System PMIC for Battery Powered Systems

BD71805MWV

General Description

The BD71805MWV is a single chip power management IC for battery-powered portable devices. It integrates 4 bucks, 3 LDOs, 2A single-cell linear charger, OVP, Coulomb counter, RTC, 32 kHz crystal circuitry and 3 GPOs.

Four highly efficient 2.5MHz step-down converters supply power to the application processor as well as system peripherals such as DDR memory, wireless modules, sensors, etc. The regulators to the processor core supports DVS. The regulators maintain high efficiency over a wide range of current loads by supporting both PFM and PWM modes. High switching frequency allows the use of smaller and cheaper inductors and capacitors.

Features

- 4 programmable buck converters:
  - 1A and 2A bucks supporting DVS; 0.8-2V
  - 1A buck 1-2.7V and 1A buck 2.6-3.35V
- 3 LDOs with programmable output 0.8-3.3V
  - 300mA each
- LDO for DDR Reference Voltage
- LDO for Secure Non-Volatile Storage (SNVS)
- Single-cell Linear LIB Charger with 30V-OVP
  - Selectable Charging Voltage : 3.72 to 4.34 V
  - Programmable Charge Current : 100 to 2000mA
  - DCIN Over Voltage Protection
  - Battery Over Voltage Protection
  - Support Battery Supplement Mode
  - Battery Short Circuit Detection
- Voltage Measurement for Thermistor
  - Bias Voltage Output for External Thermistor
- Embedded Coulomb Counter for Battery Fuel Gauging
  - 15-bit ΔΣ-ADC with External Current Sense Resistor (10 mΩ, ±1%)
  - 1-sec cycle, 28-bit Accumulation
  - Coulomb Count while Charging/Discharging
- Battery Monitoring and Alarm Output
  - Under Voltage Alarm while Discharging
  - Over Discharge Current Alarm
  - Over/Under Temperature Alarm
  - Programmable Thresholds and Time Durations
  - Automatic Low Voltage Mode (Battery Protection)
    - 3.5V Detection :
      Interrupt to Processor to Ask User Plug-in
    - 3.3V Detection :
      Interrupt to Processor to Indicate Battery Critically Low Condition
- Real Time Clock with 32.768kHz Crystal Oscillator
  - 32.768kHz Clock Output
    (Open Drain or CMOS Output Selectable)
- 3 GPOs (Open Drain or CMOS Output Selectable)
- Power Control I/O
  - Power On/Off Control Input
  - Standby Input for Switching ON / STANDBY Mode
  - Reset Input to Reset Hung PMIC
  - Power On Reset Output
- I2C Interface

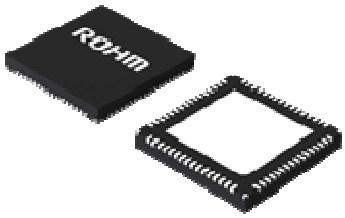
Applications

- E-Book Reader, Tablets, Media Boxes
- Portable Printers, Scanners, POS
- HMI, Home Automation, SBC

Key Specifications

- Input Voltage Range (DCIN): 3.5V to 28V
- Input Voltage Range (VIN,VSYS): 3.3V to 5.5V
- Input Voltage Range (DVDD): 1.5V to 3.4V
- Off Current : 25 μA (Typ)
  [RTC + Coulomb counter + LDO_SNVS+ 32-kHz OSC]
- Operating temperature range: -40℃ to +85℃

Package	W(Typ)	D(Typ)	H(Max)
UQFN64MV8080	8.0mm x 8.0mm x 1.0mm		



Status of this document
The English version of this document is formal specification. A customer may use this translation version only for a reference to help reading the formal version. If there are any differences in translation version of this document formal version takes priority.

Typical Applications

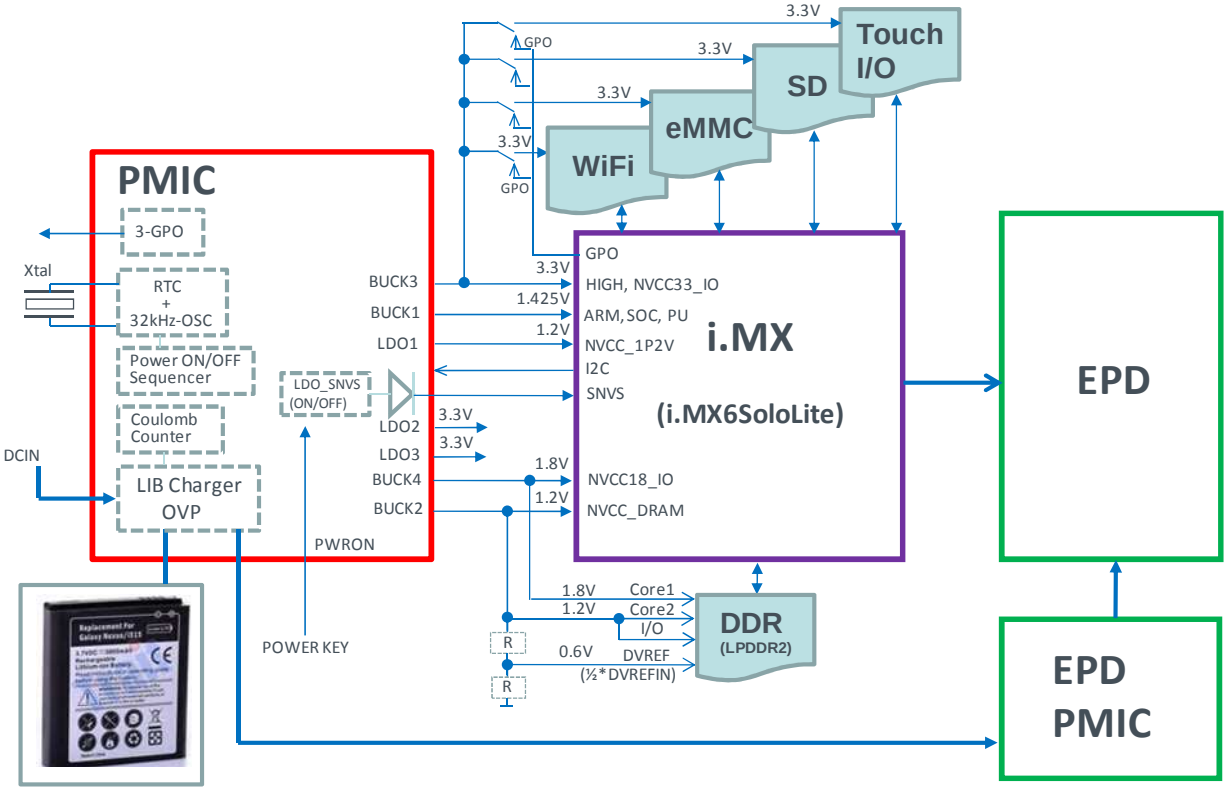


Figure 1. Typical Applications 1 (Master Control Mode)

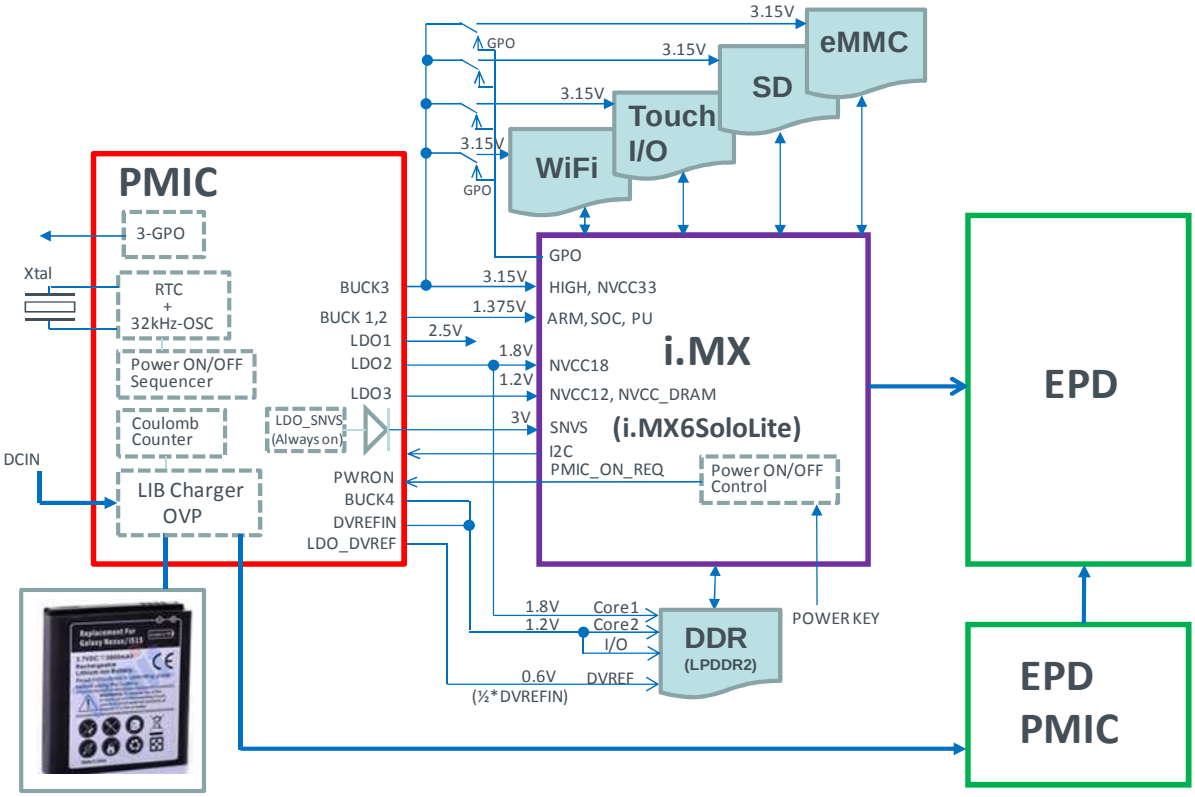


Figure 2. Typical Applications 2 (Slave Control Mode)

