Rockchip RK803 Datasheet

Revision 1.0
June.2019

Revision History

Date	Revision	Description
2019-6-26	1.0	Initial Release

Table of Content

Figure Index

Table Index

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Chapter 1 Introduction

1.1 Overview

The RK803 is a complete structured light LED and natural light LED driver solution for Portable systems. The highly integrated device includes a buck-boost DC-DC converters that can drive structured light LED and natural light LED at wide input voltage range(from 2.7V to 5.5V).The RK803 also integrates two channels LDO keep the structured light LED and natural light LED work as high accuracy constant current mode. The I^2C interface is integrated, so users can program it easily.

The RK803 improves performance, reduces component count and size, and therefore provides lower cost solution compared to conventional portable designs. The ultra fast 2.2MHz current mode buck-boost DC/DC architecture is compatible with tiny low cost ceramic inductors and capacitors. The total efficiency of structured light LED solution is higher than 80%, and the total efficiency of natural light LED solution is higher than 85%.

The RK803 includes input OVP, UVLO, OUT (the output of buck-boost) short to GND protection, VCSEL (structured light LED) short to GND protection, LED (natural light LED) short to GND protection, VCSEL short to OUT protection, LED short to OUT protection, VCSEL or LED open protection, VIN short to SW1 protection, VCSEL or LED time out protection, OTP, OCP. All of this protection avoid the RK803, VCSEL and LED damage.

1.2 Feature

The features listed below which may or may not be present in actual product, may be subject to the third party licensing requirements. Please contact Rockchip for actual product feature configurations and licensing requirements.

- Working Voltage ：2.7V-5.5V
- Standby current :220uA （EN is high, but ENCC1\ENCC2 are both low）
- I2C programmed LED current
- Internal loop compensation and soft start function
- Independent IP with high conversion efficiency circuit architecture
- CC1\2：programmable low dropout constant current source，3.2A Max
- **CC1\2 CAN NOT WORK AT THE SAME TIME（THAT IS, THE ENCC1\ENCC2 CAN NOT BE HIGH AT THE SAME TIME）**
- package：2.32mm（Length） *2.06mm（Width） *0.57mm（Height） WLCSP25(pitch 0.4mm)

