

# Power unit IC for pagers

## BH6111FV

The BH6111FV is a power unit IC with a driver for VFM switching regulator controllers and vibrators, LEDs, speakers, and LCD backlights. It has internal sensors to detect the reset voltage and battery ejection.

### ●Applications

Pagers

### ●Features

- 1) Internal VFM-type CMOS switching regulator and drivers for 6 channels.
- 2) Equipped with a reset voltage sensor and battery ejection sensor.

### ●Absolute maximum ratings (Ta = 25°C)

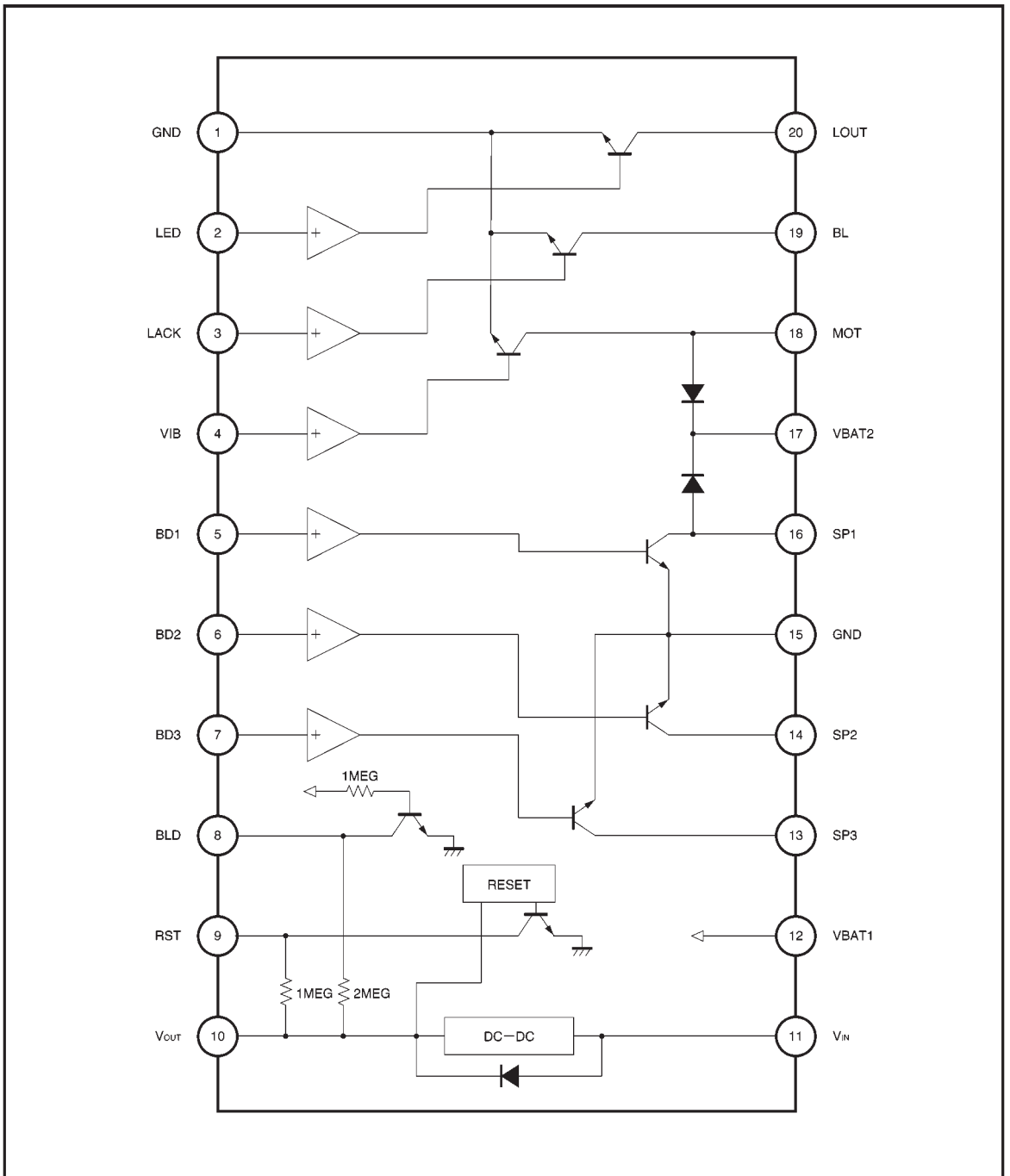
| Parameter                         | Symbol            | Limits    | Unit |
|-----------------------------------|-------------------|-----------|------|
| Power supply voltage              | V <sub>CC</sub>   | -0.3~+6.0 | V    |
| Driver output applied voltage     | V <sub>Max.</sub> | -0.3~+7.0 | V    |
| Power dissipation                 | P <sub>d</sub>    | *400      | mW   |
| Maximum driver output current (1) | I <sub>OM1</sub>  | 500       | mA   |
| Maximum driver output current (2) | I <sub>OM2</sub>  | 400       | mA   |
| Maximum driver output current (3) | I <sub>OM3</sub>  | 300       | mA   |
| Operating temperature             | T <sub>opr</sub>  | -15~+60   | °C   |
| Storage temperature               | T <sub>stg</sub>  | -55~+125  | °C   |