Block Diagram

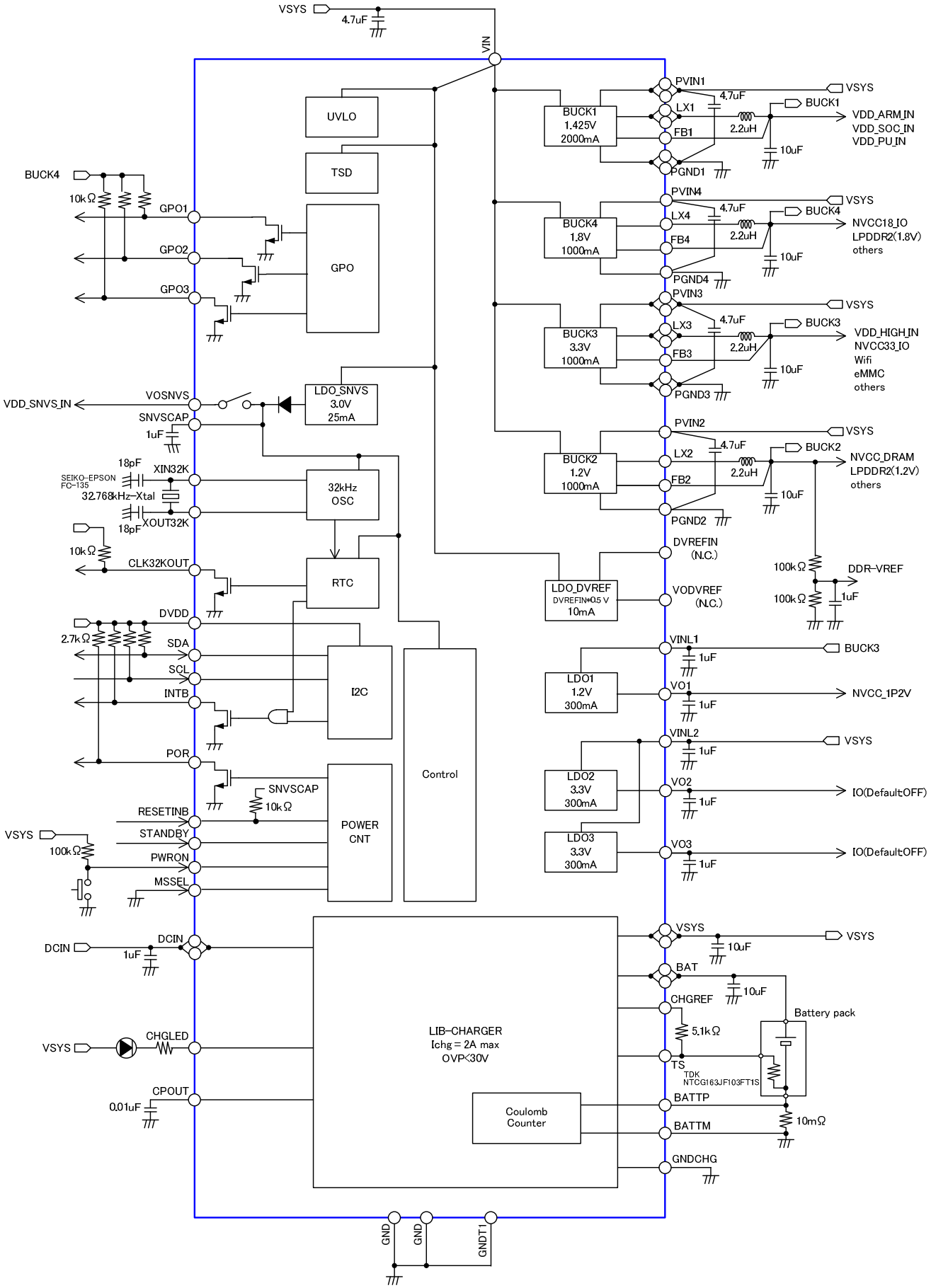


Figure 3. IC Block Diagram (Master Control Mode)

Block Diagram - continued

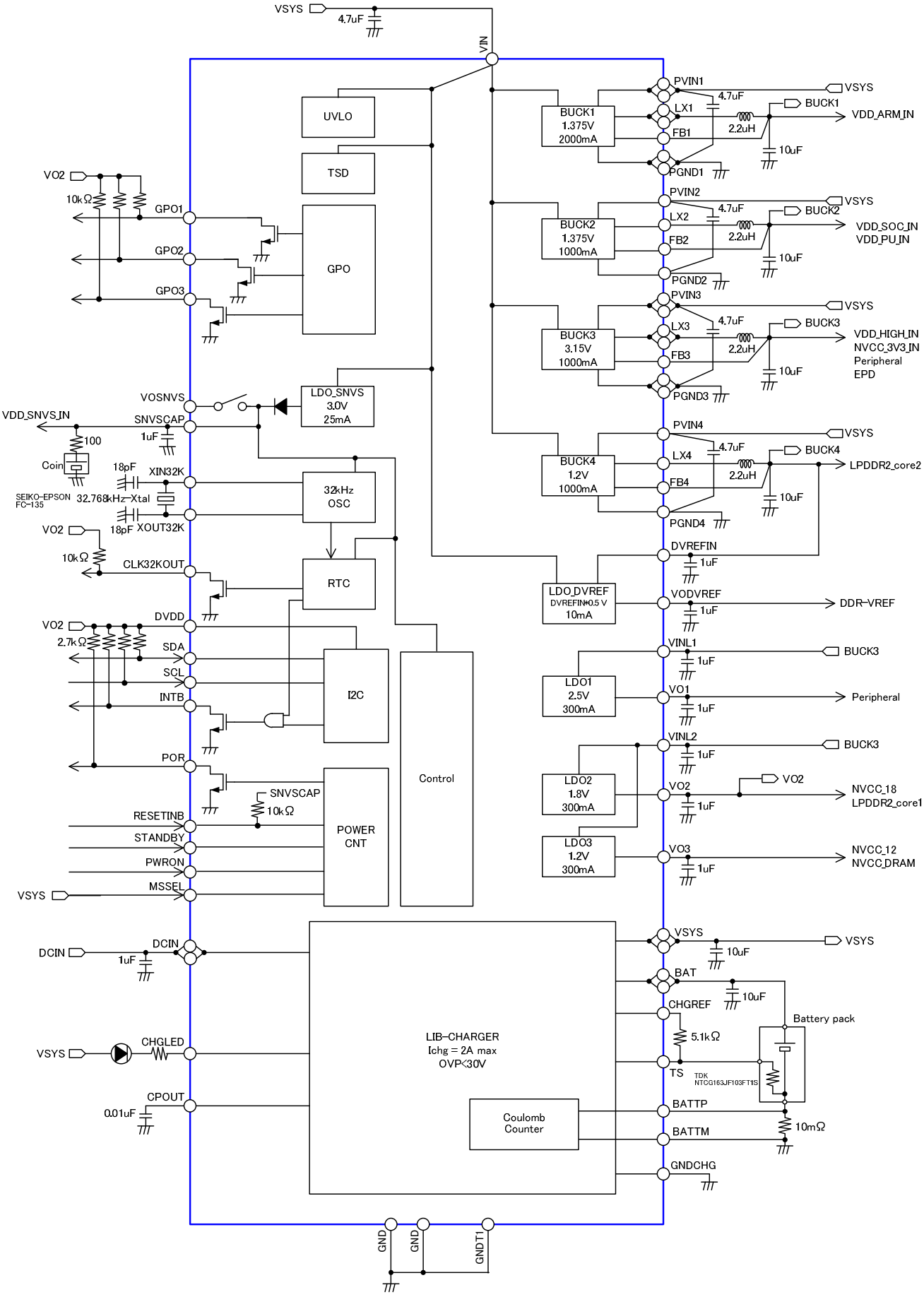


Figure 4. IC Block Diagram (Slave Control Mode)