1.3 Typical Application Diagrams

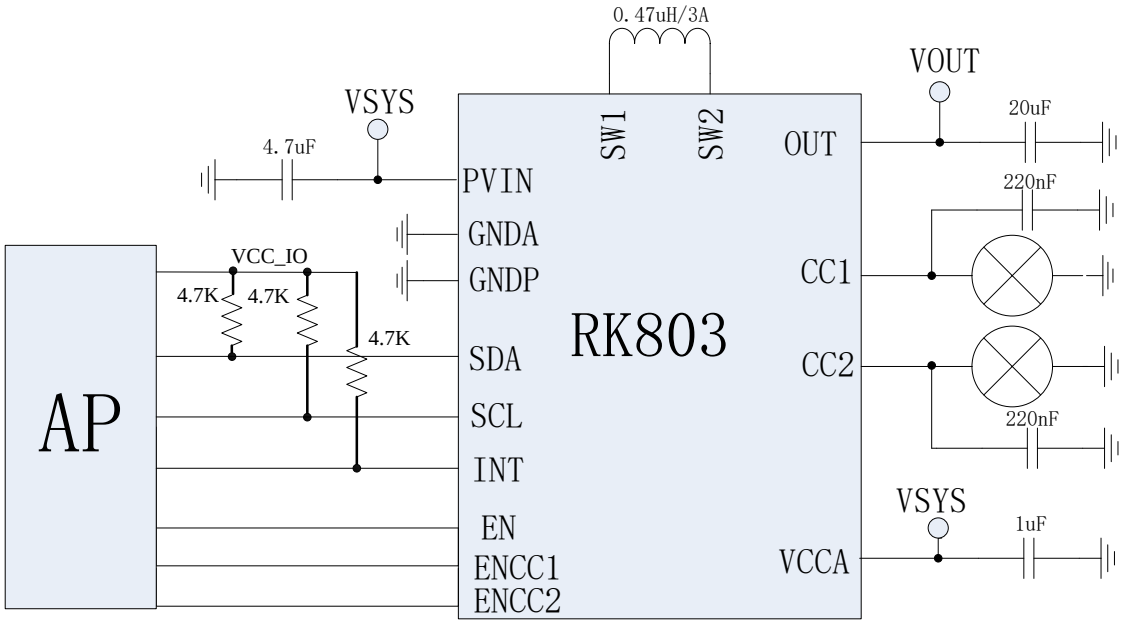


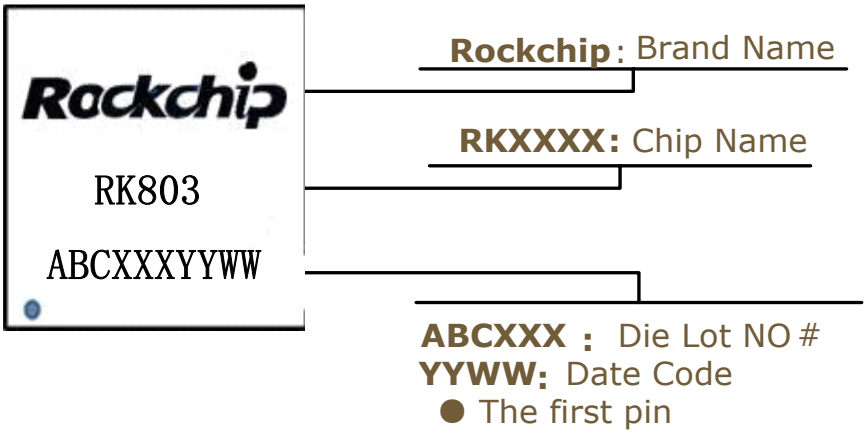
Fig. 1-1 RK803 Application

Chapter 2 Package information

2.1 Ordering information

Orderable Device	RoHS status	Package	Package Qty
RK803	RoHS	WLCSP25(pitch 0.4mm)	5000pcs by tape

2.2 Top Marking



2.3 Dimension

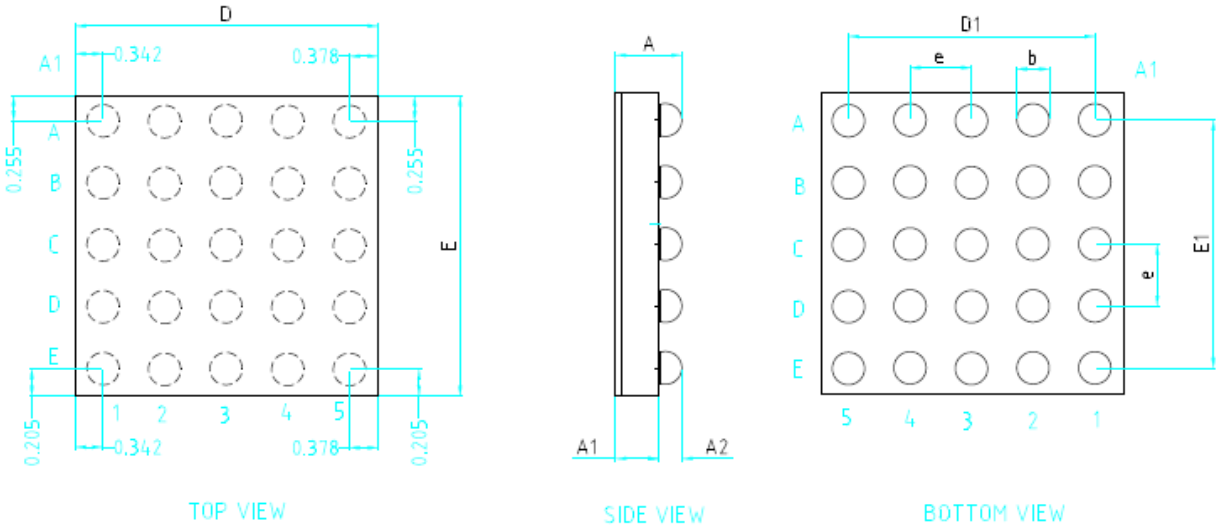


Fig. 2-1WLCSP25（Pitch is 0.4mm）

Symbol	Dimension in mm		
	MIN	NOM	MAX
A	0.5375	0.575	0.6125
A1	0.3575	0.375	0.3925
A2	0.18	0.20	0.22
D	2.295	2.32	2.345
E	2.035	2.06	2.085
D1	---	1.60	---
E1	---	1.60	---
e	---	0.4	---
b	0.24	0.26	0.28
MD/ME	5/5		

