

# BA3902 BA3904A BA3906

Power supply, standard voltage

The BA3902, BA3904A, and BA3906 are power supplies used in car audio systems.

## Features

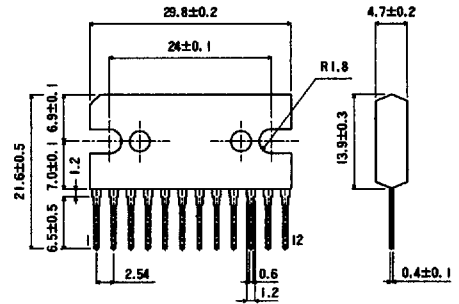
- available in an SIP-M12 package
- four power sources available from each IC
  - BA3902: 5.0 V, 8.5 V (×2), 9.0 V
  - BA3904A: 5.6 V, 8.55 V (×2), 9.0 V
  - BA3906: 5.6 V, 8.3 V (×3)
- incorporates a chip enable output and a mute output for the reference voltage output and accessory voltage detection
- all output circuits use a PNP transistor with a low saturation voltage
- AM and FM band selection switch included with a standby switch, which shuts down the IC when OFF
- internal output overload protection circuit prevents damage to the IC in the event the load is short circuited
- overvoltage protection circuit
- internal thermal overload also protects the IC

## Applications

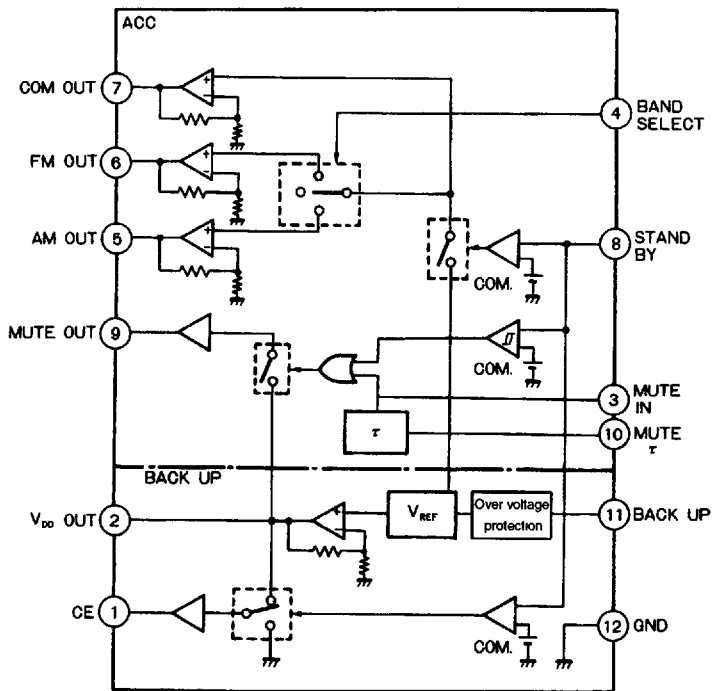
- car radio

## Dimensions (Units : mm)

BA2902, BA3904A, and BA3906 (SIP-M12)



Block diagram



absolute maximum ratings ( $T_a = 25^\circ\text{C}$ )

| Parameter              | Symbol       | Limits          | Unit             | Conditions  |
|------------------------|--------------|-----------------|------------------|---|
| supply voltage         | BACK UP      | 24              | V                |   |
| power dissipation      | $P_d$        | 3000            | mW               |   |
| operating temperature  | $T_{opr}$    | $-30 \sim +85$  | $^\circ\text{C}$ |   |
| storage temperature    | $T_{stg}$    | $-55 \sim +150$ | $^\circ\text{C}$ |   |
| maximum supply voltage | BACK UP peak | 50              | V                | $t_r \geq 1 \text{ ms}$ , maximum supply time is $< 200 \text{ ms}$ |

recommended operating conditions ( $T_a = 25^\circ\text{C}$ )

| Parameter                          | Symbol            | Min     | Typical | Max  | Unit |   |
|------------------------------------|-------------------|---------|---------|------|------|---|
| recommended<br>operating<br>supply | BA3902<br>BA4904A | BACK UP | 10      | 13.2 | 16   | V |
|                                    | BA3906            | BACK UP | 9.2     | 13.2 | 16   | V |
| operating<br>voltage range         | BA3904A<br>BA3906 | BACK UP | 9.0     | 13.2 | 24   | V |