Pin Configuration

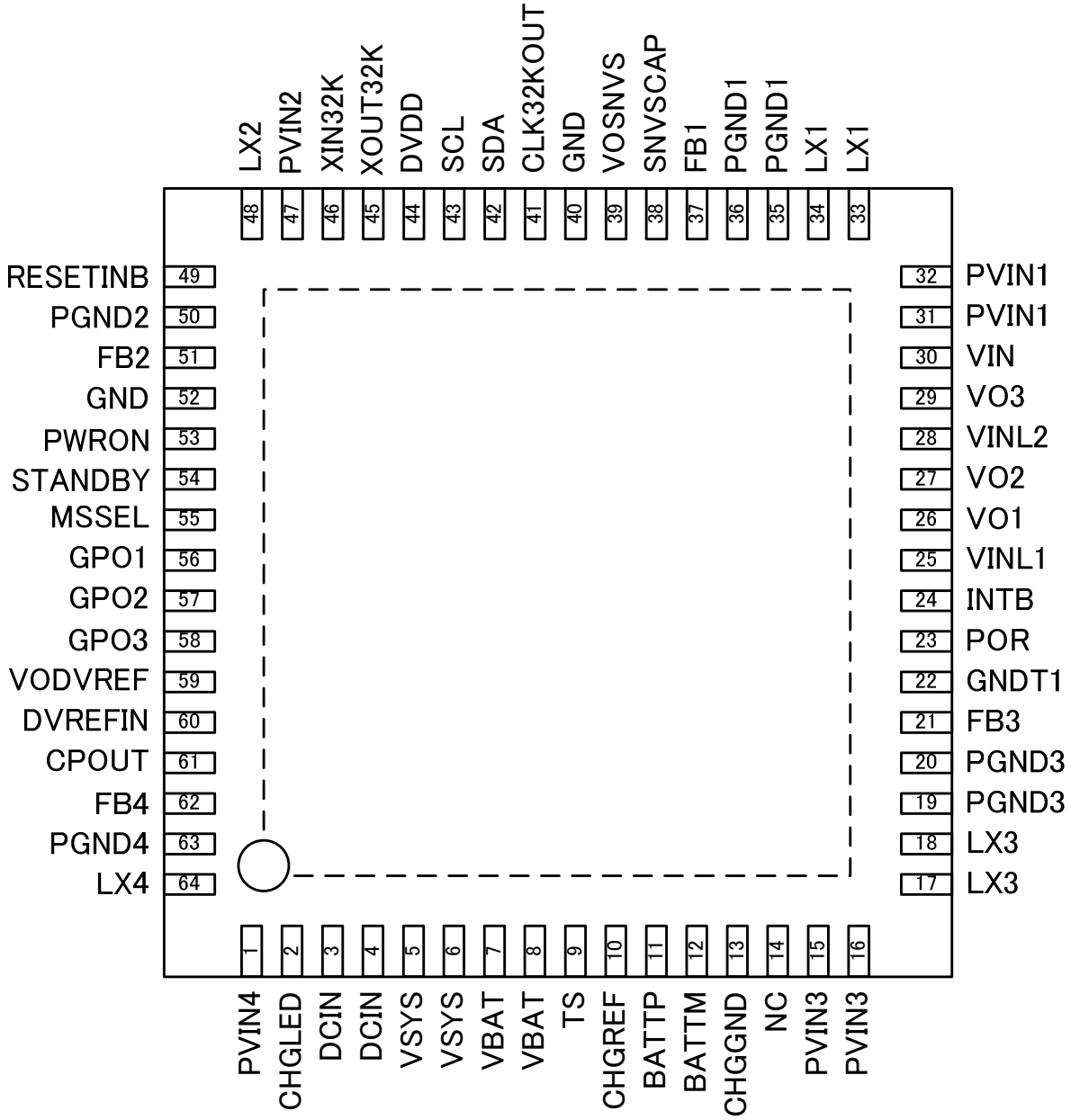


Figure 5. Pin Configuration (Top View)

Pin Descriptions

Table 1. BD71805MWV Pin Description

Pin No.	Pin Name.	I/O	Function
1	PVIN4	I	Input power supply for BUCK4
2	CHGLED	O	Open-Drain Charging status Indication output
3	DCIN	I	DCIN power supply
4	DCIN	I	DCIN power supply
5	VSYS	O	System supply output
6	VSYS	O	System supply output
7	VBAT	I/O	Charger power stage output and battery voltage sense input
8	VBAT	I/O	Charger power stage output and battery voltage sense input
9	TS	I	Battery pack thermistor voltage sense
10	CHGREF	O	Internal reference for the LIB charger
11	BATTP	I	Current sense input (battery pack side)
12	BATTM	I	Current sense input (ground side)
13	CHGGND	-	Ground for Charger
14	NC	-	No Connection
15	PVIN3	I	Input power supply for BUCK3
16	PVIN3	I	Input power supply for BUCK3
17	LX3	O	Switch node connection for BUCK3
18	LX3	O	Switch node connection for BUCK3
19	PGND3	I	Power ground for BUCK3
20	PGND3	I	Power ground for BUCK3
21	FB3	I	Output voltage feedback for BUCK3
22	GNDT1	-	Ground for test
23	POR	O	Power on reset output
24	INTB	O	Open drain interrupt signal to processor
25	VINL1	I	LDO input for LDO1
26	VO1	O	LDO output for LDO1
27	VO2	O	LDO output for LDO2
28	VINL2	I	LDO input for LDO2, LDO3
29	VO3	O	LDO output for LDO3
30	VIN	I	Input power supply
31	PVIN1	I	Input power supply for BUCK1
32	PVIN1	I	Input power supply for BUCK1
33	LX1	O	Switch node connection for BUCK1
34	LX1	O	Switch node connection for BUCK1
35	PGND1	-	Power ground for BUCK1.
36	PGND1	-	Power ground for BUCK1.

Pin Descriptions - continued

Table 2. BD71805MWV Pin Descriptions (continued)

Pin No.	Pin Name.	I/O	Function
37	FB1	I	Output voltage feedback for BUCK1
38	SNVSCAP	O	LDO output for secure non-volatile storage (requires capacitor)
39	VOSNVS	O	LDO output for secure non-volatile storage
40	GND	-	Signal ground
41	CLK32KOUT	O	32.768kHz clock output (Open drain or CMOS output selectable)
42	SDA	I/O	I2C data line (Open drain)
43	SCL	I	I2C clock
44	DVDD	I	Power supply for I2C Interface
45	XOUT32K	O	32.768kHz-Xtal output
46	XIN32K	I	32.768kHz-Xtal input
47	PVIN2	I	Input power supply for BUCK2
48	LX2	O	Switch node connection for BUCK2
49	RESETINB	I	Reset input to Shutdown BD71805MWV
50	PGND2	-	Power ground for BUCK2
51	FB2	I	Output voltage feedback for BUCK2
52	GND	-	Signal ground
53	PWRON	I	Power On/Off control input
54	STANDBY	I	Standby input signal for switching the ON and STANDBY modes
55	MSSEL	I	Master or Slave mode selector
56	GPO1	O	Output for general purpose (Open drain or CMOS output selectable)
57	GPO2	O	Output for general purpose (Open drain or CMOS output selectable)
58	GPO3	O	Output for general purpose (Open drain or CMOS output selectable)
59	VODVREF	O	LDO output for DDR-VREF
60	DVREFIN	I	LDO input for DDR-VREF
61	CPOUT	O	Charge Pump Output for OVP
62	FB4	I	Output voltage feedback for BUCK4
63	PGND4	-	Power ground for BUCK4
64	LX4	O	Switch node connection for BUCK4

Description of Blocks

1. High Efficiency Buck Converters (BUCK1 – 4) and LDOs

BD71805MWV step down converters operate at fixed frequency of 2.5MHz and employ Pulse Width Modulation (PWM) at moderate to heavy load current. At light load current, a converter would automatically enter Power Save Mode and operate in Pulse Frequency Modulation (PFM).

During PWM operation, the converter uses a unique fast response voltage mode controller scheme with feed-forward input voltage to achieve good line and load regulation, thus allowing the use of small ceramic input and output capacitors. At the beginning of each clock cycle initiated by the clock signal, the high side MOSFET switch is turned on. The current flows from the input capacitor via the high side MOSFET switch through the inductor to the output capacitor and load. During this phase, the current ramps up until the PWM comparator trip causing the control logic to turn on the switch. The current limit comparator will also turn OFF the switch in case the current limit of the high side MOSFET switch is exceeded. The low side MOSFET rectifier is turned ON and the inductor current ramps down after a dead time preventing shoot-through current. The current flows now from the inductor to the output capacitor and to the load. It returns back to the inductor through the low side MOSFET rectifier. The next cycle will again be initiated by the clock signal turning off the low side MOSFET rectifier and turning on the on the high side MOSFET switch.
When each regulators are turn off, their output capacitors are discharged via internal 600ohm resistor.

Initial output voltage of each regulators are configurable by factory OTP (One Time Programmable memory) options. These OTP options can only be programmed by ROHM. If alternate OTP setting are desired, please contact ROHM.

