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# HA13168H

## Multiple Voltage Regulator for Car Audio

REJ03F0225-0100

Rev.1.00

Jan 16, 2007

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### Description

The HA13168H is a compact multiple voltage regulator for car audio system. The outputs of this IC output consist of regulated 5.7 V output for a microcontroller, regulated 8 V output for CD driver, regulated 9.0 V output for audio control, and regulated 5 V output, VCC-dependent output for external output and VCC-dependent output for remote-ANT.

### Functions

#### General

- ACC power monitor circuit is built-in as to detect low voltage.
- Low saturation output (PNP output) used for audio output.
- A reset signal output for a microcontroller.

#### Protections

- Output current limit circuit to avoid device destruction caused by shorted output, etc.
- High surge input protector against VCC and ACC.
- Built in a thermal shutdown circuit to prevent against the thermal destruction.

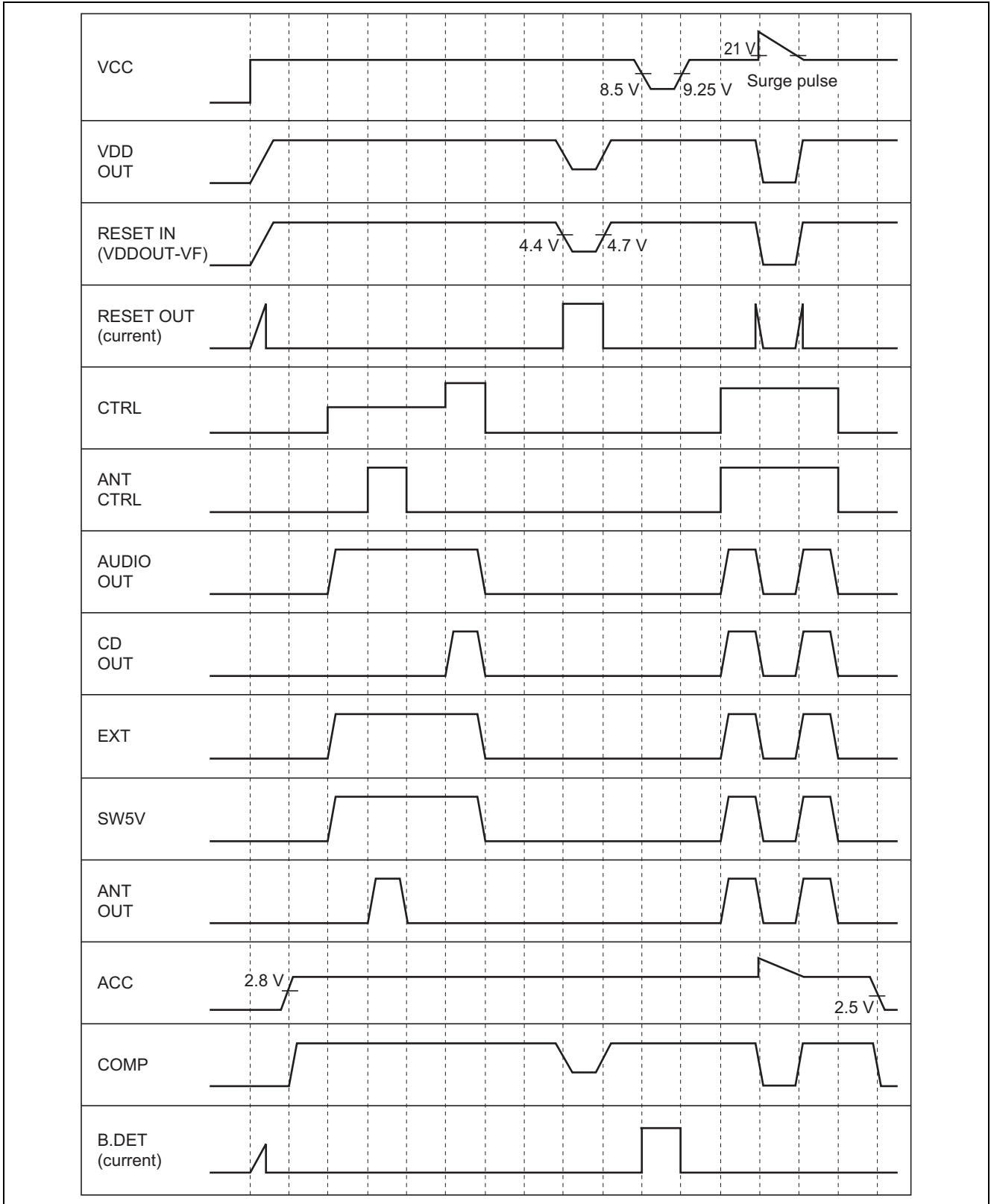
## Pin Description and Equivalent Circuit

