

Structure Silicon Monolithic Integrated Circuit  
Product Power Management LSI for MultiMedia LSI on Cellular

Type **BH6174GUL**

- Functions
- 2ch 600mA, high efficiency Step-down Converter. (16 steps adjustable VO by I<sup>2</sup>C)
  - 5-ch 300mA, CMOS-type LDOs. Power-Save mode supported. (16 steps adjustable VO by I<sup>2</sup>C)
  - LDO and Step-down converter Power ON/OFF control enabled by I2C interface or external pin
  - I<sup>2</sup>C compatible Interface. (Device address is “1001111”)
  - Discharge resistance selectable for power-down sequence ramp speed control
  - Wafer Level CSP package(2.8mm × 2.8mm) for space-constrained applications
  - 0.5mm thin package to meet ultra-thin design requirements
  - Step-down Converter output loop back available for LDO power supply (LDO3,4)

Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Maximum Supply Voltage (VBAT1, VBAT2, PBAT)	VBATMAX	6.0	V
Maximum Supply Voltage (PBAT1, PBAT2)	VPBATMAX	6.0	V
Maximum Supply Voltage (VIN34)	V34MAX	6.0	V
Maximum Supply Voltage (DVDD)	VDVDDMAX	4.5	V
Maximum Input Voltage 1 (LX1, FB1, LX2, FB2, OUT1, OUT2, OUT3, OUT4, OUT5,	VINMAX1	VBAT + 0.3	V
Maximum Input Voltage 2(NRST, CLK, DATA)	VINMAX2	DVDD + 0.3	V
Power Dissipation	Pd	960* <sup>1</sup>	mW
Operating Temperature Range	Topr	-35 ~ +85	°C
Storage Temperature Range	Tstg	-55 ~ +125	°C

\*1 This is the allowable loss of when it is mounted on a ROHM specification board 50mm × 58mm.  
When a substrate is implemented, the allowable loss varies from the size and material of the substrate.  
To use at temperature higher than 25°C, derate 9.6mW per 1°C.

Recommended Operating Conditions (Ta=25°C)

Parameter	Symbol	Range	Unit
VBAT1, 2 Voltage	VBAT	* <sup>2</sup> 2.60 ~ 5.50	V
PBAT1, 2 Voltage	VPBAT	* <sup>2</sup> 2.60 ~ 5.50	V
VIN34 Voltage	V34	* <sup>3</sup> 1.70 ~ 5.50	V
DVDD Voltage	VDVDD	* <sup>4</sup> 1.70 ~ 3.60	V

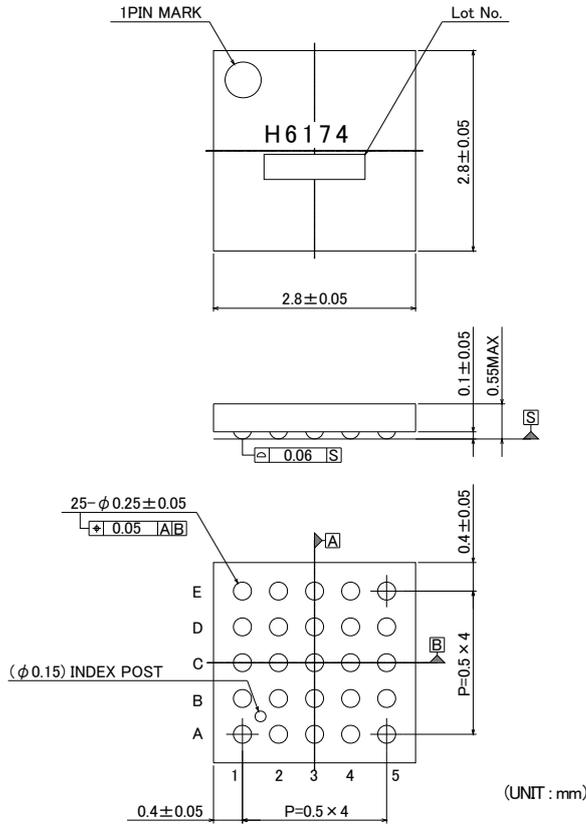
\*2 Whenever the VBAT or PBAT or VIN34 voltage is under the LDO or SWREG output voltage, the LDO and SWREG output is not guaranteed to meet its published specifications.

\*3 VIN34 Power Supply can be externally connected to the VBAT and PBAT Power Supply when necessary.

\*4 The DVDD Voltage must be under the Battery Voltage VBAT, PBAT at any times.

\* This product is not especially designed to be protected from radioactivity.

