

System power supply for car stereos

BA4900

The BA4900 is a single-chip power supply IC for use in car stereo audio systems. The IC contains one 5.8V output for a microcontroller, three 8V outputs, one 10V output, and two outputs interlocked with BACKUP and ACC systems.

● Applications

Car stereo audio systems

● Features

- 1) All output circuits, except AMP and ANT circuits, use a PNP transistor with a low saturation voltage.
- 2) Output current limit circuit prevents damage to the IC in the event output is short-circuited.
- 3) Overvoltage protection circuit provides protection against surges from the ACC or BACKUP inputs.
- 4) Compact 12-pin POWER package allows a large power dissipation.
- 5) Thermal protection circuit prevents heat damage to the IC.

● Absolute maximum ratings (Ta = 25°C)

| Parameter | Symbol | Limits | Unit |
|-----------------------|----------------------|----------|------|
| Applied voltage | V _{CC} | 24 | V |
| Power dissipation | P _d | 3000 | mW |
| Operating temperature | T _{opr} | -30~+85 | °C |
| Storage temperature | T _{stg} | -55~+150 | °C |
| Peak applied voltage | V _{CC PEAK} | 50* | V |

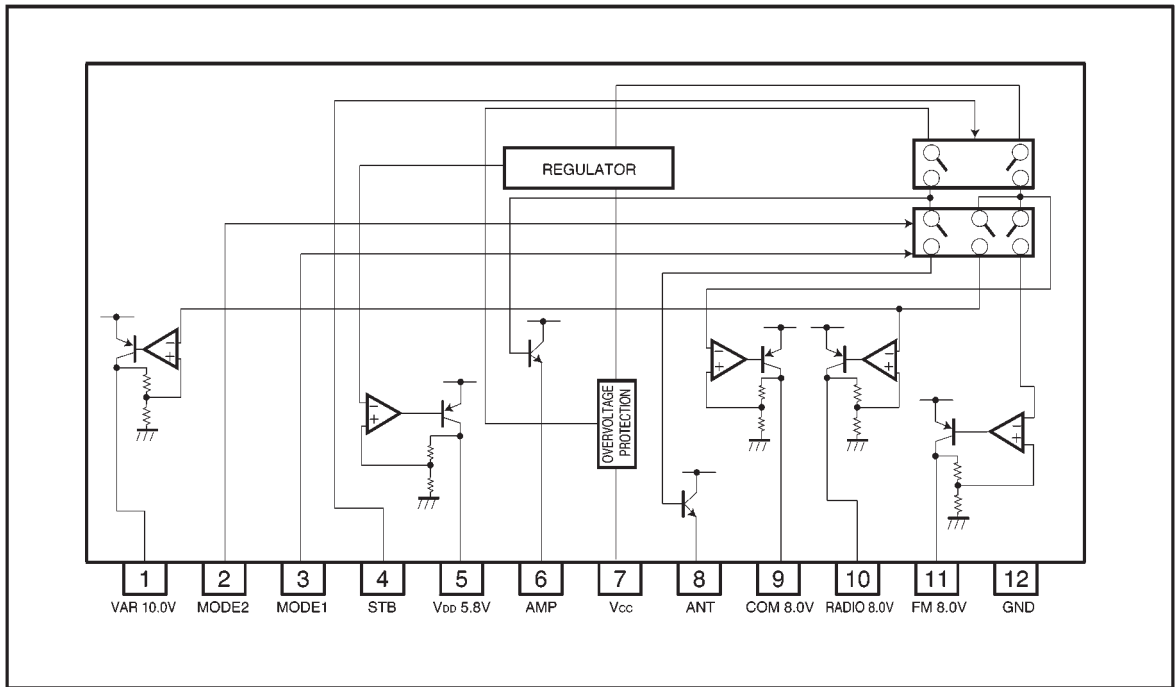
* Tr ≥ 1msec, applied time is less than 200 msec.