\* Reduced by 4 mW for each increase in Ta of 1°C over 25°C.


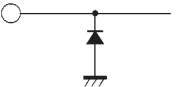
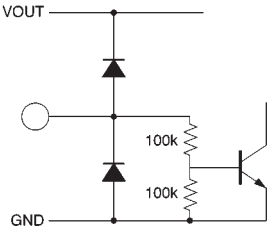
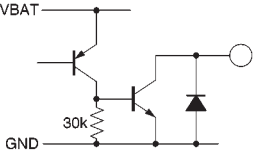
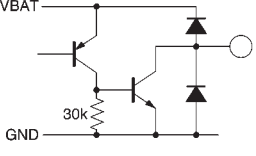
### ●Recommended operating conditions

| Parameter                       | Symbol           | Limits  | Unit |
|---------------------------------|------------------|---------|------|
| Power supply voltage            | V <sub>CC</sub>  | 0.9~2.5 | V    |
| Driver unit operating frequency | f <sub>drv</sub> | DC~100  | kHz  |

● Block diagram



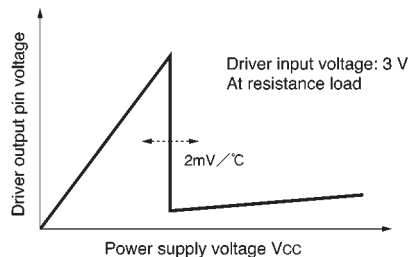
● Pin descriptions

| Pin No. | Pin name | I/O | Pin voltage | Internal equivalent circuit   | Function  |
|---------|----------|-----|-------------|---|---|
| 1       | GND 2    | I   | GND         |    | Grounding pin   |
| 15      | GND 1    | I   |             |   |   |
| 12      | VBAT 1   | I   | VBAT        |    | Battery pin   |
| 17      | VBAT 2   | I   |             |   |   |
| 2       | LED      | I   | 0V          |    | Driver input pin<br>*1<br>*2<br>*3                      |
| 3       | LACK     | I   |             |   |   |
| 4       | VIB      | I   |             |   |   |
| 5       | BD 1     | I   |             |   |   |
| 6       | BD 2     | I   |             |   |   |
| 7       | BD 3     | I   |             |   |   |
| 13      | SP 3     | O   | —           |    | Driver output pin                                       |
| 14      | SP 2     | O   |             |   |   |
| 19      | BL       | O   |             |   |   |
| 20      | LOUT     | O   |             |   |   |
| 16      | SP 1     | O   | —           |  | Driver output pin<br>(internal Di for surge absorption) |
| 18      | MOT      | O   |             |   |   |

\*1 Driver unit input current (3 V system)  
 LED, LACK, VIB, BD1, BD2, BD3: 27  $\mu$ A