Table 3. BD71805MWV Output Power Rails (Master Control Mode)

BD71805MWV Output	i.MX6 SoloLite Usage example	Power Supply	Initial Output Voltage	Load max	Adjustable range
BUCK1	ARM/SOC/PU	PVIN1	1.425V	2000mA	0.8 to 2.000V (25mV step) [DVS]
BUCK2	NVCC_DRAM / LPDDR2(1.2V) / Others	PVIN2	1.2V	1000mA	0.8 to 2.000V (25mV step) [DVS]
BUCK3	HIGH / NVCC33_IO/ Wifi / eMMC / Others	PVIN3	3.3V	1000mA	2.6 to 3.35V (50mV step)
BUCK4	NVCC18_IO / LPDDR2(1.8V) / Others	PVIN4	1.8V	1000mA	1.0 to 2.7V (50mV step)
VO1(LDO1)	NVCC_1P2V	VINL1	1.2V	300mA	0.8 to 3.3V (50mV step)
VO2(LDO2)	IO (Default:OFF)	VINL2	3.3V	300mA	0.8 to 3.3V (50mV step)
VO3(LDO3)	IO (Default:OFF)	VINL2	3.3V	300mA	0.8 to 3.3V (50mV step)
VODVREF	DDR_VREF (Default:OFF)	VIN	0.5*DVREFIN	10mA	0.4 to 1.00V (DVREFIN= BUCK2)(Note1)
VOSNVS	SNVS	VIN	3.0V	25mA	Fixed

(Note1) When VODVREF is not in use, please keep DVREFIN and VODVREF open.

Table 4. BD71805MWV Output Power Rails (Slave Control Mode)

BD71805MWV Output	i.MX6 SoloLite Usage example	Power Supply	Initial Output Voltage	Load max	Adjustable range
BUCK1	ARM	PVIN1	1.375V	2000mA	0.8 to 2.000V (25mV step) [DVS]
BUCK2	SOC/PU	PVIN2	1.375V	1000mA	0.8 to 2.000V (25mV step) [DVS]
BUCK3	HIGH / NVCC33_IO Peripheral, EPD	PVIN3	3.15V	1000mA	2.6 to 3.35V (50mV step)
BUCK4	LPDDR2(1.2V)	PVIN4	1.2V	1000mA	1.0 to 2.7V (50mV step)
VO1(LDO1)	Peripheral	VINL1	2.5V	300mA	0.8 to 3.3V (50mV step)
VO2(LDO2)	NVCC18_IO / LPDDR2(1.8V)	VINL2	1.8V	300mA	0.8 to 3.3V (50mV step)
VO3(LDO3)	NVCC_1P2V / NVCC_DRAM	VINL2	1.2V	300mA	0.8 to 3.3V (50mV step)
VODVREF	DDR_VREF	VIN	0.5*DVREFIN	10mA	0.5 to 1.35V (DVREFIN=BUCK4)
SNVSCAP	SNVS	VIN	3.0V	25mA	Fixed

Efficiency Curves of bucks

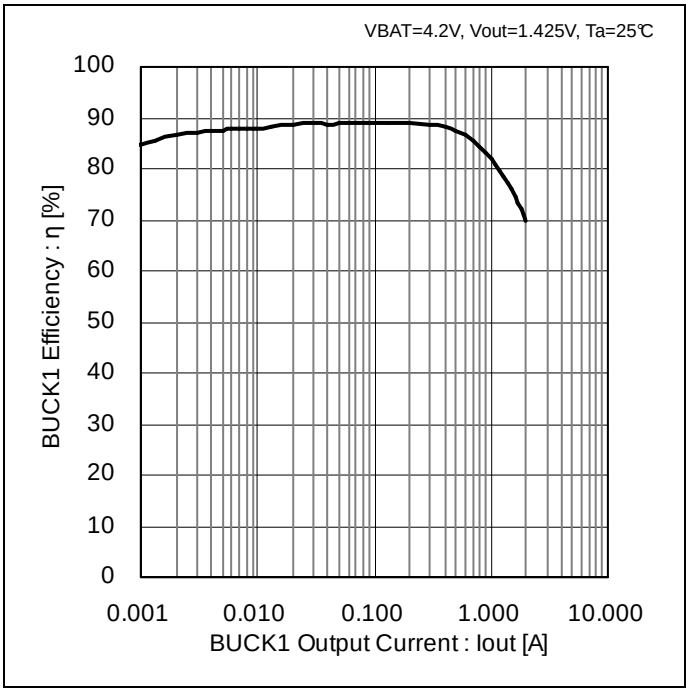


Figure 6. BUCK1 – Efficiency
(Auto Mode)

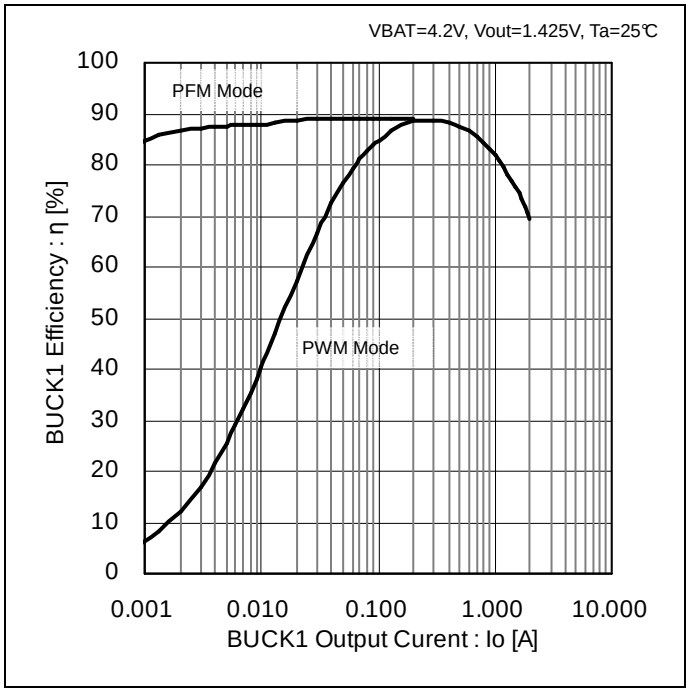


Figure 7. BUCK1 – Efficiency
(PWM Mode / PFM Mode)

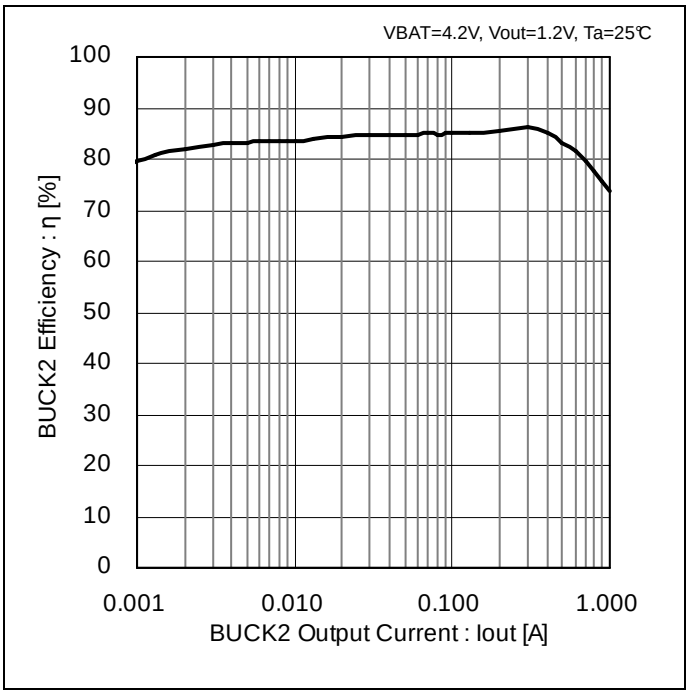


Figure 8. BUCK2 – Efficiency
(Auto Mode)

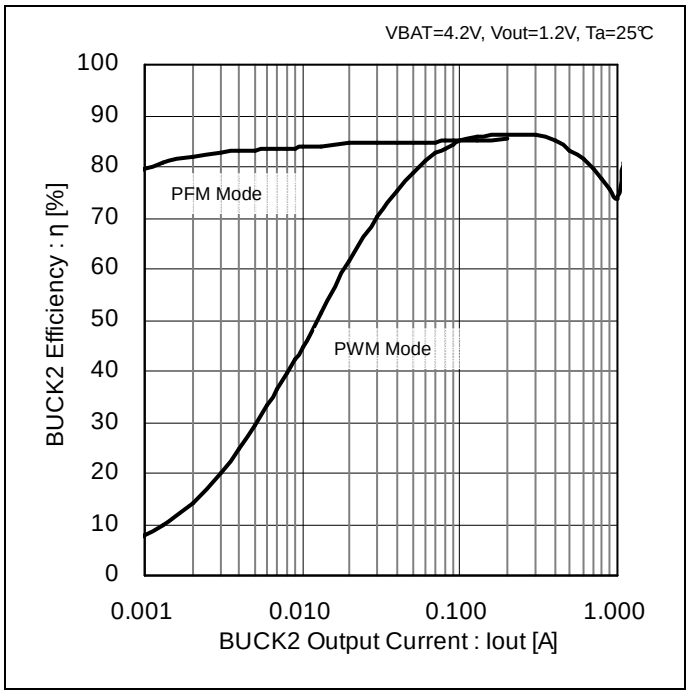


Figure 9. BUCK2 – Efficiency
(PWM Mode / PFM Mode)

