# BA3910B

## Power supply, standard voltage

The BA3910B is a power supply used in car audio systems.

### Features

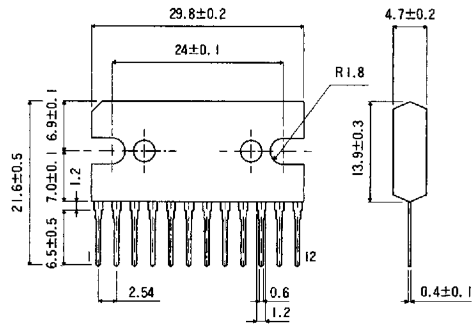
- available in an SIP-M12 package
- multiple voltages available from the same IC
  - — 5.6 V (microcontroller)
  - — 8.7 V (×3; FM, AM, and COM)
- internal overflow voltage protection circuit provides protection from surges from the ACC or BACKUP supply pins
- all output circuits use a PNP transistor with a low saturation voltage
- internal output overload protection circuit prevents damage to the IC in the event the load is short circuited
- internal thermal overload also protects the IC

### Applications

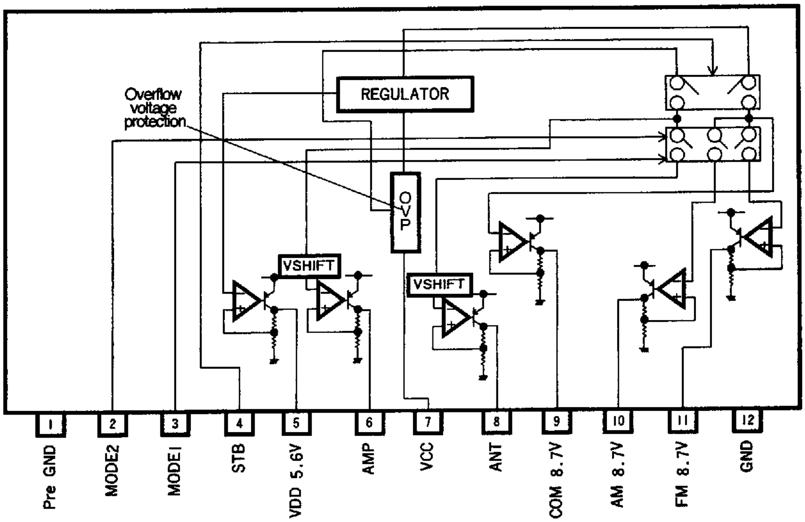
- car audio systems

### Dimensions (Units : mm)

**BA3910B (SIP-M12)**



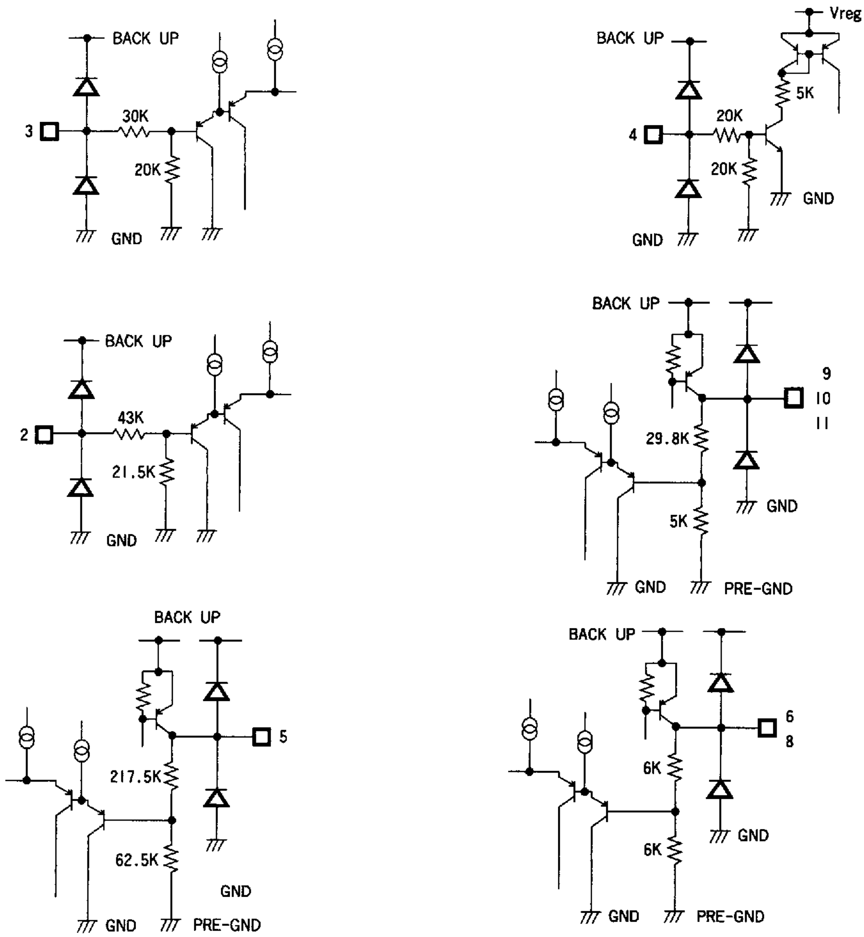
## Block diagram




## Table 1 Pin description

| Pin no. | Pin name | Function |
|---|---|---|
| 1 | Pre GND | Small current ground |
| 2 | MODE1 | AM output, ANT output rise pin |
| 3 | MODE2 | FM output or AM output switch pin |
| 4 | STB | COM output, AMP output rise pin |
| 5 | VDD 5.6 V | VDD, 4.5 V output pin |
| 6 | AMP | Remote amplifier driving power supply ($V_{CC}$ in series) |
| 7 | VCC | Power supply pin |
| 8 | ANT | Antenna driving power supply ($V_{CC}$ in series) |
| 9 | COM 8.7 V | Common power supply for the power system, electronic synchronization and variable capacitance COM 8.7 V output |
| 10 | AM 8.7 V | AM reception power supply, 8.7 V |
| 11 | FM 8.7 V | FM reception power supply, 8.7 V output |
| 12 | GND | Large current system, substrate GND |

## Figure 1 Input and output equivalent circuits




## Absolute maximum ratings ($T_a = 25^{\circ}C$)

| Parameter | Symbol | Limits | Unit | Conditions |
|---|---|---|---|---|
| Applied voltage | $V_{CC}$ | 24 | V | |
| Power dissipation | $P_d$ | 3000 | mW | Reduce power by 30 mW/°C for each degree above 25°C. |
| Peak applied voltage | $V_{CC}$ PEAK | 50 | V | tr ≥ 1 ms, maximum supply time is < 200 ms |
| Operating temperature | $T_{opr}$ | −30 ~ +85 | °C | |
| Storage temperature | $T_{stg}$ | −55 ~ +150 | °C | |