| Pin No. | Pin Name | Specification      | Equivalent Circuit | Function   |       |             |
|---------|----------|--------------------|--------------------|--|-------|-------------|
|         |          |                    |                    | Normal Operation   | TSD   | Surge Input |
| 1       | EXT OUT  | VCC-1 V/300 mA min |                    | Output voltage is VCC-1 V when M or H level applied to CTRL pin.                 | 0 V   | 0 V         |
| 2       | ANT OUT  | VCC-1 V/300 mA min |                    | Output voltage is VCC-1 V when M or H level to CTRL pin and H level to ANT-CTRL. | 0 V   | 0 V         |
| 3       | ACC IN   | —                  |                    | Connected to ACC.  | —     | —           |
| 4       | VDD OUT  | 5.7 V/100 mA min   |                    | Regular 5.7 V.   | 5.7 V | 0 V         |
| 5       | SW5V OUT | 5.0 V/100 mA min   |                    | Output voltage is 5 V when M or H level applied to CTRL pin.                     | 0 V   | 0 V         |
| 6       | COMP OUT | 5.0 V/100 mA min   |                    | Output for ACC detector  | 0 V   | 0 V         |
| 7       | ANT CTRL | —                  |                    | L: ANT output OFF<br>H: ANT output ON  | —     | —           |
| 8       | VCC      | —                  |                    | Connected to VCC   | —     | —           |

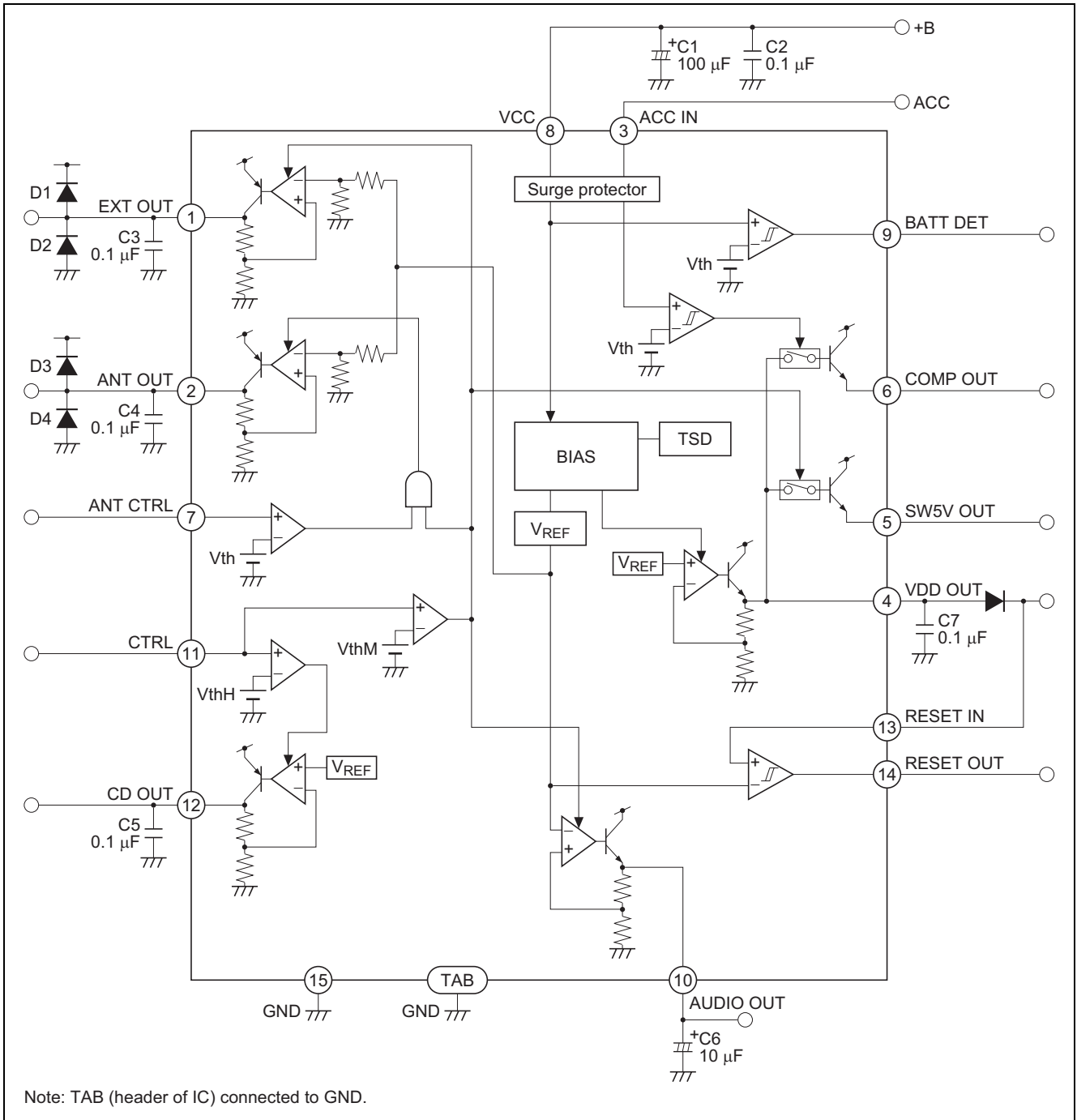
Pin Description and Equivalent Circuit (cont.)