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Standard & Memory ICs

**Electrical characteristics (unless otherwise noted,  $T_a = 25^\circ\text{C}$ , BACK UP = 13.2 V)**  
**(Sheet 1 of 3)**

| Parameter                                     |         | Symbol           | Min  | Typical | Max  | Unit | Conditions                                     |
|---|---------|------------------|------|---------|------|------|--|
| Standby current                               |         | $I_{st}$         |      | 0.7     | 1.0  | mA   | Stand by = 0 V                                 |
| <b>Output voltage 1 (<math>V_{DD}</math>)</b> |         |                  |      |         |      |      |  |
| Output voltage 1                              | BA3902  | $V_{O1}$         | 4.7  | 5.0     | 5.3  | V    | $I_{O1} = 40 \text{ mA}$                       |
|   | BA3904A |                  | 5.3  | 5.6     | 5.9  |      |  |
|   | BA3906  |                  | 5.3  | 5.6     | 5.9  |      |  |
| Line regulation                               |         | $\Delta V_{O11}$ |      | 20      | 100  | mV   | Back up = 10 ~ 16 V, $I_{O1} = 40 \text{ mA}$  |
| Load regulation                               |         | $\Delta V_{O12}$ |      | 20      | 100  | mV   | $I_{O1} = 10 \sim 50 \text{ mA}$               |
| Dropout voltage                               |         | $\Delta V_{O13}$ |      | 0.45    | 1.0  | V    | $I_{O1} = 40 \text{ mA}$                       |
| Output current                                | BA3902  | $I_{11}$         | 0    |         | 60   | mA   | $V_{O1} \geq 4.7 \text{ V}$                    |
|   | BA3904A |                  | 0    |         | 60   |      | $V_{O1} \geq 5.3 \text{ V}$                    |
|   | BA3906  |                  | 0    |         | 60   |      | $V_{O1} \geq 5.3 \text{ V}$                    |
| <b>Output voltage 2 (COM)</b>                 |         |                  |      |         |      |      |  |
| Output voltage 2                              | BA3902  | $V_{O2}$         | 8.6  | 9.0     | 9.4  | V    | $I_{O2} = 80 \text{ mA}$                       |
|   | BA3904A |                  | 8.6  | 9.0     | 9.4  |      |  |
|   | BA3906  |                  | 7.95 | 8.3     | 8.65 |      |  |
| Line regulation                               |         | $\Delta V_{O21}$ |      | 10      | 200  | mV   | Back up = 10 ~ 16 V, $I_{O2} = 80 \text{ mA}$  |
| Load regulation                               |         | $\Delta V_{O22}$ |      | 20      | 200  | mV   | $I_{O2} = 10 \sim 100 \text{ mA}$              |
| Dropout voltage                               | BA3902  | $\Delta V_{O23}$ |      | 0.3     | 0.6  | V    | $I_{O2} = 80 \text{ mA}$                       |
|   | BA3904A |                  |      | 0.3     | 0.6  |      |  |
|   | BA3906  |                  |      | 0.3     | 0.55 |      |  |
| Output current                                | BA3902  | $I_{21}$         | 0    |         | 130  | mA   | $V_{O2} \geq 8.6 \text{ V}$                    |
|   | BA3904A |                  | 0    |         | 130  |      | $V_{O2} \geq 8.6 \text{ V}$                    |
|   | BA3906  |                  | 0    |         | 125  |      | $V_{O2} \geq 7.85 \text{ V}$                   |
| <b>Output voltage 3 (FM)</b>                  |         |                  |      |         |      |      |  |
| Output voltage 3                              | BA3902  | $V_{O3}$         | 8.1  | 8.5     | 8.9  | V    | $I_{O3} = 150 \text{ mA}$                      |
|   | BA3904A |                  | 8.2  | 8.55    | 8.9  |      |  |
|   | BA3906  |                  | 7.95 | 8.3     | 8.65 |      |  |
| Line regulation                               |         | $\Delta V_{O31}$ |      | 10      | 200  | mV   | Back up = 10 ~ 16 V, $I_{O3} = 150 \text{ mA}$ |
| Load regulation                               |         | $\Delta V_{O32}$ |      | 20      | 200  | mV   | $I_{O3} = 10 \sim 200 \text{ mA}$              |