## Recommended operating conditions ($T_a$ = 25°C)

| Parameter | Symbol | Range | Unit |
|---|---|---|---|
| Power supply voltage | $V_{CC}$ | 10 ~ 16 | V |

## Electrical characteristics (unless otherwise noted, $T_a$ = 25°C, $V_{CC}$ = 13.2 V) (Sheet 1 of 2)

| Parameter | Symbol | Min | Typical | Max | Unit | Conditions | Test figure |
|---|---|---|---|---|---|---|---|
| Standby circuit current | $I_{st}$ | | 0.55 | 0.80 | mA | Stand by pin = 0 V | 2 |
| **Output 1 ($V_{DD}$)** | | | | | | | |
| Output voltage | $V_{O1}$ | 5.30 | 5.60 | 5.90 | V | $I_{O1}$ = 80 mA | 2 |
| Line regulation | $\Delta V_{O11}$ | | 100 | 200 | mV | Back up= 10 ~ 16 V, $I_{O1}$ = 80 mA | |
| Load regulation | $\Delta V_{O12}$ | | 30 | 150 | mV | $I_{O1}$ = 0 ~ 80 mA | |
| Dropout voltage | $\Delta V_{O13}$ | | 0.3 | 0.7 | V | $I_{O1}$ = 80 mA | |
| Output current | $I_{O1}$ | 100 | 150 | | mA | $V_{O1} \geq 5.3$ V | |
| Ripple rejection ratio | $R.R_1$ | 43 | 47 | | dB | f = 100 Hz, $V_{RR}$ = –10 dBV | 3 |
| **Output 2 (COM)** | | | | | | | |
| Output voltage | $V_{O2}$ | 8.25 | 8.70 | 9.15 | V | $I_{O2}$ = 120 mA | 2 |
| Line regulation | $\Delta V_{O21}$ | | 100 | 200 | mV | $V_{CC}$ = 10 ~ 16 V, $I_{O2}$ = 120mA | |
| Load regulation | $\Delta V_{O22}$ | | 50 | 180 | mV | $I_{O2}$ = 0 ~ 120 mA | |
| Dropout voltage | $\Delta V_{O23}$ | | 0.4 | 0.7 | V | $I_{O2}$ = 120 mA | |
| Output current | $I_{O2}$ | 150 | 200 | | mA | $V_{O2} \geq 8.25$ V | |
| Ripple rejection ratio | R.R2 | 40 | 45 | | dB | f = 100 Hz, $V_{RR}$ = –10 dBV | 3 |
| **Output 3 (AMP)** | | | | | | | |
| Line regulation | $\Delta V_{O31}$ | | 0.5 | 0.9 | V | $I_{O3}$ = 400 mA | 2 |
| Load regulation | $\Delta V_{O32}$ | | 300 | 600 | mV | $I_{O3}$ = 0 ~ 400 mA | |
| Output current | $I_{O3}$ | 500 | 650 | | mA | $V_{O3} \geq 12.3$ V | |
| **Output 4 (ANT)** | | | | | | | |
| Line regulation | $\Delta V_{O41}$ | | 0.5 | 0.9 | V | $I_{O4}$ = 400 mA | 2 |
| Load regulation | $\Delta V_{O42}$ | | 300 | 600 | mV | $I_{O4}$ = 0 ~ 400 mA | |
| Output current | $I_{O4}$ | 500 | 650 | | V | $I_{O4} \geq 12.3$ V | |