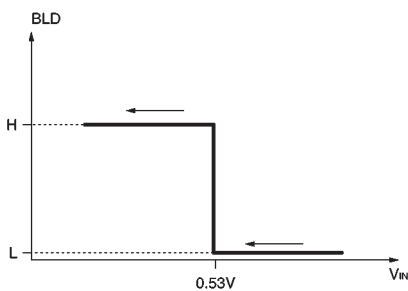
\*3 Driver unit temperature characteristic  
 (Low level hold boundary voltage)

\*2 Driver unit current consumption (1.5 V system)  
 LED, LACK, SP2, SP3: 4.1 mA  
 SP1 : 4.7 mA  
 VIB : 5.6 mA

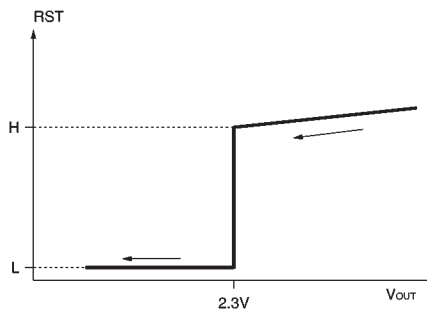


| Pin No. | Pin name         | I/O | Pin voltage | Internal equivalent circuit | Function   |
|---------|------------------|-----|-------------|-----------------------------|--|
| 8       | BLD              | O   | —           |                             | Battery ejection voltage detection pin *4<br>(When battery is removed: HIGH)<br>Current consumption<br>1.5 V system: 0.9 $\mu$ A<br>3 V system : 1.5 $\mu$ A |
| 9       | RST              | O   | —           |                             | CPU reset voltage detection pin *5<br>(When output power is reduced: LOW)<br>Current consumption<br>3 V system: 1.8 $\mu$ A                                  |
| 10      | V <sub>OUT</sub> | O   | 3V          |                             | DC/DC converter output pin   |
| 11      | V <sub>IN</sub>  | I   | —           |                             | DC/DC converter switching pin (internal Di for rectification)  |

\*4 Operation theory for battery ejection circuit



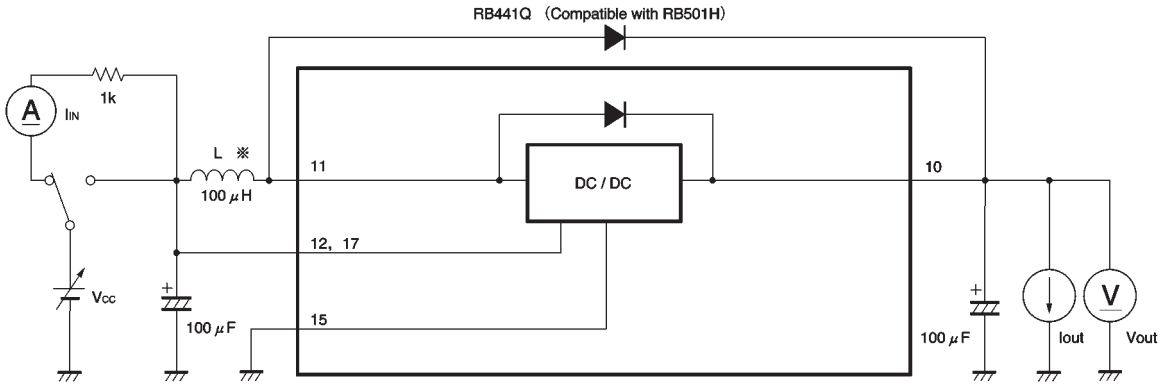
\*5 Operation theory for CPU reset circuit



●Electrical characteristics (unless otherwise noted, Ta = 25°C, V<sub>DD</sub> = 1.5V)