**BA3902, BA3904A, BA3906** System power supply, BA3900 & BA3910 series

**Electrical characteristics (unless otherwise noted,  $T_a = 25^\circ\text{C}$ , BACK UP = 13.2 V)**  
 (Sheet 2 of 3)

| Parameter                    |         | Symbol           | Min  | Typical | Max  | Unit          | Conditions                                    |
|------------------------------|---------|------------------|------|---------|------|---------------|---|
| Dropout voltage              | BA3902  | $\Delta V_{O33}$ |      | 0.4     | 0.6  | V             | $I_{O3} = 150 \text{ mA}$                     |
|                              | BA3904A |                  |      | 0.4     | 0.55 |               |   |
|                              | BA3906  |                  |      | 0.4     | 0.55 |               |   |
| Output current               | BA3902  | $I_{31}$         | 0    |         | 200  | mA            | $V_{O3} \geq 8.1 \text{ V}$                   |
|                              | BA3904A |                  | 0    |         | 250  |               | $V_{O3} \geq 8.1 \text{ V}$                   |
|                              | BA3906  |                  | 0    |         | 250  |               | $V_{O3} \geq 7.85 \text{ V}$                  |
| <b>Output voltage 4 (AM)</b> |         |                  |      |         |      |               |   |
| Output voltage 4             | BA3902  | $V_{O4}$         | 8.1  | 8.5     | 8.9  | V             | $I_{O4} = 80 \text{ mA}$                      |
|                              | BA3904A |                  | 8.2  | 8.55    | 8.9  |               |   |
|                              | BA3906  |                  | 7.95 | 8.3     | 8.65 |               |   |
| Line regulation              |         | $\Delta V_{O41}$ |      | 10      | 200  | mV            | Back up = 10 ~ 16 V, $I_{O4} = 80 \text{ mA}$ |
| Load regulation              |         | $\Delta V_{O42}$ |      | 20      | 200  | mV            | $I_{O4} = 10 \sim 100 \text{ mA}$             |
| Dropout voltage              | BA3902  | $\Delta V_{O43}$ |      | 0.3     | 0.6  | V             | $I_{O4} = 80 \text{ mA}$                      |
|                              | BA3904A |                  |      | 0.3     | 0.55 |               |   |
|                              | BA3906  |                  |      | 0.3     | 0.55 |               |   |
| Output current               | BA3902  | $I_{41}$         | 0    |         | 130  | mA            | $V_{O4} \geq 8.1 \text{ V}$                   |
|                              | BA3904A |                  | 0    |         | 145  |               | $V_{O4} \geq 8.1 \text{ V}$                   |
|                              | BA3906  |                  | 0    |         | 145  |               | $V_{O4} \geq 7.85 \text{ V}$                  |
| <b>Input 1 (STAND BY)</b>    |         |                  |      |         |      |               |   |
| Input change level           |         | $V_{IH1}$        | 5.5  | 6.0     | 6.5  | V             | COM = ON                                      |
| Input current, high          |         | $V_{H1}$         | 100  | 180     | 260  | $\mu\text{A}$ | Stand by = 8 V                                |
| CE up threshold voltage      |         | $V_{TH11}$       | 6.0  | 6.3     | 6.6  | V             | Stand by > $V_{TH11}$ , CE = HIGH             |
| CE down threshold voltage    |         | $V_{TH12}$       | 5.2  | 5.5     | 5.8  | V             | Stand by < $V_{TH12}$ , CE = LOW              |
| MUTE down threshold voltage  | BA3902  | $V_{TH21}$       | 6.7  | 7.1     | 7.5  | V             | Stand by < $V_{TH21}$ , MUTE OUT = LOW        |
|                              | BA3904A |                  | 6.85 | 7.25    | 7.65 |               |   |
|                              | BA3906  |                  | 6.85 | 7.25    | 7.65 |               |   |
| MUTE up threshold voltage    |         | $V_{TH22}$       | 7.6  | 8.0     | 8.4  | V             | Stand by > $V_{TH22}$ , MUTE OUT = HIGH       |
| <b>Input 2 (BAND SELECT)</b> |         |                  |      |         |      |               |   |
| FM out change level          |         | $V_{IH2}$        | 1.0  | 1.4     | 1.8  | V             |   |
| AM out change level          |         | $V_{IM2}$        | 3.0  | 3.4     | 3.8  | V             |   |
| Input current, high          |         | $I_{H2}$         |      | 10      | 60   | $\mu\text{A}$ | Band select = 5 V                             |