● Recommended operating conditions (Ta = 25°C)

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|----------------------------------|-----------------|------|------|------|------|
| Recommended power supply voltage | V _{CC} | 10 | 13.2 | 16 | V |
| Operable voltage | V _{CC} | 6.3 | 13.2 | 24 | V |



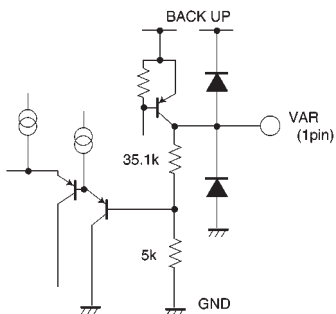
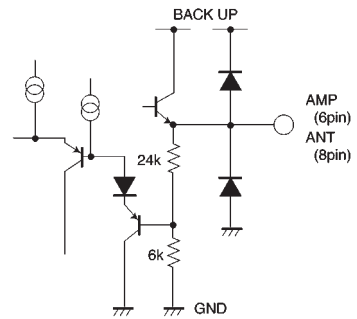
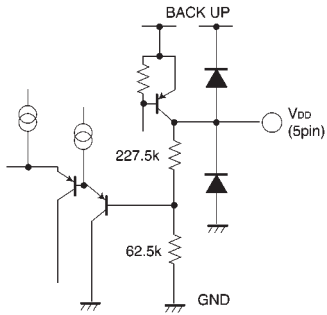
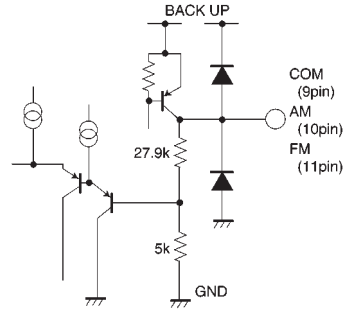
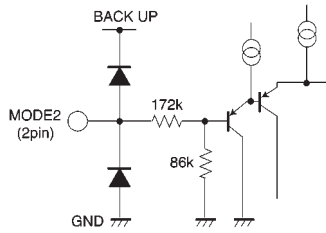
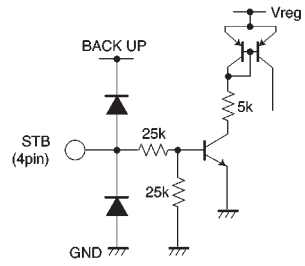
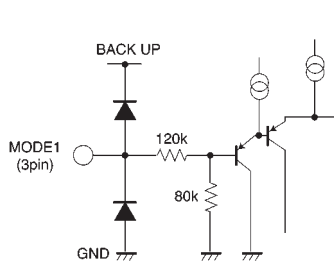
● Block diagram



● Pin descriptions

| Pin No. | Pin name | Function |
|---------|------------------------|--|
| 1 | VAR output | 10.0 V power supply for variable capacitor; maximum output is 12.5 mA. |
| 2 | MODE2 SW | RADIO, ANT, and VAR outputs are turned ON when this pin is 5 V. |
| 3 | MODE1 SW | FM output is turned ON when this pin is 5 V. |
| 4 | STAND BY | COM and AMP outputs are turned on when this pin is 5 V; only V _{DD} is output in standby mode (0 V). |
| 5 | V _{DD} output | 5.8 V power supply for a microcontroller; maximum output is 100 mA; output is always available if BACKUP power supply is connected. |
| 6 | AMP output | Power supply to drive a remote amplifier; a voltage of about 1 V (typical) lower than the V _{CC} pin voltage is provided with a maximum output of 500 mA. |
| 7 | V _{CC} | Connected to car BACKUP and ACC power supplies. |
| 8 | ANT output | Power supply to drive an antenna; a voltage of about 1 V (typical) lower than the V _{CC} pin voltage is provided with a maximum output of 500 mA. |
| 9 | COM output | 8.0 V power supply with a maximum output of 150 mA; this can be used as system common power supply (such as tone, volume, and balance control) as well as power supply for cassette player equalizers and electronic tuning variable capacitors. |
| 10 | RADIO output | 8.0 V main power supply with a maximum output of 250 mA for radio |
| 11 | FM output | 8.0 V power supply with a maximum output of 250 mA for FM receiver |
| 12 | GND | Connected to the IC substrate. |

● Input / output circuits



●Electrical characteristics (unless otherwise noted, Ta = 25°C and V_{CC} = 13.2V)