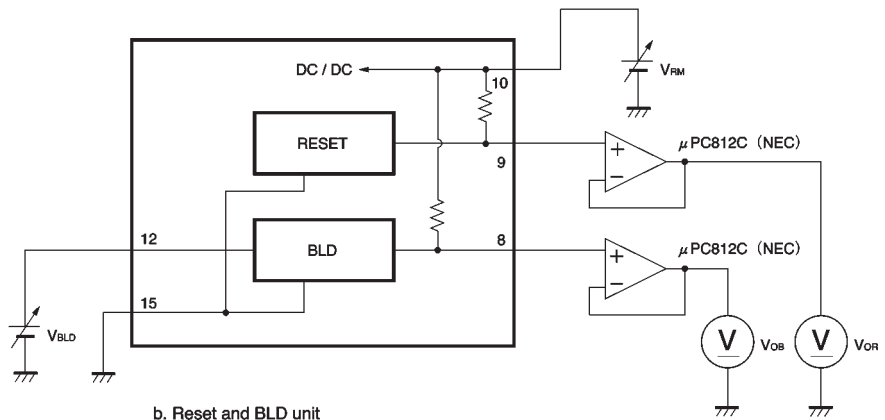
| Parameter   | Symbol             | Min. | Typ. | Max. | Unit | Conditions   | Measurement circuit |
|---|--------------------|------|------|------|------|--|---------------------|
| 〈Overall circuit〉   |                    |      |      |      |      |  |                     |
| Current dissipation   | I <sub>IN</sub>    | —    | 34   | 60   | μA   | With no load on DC-DC converter                    | Fig.1               |
| 〈DC-DC converter unit〉  |                    |      |      |      |      |  |                     |
| Output voltage  | V <sub>OUT</sub>   | 2.85 | 3.00 | 3.08 | V    | I <sub>OUT</sub> =1.0mA                            | Fig.1               |
| Operation initiation power supply voltage                                     | V <sub>ST</sub>    | —    | 0.85 | 0.9  | V    | I <sub>OUT</sub> =1.0mA, V <sub>CC</sub> ; 0V→2V   | Fig.1               |
| Operation sustain power supply voltage  | V <sub>HD</sub>    | —    | 0.50 | 0.7  | V    | I <sub>OUT</sub> =1.0mA, V <sub>CC</sub> ; 2V→0V   | Fig.1               |
| Input voltage stability   | ΔV <sub>O1</sub>   | —    | 20   | 100  | mV   | I <sub>OUT</sub> =1.0mA, V <sub>CC</sub> =0.9~2.5V | Fig.1               |
| Load regulation   | ΔV <sub>O2</sub>   | —    | 20   | 100  | mV   | I <sub>OUT</sub> =0.1~5.0mA                        | Fig.1               |
| Oscillation duty ratio  | D <sub>fMax.</sub> | —    | 70   | —    | %    |  | Fig.1               |
| Oscillation frequency   | f <sub>osc</sub>   | 80   | 100  | 120  | kHz  |  | Fig.1               |
| Efficiency  | η                  | 70   | 80   | —    | %    | I <sub>OUT</sub> =3.0mA                            | Fig.1               |
| 〈CPU reset circuit / battery ejection circuit unit〉                           |                    |      |      |      |      |  |                     |
| Reset detection voltage   | VRM                | 2.1  | 2.3  | 2.5  | V    |  | Fig.1               |
| BLD detection voltage   | VBLD               | 0.48 | 0.53 | 0.58 | V    | V <sub>CC</sub> value when V8 pin is 1.5 V         | Fig.1               |
| Output high level voltage   | VOH                | 2.7  | 3.0  | —    | V    |  | Fig.1               |
| Output low level voltage  | VOL                | —    | 0.1  | 0.4  | V    |  | Fig.1               |
| 〈Vibrator control unit〉   |                    |      |      |      |      |  |                     |