Note:

- *Coplanarity applies to leads, corner leads and die attach pad.*
- *Dimension b applies to metalized terminal and is measured between 0.15mm and 0.30mm from the terminal tip. If the terminal has the optional radius on the other end of the terminal, the dimension b should not be measure in that radius area.*
- *0.15mm of dimension b is recommended in PCB layout.*

2.4 Pin Assignment

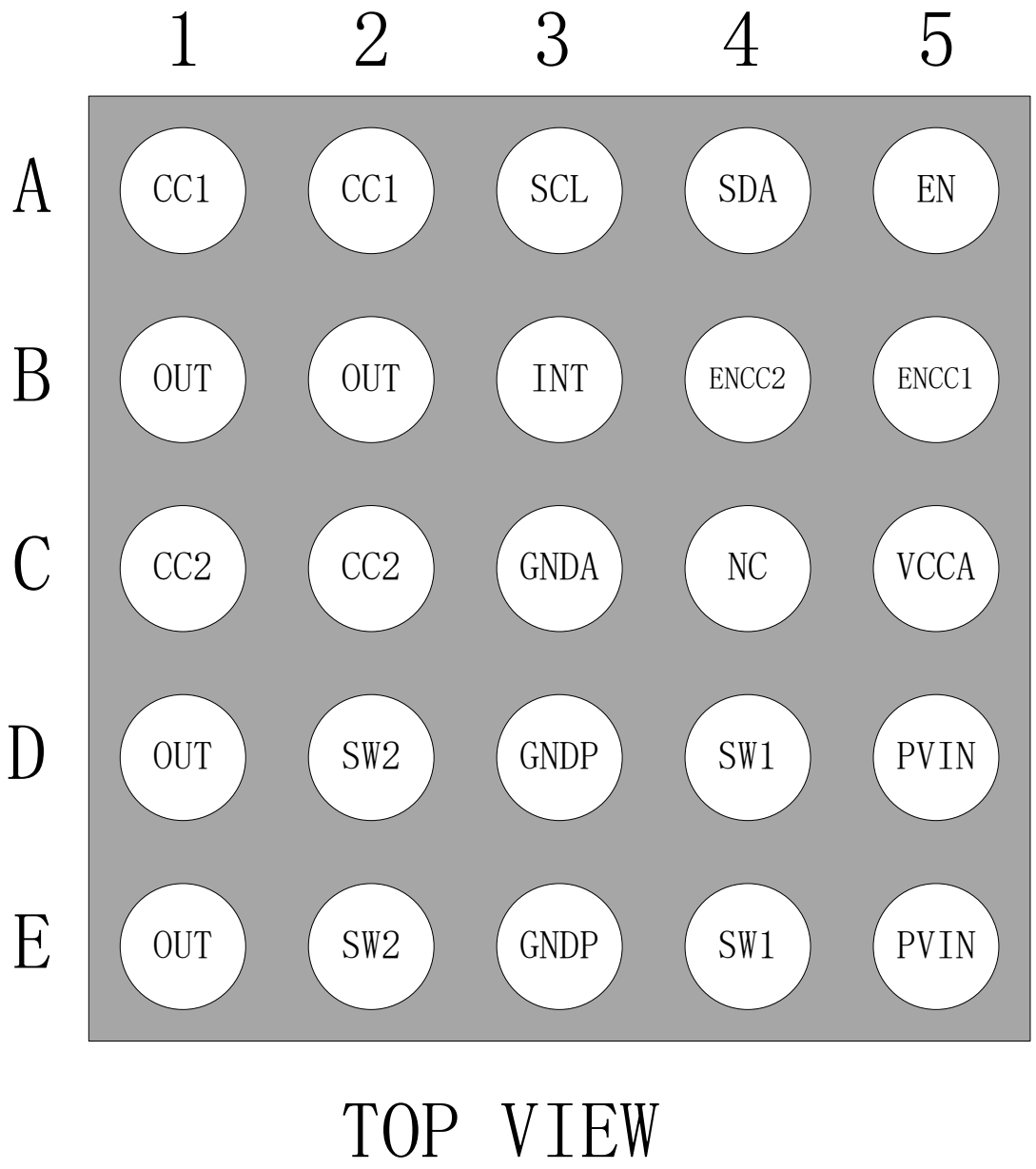


Fig. 2-2 Pin Assignment

2.5 Pinout Number Order

PIN DESCRIPTION				
Number	Name	Function	I/O	
A5	EN	Chip enable, active high.	Input	
A4	SDA	I2C data line.	Input/Output	
A3	SCL	I2C clock line.	Input	
B5	ENCC1	CC1（constant current channel 1）enable pin.	Input	
B4	ENCC2	CC2（constant current channel 2）enable pin.	Input	

PIN DESCRIPTION				
Number	Name	Function	I/O	
B3	INT	Interrupt, active low.	Output	
C5	VCCA	Analog power supply for the RK803.	Power	
C4	NC	Not connection.		
C3	GNDA	Ground.	Ground	
D5	PVIN	Power supply for the buck-boost.	Power	
E5	PVIN		Power	
D4	SW1	Switching node 1.	Power	
E4	SW1		Power	
D3	GNDP	Buck-boost ground.	Ground	
E3	GNDP		Ground	
D2	SW2	Switching node 2.	Power	
E2	SW2		Power	
D1	OUT	Output of buck-boost, power supply for the CC1\CC2 block.	Power	
E1	OUT		Power	
B1	OUT		Power	
B2	OUT		Power	
A1	CC1	CC1 output pin. **CC1 must ties LED.**	Power	
A2	CC1		Power	
C1	CC2	CC2 output pin. **CC2must ties VCSEL.**	Power	
C2	CC2		Power	