**Electrical characteristics (unless otherwise noted,  $T_a = 25^\circ\text{C}$ , BACK UP = 13.2 V)**  
 (Sheet 3 of 3)

| Parameter                | Symbol                      | Min       | Typical              | Max | Unit          | Conditions           |                                    |
|--------------------------|-----------------------------|-----------|----------------------|-----|---------------|----------------------|------------------------------------|
| <b>Input 3 (MUTE IN)</b> |                             |           |                      |     |               |                      |                                    |
| MUTE OUT change level    | $V_{TH3}$                   | 1.4       | 2.3                  | 3.3 | V             | Mute out HI          |                                    |
| Input current, high      | $I_{H3}$                    |           | 100                  | 170 | $\mu\text{A}$ | Mute in = 5 V        |                                    |
| MUTE OUT output current  | $I_{O5}$                    | 12        | 19                   |     | mA            | Mute out > 4.2 V     |                                    |
| CE output voltage        | BA3902<br>BA3904A<br>BA3906 | $V_{O61}$ | $0.82 \times V_{DD}$ |     | $V_{DD}$      | V                    | CE = HIGH, $I_{O6} = 1 \text{ mA}$ |
|                          |                             |           | $0.82 \times 5$      |     |               |                      |                                    |
|                          |                             |           | $0.82 \times 5$      |     |               |                      |                                    |
| CE output voltage        | $V_{O62}$                   |           | 0                    | 0.3 | V             | CE = LOW             |                                    |
| Ripple rejection ratio   | RR                          |           | 60                   |     | dB            | $f = 100 \text{ Hz}$ |                                    |

