High Efficiency PMIC with Dynamic Voltage Management

General Description

The uP6636Q includes 4 synchronous-rectified buck converters and 9 linear regulators. With internal low RDS(ON) switches, the buck converter is capable of delivering 1.5A or 2.8A output current over a wide input voltage range from 2.7V to 5.3V. Fixed 2.25MHz PWM operation allows possible smallest output ripple and external component size. Dynamic Voltage Scaling (DVS) is supported either by dedicated control pins, or through I2C interface to optimize the system performance for the processor. Other features include internal soft-start, over-temperature, and over-current protections.

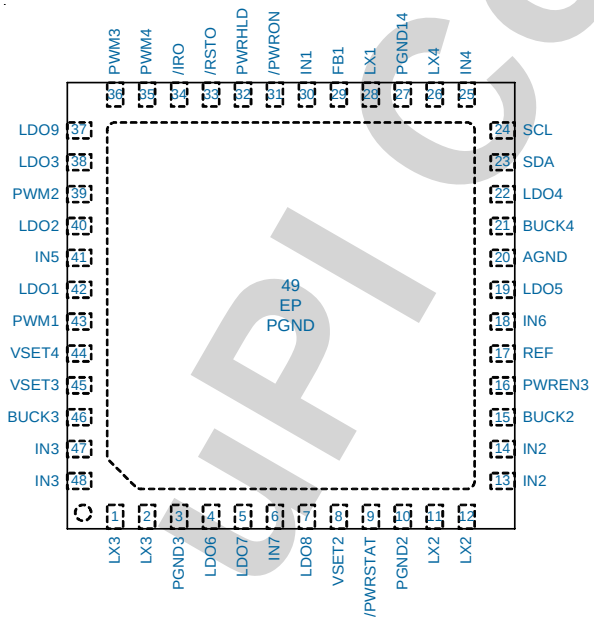
The power sequence and reset controller provides power-on reset, software initiated reset, and power cycle reset for the processor. It also features the watchdog supervisory function. Multiple sleep modes with autonomous sleep and wake-up sequence control are supported.

The uP6636Q is available in a space-saving, VQFN6x6-48L package.

Applications

- Tablet
- Phone
- MID
- PND

Pin Configuration



VQFN6x6-48L

Features

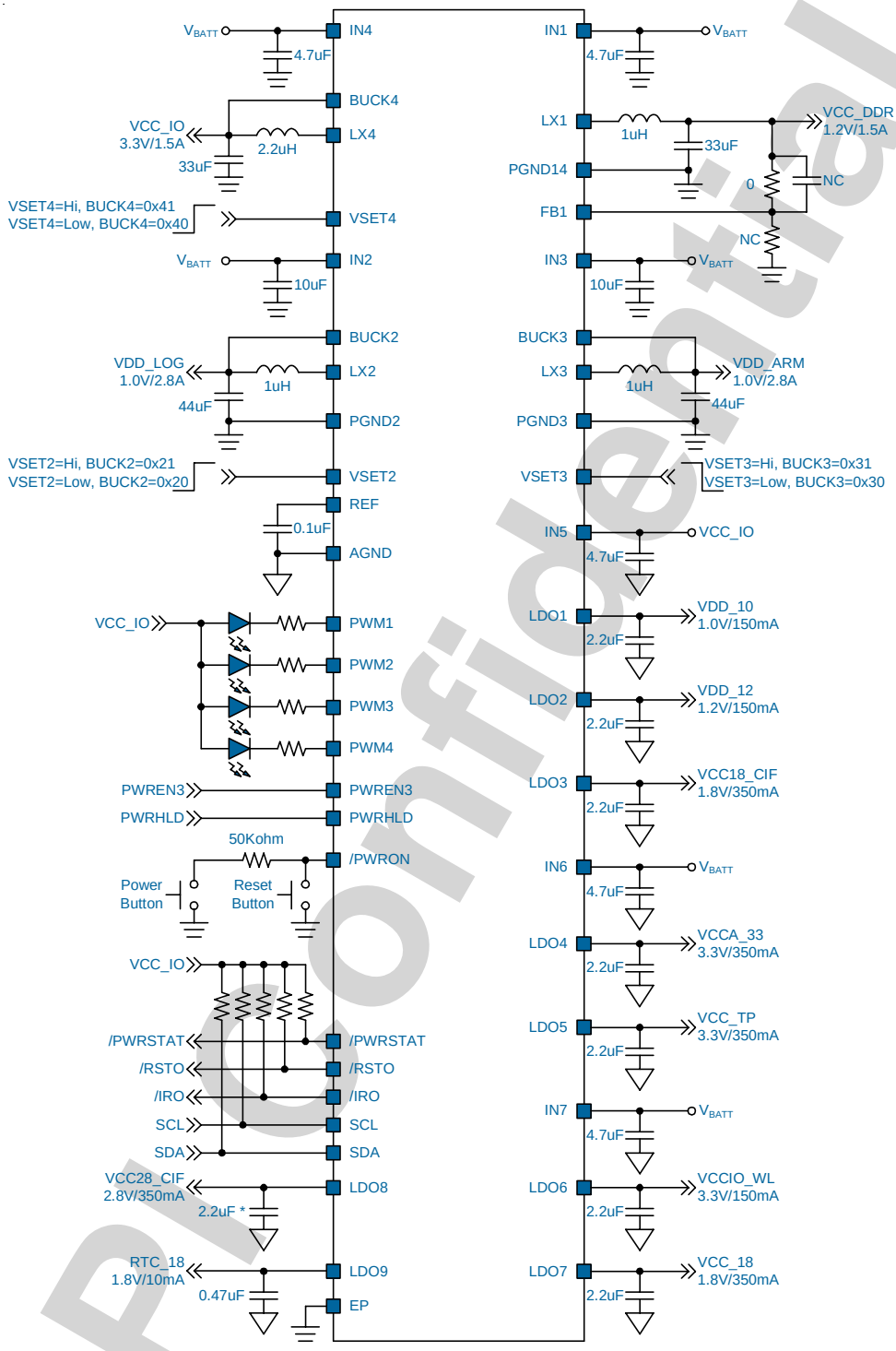
- 4 Synchronous Step-Down Converters
  - Buck_1 for VDD_DDR: 1.2V/1.5A
  - Buck_2 for VDD_LOG: 1.0V/2.8A
  - Buck_3 for VDD_ARM: 1.0V/2.8A
  - Buck_4 for VCC_IO: 3.3V/1.5A
- 5 Low-Noise Linear Regulators
  - LDO1 for VDD_10: 1.0V/150mA
  - LDO2 for VDD_12: 1.2V/150mA
  - LDO3 for VCC18_CIF: 1.8V/350mA
  - LDO4 for VCCA_33: 3.3V/350mA
  - LDO5 for VCC_TP: 3.3V/350mA
- 3 Low Input Linear Regulators
  - LDO6 for VCCIO_WL: 3.3V/150mA
  - LDO7 for VCC_18: 1.8V/350mA
  - LDO8 for VCC28_CIF: 2.8V/350mA
- 1 Low Quiescent Linear Regulator
  - LDO9 for RTC: 1.8V/50mA
- 2.7V to 5.3V Input Range
- I²C Interface
- BUCK2, BUCK3, and BUCK4 Default Voltage with I/O Select
- Build-In Fault Interrupt Controller
- Power Sequencing and Reset Controller
  - Power ON/OFF
  - Power ON Reset
  - Soft/Hard Ware Reset
  - Watchdog Supervision
  - Multiple Sleep Modes
- Space-Saving VQFN6x6-48L Package
- RoHS Compliant and Halogen Free

Ordering Information

Order Number	Package Type	Top Marking
uP6636QQGK	VQFN6x6-48L	uP6636Q

Note:
(1) Please check the sample/production availability with uPI representatives.
(2) uPI products are compatible with the current IPC/JEDEC J-STD-020 requirement. They are halogen-free, RoHS compliant and 100% matte tin (Sn) plating that are suitable for use in SnPb or Pb-free soldering processes.

Typical Application Circuit



* When power is used in sensor such as camera, in order to obtain a better PSRR and output noise, it is recommended output capacitor 22uF.

Functional Pin Description

No.	Pin Name	Pin Function
1, 2	LX3	Switches Output for BUCK3. Connect this pin to the output inductor.
3	PGND3	**Power Ground for BUCK3.** Connect the input and output capacitor GND for BUCK3 to this pin directly.
4	LDO6	**LDO6 Output Voltage.** This pin is LDO6 power output of the device. A minimum 2.2uF output capacitor is required.
5	LDO7	**LDO7 Output Voltage.** This pin is LDO7 power output of the device. A minimum 2.2uF output capacitor is required.
6	IN7	**Supply Input for LDO6, LDO7, and LDO8.** A minimum 4.7uF ceramic capacitor is required for locally bypassing the supply voltage.
7	LDO8	**LDO8 Output Voltage.** This pin is LDO8 power output of the device. A minimum 2.2uF output capacitor is required.
8	VSET2	**Output Voltage Selection for BUCK2.** This pin can selects the BUCK2 default output voltage (0x20 or 0x21).
9	/PWRSTAT	**Active-Low Open-Drain Power-Button Status Output.** /PWRSTAT is active low whenever the /PWRON is pushed, and is high-Z otherwise.
10	PGND2	**Power Ground for BUCK2.** Connect the input and output capacitor GND for BUCK2 to this pin directly.
11, 12	LX2	**Switches Output for BUCK2.** Connect this pin to the output inductor.
13, 14	IN2	**Supply Input for BUCK2 Converter.** A minimum 10uF ceramic capacitor is required for locally bypassing the supply voltage. Place the bypassing capacitor physically near this pin and connect it to the PGND2 pin with wide and short trace.
15	BUCK2	**BUCK2 Output Feedback Voltage.** A minimum 44uF output capacitor is required.
16	PWREN3	**Power Enable Input for BUCK3.** PWREN3 is functional only when PWRHLD is driven high. Drive PWREN to a logic high to turn on the BUCK3. Drive PWREN to a logic low to turn off the BUCK3.
17	REF	**Reference Voltage.** Connect a 0.1uF capacitor from this pin to AGND for bypassing the internal reference voltage.
18	IN6	**Supply Input for LDO4 and LDO5.** A minimum 4.7uF ceramic capacitor is required for locally bypassing the supply voltage.
19	LDO5	**LDO5 Output Voltage.** This pin is LDO5 power output of the device. A minimum 2.2uF output capacitor is required.
20	AGND	**Analog Ground.** Connect the REF bypass capacitor to this pin directly.
21	BUCK4	**BUCK4 Output Feedback Voltage.** A minimum 33uF output capacitor is required.
22	LDO4	**LDO4 Output Voltage.** This pin is LDO4 power output of the device. A minimum 2.2uF output capacitor is required.
23	SDA	**Data Input/Output for Serial Interface.** An external pull-up resistor is needed.
24	SCL	**Clock Input for Serial Interface.** An external pull-up resistor is needed.