Chapter 3 Electrical Characteristics

3.1 Absolute Maximum Ratings

Parameter	Min	Max	Units
Voltage range on pins PVIN：	-0.3	6	V
Voltage range on pins SDA\SCL\ EN\ ENCC1 \ENCC2	-0.3	VCCA+0.3	V
Voltage range on pins SW1\SW2\ OUT\ CC1 \CC2：	-0.3	PVIN+0.3	V
Storage temperature range, T_S	-40	150	☐
Operating temperature range, T_J	-40	125	☐
Maximum Soldering Temperature,T_{SOLDER}		300	☐

Note 1. Exposure to the conditions exceeded absolute maximum ratings may cause the permanent damages and affect the reliability and safety of both device and systems using the device. The functional operations cannot be guaranteed beyond specified values in the recommended conditions.

3.2 Recommended Operating Conditions

Parameter	Min	TYP	Max	Units
Voltage range on pins PVIN	2.7	3.8	5.5	V
Voltage range on other pins			5.5	V
Power Dissipation			TBD	W

3.3 DC Characteristics

T_J=25C; V_{VCCA}=PVIN=5V, unless otherwise specified.

Parameter	Condition	Min	Typ	Max
Input voltage Range	VCCA/PVIN pin	2.7V	3.8V	5.5V
Under Voltage Lock Out Threshold	Register adjustable，step=0.1V,default=2.7V	2.7V		3.0V
Under Voltage Lock Out Threshold Hysteresis			200mV	
Over Voltage Lock Out Threshold of VCCA	Register adjustable，5V/6V,default=5V	5V		6V
Over Voltage Lock Out Threshold Hysteresis of VCCA			150mV	
CCx output current Range	Register adjustable，step=0.1A,default=1A	0.1A		3.2A
CCx output current precision	Output current is 1A	-7%		+7%
			5V	

