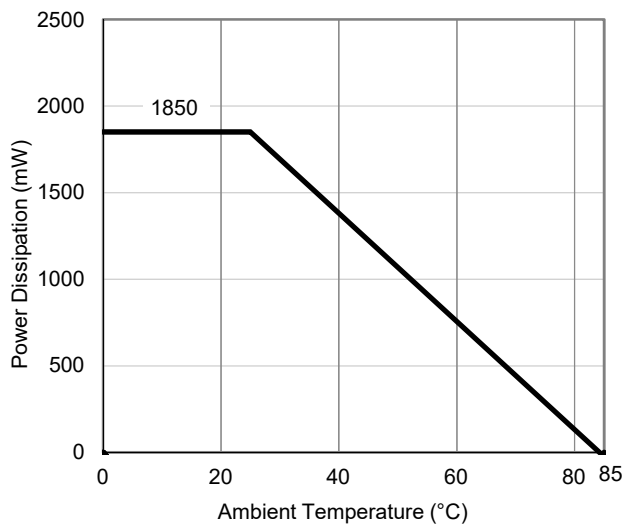
**Measurement Result**

(Ta = 25°C, Tjmax = 85°C)

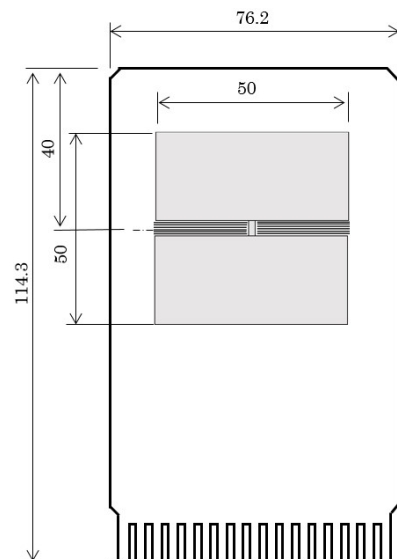
Item	Measurement Result
Power Dissipation	1850 mW
Thermal Resistance ( $\theta_{ja}$ )	$\theta_{ja} = 32^{\circ}\text{C/W}$
Thermal Characterization Parameter ( $\psi_{jt}$ )	$\psi_{jt} = 8^{\circ}\text{C/W}$

$\theta_{ja}$ : Junction-to-Ambient Thermal Resistance

$\psi_{jt}$ : Junction-to-Top Thermal Characterization Parameter



**Power Dissipation vs. Ambient Temperature**

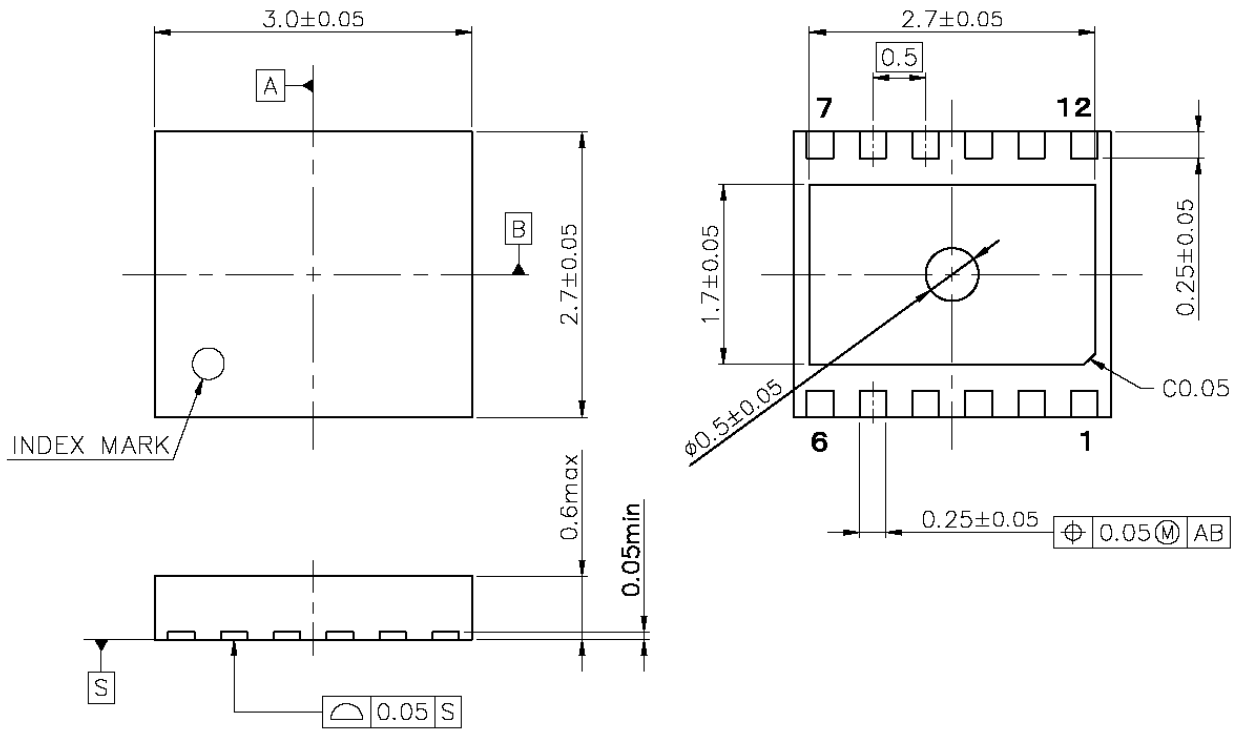


**Measurement Board Pattern**

# PACKAGE DIMENSIONS

# DFN(PLP)2730-12

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



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



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