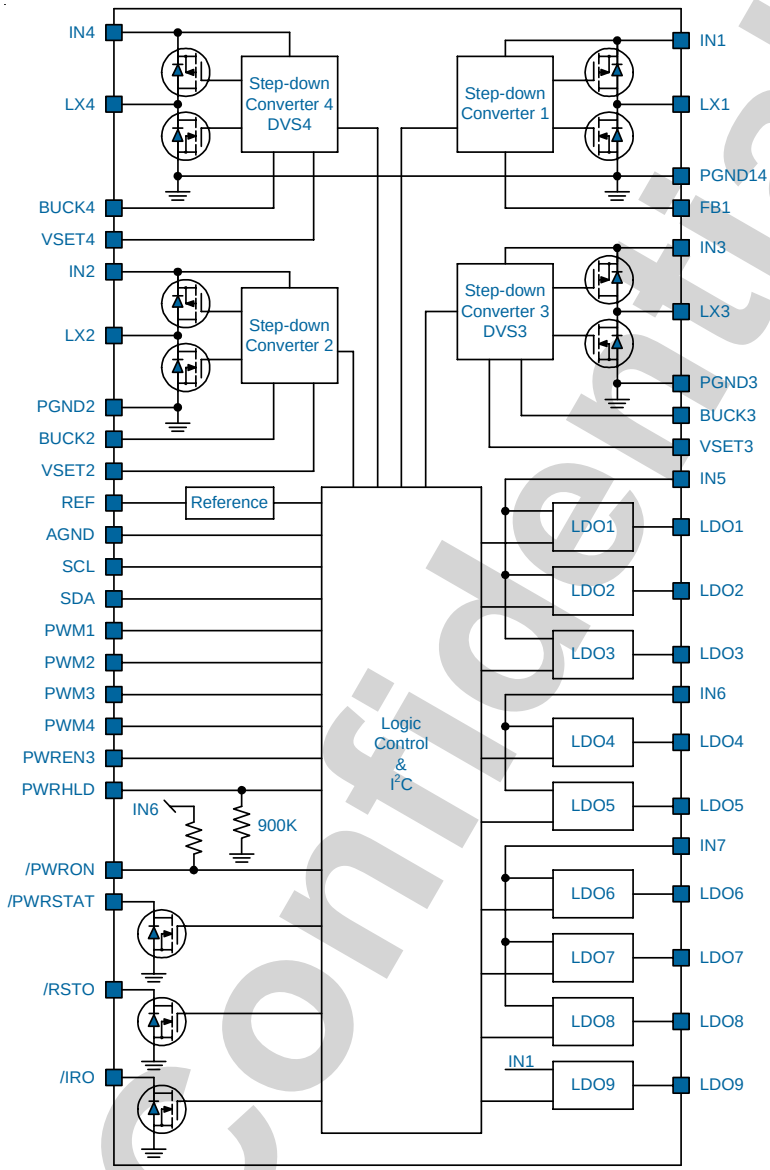
Functional Pin Description

No.	Pin Name	Pin Function
25	IN4	**Supply Input for BUCK4 Converter.** A minimum 4.7uF ceramic capacitor is required for locally bypassing the supply voltage. Place the bypassing capacitor physically near this pin and connect it to the PGND14 pin with wide and short trace.
26	LX4	**Switches Output for BUCK4.** Connect this pin to the output inductor.
27	PGND14	**Power Ground for BUCK1 and BUCK4.** Connect the input and output capacitor GND for BUCK1 and BUCK4 to this pin directly.
28	LX1	**Switches Output for BUCK1.** Connect this pin to the output inductor.
29	FB1	**BUCK1 Output Feedback Voltage.** For the adjustable output voltage options, connect this pin to the output feedback resistor divider for voltage setting. For the fixed output voltage options, connect this pin to the output directly to regulate the output voltage. A minimum 33uF output capacitor is required.
30	IN1	**Supply Input for BUCK1 Converter.** A minimum 4.7uF ceramic capacitor is required for locally bypassing the supply voltage. Place the bypassing capacitor physically near this pin and connect it to the PGND14 pin with wide and short trace.
31	/PWRON	**Power ON/OFF Controller Input.** /PWRON is a unique, multi-function input. Drive /PWRON to GND through a 50kΩ resistor to enable the IC, drive /PWRON directly to GND to assert a Manual-Reset condition.
32	PWRHLD	**Power Hold Input.** Power Enable input for BUCK1, BUCK2, BUCK3, BUCK4, LDO1, and LDO7. PWRHLD is internally pulled down to GND through a 900kΩ resistor.
33	/RSTO	**Open-Drain Reset Output.** /RSTO is active low upon startup or when manual reset is to occur via the /PWRON input. When active on startup, /RSTO remains low until reset time-out period expires. When manual-reset is active, /RSTO immediately active low, then remains active low until the /PWRON input is non-active and the reset time-out period expires.
34	/IRO	**Open-Drain Interrupt Output.** /IRO is an active low when interrupt is generated.
35	PWM4	**General Purpose PWM I/O.** Configured as PWM LED driver output for up to 6mA current with programmable frequency and duty cycle. See the PWM LED Drive section for more information.
36	PWM3	**General Purpose PWM I/O.** Configured as PWM LED driver output for up to 6mA current with programmable frequency and duty cycle. See the PWM LED Drive section for more information.
37	LDO9	**LDO9 Output Voltage.** This pin is LDO9 power output of the device. A minimum 0.47uF output capacitor is required.
38	LDO3	**LDO3 Output Voltage.** This pin is LDO3 power output of the device. A minimum 2.2uF output capacitor is required.
39	PWM2	**General Purpose PWM I/O.** Configured as PWM LED driver output for up to 6mA current with programmable frequency and duty cycle. See the PWM LED Drive section for more information
40	LDO2	**LDO2 Output Voltage.** This pin is LDO2 power output of the device. A minimum 2.2uF output capacitor is required.
41	IN5	**Supply Input for LDO1, LDO2, and LDO3.** A minimum 4.7uF ceramic capacitor is required for locally bypassing the supply voltage.
42	LDO1	**LDO1 Output Voltage.** This pin is LDO1 power output of the device. A minimum 2.2uF output capacitor is required.

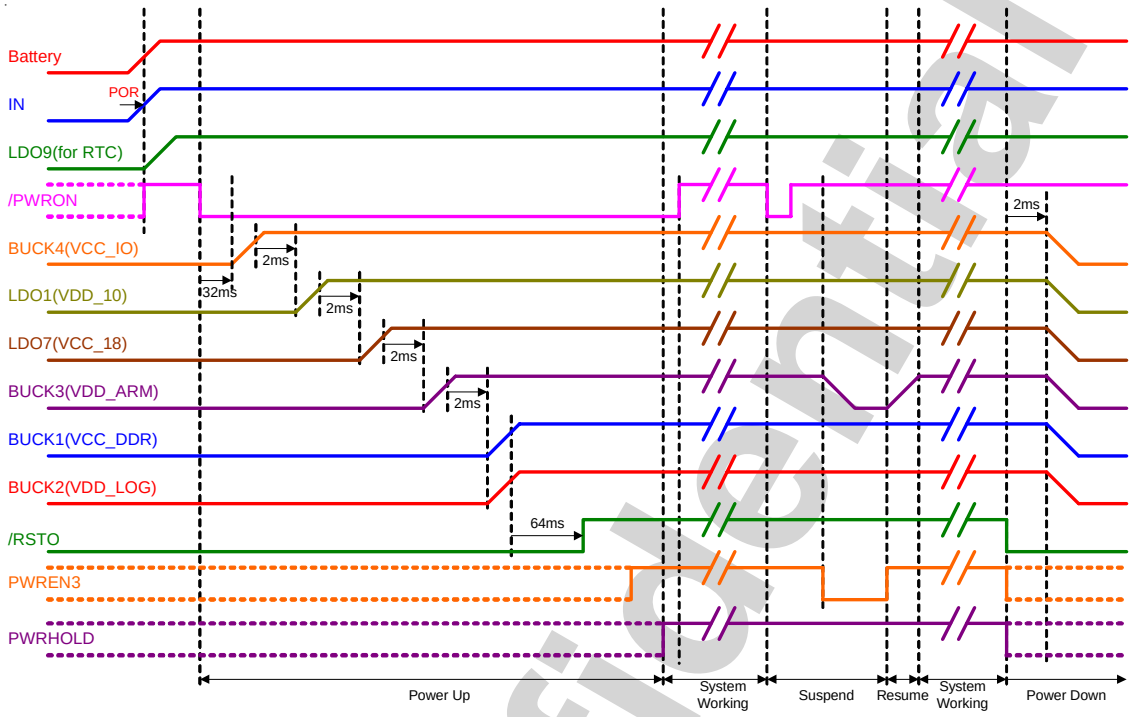
Functional Pin Description

No.	Pin Name	Pin Function
43	PWM1	**General Purpose PWM I/O.** Configured as PWM LED driver output for up to 6mA current with programmable frequency and duty cycle. See the PWM LED Drive section for more information.
44	VSET4	**Output Voltage Selection for BUCK4.** This pin can selects the BUCK4 default output voltage (0x40 or 0x41).
45	VSET3	**Output Voltage Selection for BUCK3.** This pin can selects the BUCK3 default output voltage (0x30 or 0x31).
46	BUCK3	**BUCK3 Output Feedback Voltage.** A minimum 44uF output capacitor is required.
47, 48	IN3	**Supply Input for BUCK3 Converter.** A minimum 10uF ceramic capacitor is required for locally bypassing the supply voltage. Place the bypassing capacitor physically near this pin and connect it to the PGND3 pin with wide and short trace.
49	Exposed Pad (PGND)	**Power Ground for All Regulators.** Connect the input and output capacitor for all regulators to this pin directly. The exposed pad should be well soldered to PCB with multiple via to ground plane for optimal thermal performance.

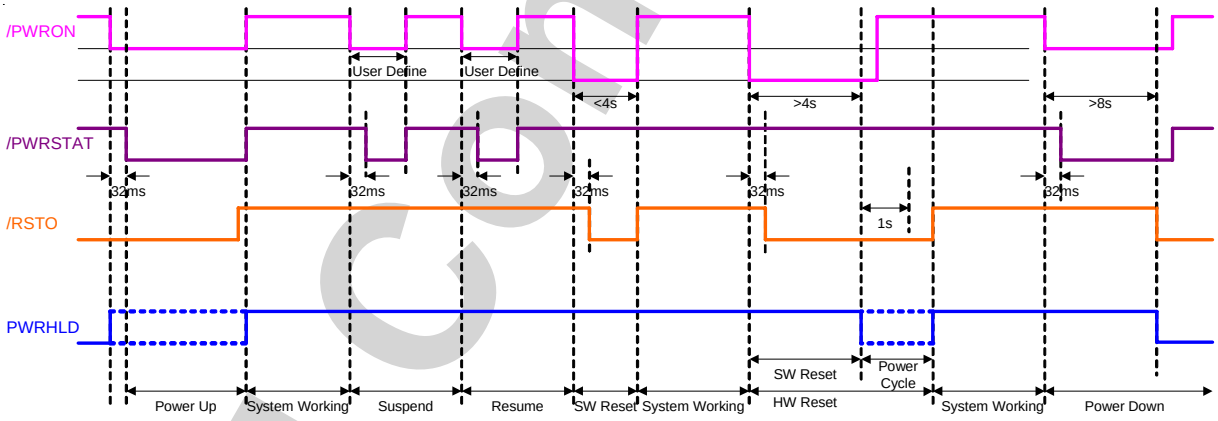
Functional Block Diagram



Power ON/OFF Control Sequence



/PWRON, /PWRSTAT, /RSTO and PWRHLD



Triggering uP6636Q Power on Sequence

Any term of the following descriptions will trigger the uP6636Q to transition from off condition to power on sequence condition:

- /PWRON goes to middle level.
- PWRHLD goes to high level.
- When /PWRON is middle level or PWRHLD is high level, and then OFFSYS is set to 0.

Triggering uP6636Q Power off Sequence

Any term of the following descriptions will trigger the uP6636Q to transition from working condition to power off sequence condition:

- /PWRON goes to high level and PWRHLD goes to low level.
- When /PWRON is middle level or PWRHLD is high level, and then OFFSYS is set to 1.
- When PWRHLD is high level and /PWRON is pulled down to middle level for over 8s.

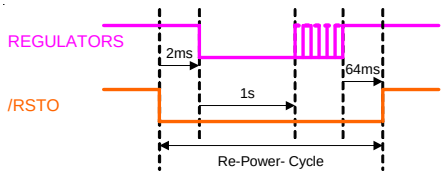
Normal Mode Operation

- When /PWRON is middle level or PWRHLD is high level.