Parameter	Condition	Min	Typ	Max
Over Voltage Lock Out of OUT				
Over Voltage Lock Out Threshold Hysteresis of OUT			300mV	
Output voltage range of LED		1.5V		4V
Discharge resistor			250 ohm	
Efficiency: Vin=3.8V , Iout=1A, CC1 voltage=3.5V	From PVIN to CC1		88%	
Efficiency: Vin=3.8V , Iout=1A, CC2 voltage=2.2V	From PVIN to CC2		87%	
Standby current	EN is high level,ENCC1 and ENCC2 are both low level		220uA	
Shutdown current	EN is low level		0.8uA	3uA
Soft start time	Register adjustable	100uS		400uS
Maximum ON time of LED channel	Register adjustable , step=2ms,default=10ms	6mS		20mS
Over Temperature Protection	Register adjustable , 140℃/160℃, default=140℃	140℃		160℃
Input High-Level voltage		1.4V		3.3V
Input Low-level voltage		0		0.4V
I2C 7bit address		(1100011)		
I2C SCL frequency				400KHz

Chapter 4 Register Description

LED1_CUR
Address: (0x00)

Bit	Attr	Reset Value	Description
7:5	RW	0x0	RESV: Reserved.
4:0	RW	0x9	LED1_CUR_SEL : Set the LED1 current. 00000: 100mA; 00001: 200mA; 00010: 300mA; … 11110: 3100mA; 11111: 3200mA;

LED2_CUR
Address: (0x01)

Bit	Attr	Reset Value	Description
7:5	RW	0x0	RESV: Reserved.
4:0	RW	0x9	LED2_CUR_SEL(VCSEL_CUR_SEL): Set the LED2 current. 00000: 100mA; 00001: 200mA; 00010: 300mA; … 11110: 3100mA; 11111: 3200mA;

LDO_CTRL
Address: (0x02)

Bit	Attr	Reset Value	Description
7:5	RW	0x2	ENCC_TIME_OUT_SEL: Set ENCC1/ENCC2 time out. 000: 6mS; 001: 8mS; 010: 10mS; 011: 12mS; 100: 14mS; 101:16mS; 110: 18mS; 111: 20mS.
4	RW	0x0	TSD_SEL: Set thermal shut down temperature. 0: 140°; 1: 160°;
3	RW	0x0	RESV: Reserved.
2	RW	0x0	ENB_SS_CC: LED1/2 current soft-start enable bit. 0: enable; 1: disable.
1:0	RW	0x0	SS_TIME_CC: Set LED1/2 current soft-start time. 00: 3uS; 01:5uS; 10:10uS; 11:20uS.

DCDC_CTRL

Address: (0x03)

Bit	Attr	Reset Value	Description
7:6	RW	0x0	LED2_VDROP_SEL: Set the voltage between CC2 and OUT. 00: 300mV; 01: 250mV; 10: 200mV; 11:400mV.
5:4	RW	0x0	LED1_VDROP_SEL: Set the voltage between CC1 and OUT. 00: 300mV; 01: 250mV; 10: 200mV; 11:400mV.
3	RW	0x0	RESV: Reserved.
2:1	RW	0x0	OUT_CV_SEL: Set OUT CV mode voltage. 00: 4.4V; 01: 4V; 10:3.8V; 11: 2.5V.
0	RW	0x0	SS_TIME_CV: Set OUT voltage soft-start time. 0: 100uS; 1:400uS.

IN_PROT
Address: (0x04)

Bit	Attr	Reset Value	Description
7:6	RW	0x0	IN_CV_SEL: Set the input constant voltage. 00: 3.2V; 01: 3.3V; 10: 3.4V; 11:3.5V.
5	RW	0x0	IN_CV_ENB: Input constant voltage enable bit. 0: enable; 1: disable.
4:3	RW	0x0	IN_UVLO_SEL: Set input under voltage lock-out. 00: 2.7V; 01: 2.8V; 10: 2.9V; 11:3.0V.
2	RW	0x0	RESV: Reserved.
1	RW	0x0	RESV: Reserved.
0	RW	0x0	IN_OVP_SEL: Set input over voltage. 0: 5V; 1:6V.

OUT_PROT
Address: (0x05)

Bit	Attr	Reset Value	Description
7:5	RW	0x0	RESV: Reserved.