**Figure 1 Test circuit**

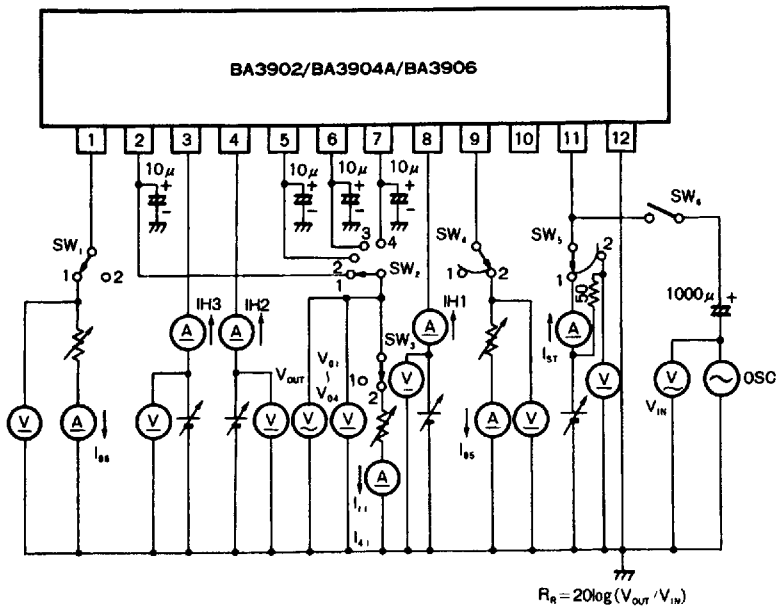


Figure 2 Application example—BA3902

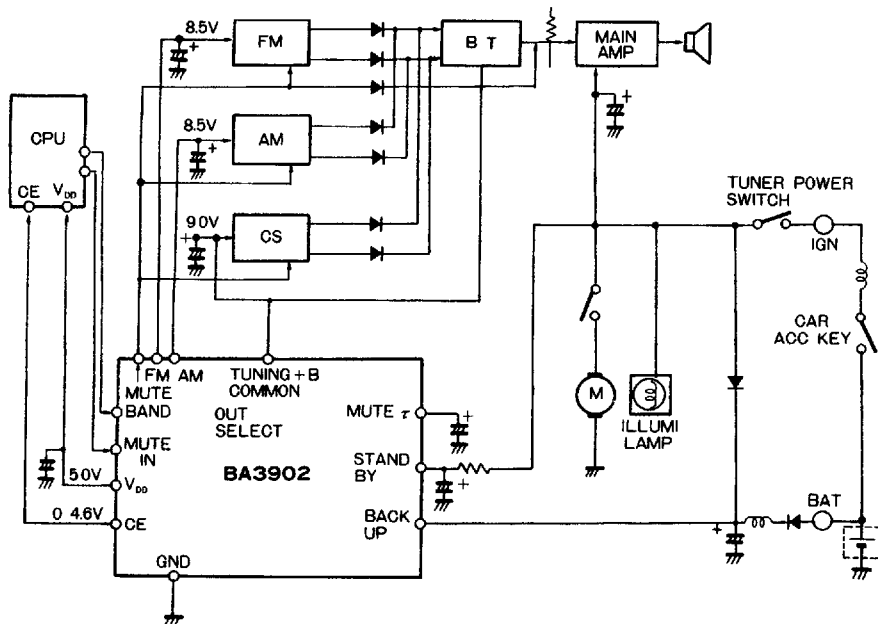
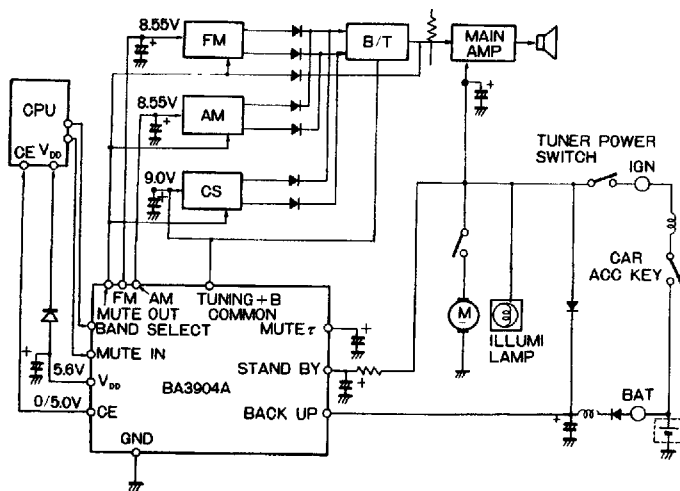
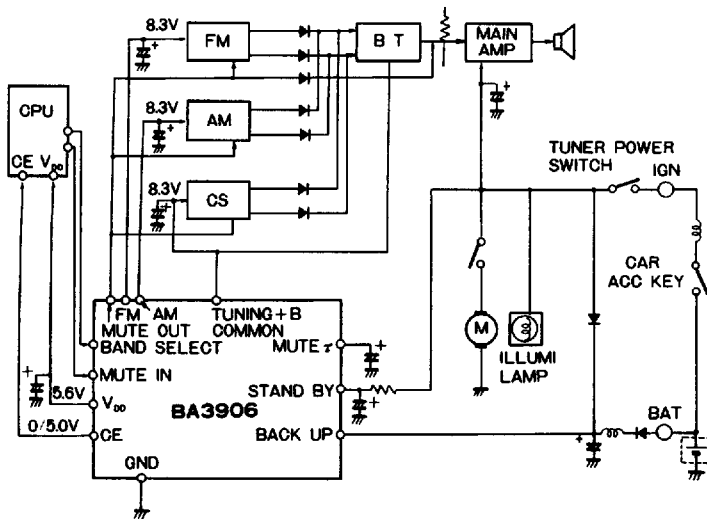