Triggering uP6636Q Rebooting Power cycle sequence (Hardware Reset)

Any term of the following descriptions will trigger the uP6636Q to transition from working condition to reboot power cycle sequence condition and any term of them will cause PCSTAT[] from 0 to 1 (read clear):

- SIPC is set to 1.
- When PWRHLD is high level and /PWRON is pulled down to low level for over 4s.
- When PWRHLD is high level and PWREN3 is high level and WDPCEN[] is set to 1.



Triggering uP6636Q Software Reset

Any term of the following descriptions will trigger the uP6636Q to transition from working condition to software reset condition:

- PWRHLD is high level and /PWRON is pulled down to low level for less than 4s.
- When PWRHLD is high level and PWREN3 is high level and WDSREN[] is set to 1.

Buck3 Control

Any term of the following descriptions will trigger the uP6636P to transition from working condition to ON/OFF Buck3 condition:

- Regardless of throw-in sequence, as long as PWRHLD is high level and /PWRON is middle level, Buck3 can only be controlled by PWREN3.
- When /PWRON is middle level, Buck3 can only be controlled by EN[7](32h) control.
- When PWRHLD is high level, Buck3 can only be controlled by PWREN3 control.

The transition of /RSTO

Any term of the following descriptions will trigger the transition of /RSTO.

- When Buck4 is falling and lower than VBUCKPG, then /RSTO goes to low after 1ms (Typ.) /RSTO fault delay time.
- Power on.
- Power off.
- Hardware Reset.
- Software Reset.

Registers Reset

- When power on reset of IN6 is detected, to reset all registers.
- When power on sequence, power off sequence, software reset, hardware reset, to reset regulators registers.

/PWRON Delay Time

- /PWRON delay time is 500ms (Typ.) only when power on reset of IN6 is detected, otherwise, /PWRON delay time is 32ms (Typ.).

Interrupt Address Indicator Operation

- If two interrupt events occur, then interrupt address indicator points to the register address which occurs firstly, and when one is read, then interrupt address indicator points to another.
- If all interrupt register addresses are read, interrupt address indicator is set to 0xFF, and /IRO goes to high level.

All Registers Software Control Condition

- Regardless of throw-in sequence, as long as PWRHLD is high level and /PWRON is middle level, all the registers can be controlled by software except EN[7](32h).
- When /PWRON is middle level, all registers can be controlled by software without exception.
- When PWRHLD is high level, all the registers can be controlled by software except EN[7](32h).

uP6636Q With Rockchip RK31x8 Power Domains

uP6636Q	RK31x8	Default Voltage	Max. Current	Power ON Sequence	Sleep Mode State
BUCK1	VCC_DDR	Adjustable	1.5A	5	ON
BUCK2	VDD_LOG	1.0V	2.8A	5	ON
BUCK3	VDD_ARM	1.0V	2.8A	4	OFF
BUCK4	VCC_IO	3.3V	1.5A	1	ON
LDO1	VDD_10	1.0V	150mA	2	ON
LDO2	VDD_12	1.2V	150mA	--	OFF
LDO3	VCC18_CIF	1.8V	350mA	--	OFF
LDO4	VCCA_33	3.3V	350mA	--	OFF
LDO5	VCC_TP	3.3V	350mA	--	OFF
LDO6	VCCIO_WL	3.3V	150mA	--	OFF
LDO7	VCC_18	1.8V	350mA	3	ON
LDO8	VCC28_CIF	2.8V	350mA	--	OFF
LDO9	RTC_18	1.8V	50mA	0	Always ON

I2C Read and Write Protocol

Write to a Single Register

S	Slave_addr+W [A7 : A0]	AS	Reg_addr(index) [I7 : I0]	AS	Reg_data [D7 : D0]	AS	P

Read from a Single Register

S	Slave_addr+W [A7 : A0]	AS	Reg_addr(index) [I7 : I0]	AS	RS	Slave_addr + R [A7 : A0]	AS	Reg_data [D7 : D0]	NA	P

S = Start
P = Stop
AS = ACK from slave
AM = ACK from master
NA = No ACK
RS = Repeat Start

Functional Description

The uP6636Q PMU acts a Slave Transmitter/Receiver.
The Address of the uP6636Q PMU for WRITE is B4H.
The Address of the uP6636Q PMU for READ is B5H.
PMU I²C Register Map
(Note: Please do not write "Reserve" Register.)

--	Index	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
SYS	00h	BATLEVMSK	BATSTAT	VBATDAT		BATLEV			
	01h	TMSK	TSTAT	--	--	--	--	--	--
	02h	**Reserve**							
	03h	**Reserve**							
	04h	**Reserve**							
BUCK1	10h	--	--	VSET					
	11h	**Reserve**							
	12h	EN	--	--	--	--	--	FLTMSK	PG
BUCK2	20h	--	--	VSETL					
	21h	--	--	VSETH					
	22h	EN	--	--	--	--	--	FLTMSK	PG
	23h	**Reserve**							
BUCK3	30h	--	--	VSETL					
	31h	--	--	VSETH					
	32h	EN	--	--	--	--	--	FLTMSK	PG
	33h	**Reserve**							
BUCK4	40h	--	--	VSETL					
	41h	--	--	VSETH					
	42h	EN	--	--	--	--	--	FLTMSK	PG
	43h	**Reserve**							
LDO1	50h	--	--	VSET					
	51h	EN	--	--	--	--	DIS	FLTMSK	PG
LDO2	58h	--	--	VSET					
	59h	EN	--	--	--	--	DIS	FLTMSK	PG
LDO3	60h	--	--	VSET					
	61h	EN	--	--	--	--	DIS	FLTMSK	PG
LDO4	68h	--	--	VSET					
	69h	EN	--	--	--	--	DIS	FLTMSK	PG
LDO5	70h	--	--	VSET					
	71h	EN	--	--	--	--	DIS	FLTMSK	PG
LDO6	80h	--	--	VSET					
	81h	EN	--	--	--	--	DIS	FLTMSK	PG

PMU I²C Register Map (cont.)

--	Index	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
LDO7	90h	--	--	VSET					
	91h	EN	--	--	--	--	DIS	FLTMSK	PG
LDO8	A0h	--	--	VSET					
	A1h	EN	--	--	--	--	DIS	FLTMSK	PG
LDO9	B1h	EN	--	--	--	--	--	--	--
PB	C0h	PBAMSK	PBDMSK	--	--	--	--	WDSREN	WDPCEN
	C1h	INTADR							
	C2h	PBASTAT	PBDSTAT	PBDAT	--	--	--	--	--
	C3h	--	--	--	OFFSYS	OFFSYSCLR	--	--	SIPC
	C5h	--	--	--	--	--	--	PCSTAT	SRSTAT
PWM4	E3h	EN	FREQ			DUTY			
PWM3	E4h	EN	FREQ			DUTY			
PWM1	F4h	EN	FREQ			DUTY			
PWM2	F5h	EN	FREQ			DUTY			

Serial Codes for Battery Voltage Monitor Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
00	04	BATLEVMSK	BATSTAT	VBATDAT	--	BATLEV			
		R/W	R	R	--	R/W			

Name	Default	Description
BATLEVMSK	0	Battery Voltage Level Interrupt ON/OFF. 0= Disable the Battery Voltage Level interrupt. (Default) 1= Enable the Battery Voltage Level Interrupt.
BATSTAT	R	Battery Voltage Interrupt Status. This bit is automatically cleared to 0 after read. 0= BATLEV interrupt is normal. 1=BATLEV interrupt is generated.
VBATDAT	R	Battery Voltage Monitor real time status. Value is 1 when VBAT < BATLEV, value is 0 otherwise. 0= IN6 voltage is normal. 1=IN6 voltage is below BATLEV threshold.
BATLEV	2.9V	Battery Voltage Detect Threshold. 0000=2.5V 0001=2.6V 0010=2.7V 0011=2.8V 0100=2.9V (Default) 0101=3.0V 0110=3.1V 0111=3.2V 1000=3.3V 1001=3.4V 1010=3.5V 1011=3.6V 1100=3.7V 1101=3.8V 1110=3.9V 1111=4.0V

Serial Codes for Thermal Monitor Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
01	00	TMSK	TSTAT	--	--	--	--	--	--
		R/W	R	--	--	--	--	--	--

Name	Default	Description
TMSK	0	Thermal Interrupt ON/OFF. 0= Disable the interrupt. (Default) 1= Enable the Thermal Monitor.
TSTAT	R	Thermal Interrupt Status. This bit is automatically cleared to 0 after read. 0= Thermal interrupt is normal. 1=Thermal interrupt is generated.

Serial Codes for BUCK1 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
10	18	--	--	VSET					
		--	--	R/W					

Name	Default	Description		
VSET	1.2V	BUCK1 Output Voltage Selection 000000=0.600V 000001=0.600V 000010=0.600V 000011=0.600V 000100=0.600V 000101=0.600V 000110=0.600V 000111=0.600V 001000=0.600V 001001=0.600V 001010=0.600V 001011=0.600V 001100=0.600V 001101=0.600V 001110=0.600V 001111=0.600V 010000=0.600V 010001=0.600V 010010=0.600V 010011=0.600V 010100=0.600V 010101=0.600V	010110=0.600V 010111=0.600V 011000=1.200V (Default) 011001=1.200V 011010=1.200V 011011=1.200V 011100=1.200V 011101=1.200V 011110=1.200V 011111=1.200V 100000=1.200V 100001=1.200V 100010=1.200V 100011=1.200V 100100=1.200V 100101=1.200V 100110=1.200V 100111=1.200V 101000=1.200V 101001=1.200V 101010=1.200V	101011=1.200V 101100=1.200V 101101=1.200V 101110=1.200V 101111=1.200V 110000=1.200V 110001=1.200V 110010=1.200V 110011=1.200V 110100=1.200V 110101=1.200V 110110=1.200V 110111=1.200V 111000=1.200V 111001=1.200V 111010=1.200V 111011=1.200V 111100=1.200V 111101=1.200V 111110=1.200V 111111=1.200V

Serial Codes for BUCK1 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
12	8x	EN	--	--	--	--	--	FLTMSK	PG
		R/W	--	--	--	--	--	R/W	R

Name	Default	Description
EN	1	BUCK1 ON/OFF Bit. 0=Disable. 1=Enable. (Default)
FLTMSK	0	BUCK1 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	BUCK1 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for BUCK2 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
20/21	10	--	--	VSETL/VSETH					
		--	--	R/W					

Name	Default	Description		
VSETL VSETH	1.0V	BUCK2 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V (Default) 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for BUCK2 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
22	8x	EN	--	--	--	--	--	FLTMSK	PG
		R/W	--	--	--	--	--	R/W	R

Name	Default	Description
EN	1	BUCK2 ON/OFF Bit. 0=Disable. 1=Enable. (Default)
FLTMSK	0	BUCK2 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	BUCK2 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for BUCK3 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
30/31	10	--	--	VSETL/VSETH					
		--	--	R/W					

Name	Default	Description		
VSETL VSETH	1.0V	BUCK3 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V (Default) 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for BUCK3 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
32	8x	EN	--	--	--	--	--	FLTMSK	PG
		R/W	--	--	--	--	--	R/W	R

Name	Default	Description
EN	1	BUCK3 ON/OFF Bit. 0=Disable. 1=Enable. (Default)
FLTMSK	0	BUCK3 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	BUCK3 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for BUCK4 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
40/41	39	--	--	VSETL/VSETH					
		--	--	R/W					

Name	Default	Description		
VSETL VSETH	3.3V	BUCK4 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V (Default) 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for BUCK4 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
42	8x	EN	--	--	--	--	--	FLTMSK	PG
		R/W	--	--	--	--	--	R/W	R

Name	Default	Description
EN	1	BUCK4 ON/OFF Bit. 0=Disable. 1=Enable. (Default)
FLTMSK	0	BUCK4 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	BUCK4 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for LDO1 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
50	10	--	--	VSET					
		--	--	R/W					

Name	Default	Description		
VSET	1.0V	LDO1 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V (Default) 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for LDO1 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
51	8x	EN	--	--	--	--	DIS	FLTMSK	PG
		R/W	--	--	--	--	R/W	R/W	R