| Pin No. | Pin Name  | Specification    | Equivalent Circuit | Function   |        |             |
|---------|-----------|------------------|--------------------|--|--------|-------------|
|         |           |                  |                    | Normal Operation   | TSD    | Surge Input |
| 9       | BAT DET   | —                |                    | Low battery detects.<br>Active "L"                           | Detect | Not detect  |
| 10      | AUDIO OUT | 9.0 V/250 mA min |                    | Output voltage is 9 V when M or H level applied to CTRL pin. | 0 V    | 0 V         |
| 11      | CTRL      | —                |                    | L: BIAS OFF<br>M: BIAS ON<br>H: CD ON                        | —      | —           |
| 12      | CD OUT    | 8.0 V/1.3 A min  |                    | Output voltage is 8 V when H level applied to CTRL pin.      | 0 V    | 0 V         |
| 13      | RESET IN  | —                |                    | Connected to power supply of microcontroller                 | —      | —           |
| 14      | RESET OUT | 1 mA min         |                    | A reset signal output: active "L"                            | Detect | —           |
| 15      | GND       | —                |                    | Connected to GND   | —      | —           |

Timing Chart



Block Diagram



## External Parts Lineup

| Parts No.         | Function   | Range of Recommended                                  | Operation with Different Value from the Range of Recommended Value |   |
|-------------------|--|---|--|---|
|                   |  |   | More than the Range  | Less than the Range   |
| C1                | Bypass capacitor<br>(Chemical capacitor)   | Upper 100 $\mu\text{F}$                               | —  | Unstable<br>Lower ripple rejection ratio  |
| C2                | To prevent oscillation<br>For stability of IC, this capacitor is inserted near the power supply pin of the IC. We recommend Polyester film capacitor. * <sup>1</sup>   | 0.1 $\mu\text{F}$                                     | Stability improve  | Unstable  |
| C3<br>C4          | To prevent oscillation * <sup>2</sup>  | 0.1 to 10000 $\mu\text{F}$                            | Unconfirmed  | Unstable  |
| C5<br>C7          | To prevent oscillation * <sup>2</sup>  | 0.1 to 470 $\mu\text{F}$                              | Unconfirmed  | Unstable  |
| C6                | To prevent oscillation   | 10 to 470 $\mu\text{F}$<br>(ESR = 0.1 to 2 $\Omega$ ) | Unconfirmed  | Unstable  |
| D1, D2,<br>D3, D4 | Protection against mistake in joining.<br>Terminal protection for short circuit to +B when VCC terminal is open and for short circuit to GND when GND terminal is open.<br>We recommend Schottky barrier diodes. | $I_F \geq 1 \text{ A}$                                | The ability to protect terminal improve.                           | The ability to protect terminal lower.<br>And there is some possibility of destruction. |

- Notes: 1. To improve stability, take notes of the below precautions.
- (1) Use capacitor that is temperature independent.
  - (2) Use capacitor that is bias voltage independent.
  - (3) No secondary resonance (non-inductive) capacitor.
- And, pay attention to the following points so that there can be an efficient bypass of high frequency noise.
- (1) To eliminate PCB pattern inductance mount the capacitor as close as possible to the VCC and GND of IC.
2. For using of the lower limit of recommended value, take notes of the below precautions.
- (1) Use capacitor that is temperature independent.
  - (2) Use capacitor that is bias voltage independent.
  - (3) No secondary resonance (non-inductive) capacitor.
3. To eliminate PCB pattern inductance mount the capacitor as close as possible to the VCC and GND of IC about C3, C4, C5, C6 and C7.