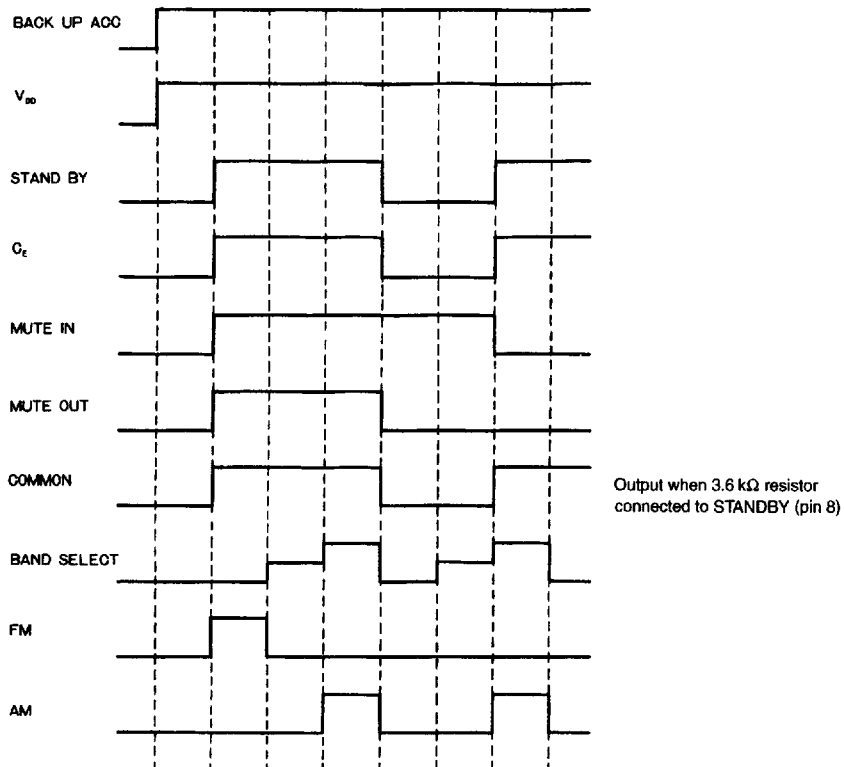
Figure 3 Application example—BA3904A



**Figure 4 Application example—BA3906**



**Figure 5 Input and output timing chart**



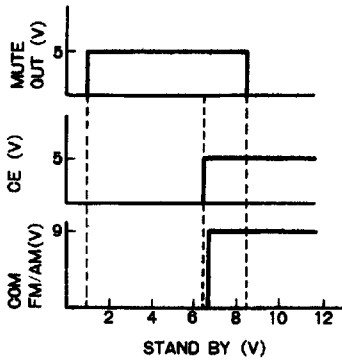


Figure 6 Standby (pin 8) 3.6 kΩ

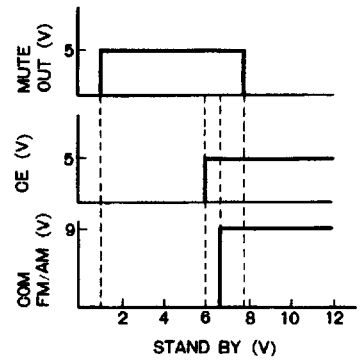


Figure 7

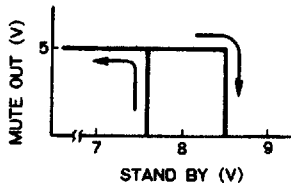


Figure 8 MUTEOUT (pin 9) output pin

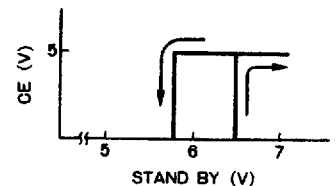
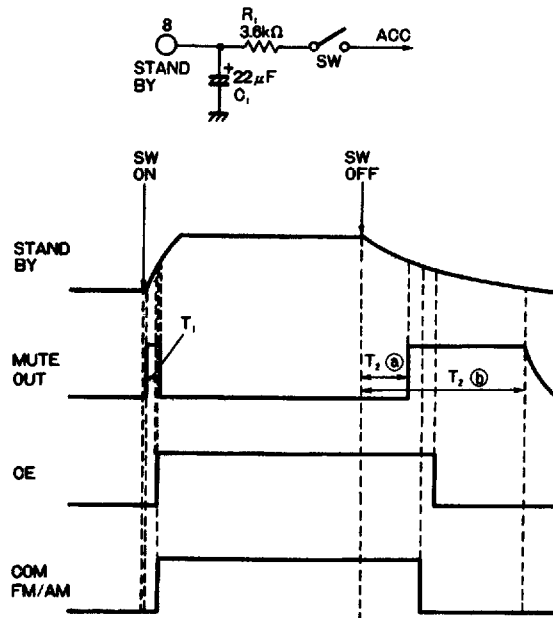