Name	Default	Description
EN	1	LDO1 ON/OFF Bit. 0=Disable. 1=Enable. (Default)
DIS	1	LDO1 OFF Discharge Control. 0=Disable discharge. 1=Enable discharge.Default)
FLTMSK	0	LDO1 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	LDO1 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for LDO2 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
58	18	--	--	VSET					
		--	--	R/W					

Name	Default	Description		
VSET	1.2V	LDO2 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V (Default) 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for LDO2 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
59	0x	EN	--	--	--	--	DIS	FLTMSK	PG
		R/W	--	--	--	--	R/W	R/W	R

Name	Default	Description
EN	0	LDO2 ON/OFF Bit. 0=Disable. (Default) 1=Enable.
DIS	1	LDO2 OFF Discharge Control. 0=Disable discharge. 1=Enable discharge. (Default)
FLTMSK	0	LDO2 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	LDO2 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for LDO3 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
60	24	--	--	VSET					
		--	--	R/W					

Name	Default	Description		
VSET	1.8V	LDO3 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V (Default) 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for LDO3 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
61	0x	EN	--	--	--	--	DIS	FLTMSK	PG
		R/W	--	--	--	--	R/W	R/W	R

Name	Default	Description
EN	0	LDO3 ON/OFF Bit. 0=Disable. (Default) 1=Enable.
DIS	1	LDO3 OFF Discharge Control. 0=Disable discharge. 1=Enable discharge. (Default)
FLTMSK	0	LDO3 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	LDO3 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for LDO4 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
68	39	--	--	VSET					
		--	--	R/W					

Name	Default	Description		
VSET	3.3V	LDO4 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V (Default) 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for LDO4 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
69	0x	EN	--	--	--	--	DIS	FLTMSK	PG
		R/W	--	--	--	--	R/W	R/W	R

Name	Default	Description
EN	0	LDO4 ON/OFF Bit. 0=Disable. (Default) 1=Enable.
DIS	1	LDO4 OFF Discharge Control. 0=Disable discharge. 1=Enable discharge. (Default)
FLTMSK	0	LDO4 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	LDO4 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for LDO5 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
70	39	--	--	VSET					
		--	--	R/W					

Name	Default	Description		
VSET	3.3V	LDO5 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V (Default) 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for LDO5 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
71	0x	EN	--	--	--	--	DIS	FLTMSK	PG
		R/W	--	--	--	--	R/W	R/W	R

Name	Default	Description
EN	0	LDO5 ON/OFF Bit. 0=Disable. (Default) 1=Enable.
DIS	1	LDO5 OFF Discharge Control. 0=Disable discharge. 1=Enable discharge. (Default)
FLTMSK	0	LDO5 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	LDO5 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for LDO6 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
80	39	--	--	VSET					
		--	--	R/W					

Name	Default	Description		
VSET	3.3V	LDO6 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V (Default) 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for LDO6 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
81	0x	EN	--	--	--	--	DIS	FLTMSK	PG
		R/W	--	--	--	--	R/W	R/W	R

Name	Default	Description
EN	0	LDO6 ON/OFF Bit. 0=Disable. (Default) 1=Enable.
DIS	1	LDO5 OFF Discharge Control. 0=Disable discharge. 1=Enable discharge. (Default)
FLTMSK	0	LDO5 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	LDO5 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for LDO7 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
90	24	--	--	VSET					
		--	--	R/W					

Name	Default	Description		
VSET	1.8V	LDO7 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V (Default) 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for LDO7 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
91	8x	EN	--	--	--	--	DIS	FLTMSK	PG
		R/W	--	--	--	--	R/W	R/W	R

Name	Default	Description
EN	1	LDO7 ON/OFF Bit. 0=Disable. 1=Enable. (Default)
DIS	1	LDO7 OFF Discharge Control. 0=Disable discharge. 1=Enable discharge. (Default)
FLTMSK	0	LDO7 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	LDO7 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for LDO8 Output Voltage Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
A0	34	--	--	VSET					
		--	--	R/W					

Name	Default	Description		
VSET	2.8V	LDO8 Output Voltage Selection. 000000=0.600V 000001=0.625V 000010=0.650V 000011=0.675V 000100=0.700V 000101=0.725V 000110=0.750V 000111=0.775V 001000=0.800V 001001=0.825V 001010=0.850V 001011=0.875V 001100=0.900V 001101=0.925V 001110=0.950V 001111=0.975V 010000=1.000V 010001=1.025V 010010=1.050V 010011=1.075V 010100=1.100V 010101=1.125V	010110=1.150V 010111=1.175V 011000=1.200V 011001=1.250V 011010=1.300V 011011=1.350V 011100=1.400V 011101=1.450V 011110=1.500V 011111=1.550V 100000=1.600V 100001=1.650V 100010=1.700V 100011=1.750V 100100=1.800V 100101=1.850V 100110=1.900V 100111=1.950V 101000=2.000V 101001=2.050V 101010=2.100V	101011=2.150V 101100=2.200V 101101=2.250V 101110=2.300V 101111=2.350V 110000=2.400V 110001=2.500V 110010=2.600V 110011=2.700V 110100=2.800V (Default) 110101=2.900V 110110=3.000V 110111=3.100V 111000=3.200V 111001=3.300V 111010=3.400V 111011=3.500V 111100=3.600V 111101=3.700V 111110=3.800V 111111=3.900V

Serial Codes for LDO8 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
A1	0x	EN	--	--	--	--	DIS	FLTMSK	PG
		R/W	--	--	--	--	R/W	R/W	R

Name	Default	Description
EN	0	LDO8 ON/OFF Bit. 0=Disable. (Default) 1=Enable.
DIS	1	LDO8 OFF Discharge Control. 0=Disable discharge. 1=Enable discharge. (Default)
FLTMSK	0	LDO8 Fault Interrupt ON/OFF Control. 0=Disable the interrupt. (Default) 1=Enable the interrupt.
PG	R	LDO8 Power-Good Interrupt Status. This bit is automatically cleared to 0 after read. 0= Output Voltage is not Power-Good. 1= Output Voltage is Power-Good.

Serial Codes for LDO9 State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
B1		EN	--	--	--	--	--	--	--
		R/W	--	--	--	--	--	--	--
Name	Default	Description							
EN	1	LDO9 ON/OFF Bit. 0=Disable. 1=Enable. (Default)							

Serial Codes for PMU Control State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
C0	00	PBAMSK	PBDMSK	--	--	--	--	WDSREN	WDPCEN
		R/W	R/W	--	--	--	--	R/W	R/W
Name	Default	Description							
PBAMSK	0	/PWRON Active Interrupt ON/OFF Control. 0=Disable. (Default) 1=Enable.							
PBDMSK	0	/PWRON Non-Active Interrupt ON/OFF Control. 0=Disable. (Default) 1=Enable.							
WDSREN	0	Watchdog Soft-Reset ON/OFF Control. When the watchdog timer expires, the PMU commences a soft-reset routine. This bit is automatically reset to 0 when entering sleep mode. 0=Disable. (Default) 1=Enable.							
WDPCEN	0	Watchdog Power Cycle ON/OFF Control. When watchdog timer expires, the PMU commence a power cycle. This bit is automatically reset to 0 when entering sleep mode. 0=Disable. (Default) 1=Enable.							

Serial Codes for PWM4 LED Driver State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
E3		EN	FREQ			DUTY			
		R/W	R/W			R/W			

Name	Default	Description
EN	0	PWM4 ON/OFF Bit. 0=Disable. (Default) 1=Enable.
FREQ	000	PWM4 Frequency Selection Bits. 000=0.25Hz. (Default) 001=0.5Hz. 010=1Hz. 011=2Hz. 100=128Hz. 101=256Hz.
DUTY	0000	PWM4 Duty Cycle Selection Bits. 0000=06.25% (Default) 0001=12.50% 0010=18.75% 0011=25.00% 0100=31.25% 0101=37.50% 0110=43.75% 0111=50.00% 1000=56.25% 1001=62.50% 1010=68.75% 1011=75.00% 1100=81.25% 1101=87.50% 1110=93.75% 1111=100.0%

Serial Codes for PWM3 LED Driver State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
E4		EN	FREQ			DUTY			
		R/W	R/W			R/W			

Name	Default	Description
EN	0	PWM3 ON/OFF Bit. 0=Disable. (Default) 1=Enable.
FREQ	000	PWM3 Frequency Selection Bits. 000=0.25Hz. (Default) 001=0.5Hz. 010=1Hz. 011=2Hz. 100=128Hz. 101=256Hz.
DUTY	0000	PWM3 Duty Cycle Selection Bits. 0000=06.25% (Default) 0001=12.50% 0010=18.75% 0011=25.00% 0100=31.25% 0101=37.50% 0110=43.75% 0111=50.00% 1000=56.25% 1001=62.50% 1010=68.75% 1011=75.00% 1100=81.25% 1101=87.50% 1110=93.75% 1111=100.0%

Serial Codes for PWM1 LED Driver State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
F4		EN	FREQ			DUTY			
		R/W	R/W			R/W			

Name	Default	Description
EN	1	PWM1 ON/OFF Bit. 0=Disable. 1=Enable. (Default)
FREQ	101	PWM1 Frequency Selection Bits. 000=0.25Hz. 001=0.5Hz. 010=1Hz. 011=2Hz. 100=128Hz. 101=256Hz. (Default)
DUTY	0111	PWM1 Duty Cycle Selection Bits. 0000=06.25% 0001=12.50% 0010=18.75% 0011=25.00% 0100=31.25% 0101=37.50% 0110=43.75% 0111=50.00% (Default) 1000=56.25% 1001=62.50% 1010=68.75% 1011=75.00% 1100=81.25% 1101=87.50% 1110=93.75% 1111=100.0%

Serial Codes for PWM2 LED Driver State Register

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
F5		EN	FREQ			DUTY			
		R/W	R/W			R/W			

Name	Default	Description
EN	0	PWM2 ON/OFF Bit. 0=Disable. (Default) 1=Enable.
FREQ	000	PWM2 Frequency Selection Bits. 000=0.25Hz. (Default) 001=0.5Hz. 010=1Hz. 011=2Hz. 100=128Hz. 101=256Hz.
DUTY	0000	PWM2 Duty Cycle Selection Bits. 0000=06.25% (Default) 0001=12.50% 0010=18.75% 0011=25.00% 0100=31.25% 0101=37.50% 0110=43.75% 0111=50.00% 1000=56.25% 1001=62.50% 1010=68.75% 1011=75.00% 1100=81.25% 1101=87.50% 1110=93.75% 1111=100.0%

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
C1	FF	INTADR							
		R							
Name	Default	Description							
INTADR	R	Interrupt Index. It holds the Index of the block that triggers the interrupt. This byte defaults to 0xFF and is automatically set to 0xFF after being read. Bit 7 is the MSB while Bit 0 is the LSB.							

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
C2	xx	PBASTAT	PBDSTAT	PBDAT	--	--	--	--	--
		R	R	R	--	--	--	--	--
Name	Default	Description							
PBASTAT	R	/PWRON Active Interrupt Status. This bit is automatically cleared to 0 after read. 0= /PWRON active interrupt is normal. 1= /PWRON active interrupt is generated.							
PBDSTAT	R	/PWRON Non-Active Interrupt Status. This bit is automatically cleared to 0 after read. 0= /PWRON non-active interrupt is normal. 1= /PWRON non-active interrupt is generated.							
PBDAT	R	/PWRON Status bit. This bit contains the real-time status of the /PWRON pin. 0= /PWRON is non-active. 1= /PWRON is active.							

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
C3	00	--	--	--	OFFSYS	--	--	--	SIPC
		--	--	--	R/W	--	--	--	R/W
Name	Default	Description							
OFFSYS	0	Power Off Control. Set this bit to 1 to turn off all outputs. 0=Power is normal. (Default) 1=Power is off.							
SIPC	0	Software Initiated Power Cycle ON/OFF Control. This bit is automatically cleared to 0. When this bit is set, the PMU commences a power cycle after 8ms delay. 0=Disable. (Default) 1=Enable.							