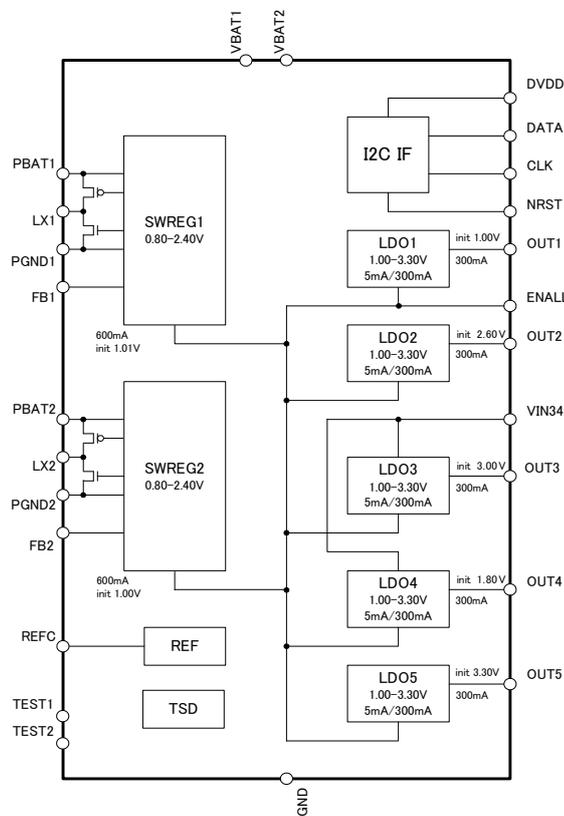
● Overview Dimensions



● Ball Descriptions

Ball No.	PIN Name
B4	DATA
C4	CLK
E4	VBAT1
E1	VIN34
A5	PBAT1
A4	LX1
A3	PGND1
B5	FB1
D4	NRST
D5	OUT1
E5	OUT2
E2	OUT3
D1	OUT4
E3	OUT5
D2	REFC
C3	ENALL
A1	PBAT2
A2	LX2
B3	PGND2
B1	FB2
C5	DVDD
C1	GND
D3	TEST1
C2	TEST2
B2	VBAT2

● Block Diagram



Electrical Characteristics (Unless otherwise specified, Ta=25°C, VBAT1=VBAT2=PBAT=VIN34=3.6V, DVDD=2.6V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>●Circuit Current</b>						
VBAT Circuit Current 1 (OFF)	IQVB1	0.05	0.4	0.8	μA	LDO1~5=OFF, SWREG1, 2=OFF, NRST=L, DVDD=0V VIN34=VBAT external connection
VBAT Circuit Current 2 (Standby)	IQVB2	0.1	0.7	1.4	μA	LDO1~5=OFF, SWREG1, 2=OFF, NRST=H, DVDD=2.6V VIN34=VBAT external connection
VBAT Circuit Current 3 (Active)	IQVB3	110	220	330	μA	LDO1~5=ON (no load, initial voltage) SWREG1,2=ON (no load, initial voltage) NRST=H, DVDD=2.6V VIN34=VBAT external connection SWREG1, 2 PWM/PFM AUTO MODE
<b>●DVDD Quiescent Current</b>						
DVDD Quiescent Current 1 (OFF)	IQVD1	-	0	1	μA	LDO1~5=OFF, SWREG1, 2=OFF, NRST=L, DVDD=2.6V VIN34=VBAT external connection

Electrical Characteristics (Unless otherwise specified, Ta=25°C, VBAT1=VBAT2=PBAT=VIN34=3.6V, DVDD=2.6V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition	
<b>●Logic pin character</b>							
NRST (CMOS input)	Input "H" level	VIH1	DVDD* 0.7	-	DVDD+ 0.3	V	Pin voltage: DVDD
	Input "L" level	VIL1	-0.3	-	DVDD* 0.3	V	Pin voltage: 0V
	"H" Input current	IIC1	0	0.3	1	μA	Pin voltage: 2.6V
ENALL (NMOS input)	Input "H" level	VIH2	1.44	-	VBAT+ 0.3	V	
	Input "L" level	VIL2	-0.3	-	0.4	V	
	Input leak current	IIC2	-1	0	1	μA	
<b>●Digital characteristics (Digital pins: CLK and DATA)</b>							
Input "H" level	VIH3	DVDD* 0.7	-	DVDD+ 0.3	V		
Input "L" level	VIL3	-0.3	-	DVDD* 0.3	V		
Input leak current	IIC3	-1	0	1	μA	Pin voltage: DVDD	
DATA output "L" level voltage	VOL	0	-	0.4	V	IOL=6mA	
<b>●SWREGs</b>							
SWREG1	Output Voltage	VOSW1I	0.9797	1.01	1.0403	V	initial value, Io=100mA, PWM MODE
SWREG2	Output Voltage	VOSW2I	0.970	1.00	1.030	V	initial value, Io=100mA, PWM MODE
<b>●LDOs</b>							
LDO1	Output voltage	VOM1	0.97	1.00	1.03	V	initial value, Io=5mA
LDO2	Output voltage	VOM2	2.522	2.60	2.678	V	initial value, Io=5mA
LDO3	Output voltage	VOM3	2.91	3.00	3.09	V	initial value, Io=5mA
LDO4	Output voltage	VOM4	1.764	1.80	1.836	V	initial value, Io=5mA
LDO5	Output voltage	VOM5	3.201	3.30	3.399	V	initial value, Io=5mA