| Maximum output drive current  | I <sub>OM1</sub>   | 300  | —    | —    | mA   | V <sub>SAT</sub> ≤0.5V                             | Fig.1               |
| Saturation voltage  | V <sub>SAT1</sub>  | —    | 0.2  | 0.3  | V    | I <sub>OUT</sub> =195mA                            | Fig.1               |
| Leakage current when off  | I <sub>L1</sub>    | —    | 0.0  | 5.0  | μA   | V <sub>OUT</sub> =5V                               | Fig.1               |
| Input threshold level   | V <sub>TH1</sub>   | 1.0  | 1.4  | 1.8  | V    |  | Fig.1               |
| Input current   | I <sub>IN1</sub>   | 15   | 27   | 35   | μA   | V <sub>IN</sub> =3.0V                              | Fig.1               |
| 〈Speaker control unit 1〉  |                    |      |      |      |      |  |                     |
| Maximum output drive current  | I <sub>OM2</sub>   | 200  | —    | —    | mA   | V <sub>SAT</sub> ≤0.5V                             | Fig.1               |
| Saturation voltage  | V <sub>SAT2</sub>  | —    | 0.1  | 0.2  | V    | I <sub>OUT</sub> =90mA                             | Fig.1               |
| Leakage current when off  | I <sub>L2</sub>    | —    | 0.0  | 5.0  | μA   | V <sub>OUT</sub> =5V                               | Fig.1               |
| Input threshold level   | V <sub>TH2</sub>   | 1.0  | 1.4  | 1.8  | V    |  | Fig.1               |
| Input current   | I <sub>IN2</sub>   | 15   | 27   | 35   | μA   | V <sub>IN</sub> =3.0V                              | Fig.1               |
| 〈Speaker control units 2 and 3, LED control unit, LCD backlight control unit〉 |                    |      |      |      |      |  |                     |
| Maximum output drive current  | I <sub>OM3</sub>   | 100  | —    | —    | mA   | V <sub>SAT</sub> ≤0.5V                             | Fig.1               |
| Saturation voltage  | V <sub>SAT3</sub>  | —    | 0.1  | 0.2  | V    | I <sub>OUT</sub> =45mA                             | Fig.1               |
| Leakage current when off  | I <sub>L3</sub>    | —    | 0.0  | 5.0  | μA   | V <sub>OUT</sub> =5V                               | Fig.1               |
| Input threshold level   | V <sub>TH3</sub>   | 1.0  | 1.4  | 1.8  | V    |  | Fig.1               |
| Input current   | I <sub>IN3</sub>   | 15   | 27   | 35   | μA   | V <sub>IN</sub> =3.0V                              | Fig.1               |