Index (hex)	Default (hex)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
C5	xx	--	--	--	--	--	--	PCSTAT	SRSTAT
		--	--	--	--	--	--	R	R

Name	Default	Description
PCSTAT	R	Power-cycle Indicator. The value of this bit is 1 after a power cycle. This bit is automatically cleared to 0 after read.
SRSTAT	R	Soft-reset Indicator. The value of this bit is 1 after a soft-reset. This bit is automatically cleared to 0 after read.

Absolute Maximum Rating

(Note 1)

Supply Input Voltage, IN1, IN2, IN3, IN4, IN5, IN6, IN7 to GND ---------- -0.3V to +5.5V
LX_Pin Voltage ---------- -0.3V to (IN_+0.3V)
Other Pins ---------- -0.3V to (IN_+0.3V)
Storage Temperature Range ---------- -65°C to +150°C
Junction Temperature ---------- 150°C
Lead Temperature (Soldering, 10 sec) ---------- 260°C
ESD Rating (Note 2)
HBM (Human Body Mode) ---------- 2kV
MM (Machine Mode) ---------- 200V

Thermal Information

Package Thermal Resistance (Note 3)
VQFN 6x6-48L θ_{JA} ---------- 35°C/W
VQFN 6x6-48L θ_{JC} ---------- 3°C/W
Power Dissipation, P_D @ T_A = 25°C
VQFN 6x6-48L ---------- 2.86W

Recommended Operation Conditions

(Note 4)

Operating Junction Temperature Range ---------- -40°C to +125°C
Operating Ambient Temperature Range ---------- -40°C to +85°C
Supply Input Voltage ---------- 2.7V to 5.3V

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended.

Note 3. θ_{JA} is measured in the natural convection at T_A = 25°C on a high effective thermal conductivity test board of JEDEC 51-7 thermal measurement standard.

Note 4. The device is not guaranteed to function outside its operating conditions.

Electrical Characteristics

(V_{IN}=3.7V, C_{REF}=0.1uF, T_A=25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reference						
Reference Output Voltage	VREF	C_{REF}=0.1uF	1.237	1.25	1.263	V
Power ON Sequence Delay Time	T_{ON-DY}	Channel to channel	--	2	--	ms
Power OFF Sequence Delay Time	T_{OFF-DY}	PWRHLD to channel off	--	2	--	ms
BUCK Converter : BUCK1, BUCK2, BUCK3, BUCK4						
Input Voltage Range	V_{IN1-4}	I_{BUCK} = 0mA	2.7	--	5.3	V
POR Threshold	V_{INPOR}	V_{IN1-4} Rising	--	--	2.5	V
		V_{IN1-4} Falling	2.2	--	--	
Supply Current	I_Q	Enable BUCK, No switching.	--	120	TBD	uA
Shutdown Current	I_{SD}	Disable BUCK	--	0	2	uA
Default Output Voltage Accuracy	V_{DF}	V_{BUCK} >= 1.0V, I_{BUCK} = 10mA	-1.00	--	1.00	%
		V_{BUCK} < 1.0V, I_{BUCK} = 10mA	-10	--	10	mV
Line Regulation	ΔV_{LINE}	IN_=2.7V to 5.5V, I_{BUCK} = 100mA	--	0.15	--	%/V
Load Regulation	ΔV_{LOAD}	$I_{BUCK1/4}$ = 10mA to 1.5A	--	1.7	--	%/A
		$I_{BUCK2/3}$ = 10mA to 2.8A	--	1.0	--	
Power Good Threshold	V_{BUCKPG}	V_{BUCK} Rising	--	90	--	$\%V_{DF}$
		V_{BUCK} Falling	--	85	--	
Switching Frequency Range	F_{OSC}	PWM	2.0	2.25	2.5	MHz
Soft Start Time	SS		--	1	--	ms
Minimum On Time	T_{on-min}		--	80	--	ns
Maximum Output Current	I_{MAX}	BUCK1, BUCK4	1.5	--	--	A
		BUCK2, BUCK3	2.8	--	--	
Current Limit	I_{CL}	BUCK1, BUCK4	1.8	2.2	2.7	A
		BUCK2, BUCK3	3.5	4.2	4.9	
ON Resistance	R_{ON}	BUCK1, BUCK4; High-side MOS; $I_{LX1/4}$=100mA.	--	110	--	mΩ
		BUCK1, BUCK4; Low-side MOS; $I_{LX1/4}$=100mA.	--	80	--	
		BUCK2, BUCK3; High-side MOS; ILX2/3=100mA.	--	70	--	
		BUCK2, BUCK3; Low-side MOS; $I_{LX2/3}$=100mA.	--	80	--	

Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Shutdown Discharge Resistance	R_{DIS}	BUCK Disable	--	1.0	--	kΩ
LX Leakage Current	I_{LX-LK}	Disable BUCK, IN=5.5V, LX=0V or 5.5V.	--	0	2	uA
Low Noise Linear Regulator : LDO1, LDO2, LDO3, LDO4, LDO5						
Input Voltage Range	V_{IN5-6}	IN5, I_{LDO1-3} = 0mA	2.5	--	5.3	V
		IN6, I_{LDO4-5} = 0mA	2.7	--	5.5	
POR Threshold	V_{IN6POR}	V_{IN6} Rising	--	--	2.2	V
		V_{IN6} Falling	1.8	--	--	
Default Output Voltage Accuracy	V_{DF}	V_{LDO} >= 1.0V, I_{LDO} = 10mA	-1.00	--	1.00	%
		V_{LDO} < 1.0V, I_{LDO} = 10mA	-10	--	10	mV
Line Regulation	ΔV_{LINE}	IN5-6 = 3.0V to 5.5V, I_{LDO} = 10mA	--	0.5	--	mV
Load Regulation	ΔV_{LOAD}	$I_{LDO1/2}$ = 1mA to 150mA	--	0.1	--	V/A
		$I_{LDO3/4/5}$ = 1mA to 350mA	--	0.1	--	
PSRR	PSRR	1kHz, V_{LDO} = 1.2V, I_{LDO} =20mA	--	70	--	dB
		10kHz, V_{LDO} = 1.2V, I_{LDO} =20mA	--	50	--	
Supply Current	I_Q	Enable LDO	--	60	--	uA
Shutdown Current	I_{SD}	Disable LDO	--	0	2	uA
Soft Start Time	SS	V_{LDO} = 3.0V	--	500	--	us
Power Good Threshold	V_{LDOPG}	V_{LDO} Rising	--	90	--	$\%V_{DF}$
		V_{LDO} Falling	--	85	--	
Output Noise	V_{NOISE}	10Hz-100kHz, V_{LDO} = 1.2V, I_{LDO} =20mA	--	50	--	uV_{RMS}
Shutdown Discharge Resistance	R_{DIS}	LDO Disable, DIS[2]=1	--	1.5	--	kΩ
Dropout Voltage	V_{DV}	LDO1, LDO2; I_{LDO} =80mA, V_{LDO} > 3.1V	--	140	280	mV
		LDO3, LDO4, LDO5; I_{LDO} =160mA, V_{LDO} > 3.1V	--	140	280	
Maximum Output Current	I_{MAX}	LDO1, LDO2	150	--	--	mA
		LDO3, LDO4, LDO5	350	--	--	
Current Limit	I_{CL}	LDO1, LDO2; V_{LDO} = 0.95xVDF	180	260	340	mA
		LDO3, LDO4, LDO5; V_{LDO} = 0.95xVDF	400	500	600	
Output Short Circuit Current Limit	I_{SCL}	LDO1, LDO2; V_{LDO} = 0V	45	65	85	mA
		LDO3, LDO4, LDO5; V_{LDO} = 0V	85	125	165	

Electrical Characteristics

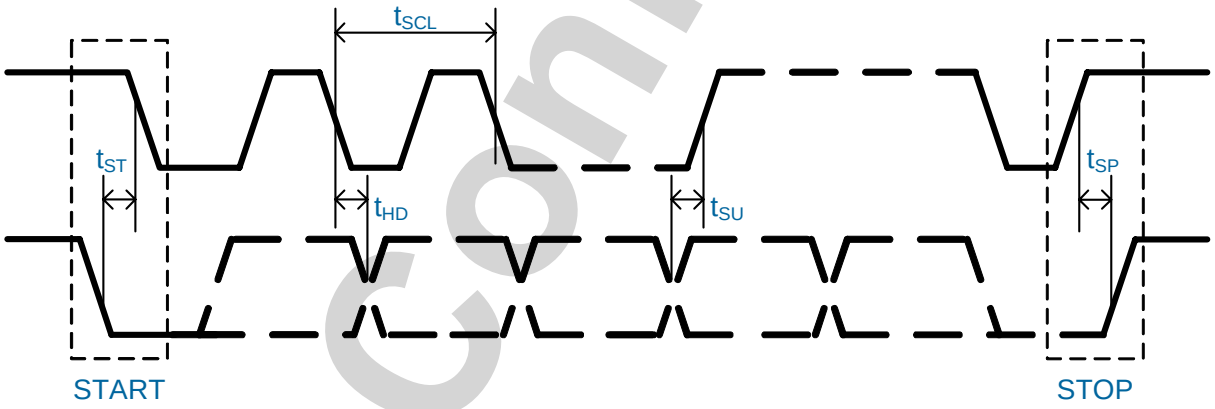
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Low Input Voltage Linear Regulator : LDO6, LDO7, LDO8						
Input Voltage Range	V_{IN7}	IN7, I_{LDO6-8} = 0mA	1.7	--	5.3	V
Default Output Voltage Accuracy	V_{DF}	V_{LDO} >= 1.0V, I_{LDO} = 10mA	-1.00	--	1.00	%
		V_{LDO} < 1.0V, I_{LDO} = 10mA	-10	--	10	mV
Line Regulation	ΔV_{LINE}	IN7=3.0V to 5.5V, I_{LDO} =10mA	--	0.5	--	mV
Load Regulation	ΔV_{LOAD}	I_{LDO6} = 1mA to 150mA	--	0.1	--	V/A
		$I_{LDO7/8}$ = 1mA to 350mA	--	0.1	--	
PSRR	PSRR	1kHz, V_{LDO} = 1.2V, I_{LDO} =20mA	--	50	--	dB
		10kHz, V_{LDO} = 1.2V, I_{LDO} =20mA	--	30	--	
Supply Current	I_Q	Enable LDO	--	50	--	uA
Shutdown Current	I_{SD}	Disable LDO	--	0	2	uA
Soft Start Time	SS	V_{LDO} = 3.0V	--	500	--	us
Power Good Threshold	V_{LDOPG}	V_{LDO} Rising	--	90	--	$\%V_{DF}$
		V_{LDO} Falling	--	85	--	
Output Noise	V_{NOISE}	10Hz-100kHz, V_{LDO} = 1.2V, I_{LDO} =20mA	--	50	--	uV_{RMS}
Shutdown Discharge Resistance	R_{DIS}	LDO Disable, DIS[2]=1	--	1.5	--	kΩ
Dropout Voltage	V_{DV}	LDO6; I_{LDO} =80mA, V_{LDO} > 3.1V	--	100	200	mV
		LDO7, LDO8; I_{LDO} =160mA, V_{LDO} > 3.1V	--	100	200	
Maximum Output Current	IMAX	LDO6	150	--	--	mA
		LDO7, LDO8	350	--	--	
Current Limit	I_{CL}	LDO6; V_{LDO} = 0.95xVDF	180	260	340	mA
		LDO7, LDO8; VLDO = 0.95xVDF	400	500	600	
Output Short Circuit Current Limit	I_{SCL}	LDO6; V_{LDO} = 0V	45	65	85	mA
		LDO7, LDO8; V_{LDO} = 0V	85	125	165	
Low Input Power Linear Regulator : LDO9						
Input Voltage Range	V_{IN5}	IN5, I_{LDO9} = 0mA	2.5	--	5.3	V
Default Output Voltage Accuracy	V_{DF}	I_{LDO} = 10mA	-3	--	3	%
Line Regulation	ΔV_{LINE}	IN5 = 2.5V to 5.5V, Iout = 1mA	--	13	--	mV

Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Current	I_Q	Enable LDO	--	5	--	uA
Maximum Output Current	I_{MAX}	LDO9	10	--	--	mA
Output Capacitor	C_{OUT}		0.47	--	--	uF
PWM LED Driver						
Maximum Output Current	$I_{LED-MAX}$	IN6 = 3.7V, 100% Duty Cycle	6	10	16	mA
Output Low Voltage	$V_{LED-LOW}$	PWM1-PWM4, Sink Current = 6mA	--	--	0.35	V
Output Leakage Current	I_{LK}	PWM1-PWM4 = 5.5V, Source Current	--	--	1	uA
PWM Frequency	FREQ	FRE[2:0] = 000	--	0.25	--	Hz
PWM Duty Range	DUTY	DUTY[3:0] = 0000 to 1111	6.26	--	100	%
Low Battery Detect						
Low Battery Detect Threshold	LBDT	IN6 falling, BATLEV[3:0]	2.863	2.9	2.972	V
Low Battery Hysteresis Threshold	LBHT	IN6 rising	--	0.2	--	V
Logic Input and Output : /PWRON, PWRHLD, PWREN3, VSET2, VSET3, VSET4, /IRO, /RSTO, /PWRSTAT						
Input High Level	V_H	PWRHLD, PWREN3, VSET2, VSET3, VSET4	1.4	--	--	V
Input Low Level	V_L	PWRHLD, PWREN3, VSET2, VSET3, VSET4	--	--	0.4	V
Leakage Current	I_{LK}	/IRO, /RSTO = 5.5V	--	0.1	1	uA
Output Low Voltage	V_{LOW}	/IRO, /RSTO, Sink Current = 5mA	--	--	0.3	V
/PWRON High Level	$V_{Standby}$	/PWRON Standby	0.9IN	--	IN	V
/PWRON Middle Level	V_{PWR}	PWR ON/OFF/Suspend/Resume Mode	0.4IN	--	0.6IN	V
/PWRON Low Level	V_{RESET}	SW/Power Cycle Reset	--	--	0.4	V
/PWRON Power Off detect Time	$T_{PWOFF-DY}$	/PWRON to Middle Level	--	8	--	s
/PWRON Reset detect Time	T_{HWR-DY}	/PWRON to Low Level	--	4	--	s
/PWRON Delay Time	T_{PWR-DY}	/PWRON to power on (after power off)	--	32	--	ms
/PWRON Delay Time	T_{PWR-DY}	/PWRON to power on (after IN6 power on reset)	--	500	--	ms
/PWRSTAT Falling Delay Time	$T_{STAT-FDY}$	/PWRON to /PWRSTAT falling delay time	--	32	--	ms
/RSTO Power ON Delay Time	$T_{RSTO-DY}$	BUCK1 and BUCK2 to /RSTO	--	64	--	ms
/RSTO Fault Delay Time	T_{RSF-DY}	BUCK4 VBUCKPG falling to /RSTO	--	1	--	ms
/RSTO Reset Delay Time	T_{RSF-DY}	/PWRON falling to /RSTO	--	32	--	ms
Interrupt Delay Time	T_{INT-DY}	Fault to /IRO	--	1	--	ms
Power Cycle Delay Time	T_{PC-DY}	Power OFF to Power ON(SIPC[] and WDPCEN[])	--	1	--	s

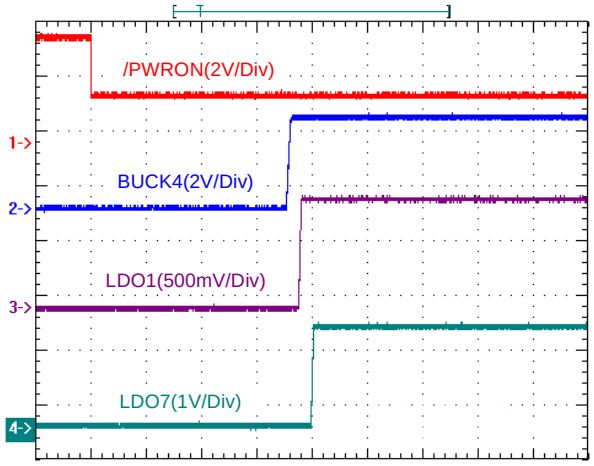
Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
I2C Interface						
SCL, SDA Low Level	V_L	IN6=3.1V to 5.5V, TA = -40°C to 85°C	--	--	0.35	V
SCL, SDA High Level	V_H	IN6=3.1V to 5.5V, TA = -40°C to 85°C	1.55	--		V
Leakage Current	I_{LK}	SCL, SDA = 5.5V	--	--	1	uA
SDA Output Low Voltage	V_{OL}	SDA, Sink Current = 5mA	--	--	0.35	V
SCL Clock Period	t_{SCL}		1.5	--	--	us
SDA Data Setup Time	t_{SU}		100	--	--	ns
SDA Data Hold Time	t_{HD}		300	--	--	ns
Start Setup Time	t_{ST}	For Start Condition	100	--	--	ns
Stop Setup Time	t_{SP}	For Stop Condition	100	--	--	ns
Over Temperature Protection						
Over Temperature Protection	OTP		--	160	--	°C
Over Temperature Hysteresis	ΔT		--	20	--	°C