Efficiency Curves of bucks - continued

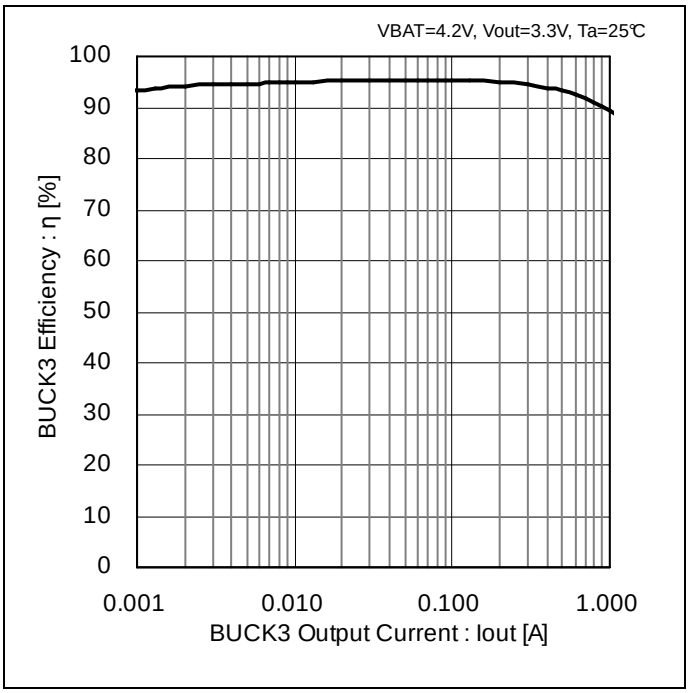


Figure 10. BUCK3 – Efficiency
(Auto Mode)

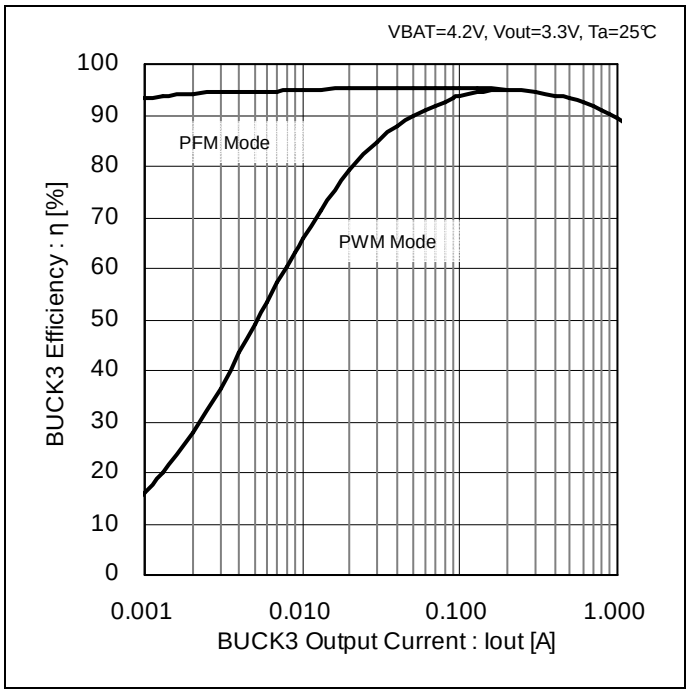


Figure 11. BUCK3 – Efficiency
(PWM Mode / PFM Mode)

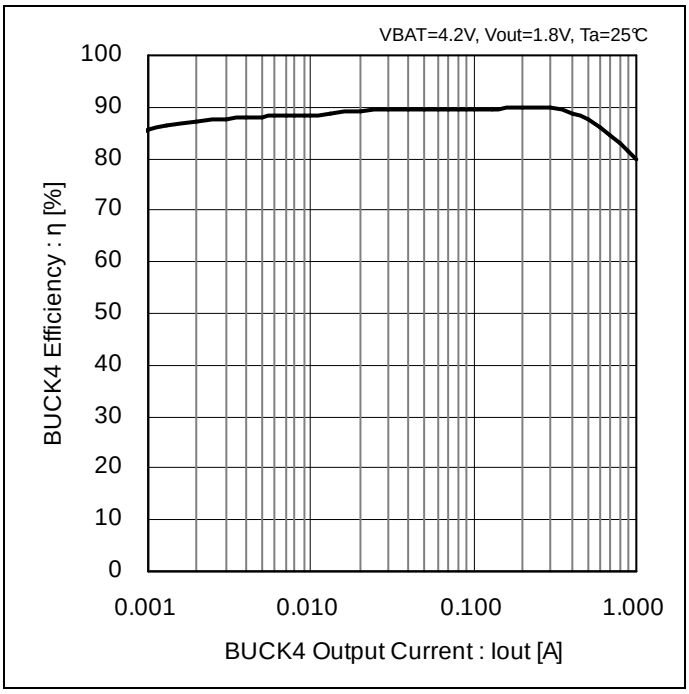


Figure 12. BUCK4 – Efficiency
(Auto Mode)

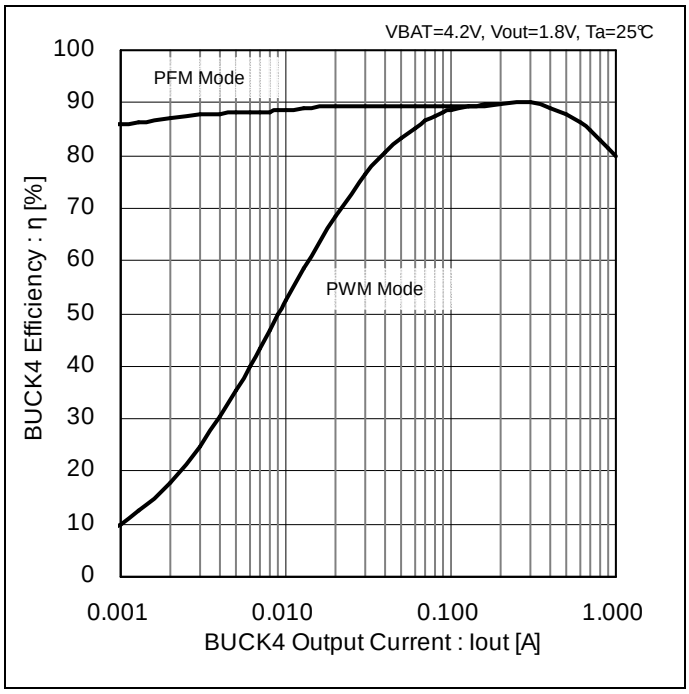


Figure 13. BUCK4 – Efficiency
(PWM Mode / PFM Mode)

2. Power ON/OFF Sequence

(1) Master Control Mode

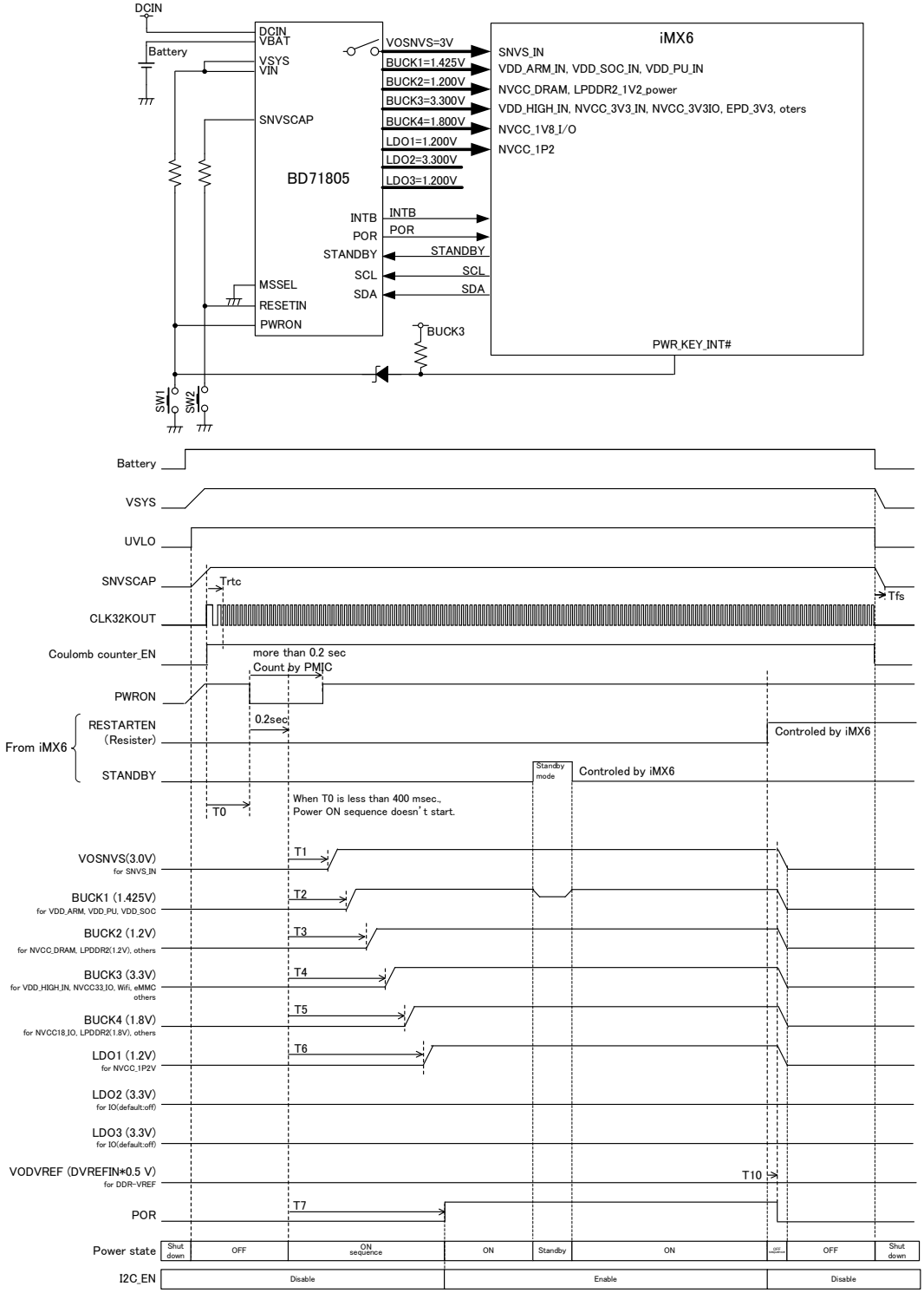


Figure 14. Power-ON/OFF Sequence (Master control mode)