Bit	Attr	Reset Value	Description
4:3	RW	0x0	IL_OCP_SEL: Set maximum inductor current. 00: 2.5A; 01: 3A. 10: 4.5A; 11: 5A
2	RW	0x0	LED_SHORT_ENB: LED1/2 short to GND detect enable bit. 0: enable; 1: disable.
1:0	RW	0x0	RESV: Reserved.

INT1
Address: (0x06)

Bit	Attr	Reset Value	Description
7:5	RW	0x0	RESV: Reserved.
4	RW	0x0	IN_SW1_SHORT_INT: PVIN to SW1 short interrupt. 1: PVIN to SW1 short interrupt occurs. 0: PVIN to SW1 short interrupt not occurs. Write "1" to clear this bit.
3	RW	0x0	TIME-OUT_INT: ENCC1/ENCC2 time out interrupt. 1: ENCC1/ENCC2 time out interrupt occurs. 0: ENCC1/ENCC2 time out interrupt not occurs. Write "1" to clear this bit.
2	RW	0x0	OCP_INT: Over current protect interrupt. 1: Over current protect interrupt occurs. 0: Over current protect interrupt not occurs. Write "1" to clear this bit.
1	RW	0x0	LED2_OUT_SHORT_INT: LED2 to OUT short interrupt. 1: LED2 to OUT short interrupt occurs. 0: LED2 to OUT short interrupt not occurs. Write "1" to clear this bit.
0	RW	0x0	LED1_OUT_SHORT_INT: LED1 to OUT short interrupt. 1: LED1 to OUT short interrupt occurs. 0: LED1 to OUT short interrupt not occurs. Write "1" to clear this bit.

INT1_IM
Address: (0x07)

Bit	Attr	Reset Value	Description
7:5	RW	0x0	RESV: Reserved.
4	RW	0x0	IN_SW1_SHORT_IM: PVIN to SW1 short interrupt mask. 1: mask PVIN to SW1 short interrupt. 0: Do not mask PVIN to SW1 short interrupt.
3	RW	0x0	TIME-OUT_IM: ENCC1/ENCC2 time out interrupt mask. 1: mask ENCC1/ENCC2 time out interrupt. 0: Do not mask ENCC1/ENCC2 time out interrupt.
2	RW	0x0	OCP_IM: Over current protect interrupt mask. 1: mask Over current protect interrup. 0: Do not mask Over current protect interrupt.
1	RW	0x0	LED2_OUT_SHORT_IM: LED2 to OUT short interrupt mask. 1: mask LED2 to OUT short interrupt. 0: Do not mask LED2 to OUT short interrupt.
0	RW	0x0	LED1_OUT_SHORT_IM: LED1 to OUT short interrupt mask. 1: mask LED1 to OUT short interrupt. 0: Do not mask LED1 to OUT short interrupt.

INT2
Address: (0x08)

Bit	Attr	Reset Value	Description
7	RW	0x0	TSD_INT: Thermal shut down interrupt. 1: Thermal shut down interrupt occurs. 0: Thermal shut down interrupt not occurs. Write "1" to clear this bit.
6	RW	0x0	OUT_OVP_INT: OUT over voltage interrupt. 1: OUT over voltage interrupt occurs. 0: OUT over voltage interrupt not occurs. Write "1" to clear this bit.
5	RW	0x0	LED2_SHORT_INT: LED2 to GND short interrupt. 1: LED2 to GND short interrupt occurs. 0: LED2 to GND short interrupt not occurs. Write "1" to clear this bit.

Bit	Attr	Reset Value	Description
4	RW	0x0	LED1_SHORT_INT: LED1 to GND short interrupt. 1: LED1 to GND short interrupt occurs. 0: LED1 to GND short interrupt not occurs. Write "1" to clear this bit.
3	RW	0x0	OUT_SHORT_INT: OUT to GND short interrupt. 1: OUT to GND short interrupt occurs. 0: OUT to GND short interrupt not occurs. Write "1" to clear this bit.
2	RW	0x0	IN_CV_INT: Input constant voltage interrupt. 1: Input constant voltage interrupt occurs. 0: Input constant voltage interrupt not occurs. Write "1" to clear this bit.
1	RW	0x0	IN_UVLO_INT: Input under voltage interrupt. 1: Input under voltage interrupt occurs. 0: Input under voltage interrupt not occurs. Write "1" to clear this bit.
0	RW	0x0	IN_OVP_INT: Input over voltage interrupt. 1: Input over voltage interrupt occurs. 0: Input over voltage interrupt not occurs. Write "1" to clear this bit.