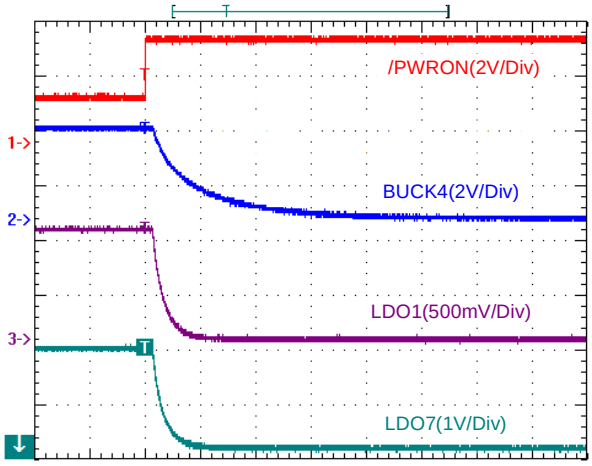
Typical Operation Characteristics

Power ON



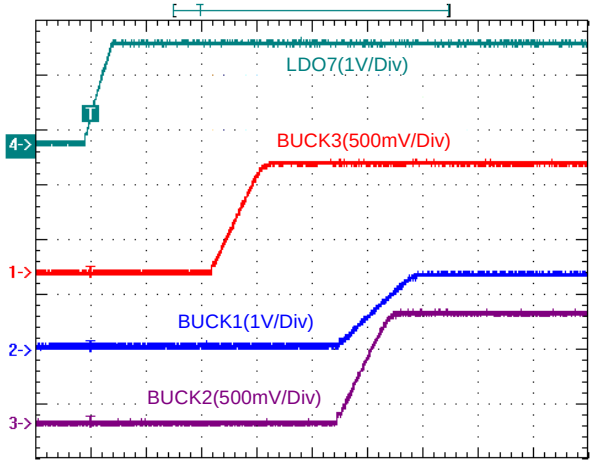
10ms/Div
BAT = 3.8V, Load = 0mA

Power OFF



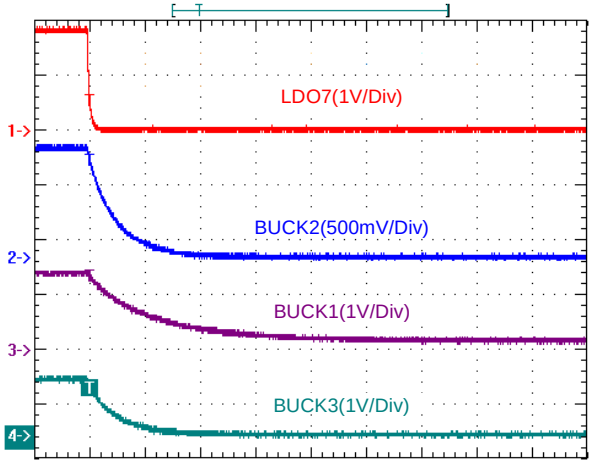
20ms/Div
BAT = 3.8V, Load = 0mA

Power ON



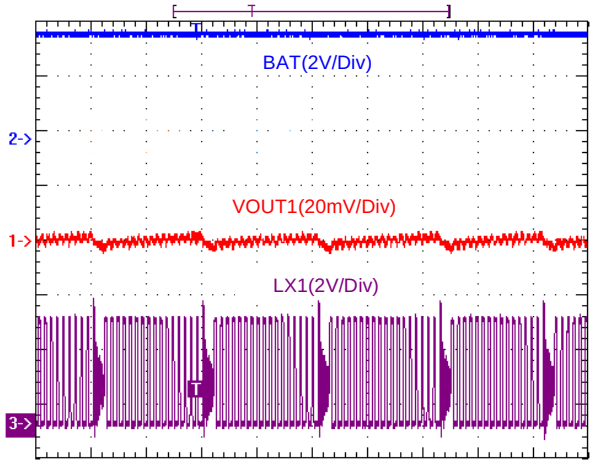
1ms/Div
BAT = 3.8V, Load = 0mA

Power OFF



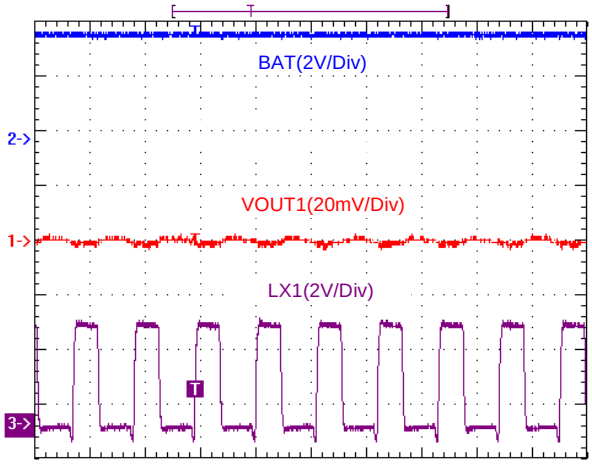
100ms/Div
BAT = 3.8V, Load = 0mA

BUCK1 Steady State Waveform



4us/Div
BAT = 3.8V, Load = 50mA

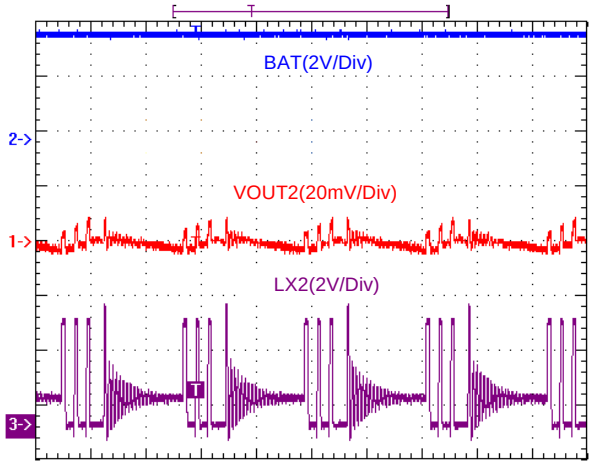
BUCK1 Steady State Waveform



400ns/Div
BAT = 3.8V, Load = 1A

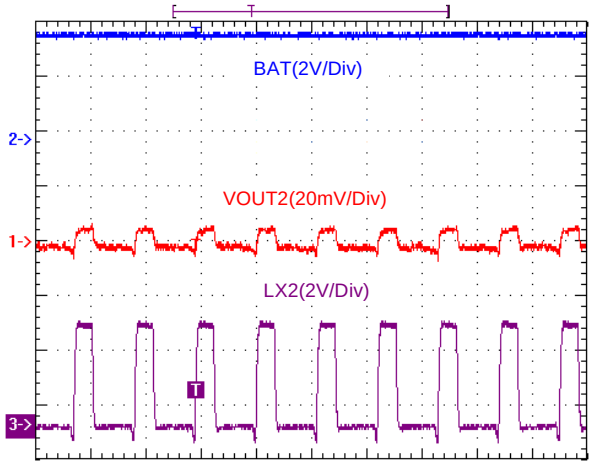
Typical Operation Characteristics

BUCK2 Steady State Waveform



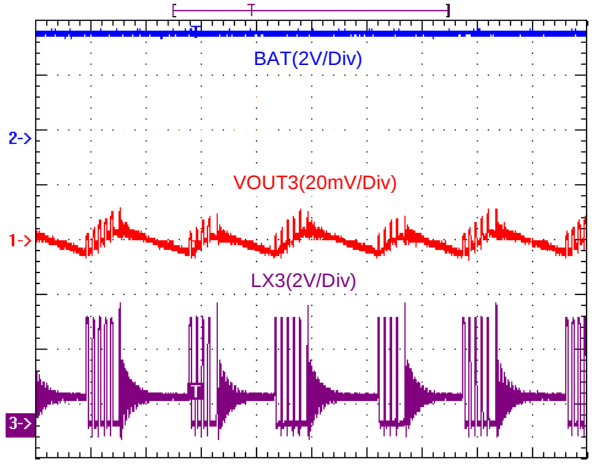
2us/Div
BAT = 3.8V, Load = 50mA

BUCK2 Steady State Waveform



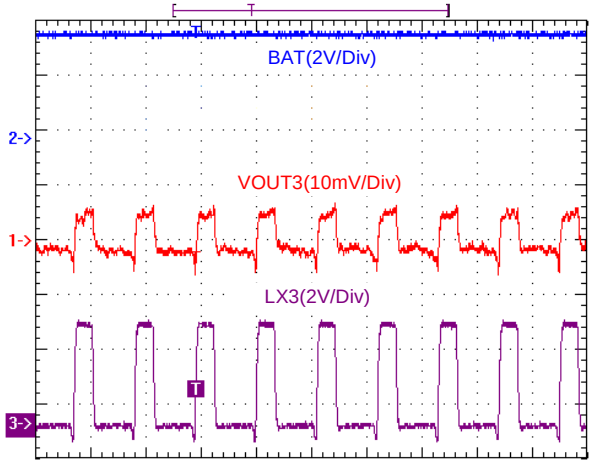
2us/Div
BAT = 3.8V, Load = 1A

BUCK3 Steady State Waveform



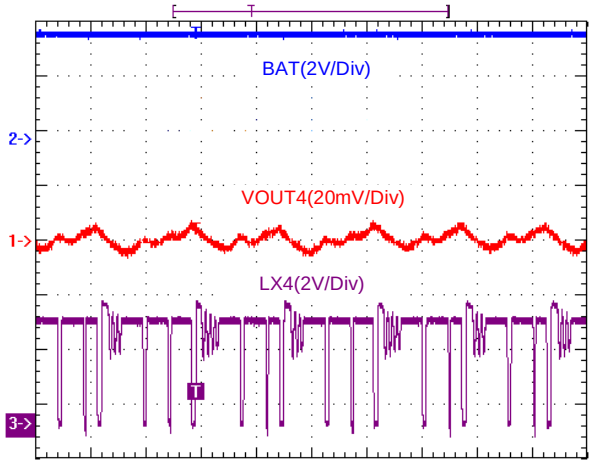
4us/Div
BAT = 3.8V, Load = 50mA

BUCK3 Steady State Waveform



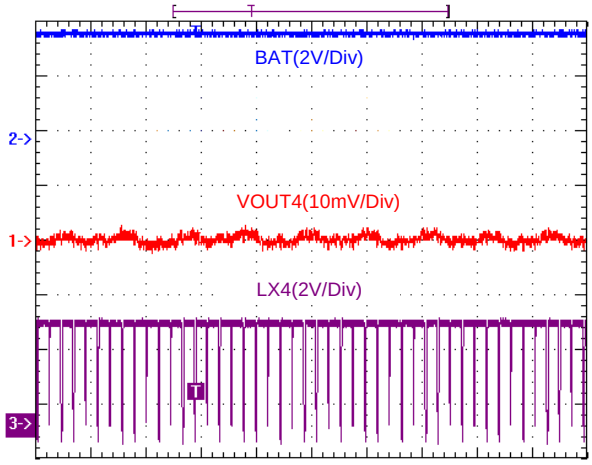
400ns/Div
BAT = 3.8V, Load = 1A

BUCK4 Steady State Waveform



2us/Div
BAT = 3.8V, Load = 50mA

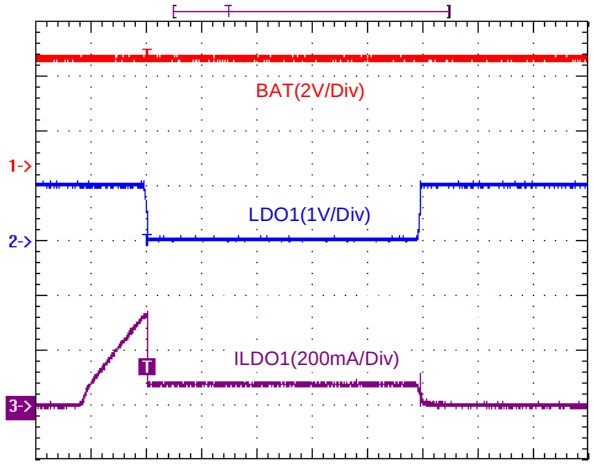
BUCK4 Steady State Waveform



2us/Div
BAT = 3.8V, Load = 1A

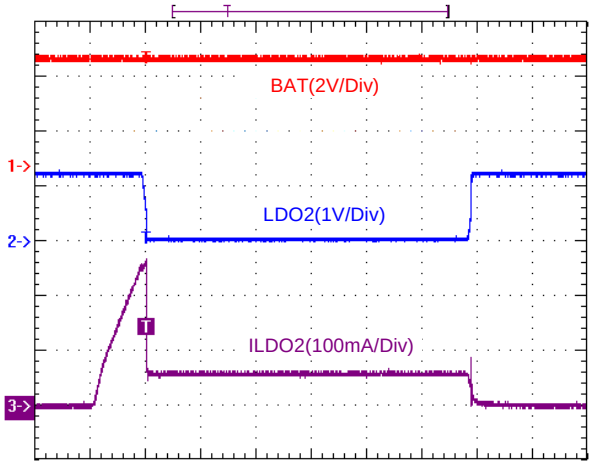
Typical Operation Characteristics

LDO1 Current Limit Waveforms



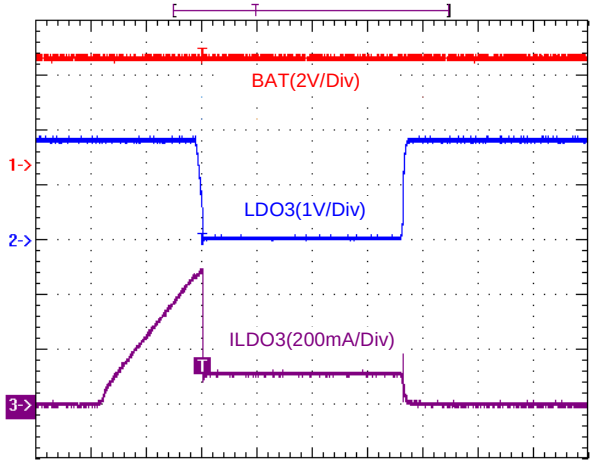
1ms/Div
BAT = 3.8V

LDO2 Current Limit Waveforms



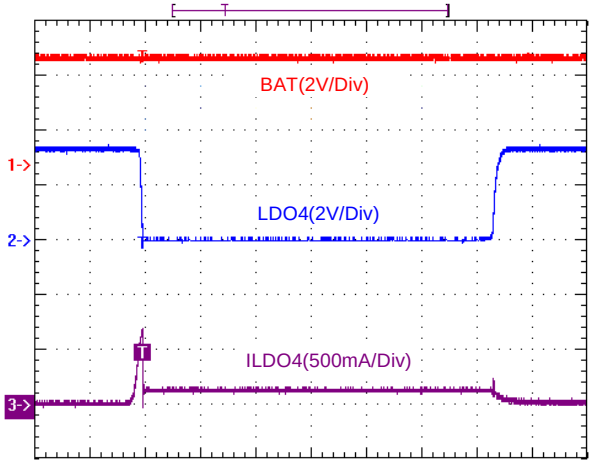
1ms/Div
BAT = 3.8V

LDO3 Current Limit Waveforms



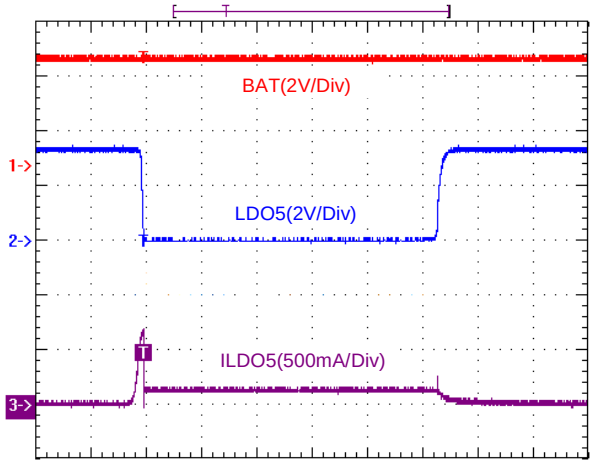
1ms/Div
BAT = 3.8V

LDO4 Current Limit Waveforms



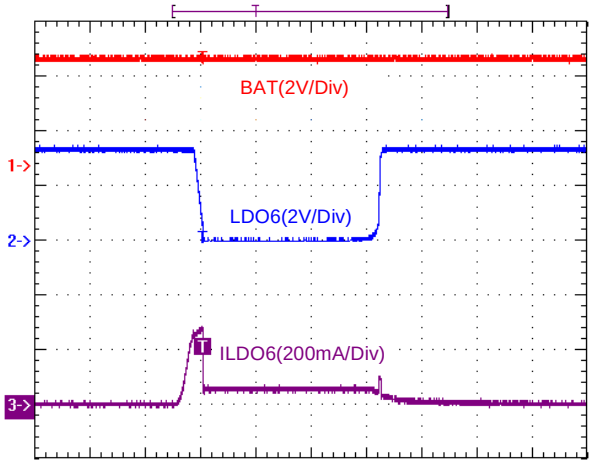
1ms/Div
BAT = 3.8V

LDO5 Current Limit Waveforms



1ms/Div
BAT = 3.8V

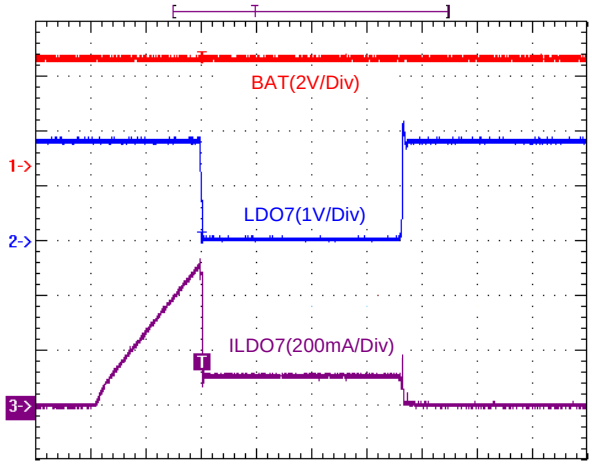
LDO6 Current Limit Waveforms



1ms/Div
BAT = 3.8V

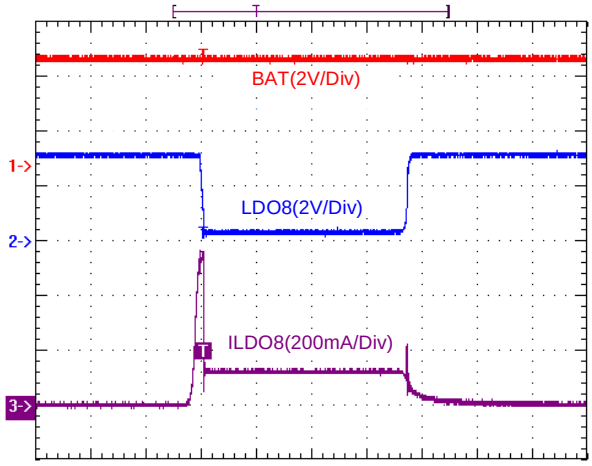
Typical Operation Characteristics

LDO7 Current Limit Waveforms



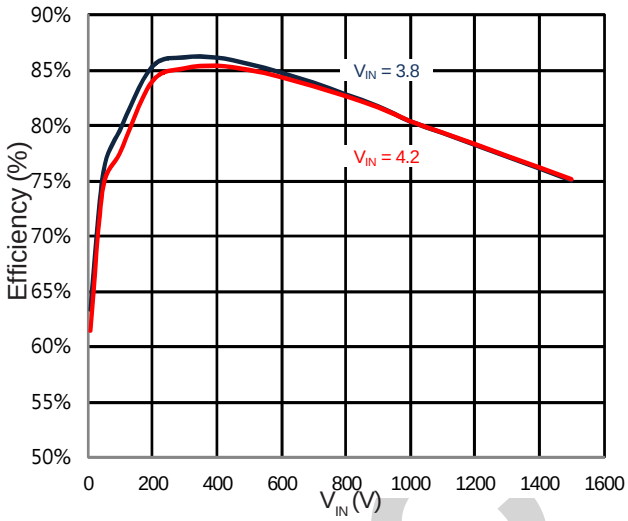
1ms/Div
BAT = 3.8V

LDO8 Current Limit Waveforms

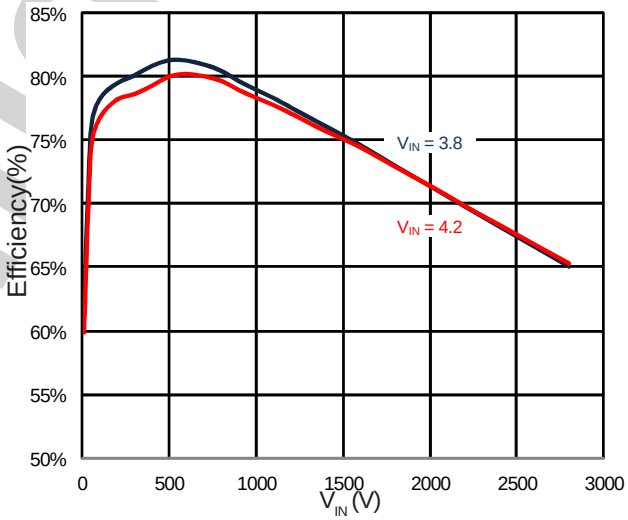


1ms/Div
BAT = 3.8V

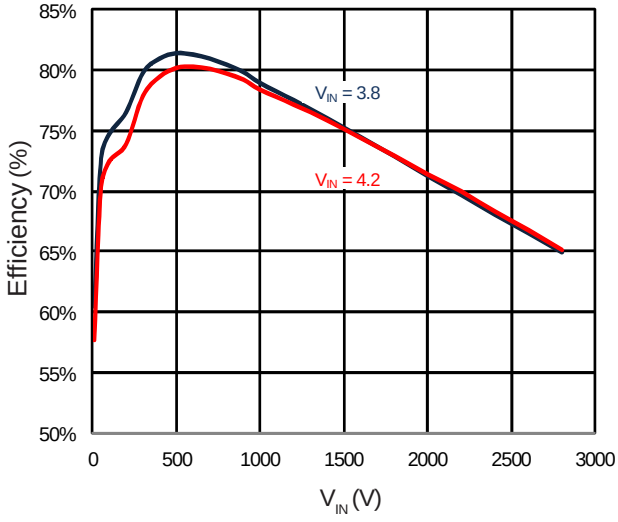
BUCK1 Efficiency



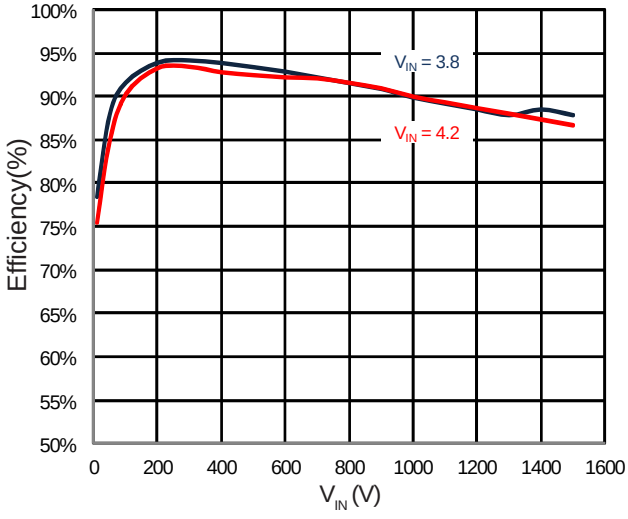
BUCK2 Efficiency



BUCK3 Efficiency



BUCK4 Efficiency



Application Information

BUCK"s: Output Inductor Selection

Output inductor selection is usually based on the considerations of inductance, rated current value, size requirements and DC resistance (DCR). The inductance is chosen based on the desired ripple current. Large value inductors result in lower ripple currents and small value inductors result in higher ripple currents. Higher input voltage or output voltage also increases the ripple current as shown in the equation below. A reasonable starting point for setting ripple current is £G IL = 20% of average load. For most applications, the value of the inductor will fall in the range of 1uH to 10uH.

$$\Delta I_L = \frac{1}{F_{SW} \times L} \times V_0 \times \left[1 - \frac{V_0}{V_1}\right]$$

where £GIL = ripple current in the inductor, fSW = operating frequency, L = inductor, VO = output voltage, and VI = input voltage.

Maximum current ratings of the inductor are generally specified in two methods: permissible DC current and saturation current. Permissible DC current is the allowable DC current that causes 40¢J temperature raise. The saturation current is the allowable current that causes 10% inductance loss. Make sure that the inductor will not saturate over the operation conditions including temperature range, input voltage range, and maximum output current.