(2) Slave Control Mode

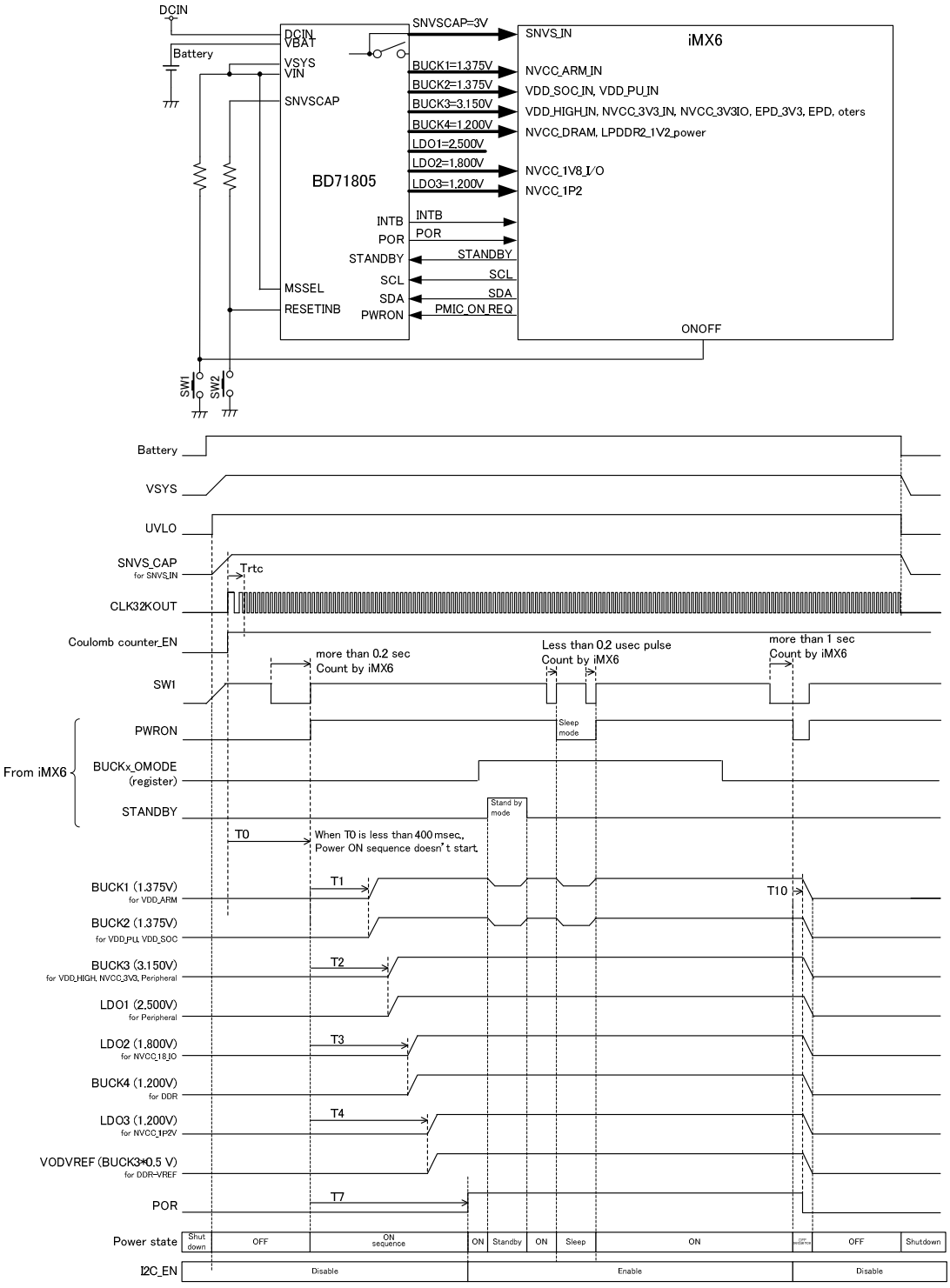


Figure 15. Power-ON/OFF Sequence (Slave control mode)

3. Over Voltage Protection (OVP) Block

Features

- Single-input for the battery charger source: DCIN
- 30V over voltage protection for DCIN input.

4. Battery Charger Block

Features

- Supports battery insertion and removal detection
- JEITA compliant Battery Charging Profile with thermal control of charging current and voltage settings. This is achieved by measuring the temperature from the external thermistor (The Initial setting of BD71805MWV is adjusted to TDK NTCG163JF103FT1S).
- Supports battery supplement mode
- Automatic or manual (software) control of Watch Dog Timer while Pre–charging and Fast-charging
- Charger statuses or Error conditions are indicated on CHGLED output (for LED lighting)

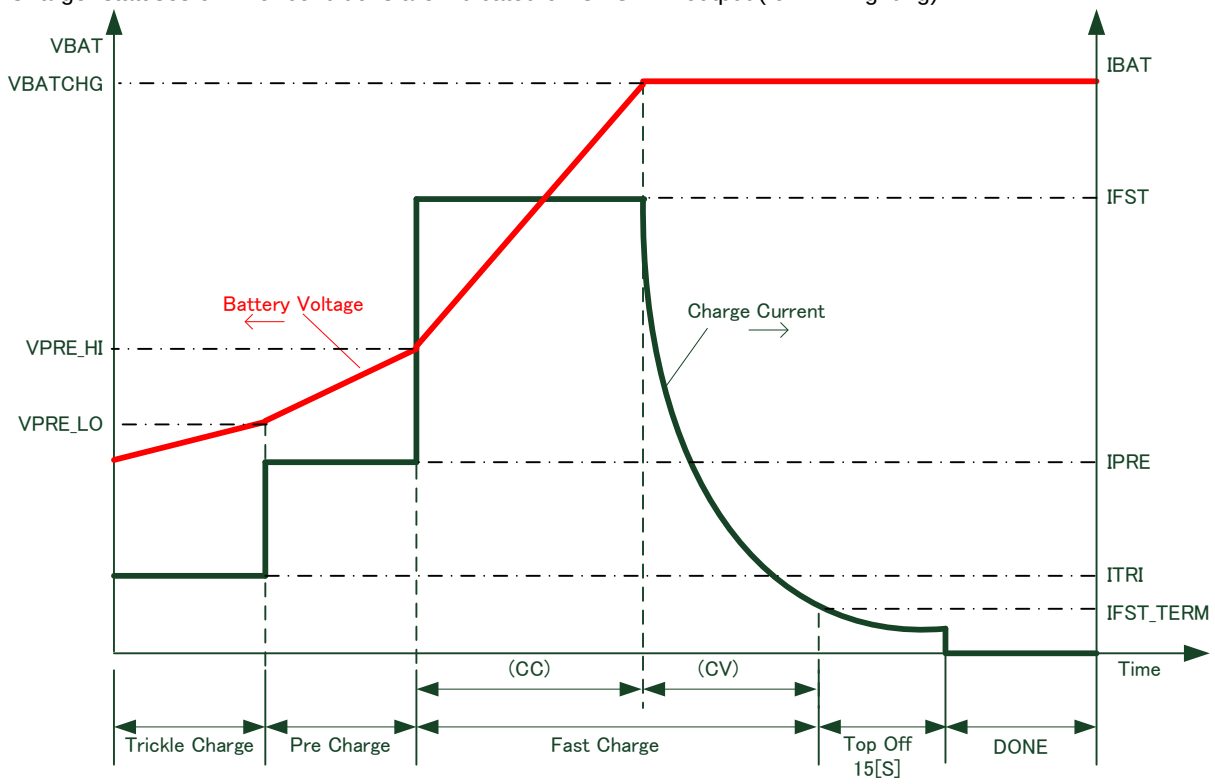


Figure 16. Battery Charger Output Control

5. Coulomb Counter Block

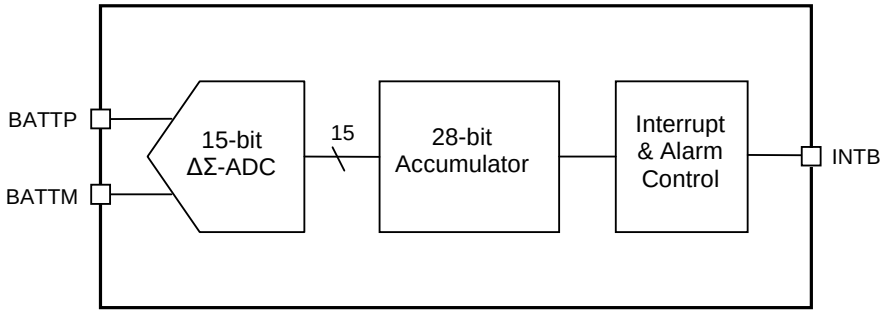


Figure 17. Coulomb Counter Block Diagram

Features

- 28-bit Coulomb Counter for battery fuel gauging
- 15-bit ΔΣ-ADC measures the battery's charge and discharge current by means of an external current sense resistor (10mΩ, ±1%).
- Charging/Discharging amount integration period : 1sec
- Coulomb Counter value approaches the battery capacity when finished charging.
- While discharging, a Half-capacity alarm and a Near-empty alarm can be output from INTB terminal