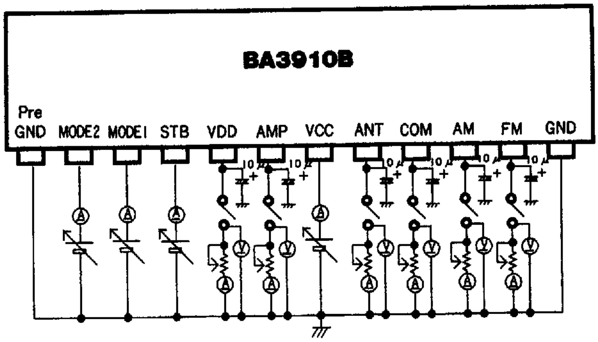
**ctrical characteristics (unless otherwise noted, $T_a$ = 25°C, $V_{CC}$ = 13.2 V) (Sheet 2 of 2)**

| Parameter | Symbol | Min | Typical | Max | Unit | Conditions | Test figure |
|---|---|---|---|---|---|---|---|
| **tput 5 (AM)** | | | | | | | |
| put voltage | $V_{O5}$ | 8.25 | 8.70 | 9.15 | V | $I_{O5}$ = 120 mA | 2 |
| e regulation | $\Delta V_{O51}$ | | 100 | 200 | mV | $V_{CC}$ = 10 ~ 16 V, $I_{O5}$ = 120 mA | |
| d regulation | $\Delta V_{O52}$ | | 50 | 180 | mV | $I_{O5}$ = 9 ~ 120 mA | |
| pout voltage | $\Delta V_{O53}$ | | 0.4 | 0.7 | V | $I_{O5}$ = 120 mA | |
| put current | $I_{O5}$ | 150 | 200 | | mA | $V_{O5}$ ≥ 8.25 V | |
| ple rejection ratio | R.R5 | 40 | 45 | | dB | f = 100 Hz, $V_{RR}$ = −10 dBV | 3 |
| **put 6 (FM)** | | | | | | | |
| put voltage | $\Delta V_{O6}$ | 8.25 | 8.70 | 9.15 | V | $I_{O6}$ = 200 mA | 2 |
| e regulation | $\Delta V_{O61}$ | | 100 | 200 | mV | $V_{CC}$ = 10 ~ 16 V, $I_{O6}$ = 200 mA | |
| d regulation | $\Delta V_{O62}$ | | 50 | 180 | mV | $I_{O6}$ = 0 ~ 200 mA | |
| pout voltage | $\Delta V_{O63}$ | | 0.4 | 0.7 | V | $I_{O6}$ = 200 mA | |
| put current | $I_{O6}$ | 250 | 350 | | mA | $V_{O6}$ ≥ 8.25 V | |
| ple rejection ratio | R.R6 | 40 | 45 | | dB | f = 100 Hz, $V_{RR}$ = −10 dBV | 3 |
| **ndby input** | | | | | | | |
| ndby level | $V_{th1-1}$ | | | 1.1 | V | | 2 |
| ve level | $V_{th1-2}$ | 1.7 | | | V | | |
| t current, high | $I_{in1}$ | 100 | 175 | 250 | µA | $V_{th1}$ = 5 V | |
| **le 2 SW input** | | | | | | | |
| ndby level | $V_{th2-1}$ | | | 1.6 | V | | 2 |
| ve level | $V_{th2-2}$ | 2.4 | | | V | | |
| t current, high | $I_{in2}$ | 40 | 90 | 140 | µA | $V_{th2}$ = 5 V | |
| **le 1 SW input** | | | | | | | |
| ON level | $V_{th3-1}$ | | | 1.1 | V | | 2 |
| ON level | $V_{th3-2}$ | 2.7 | | | V | | |
| t current, HIGH | $I_{in3}$ | 50 | 100 | 150 | µA | $V_{th3}$ = 5 V | |