BUCK's : Output Capacitor Selection

The uP1720P is specifically designed to operate with minimum 10uF X5R or X7R ceramic capacitor. The value can be increased to improve load/line transient performance. Y5V dielectrics, aside from losing most of their capacitance over temperature, they also become resistive at high frequencies. This reduces their ability to filter out high frequency noise. The ESR of the output capacitor determines the output ripple voltage and the initial voltage drop following a high slew rate load transient edge. The output ripple voltage can be calculated as:

$$\Delta V_0 = \Delta I_L \times \left[ESR + \frac{1}{8 \times F_{SW} \times C_O}\right]$$

where£GVO = output voltage ripple, £GIL = ripple current in the inductor, fSW = operating frequency, and COUT = output capacitance.

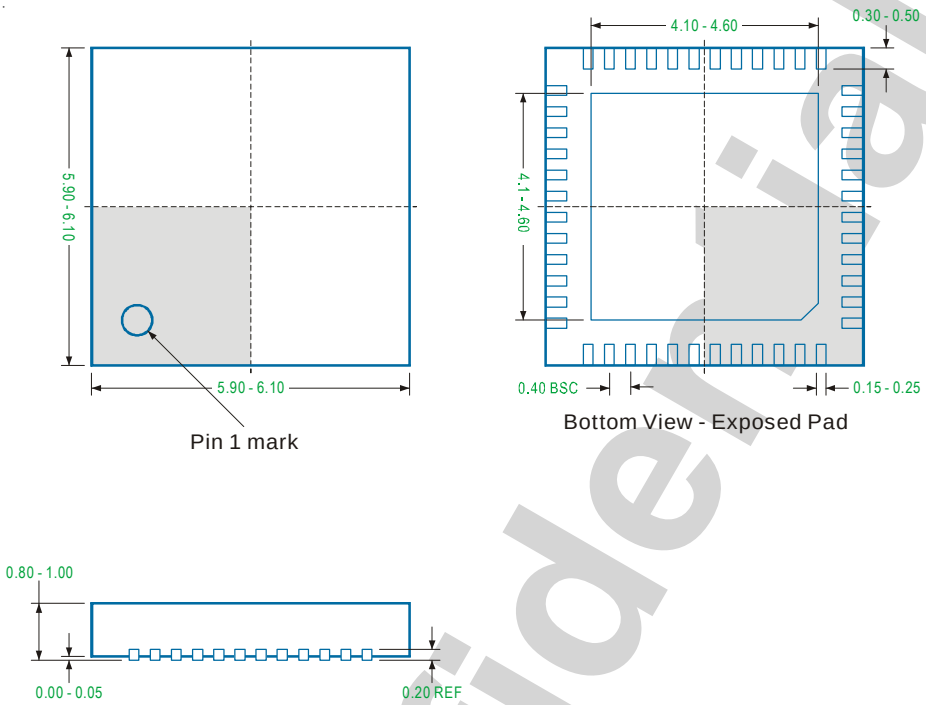
The ceramic capacitor with low ESR value provides the low output ripple and low size profile. Connect 10uF~22uF ceramic capacitor at output terminal for good performance and place the input and output capacitors as close as possible to the device.

LDO's: Input / Output Capacitors

The uP6636 is designed and optimized to work with low value, low-cost ceramic capacitors in space saving and performance consideration. A minimum 1uF capacitor is required from-input-to-ground to provide stability. Input capacitors greater than 1uF offer superior input line transient response and will assist in maximizing the highest possible power supply ripple rejection ratio (PSRR). Ceramic, tantalum, or aluminum electrolytic capacitors may be selected for CIN. Typical output capacitor values for maximum output current conditions range from 1uF to 10uF. Larger capacitors are recommended for applications expecting low output noise and optimum power supply ripple rejection characteristics. Place the capacitors physically as close as possible to the device with wide and direct PCB traces. X7R/X5R dielectric-type ceramic capacitors are recommended because of their temperature performance. X7R type capacitors loss capacitance by 15% over their operating temperature rand and are the most stable type of ceramic capacitors. Z5U or Y5V dielectric capacitors loss their capacitance by 50% and 60% respectively over their operating temperature ranges.

Package Information

VQFN 6x6-48L



Note

1. Package Outline Unit Description:
   BSC: Basic. Represents theoretical exact dimension or dimension target
   MIN: Minimum dimension specified.
   MAX: Maximum dimension specified.
   REF: Reference. Represents dimension for reference use only. This value is not a device specification.
   TYP. Typical. Provided as a general value. This value is not a device specification.
2. Dimensions in Millimeters.
3. Drawing not to scale.
4. These dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm.

Important Notice

uPI and its subsidiaries reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

uPI products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment. However, no responsibility is assumed by uPI or its subsidiaries for its use; nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of uPI or its subsidiaries.

uPI Semiconductor Corp.
Headquarter
9F.,No.5, Taiyuan 1st St. Zhubei City,
Hsinchu Taiwan, R.O.C.
TEL : 886.3.560.1666 FAX : 886.3.560.1888

Sales Branch Office
12F-5, No. 408, Ruiguang Rd. Neihu District,
Taipei Taiwan, R.O.C.
TEL : 886.2.8751.2062 FAX : 886.2.8751.5064