6. 12-bit ADC (SAR) Block

Features

- 12-bit Successive Approximation Register A/D Converter
- Conversion period: 40μs
- Input Voltage range: 0.6 to 5.4V (VBAT for Battery voltage monitor)
- Input Voltage range: 0.6 to 5.4V (VSYS for System input voltage monitor)
- Input Voltage range: 0.2 to 1.3V (Vf for BD71805MWV die temperature monitor)
- Input Voltage range: 0.2 to 1.3V (TS for Battery temperature monitor)
- Input Voltage range: -30m to 30mV (BATTP for Battery current monitor)
- Input Voltage range : 2 to 16V (DCIN for DCIN voltage monitor)

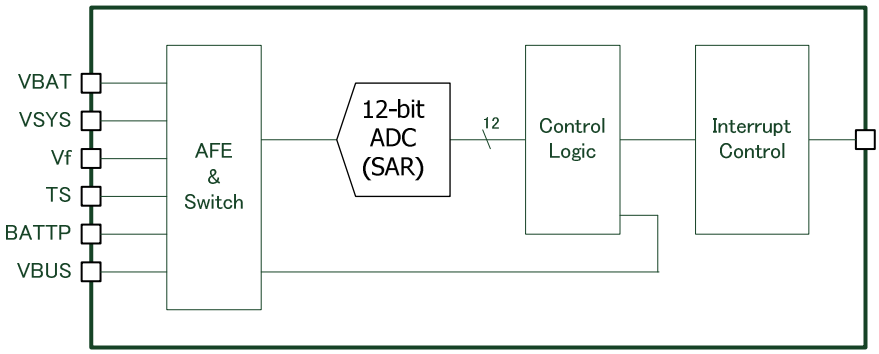


Figure 18. 12-bit ADC Block Diagram

7. Real Time Clock (RTC) Block

Features

- RTC is driven by 32.768 kHz oscillator and provides alarm and time keeping functions to the nearest second.
- Time information in seconds, minutes, and hours.
- Calendar information in day, month, year, and day of the week.
- Alarm interrupt sent at the time and day which are programmed into registers.
- Key status flags retained through reset and power cycle in RTC backup flags, e.g., reason for power-on or power-off
- Eight bit registers have values that are retained even after the main battery resets to zero when transitioning or until SHUTDOWN state.
- Eight bit registers have a lock control that once written will lock the resistor until SHUTDOWN state is entered.
- Leap year compensation up to 2099.
- Selectable 12-hour and 24-hour modes.
- RTC calibration support.
- Oscillator failure detection.
- 32.768 kHz crystal oscillator recommends SEIKO EPSON FC-135.
  When above-mentioned crystal FC-135 is used, input capacitance (Cin) value and output capacitance (Cout) value recommend 18pF. When different crystal is used, please set Cin and Cout capacitance value on enough matching validation.
- 32.768 kHz crystal oscillator is affected by PCB pattern, parasitic capacitance, the disturbance. To reduce the above-mentioned influence, please place 32.768 kHz crystal connected between XIN32K terminal and XOUT32K terminals and XIN32K input capacitance (Cin) and XOUT32K output capacitance (Cout) to the IC as close as possible. In PCB pattern design, please be careful about the interference with other signal lines.

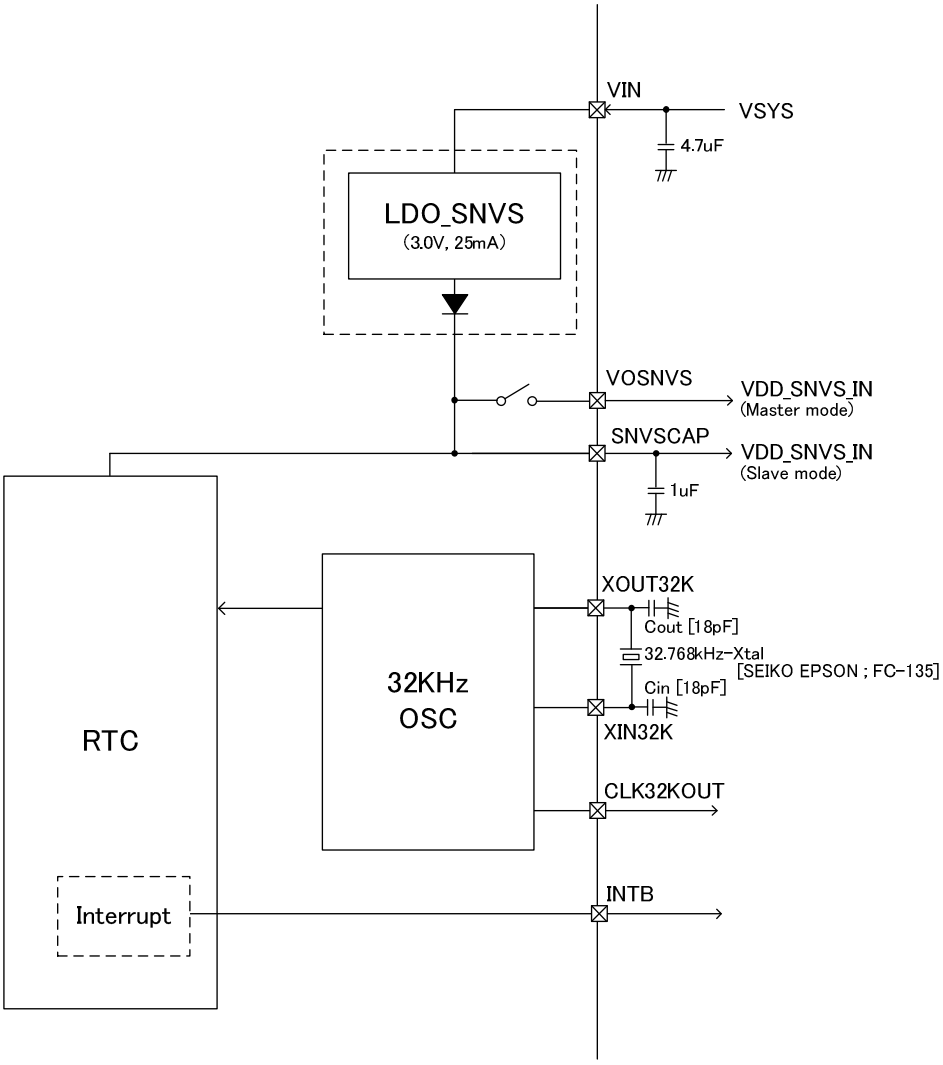


Figure 19. RTC Block Diagram

Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Rating	Unit
Maximum Supply Voltage 1 DCIN	$V_{DCINMAX}$	30	V
Maximum Supply Voltage 2 VIN, PVIN1,2,3,4, VINL1, VINL2	V_{INMAX} P_{VINMAX} $V_{INL1MAX}$ $V_{INL2MAX}$	6.0	V
Maximum Supply Voltage 3 DVDD	$V_{DVDDMAX}$	4.5	V
Power Dissipation (Note1)	Pd	4.16	W
Operating Temperature Range	Topr	-40 to +85	℃
Storage Temperature Range	Tstg	-55 to +125	℃

(Note 1) Derate by 41.6mW/℃ when operating above Ta=25℃ (w hen mounted in ROHM's standard board 74.2x74.2x1.6tmm).
Caution: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

Recommended Operating Conditions

Parameter	Symbol	Limits	Unit
Input Voltage Range 1 DCIN	V_{DCIN}	3.5 to 28	V
Input Voltage Range 2(Note2) VIN, PVIN1,2,3,4	V_{IN} P_{VIN}	3.3 to 5.5	V
Input Voltage Range 3 VINL1, VINL2	V_{INL1} V_{INL2}	2.6 to 5.5	V
Input Voltage Range 4 DVDD	V_{DVDD}	1.5 to 3.4	V

(Note2) It is necessary to supply the same voltage to VIN, and PVIN1,2,3,4

Operational Notes

1. **Reverse Connection of Power Supply**
   Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply terminals.