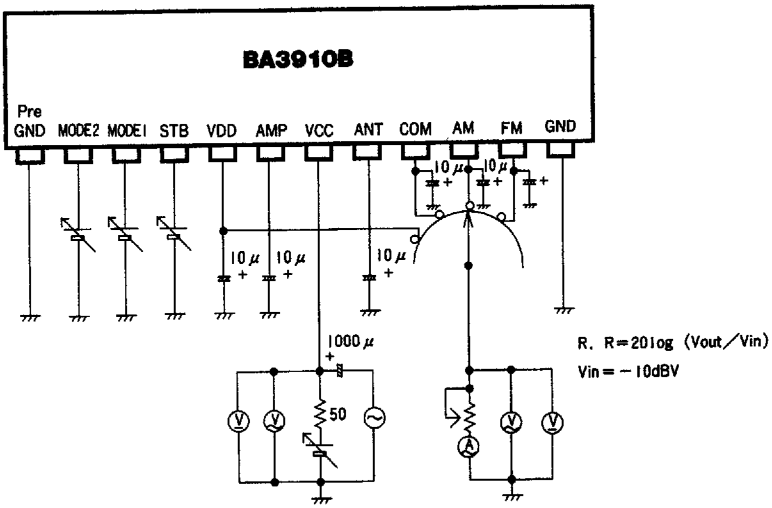
***Note:*** Ensure circuit output current is less than the maximum value