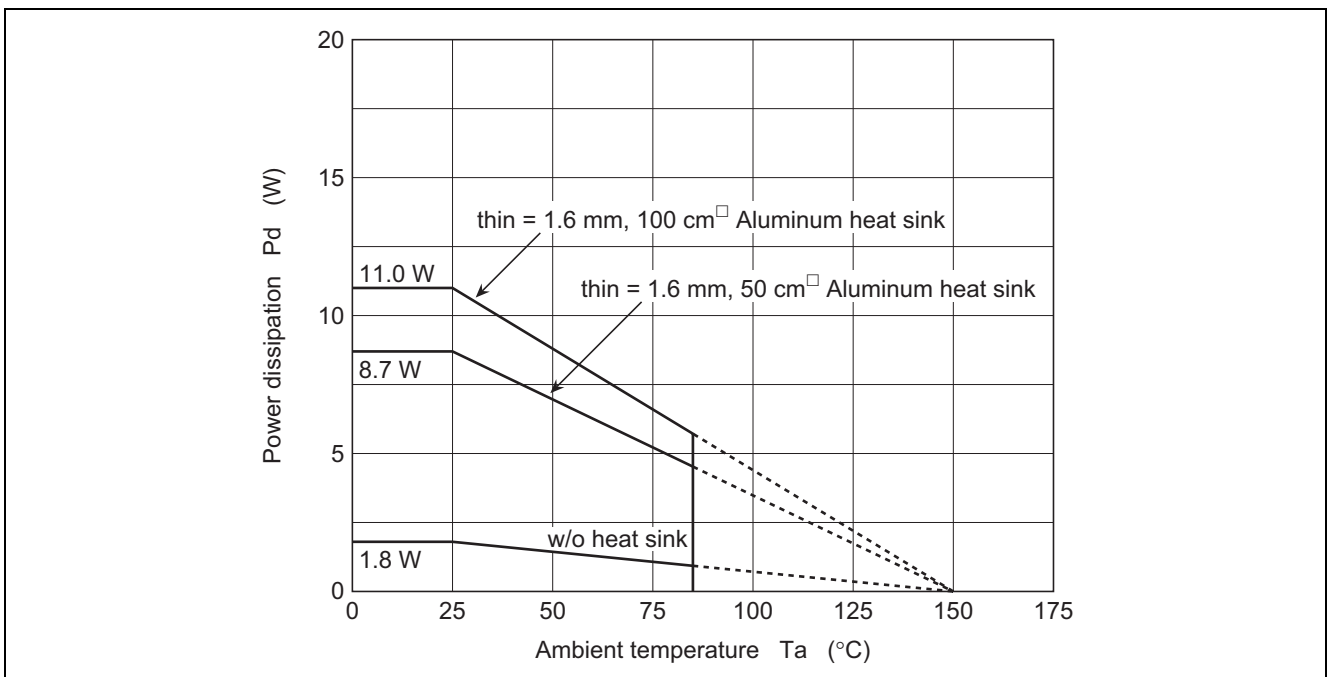
### Absolute Maximum Ratings

(Ta = 25°C)

| Item                           | Symbol    | Rating      | Unit | Note |
|--------------------------------|-----------|-------------|------|------|
| Operating power supply voltage | Vcc       | 18          | V    |      |
| DC supply voltage              | Vcc(DC)   | 26          | V    | 1    |
| Peak voltage                   | Vcc(PEAK) | 50          | V    | 2    |
| Power dissipation              | Pd        | 36          | W    | 3    |
| Junction temperature           | Tj        | 150         | °C   |      |
| Operating temperature          | Topr      | -40 to +85  | °C   |      |
| Storage temperature            | Tstg      | -55 to +125 | °C   |      |

Notes: Recommended power supply voltage range 10 to 16 V.