2. **Power Supply Lines**
   Design the PCB layout pattern to provide low impedance supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. **Ground Wiring Pattern**
   When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Thermal Consideration**
   Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in

deterioration of the properties of the chip. The absolute maximum rating of the Pd stated in this specification is when the IC is mounted on a 74.2mm x 74.2mm x 1.6tmm glass epoxy board. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the Pd rating.

6. Recommended Operating Conditions

These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

7. Inrush Current

When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

8. Operation Under Strong Electromagnetic Field

Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

9. Testing on Application Boards

When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

10. Inter-pin Short and Mounting Errors

Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

Operational Notes – continued

11. Unused Input Terminals

Input terminals of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input terminals should be connected to the power supply or ground line.

12. Regarding the Input Pin of the IC

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.
When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

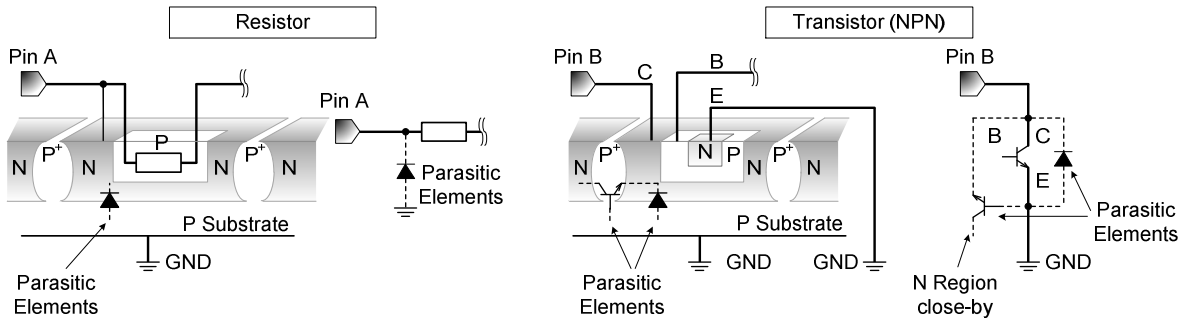


Figure 20. Example of monolithic IC structure

13. Ceramic Capacitor

When using a ceramic capacitor, determine the dielectric constant considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

14. Area of Safe Operation (ASO)

Operate the IC such that the output voltage, output current, and power dissipation are all within the Area of Safe Operation (ASO).

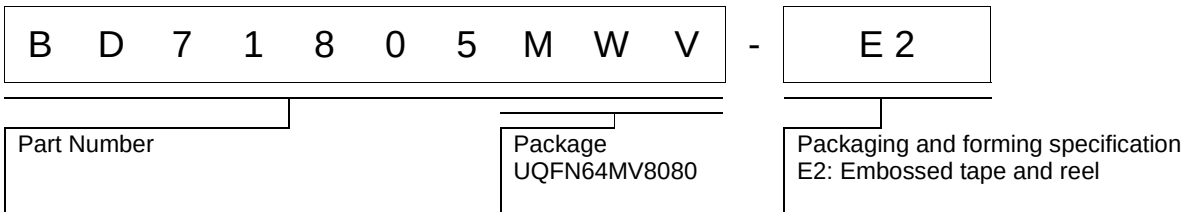
15. Thermal Shutdown Circuit(TSD)

This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's power dissipation rating. If however the rating is exceeded for a continued period, the junction temperature (Tj) will rise which will activate the TSD circuit that will turn OFF all output pins. When the Tj falls below the TSD threshold, the circuits are automatically restored to normal operation.
Note that the TSD circuit operates in a situation that exceeds the absolute maximum ratings and therefore, under no circumstances, should the TSD circuit be used in a set design or for any purpose other than protecting the IC from heat damage.

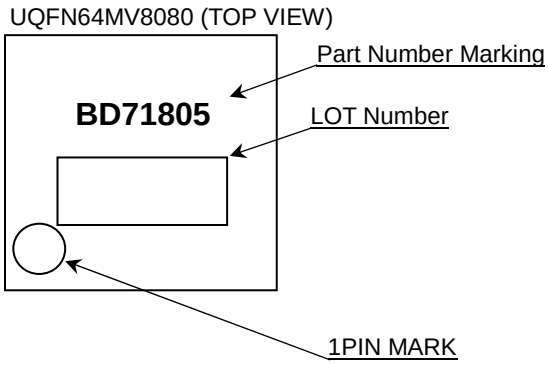
16. Over Current Protection Circuit (OCP)

This IC incorporates an integrated over-current protection circuit that is activated when the load is shorted. This protection circuit is effective in preventing damage due to sudden and unexpected incidents. However, the IC should not be used in applications characterized by continuous operation or transitioning of the protection circuit.

Ordering Information

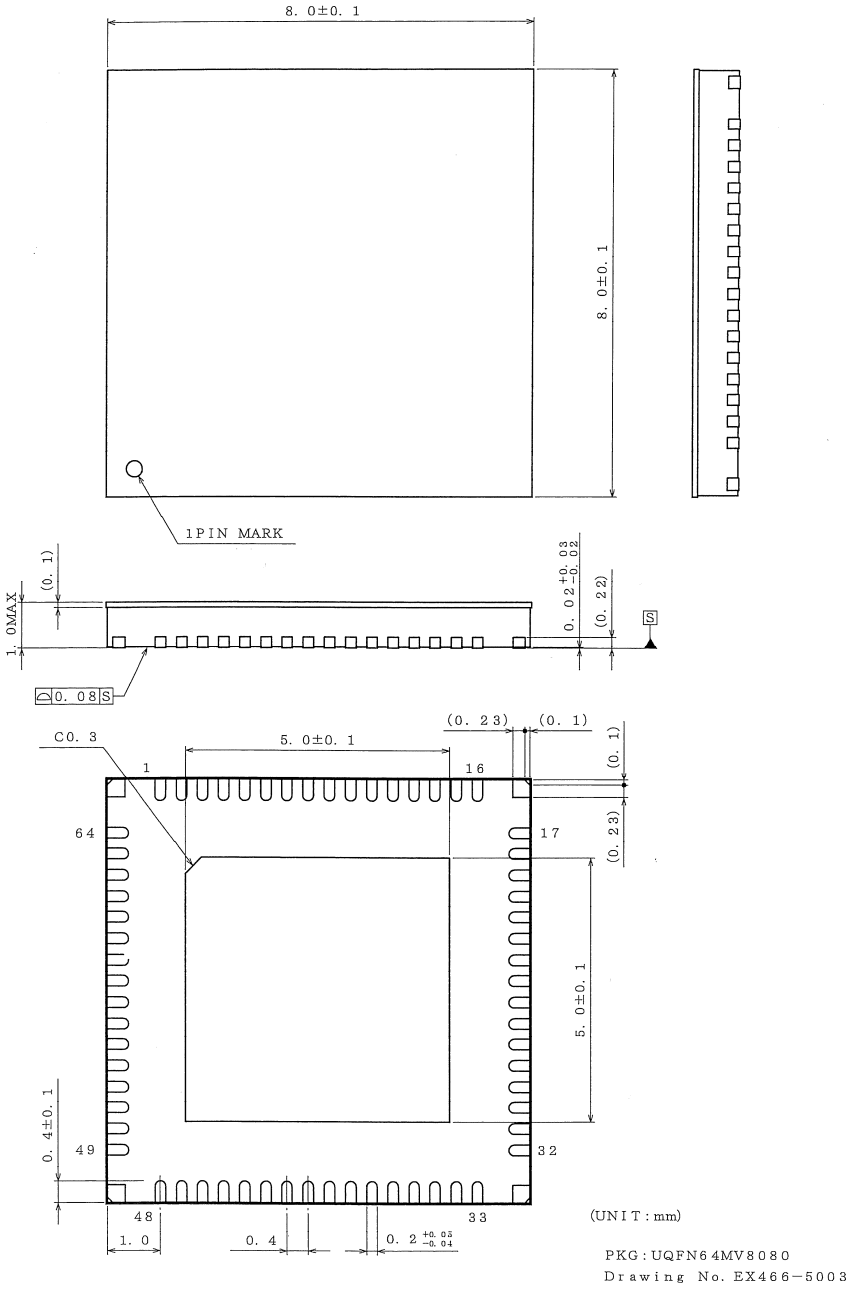


Marking Diagram



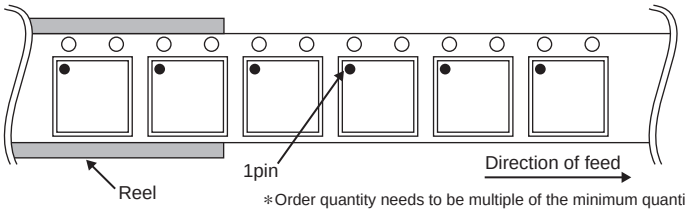
Physical Dimension, Tape and Reel Information

Package Name	UQFN64MV8080



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	1000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

Revision History

Date	Revision	Changes
2.July.2015	001	Initial Release

Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   - [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   - [b] the temperature or humidity exceeds those recommended by ROHM
   - [c] the Products are exposed to direct sunshine or condensation
   - [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

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