INT2_IM
Address: (0x09)

Bit	Attr	Reset Value	Description
7	RW	0x0	TSD_IM: Thermal shut down interrupt mask. 1: mask thermal shut down interrupt. 0: Do not mask thermal shut down interrupt. Write "1" to clear this bit.
6	RW	0x0	OUT_OVP_IM: OUT over voltage interrupt mask. 1: mask OUT over voltage interrupt. 0: Do not mask OUT over voltage interrupt. Write "1" to clear this bit.
5	RW	0x0	LED2_SHORT_IM: LED2 to GND short interrupt mask. 1: mask LED2 to GND short interrupt. 0: Do not mask LED2 to GND short interrupt. Write "1" to clear this bit.

Bit	Attr	Reset Value	Description
4	RW	0x0	LED1_SHORT_IM: LED1 to GND short interrupt mask. 1: mask LED1 to GND short interrupt. 0: Do not mask LED1 to GND short interrupt. Write "1" to clear this bit.
3	RW	0x0	OUT_SHORT_IM: OUT to GND short interrupt mask. 1: mask OUT to GND short interrupt. 0: Do not mask OUT to GND short interrupt. Write "1" to clear this bit.
2	RW	0x0	IN_CV_IM: Input constant voltage interrupt mask. 1: mask Input constant voltage interrupt. 0: Do not mask Input constant voltage interrupt. Write "1" to clear this bit.
1	RW	0x0	IN_UVLO_IM: Input under voltage interrupt mask. 1: mask Input under voltage interrupt. 0: Do not mask Input under voltage interrupt. Write "1" to clear this bit.
0	RW	0x0	IN_OVP_IM: Input over voltage interrupt mask. 1: mask Input over voltage interrupt. 0: Do not mask Input over voltage interrupt. Write "1" to clear this bit.

CHIP_ID1
Address: (0x0A)

Bit	Attr	Reset Value	Description
7:4	RW	0x8	CHIP_ID_BCD2: Chip ID BCD code 2. Constant equal "8".
3:0	RW	0x0	CHIP_ID_BCD1: Chip ID BCD code 1. Constant equal "0".

CHIP_ID2
Address: (0x0B)

Bit	Attr	Reset Value	Description
7:4	RW	0x3	CHIP_ID_BCD0: Chip ID BCD code 0. Constant equal "3".

Bit	Attr	Reset Value	Description
3:0	RW	0x1	CHIP_VER: Chip version number code.

Chapter 5 Thermal Management

5.1 Overview

For reliability and operability concerns, the absolute maximum junction temperature of RK803 has to be below 125ºC.

Depending on the thermal mechanical design (Smartphone, Tablet, Personal Navigation Device, etc), the system thermal management software and worst case thermal applications, the junction temperature might be exposed to higher values than those specified above.

Therefore, it is recommended to perform thermal simulations at device level (Smartphone, Tablet, Personal Navigation Device, etc) with the measured power of the worst case UC of the device.

5.2 Package Thermal Characteristics

Table 5-1 provides the thermal resistance characteristics for the package used on this device.

Table 5-1 Thermal Resistance Characteristics

PACKAGE (WLCSP25)	**POWER(W)**	$\boldsymbol{\theta_{JA}}(℃/\boldsymbol{W})$	$\boldsymbol{\theta_{JB}}(℃/\boldsymbol{W})$	$\boldsymbol{\theta_{JC}}(℃/\boldsymbol{W})$
RK803	TBD	TBD	TBD	TBD

Note: The testing PCB is based on 4 layers, 114mm x 76 mm, 1.6mm thickness, ambient temperature is 85°C.