## ● Use-related Cautions

- (1) Absolute maximum ratings  
If applied voltage (VBAT1, VBAT2, PBAT1, PBAT2, VIN34, DVDD), operating temperature range (Toper), or other absolute maximum ratings are exceeded, there is a risk of damage. Since it is not possible to identify short, open, or other damage modes, if special modes in which absolute maximum ratings are exceeded are assumed, consider applying fuses or other physical safety measures.
- (2) Recommended operating range  
This is the range within which it is possible to obtain roughly the expected characteristics. For electrical characteristics, it is those that are guaranteed under the conditions for each parameter. Even when these are within the recommended operating range, voltage and temperature characteristics are indicated.
- (3) Reverse connection of power supply connector  
There is a risk of damaging the LSI by reverse connection of the power supply connector. For protection from reverse connection, take measures such as externally placing a diode between the power supply and the power supply pin of the LSI.
- (4) Power supply lines  
In the design of the board pattern, make power supply and GND line wiring low impedance.  
When doing so, although the digital power supply and analog power supply are the same potential, separate the digital power supply pattern and analog power supply pattern to deter digital noise from entering the analog power supply due to the common impedance of the wiring patterns. Similarly take pattern design into account for GND lines as well.  
Furthermore, for all power supply pins of the LSI, in conjunction with inserting capacitors between power supply and GND pins, when using electrolytic capacitors, determine constants upon adequately confirming that capacitance loss occurring at low temperatures is not a problem for various characteristics of the capacitors used.
- (5) GND voltage  
Make the potential of a GND pin such that it will be the lowest potential even if operating below that. In addition, confirm that there are no pins for which the potential becomes less than a GND by actually including transition phenomena.
- (6) Shorts between pins and misinstallation  
When installing in the set board, pay adequate attention to orientation and placement discrepancies of the LSI. If it is installed erroneously, there is a risk of LSI damage. There also is a risk of damage if it is shorted by a foreign substance getting between pins or between a pin and a power supply or GND.
- (7) Operation in strong magnetic fields  
Be careful when using the LSI in a strong magnetic field, since it may malfunction.
- (8) Inspection in set board  
When inspecting the LSI in the set board, since there is a risk of stress to the LSI when capacitors are connected to low impedance LSI pins, be sure to discharge for each process. Moreover, when getting it on and off of a jig in the inspection process, always connect it after turning off the power supply, perform the inspection, and remove it after turning off the power supply. Furthermore, as countermeasures against static electricity, use grounding in the assembly process and take appropriate care in transport and storage.
- (9) Input pins  
Parasitic elements inevitably are formed on an LSI structure due to potential relationships. Because parasitic elements operate, they give rise to interference with circuit operation and may be the cause of malfunctions as well as damage. Accordingly, take care not to apply a lower voltage than GND to an input pin or use the LSI in other ways such that parasitic elements operate. Moreover, do not apply a voltage to an input pin when the power supply voltage is not being applied to the LSI. Furthermore, when the power supply voltage is being applied, make each input pin a voltage less than the power supply voltage as well as within the guaranteed values of electrical characteristics.
- (10) Ground wiring pattern  
When there is a small signal GND and a large current GND, it is recommended that you separate the large current GND pattern and small signal GND pattern and provide single point grounding at the reference point of the set so that voltage variation due to resistance components of the pattern wiring and large currents do not cause the small signal GND voltage to change. Take care that the GND wiring pattern of externally attached components also does not change.
- (11) Externally attached capacitors  
When using ceramic capacitors for externally attached capacitors, determine constants upon taking into account a lowering of the rated capacitance due to DC bias and capacitance change due to factors such as temperature.
- (12) Thermal shutdown circuit (TSD)  
When the junction temperature reaches the defined value, the thermal shutdown circuit operates and turns the switch OFF. The thermal shutdown circuit, which is aimed at isolating the LSI from thermal runaway as much as possible, is not aimed at the protection or guarantee of the LSI. Therefore, do not continuously use the LSI with this circuit operating or use the LSI assuming its operation.
- (13) Thermal design  
Perform thermal design in which there are adequate margins by taking into account the permissible dissipation (Pd) in actual states of use.
- (14) Rush Current  
Extra care must be taken on power coupling, power, ground line impedance, and PCB design while excess amount of rush current might instantly flow through the power line when powering-up a LSI which is equipped with several power supplies, depending on on/off sequence, and ramp delays.

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