● Measurement circuits

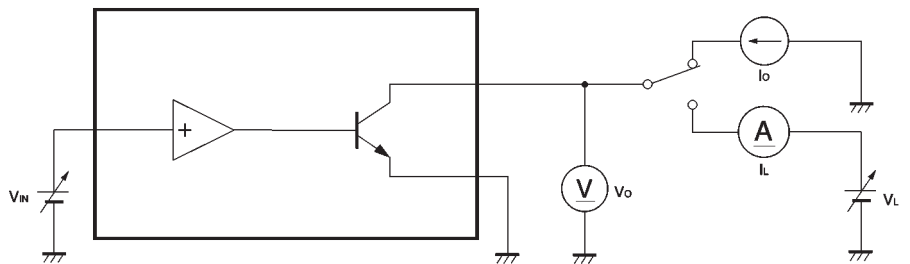


※ LQH4N (MURATA)

a. DC / DC converter unit



b. Reset and BLD unit



c. Driver unit

Fig. 1

●Application example

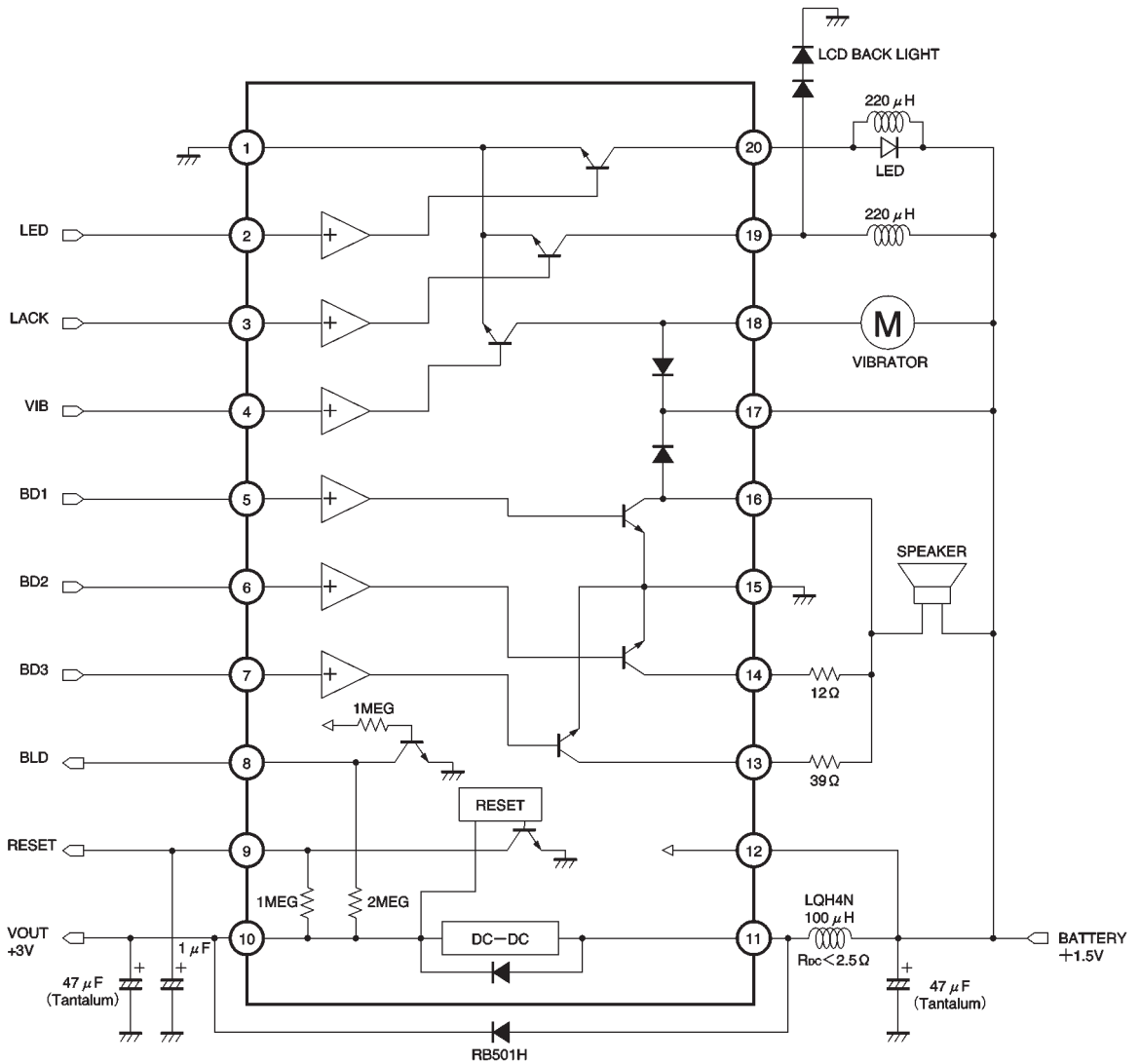


Fig. 2

●Electrical characteristic curves

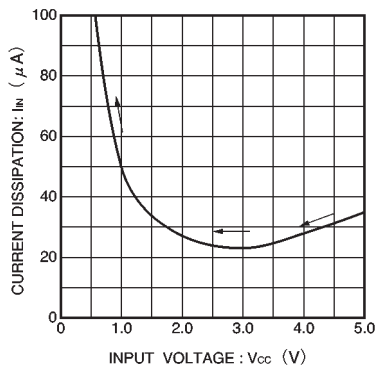


Fig. 3 Current dissipation vs. input voltage

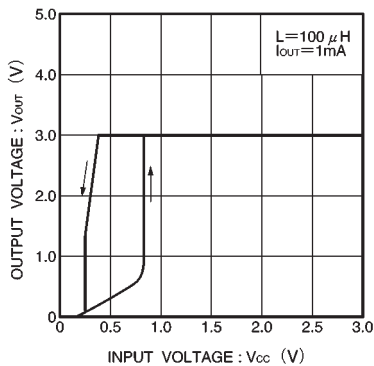


Fig. 4 DC/DC converter Output voltage vs. input voltage

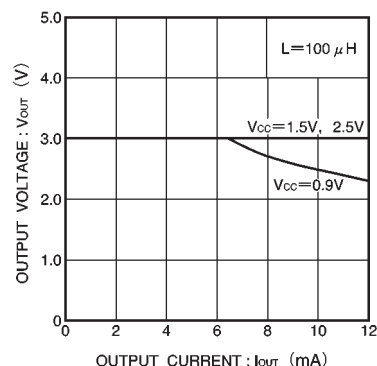


Fig. 5 DC/DC converter Output voltage vs. output current