1. Applied time is less than 30 s.
2. Surge pulse as input.
3. Ta = 25°C. : Permissible power dissipation when using a heat sink of infinite area. Refer to the derating curves below.



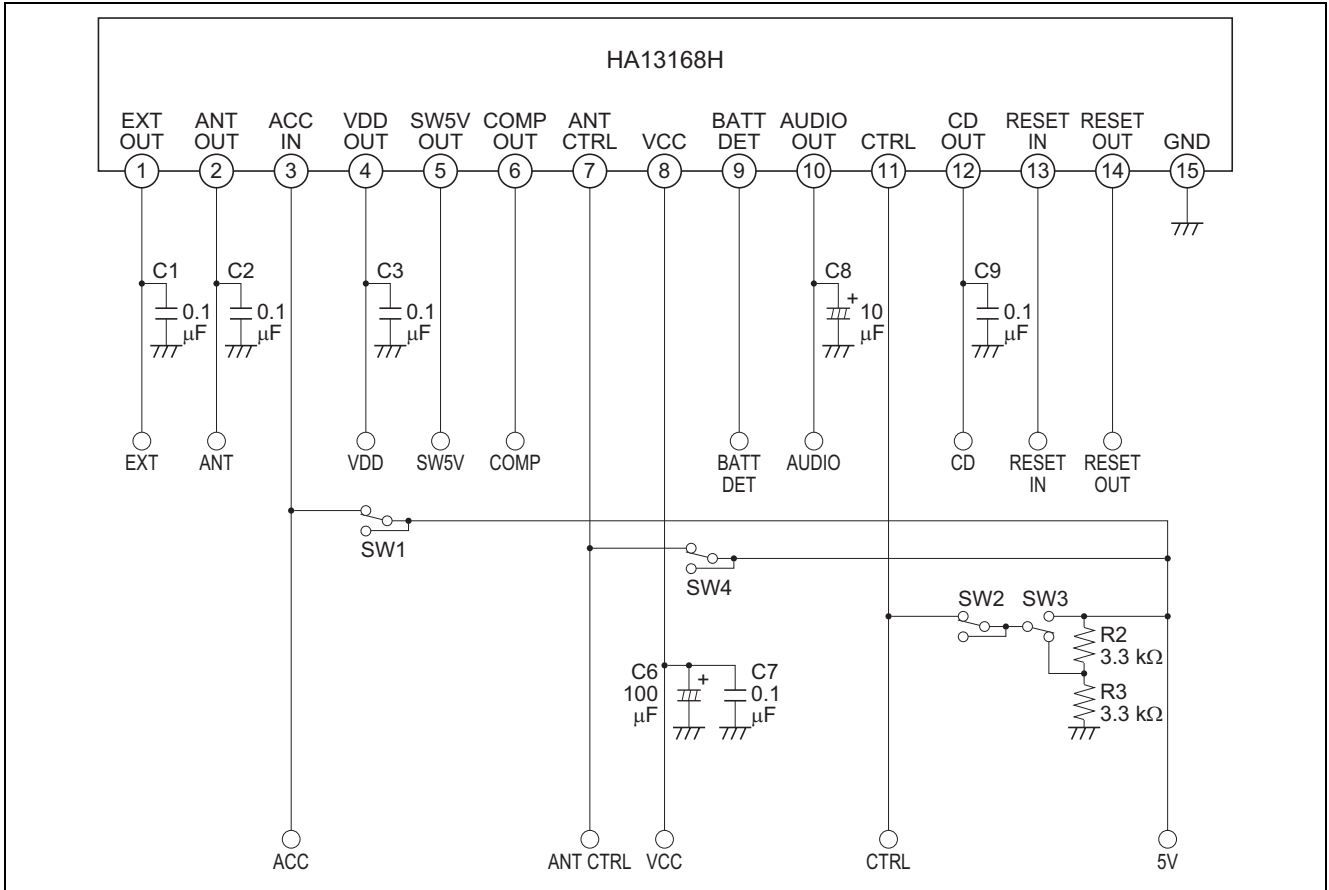
## Electrical Characteristics

(unless otherwise noted,  $V_{CC} = 13.2\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )

| Item                            | Symbol                           | Min                 | Typ  | Max  | Unit          | Test Condition        |                                     |
|---------------------------------|----------------------------------|---------------------|------|------|---------------|-----------------------|-------------------------------------|
| Standby current                 | IST                              | —                   | 460  | 700  | $\mu\text{A}$ | ACC = 0 V, CTRL = 0 V |                                     |
| CTRL L level (STBY mode)        | VCL                              | 0                   | —    | 1.0  | V             |                       |                                     |
| CTRL M level (CD OFF mode)      | VCM                              | 2.0                 | —    | 3.0  | V             |                       |                                     |
| CTRL H level (CD ON mode)       | VCH                              | 4.0                 | —    | —    | V             |                       |                                     |
| ANT CTRL L level (ANT OFF mode) | VACL                             | 0                   | —    | 2.0  | V             |                       |                                     |
| ANT CTRL H level (ANT ON mode)  | VACH                             | 3.0                 | —    | —    | V             |                       |                                     |
| VDD<br>OUT                      | Output voltage                   | Vo1                 | 5.4  | 5.7  | 6.0           | V                     | Io1 = 80 mA                         |
|                                 | Voltage regulation               | $\Delta\text{Vo}11$ | —    | 10   | 50            | mV                    | $V_{CC} = 10$ to 16 V, Io1 = 80 mA  |
|                                 | Load regulation                  | $\Delta\text{Vo}12$ | —    | 50   | 100           | mV                    | Io1 = 0 to 80 mA                    |
|                                 | Minimum I/O voltage differential | $\Delta\text{Vo}13$ | —    | 1.0  | 1.5           | V                     | Io1 = 80 mA                         |
|                                 | Output current capacity          | Io1                 | 100  | 250  | —             | mA                    | Vo1 $\geq$ 5.4 V                    |
|                                 | Ripple rejection ratio           | SVR1                | 50   | 60   | —             | dB                    | f = 100 Hz, Io1 = 80 mA             |
| CD<br>OUT                       | Output voltage                   | Vo2                 | 7.6  | 8.0  | 8.4           | V                     | Io2 = 1.0 A                         |
|                                 | Voltage regulation               | $\Delta\text{Vo}21$ | —    | 40   | 100           | mV                    | $V_{CC} = 10$ to 16V, Io2 = 1.0 A   |
|                                 | Load regulation                  | $\Delta\text{Vo}22$ | —    | 70   | 150           | mV                    | Io2 = 10m to 1.0 A                  |
|                                 | Minimum I/O voltage differential | $\Delta\text{Vo}23$ | —    | 1.0  | 1.5           | V                     | Io2 = 1.0 A                         |
|                                 | Output current capacity          | Io2                 | 1.3  | 2.0  | —             | A                     | Vo2 $\geq$ 7.6 V                    |
|                                 | Ripple rejection ratio           | SVR2                | 45   | 50   | —             | dB                    | f = 100 Hz, Io2 = 1.0 A             |
| AUDIO<br>OUT                    | Output voltage                   | Vo3                 | 8.5  | 9.0  | 9.5           | V                     | Io3 = 160 mA                        |
|                                 | Voltage regulation               | $\Delta\text{Vo}31$ | —    | 30   | 90            | mV                    | $V_{CC} = 10$ to 16 V, Io3 = 160 mA |
|                                 | Load regulation                  | $\Delta\text{Vo}32$ | —    | 100  | 200           | mV                    | Io3 = 10 to 160 mA                  |
|                                 | Minimum I/O voltage differential | $\Delta\text{Vo}33$ | —    | 0.4  | 0.9           | V                     | Io3 = 160 mA                        |
|                                 | Output current capacity          | Io3                 | 250  | 350  | —             | mA                    | Vo3 $\geq$ 8.5 V                    |
|                                 | Ripple rejection ratio           | SVR3                | 40   | 50   | —             | dB                    | f = 100 Hz, Io3 = 160 mA            |
| EXT<br>OUT                      | Differential I/O voltage         | $\Delta\text{Vo}41$ | —    | 1.0  | 1.5           | V                     | Io4 = 300 mA                        |
|                                 | Load regulation                  | $\Delta\text{Vo}42$ | —    | 350  | 600           | mV                    | Io4 = 10 to 300 mA                  |
|                                 | Output current capacity          | Io4                 | 300  | 500  | —             | mA                    | Vo4 $\geq$ 11.7 V                   |
| ANT<br>OUT                      | Differential I/O voltage         | $\Delta\text{Vo}51$ | —    | 1.0  | 1.5           | V                     | Io5 = 300 mA                        |
|                                 | Load regulation                  | $\Delta\text{Vo}52$ | —    | 350  | 600           | mV                    | Io5 = 10 to 300 mA                  |
|                                 | Output current capacity          | Io5                 | 300  | 500  | —             | mA                    | Vo5 $\geq$ 11.7 V                   |
| SW5V<br>OUT                     | Output voltage                   | Vo6                 | 4.6  | 5.0  | 5.4           | V                     | Io6 = 80 mA, VDD = no load          |
|                                 | Output current capacity          | Io6                 | 100  | 300  | —             | mA                    | Vo6 $\geq$ 4.6 V                    |
| ACC<br>OUT                      | Output voltage                   | Vo7                 | 4.6  | 5.0  | 5.4           | V                     | Io7 = 40 mA, VDD = no load          |
|                                 | Output current capacity          | Io7                 | 100  | 300  | —             | mA                    | Vo7 $\geq$ 4.6 V                    |
|                                 | Rise threshold voltage           | VTHH7               | 2.6  | 2.8  | 3.0           | V                     |                                     |
|                                 | Hysteresis range                 | $\Delta\text{VTH}7$ | 0.2  | 0.3  | 0.4           | V                     |                                     |
| BATT.<br>DET                    | Threshold voltage                | VTHH8               | 8.1  | 8.5  | 8.9           | V                     |                                     |
|                                 | Hysteresis range                 | $\Delta\text{VTH}8$ | 0.55 | 0.75 | 0.95          | V                     |                                     |
|                                 | Output current capacity          | Io8                 | 200  | —    | —             | $\mu\text{A}$         | Vo = 0.3 V                          |
| RESET                           | Threshold voltage                | VTHH9               | 4.2  | 4.4  | 4.6           | V                     |                                     |
|                                 | Hysteresis range                 | $\Delta\text{VTH}9$ | 0.15 | 0.3  | 0.45          | V                     |                                     |
|                                 | Output current capacity          | Io9                 | 1.0  | 2.5  | —             | mA                    | Vo = 0.5 V                          |
|                                 | Reset circuit current            | Icc9                | —    | 100  | 180           | $\mu\text{A}$         | Reset in = 5.0 V                    |