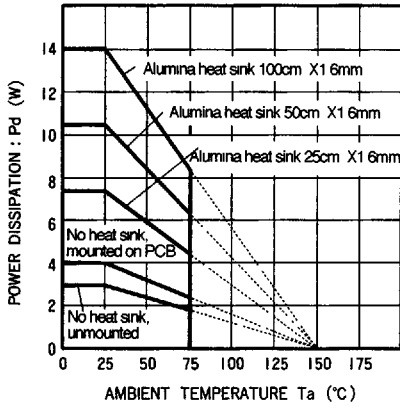
Figure 9 CE (pin 1) output pin

Figure 10





**Electrical characteristic curves**

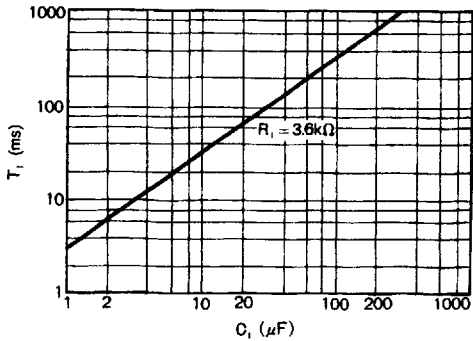


**Figure 11**

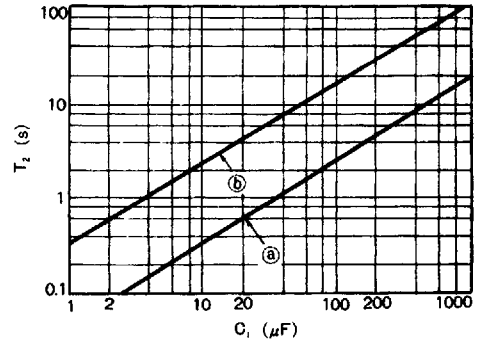
**STAND BY (pin 8)**

**BACK UP = 13.2 v**

**STAND BY: SW ON = 13.2 V: SW OFF = OPEN**



**Figure 12**



**Figure 13**

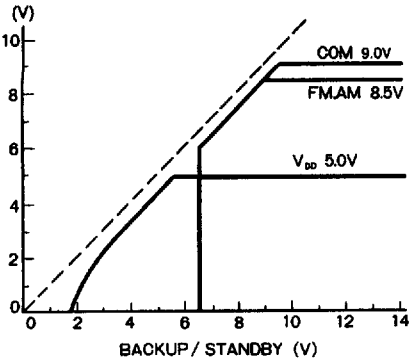


Figure 14 (BA3902)

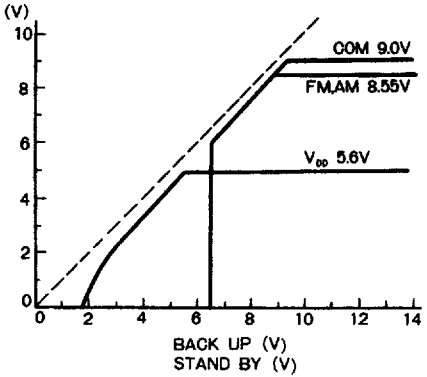


Figure 15 (BA3904A)

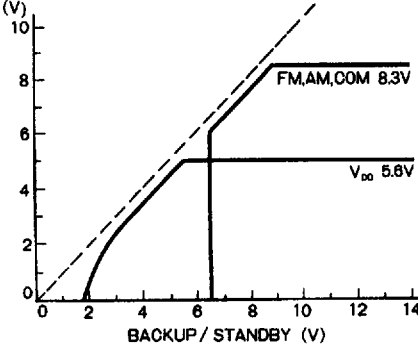


Figure 16 BA3906