## Test circuits

### Figure 2 Test circuit for each pin



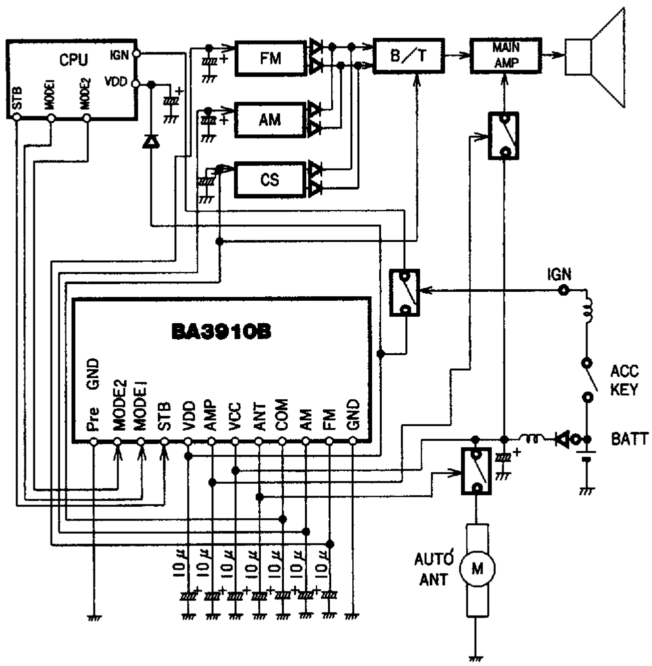

### Figure 3 Ripple rejection rate test circuit





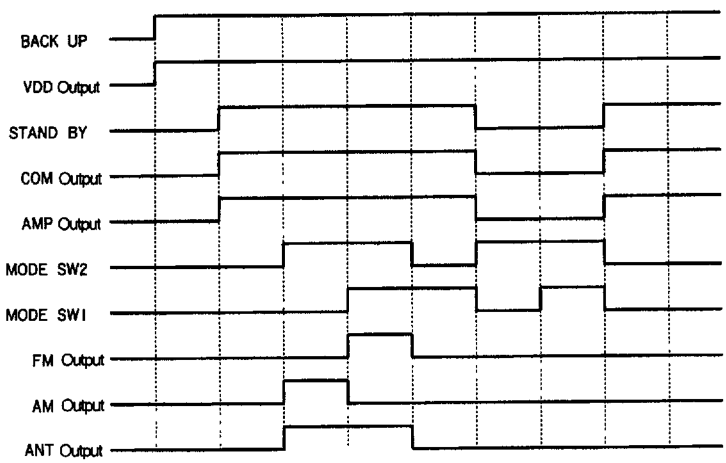

ROHM

**Figure 4 Application example**




## cuit operation

**Figure 5 Timing chart**



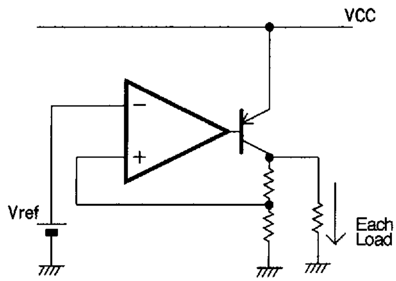

$V_{DD}$ (5.6 V) is always output when $V_{CC}$ is connected.

COM 8.7 V and AMP output are output when STB is ON.

AM 8.7 V and ANT output are output when MODE2 is ON.

Also, AM output is isolated when MODE 1 is set to 1.4 V. FM output starts when MODE 1 is set to 2.5 V.

**Figure 6 Determining maximum power consumption ($P_{max}$)**




Power consumed by $V_{DD}$ (5.6 V)

$$P_1 = (A - 5.6) \times I_1 + \left(\frac{I_1}{20} + \frac{I_1}{10}\right)A$$

Power consumed by COM8.7 V

$$P_2 = (A - 8.7) \times I_2 + \left(\frac{I_2}{30} + \frac{I_2}{10}\right)A$$

Power consumed by AMP

$$P_3 = (0.5 \times I_3) \times I_2 + \left(\frac{I_3}{100} + \frac{I_3}{10}\right)A$$

Power consumed by ANT

$$P_4 = (0.5 \times I_4) \times I_2 + \left(\frac{I_4}{100} + \frac{I_4}{10}\right)A$$

Power consumed by AM8.7 V

$$P_5 = (A - 8.7) \times I_5 + \left(\frac{I_5}{30} + \frac{I_5}{10}\right)A$$

Power consumed by FM8.7 V

$$P_6 = (A - 8.7) \times I_6 + \left(\frac{I_6}{50} + \frac{I_6}{10}\right)A$$

Power consumed internally by each circuit
(circuit current ≅ 5 mA)

$$P_7 = V_{CC} \times \text{circuit current}$$

$P_{max} = P_1 + P_2 + P_3 + P_4 +$ ($P_5$ or $P_6$, whichever is larger)
where A = maximum output voltage for $V_{CC}$
$I_1$ = maximum output current for $V_{SS}$
$I_2$ = maximum output current for COM
$I_3$ = maximum output current for AMP
$I_4$ = maximum output current for ANT
$I_5$ = maximum output current for AM
$I_6$ = maximum output current for FM

## Precautions for use

### Application example

The application circuit in Figure 4 is recommended for use. Make sure to confirm the adequacy of the characteristics. When using the circuit with changes to the external circ constants, make sure to leave an adequate margin for external components including st and transitional characteristics as well as dispersion of the IC. Note that ROHM cannot provide adequate confirmation of patents.

### Operating power supply

When operating at normal voltages and at ambient temperature, most circuit functions a guaranteed. The characteristic values cannot be absolutely guaranteed for all paramete However, there are no sudden changes of the characteristics within these ranges.

### Voltage overload protection circuit

The voltage overload protection circuit turns OFF the output when the potential difference between $V_{CC}$ (pin 7) and GND (pin 12) exceeds about 26 V (at normal temperature). Make sure to use the IC within this range.

### Preventing oscillation at each output and the ripple filter capacitor

To prevent oscillation, connect a capacitor between the $V_{DD}$ (pin 5), AMP (pin 6), ANT (pin 8), COM (pin 9), AM (pin 10), and FM (pin 11) output pins and the GND. ROHM recommends using a tantalum capacitor with a low thermal characteristic.

### Current overload protection circuit

A current overload protection circuit is installed on the $V_{DD}$ (pin 5), AMP (pin 6), ANT (pin 8), COM (pin 9), AM (pin 10), and FM (pin 11) outputs based on their respective current capacity. This prevents damage to the IC in the event that the load is short circuited.