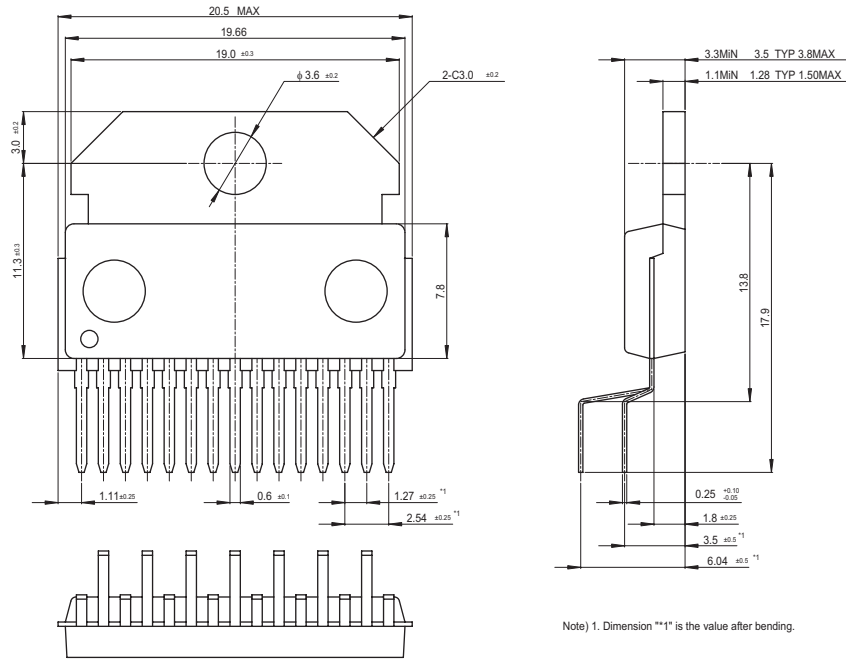
Evaluation Circuit



Package Dimensions

|                          |              |               |            |
|--------------------------|--------------|---------------|------------|
| JEITA Package Code       | RENESAS Code | Previous Code | MASS[Typ.] |
| P-HSIP15-14.3x19.66-1.27 | PRSS0015DA-C | SP-15TGV      | 3.0g       |

Unit : mm



Notes:

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