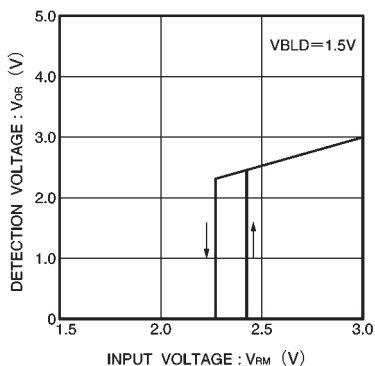


Fig. 6 Reset detection voltage

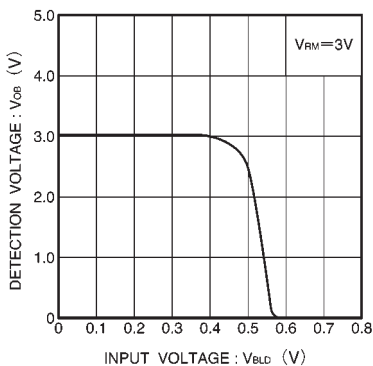


Fig. 7 BLD detection voltage

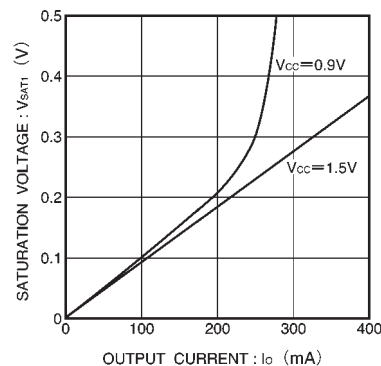


Fig. 8 Vibrator control unit Saturation voltage vs. output current

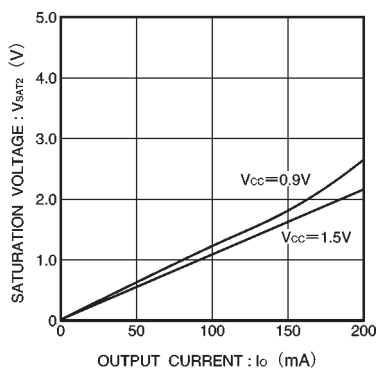


Fig. 9 Speaker control unit 1 Saturation voltage vs. output current

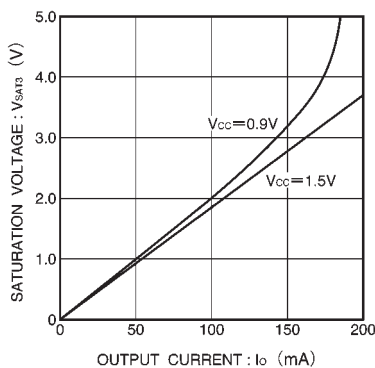


Fig. 10 Speaker control units 2 and 3, LED control unit, LCD backlight control unit Saturation voltage vs. output current



● External dimensions (Units: mm)