This protection circuit limits the current in the form of a "7" (see Figures 8 and 9). It is designed with a margin so that even if a large current suddenly flows through the large capacitor in the IC, the current is restricted and latching is prevented.

However, these protection circuits are only good for preventing accidental damage. Make sure your design does not cause the protection circuit to operate continuously (for instance: clamping at an output of 1 Vf or greater: below 1 Vf, the overload circuit operates). The capacitor has negative temperature characteristics.

### Thermal overload

A thermal overload circuit is installed to prevent thermal damage. When the thermal overload circuit operates, all outputs, except $V_{DD}$, are put in the OFF state. When the temperature drops about 25°C, the circuit is restored.

### Circuit structure of each output

The $V_{DD}$ (pin 5), AMP (pin 6), ANT (pin 8), COM (pin 9), AM (pin 10), and FM (pin 11) outputs consist of PNP power transistors. A protection circuit ensures that when the $V_{CC}$ (pin 7) voltage falls, the IC is not damaged, even if the output voltage from the external output capacitor is greater than the $V_{CC}$ voltage.

### Grounding

The ground shown in the application circuit has an adequately short pattern for the GND (pin 12) pin. Make sure to arrange these traces and other outputs in a pattern that prevents mutual interference.

### ASO

Although this IC has many types of protection circuits built in, the ASO may still be exceeded under certain conditions. When ASO is exceeded, the IC will be destroyed. Be careful never to exceed the ASO.

## Electrical characteristic curves

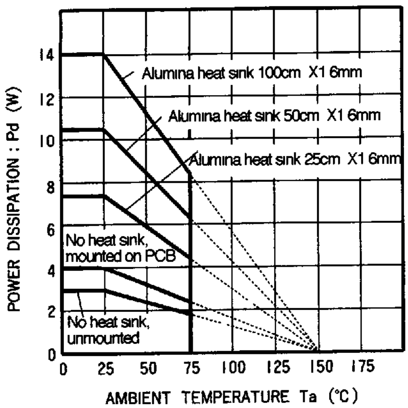
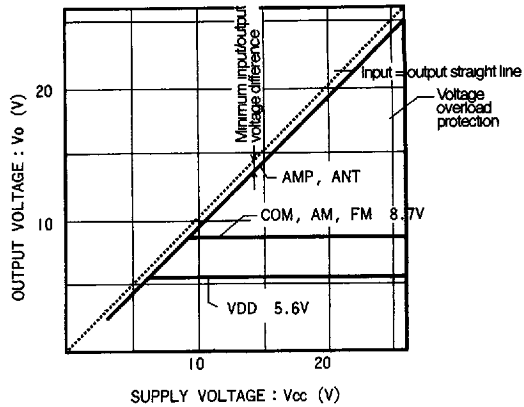



**Figure 7**



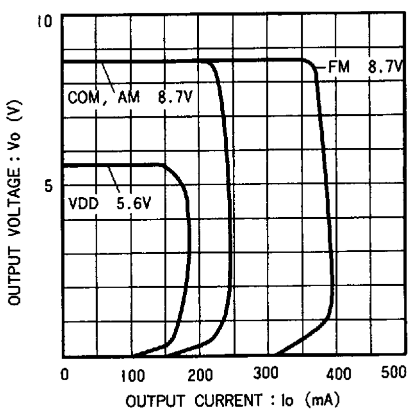




**Figure 8**

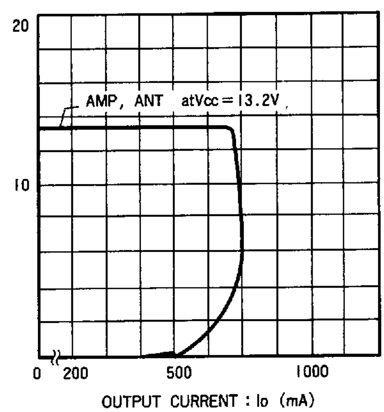



**Figure 9**

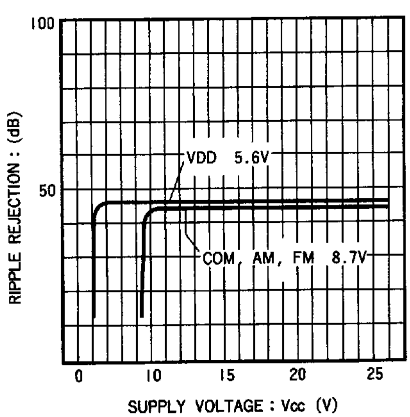



**Figure 10**