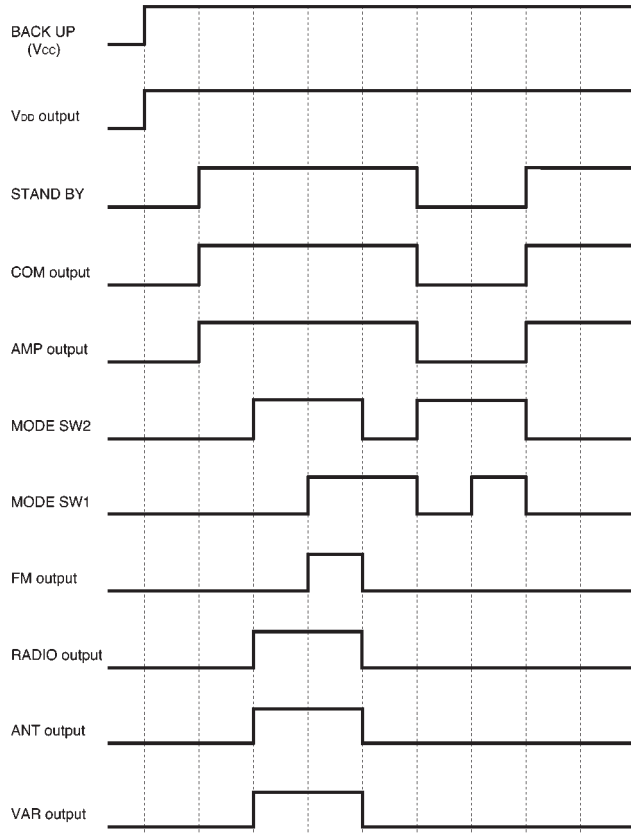
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|-------------------------------------|-------------------|------|------|------|------|--|
| Standby supply current | I _{ST} | — | 0.55 | 0.80 | mA | STAND BY pin=0 V |
| Output voltage (V _{DD}) 1 | V _{O1} | 5.50 | 5.80 | 6.10 | V | I _{O1} =80mA |
| Voltage regulation | ΔV _{O11} | — | 10 | 30 | mV | V _{CC} =10~16V I _{O1} =80mA |
| Load regulation | ΔV _{O12} | — | 100 | 180 | mV | I _{O1} =10~80mA |
| Minimum I / O voltage differential | ΔV _{O13} | — | 0.3 | 0.7 | V | I _{O1} =80mA |
| Output current capacity | I _{O1} | 100 | 200 | — | mA | V _{O1} ≥5.5V |
| Ripple rejection ratio | R.R1 | 50 | 60 | — | dB | f=100Hz VRR=-10dBV |
| Output voltage (COM) 2 | V _{O2} | 7.60 | 8.00 | 8.40 | V | I _{O2} =120mA |
| Voltage regulation | ΔV _{O21} | — | 10 | 30 | mV | V _{CC} =10~16V I _{O2} =120mA |
| Load regulation | ΔV _{O22} | — | 90 | 180 | mV | I _{O2} =10~120mA |
| Minimum I / O voltage differential | ΔV _{O23} | — | 0.4 | 0.7 | V | I _{O2} =120mA |
| Output current capacity | I _{O2} | 150 | 300 | — | mA | V _{O2} ≥7.60V |
| Ripple rejection ratio | R.R2 | 50 | 60 | — | dB | f=100Hz VRR=-10dBV |
| I / O voltage differential (AMP) 3 | ΔV _{O31} | — | 1 | 1.5 | V | I _{O3} =400mA |
| Load regulation | ΔV _{O32} | — | 350 | 600 | mV | I _{O3} =10~400mA |
| Output current capacity | I _{O3} | 500 | 900 | — | mA | V _{O3} ≥11.7V |
| I / O voltage differential (ANT) 4 | ΔV _{O41} | — | 1 | 1.5 | V | I _{O4} =400mA |
| Load regulation | ΔV _{O42} | — | 350 | 600 | mV | I _{O4} =10~400mA |
| Output current capacity | I _{O4} | 500 | 900 | — | mA | V _{O4} ≥11.7V |
| Output voltage (RADIO) 5 | V _{O5} | 7.60 | 8.00 | 8.40 | V | I _{O5} =120mA |
| Voltage regulation | ΔV _{O51} | — | 10 | 30 | mV | V _{CC} =10~16V I _{O5} =120mA |
| Load regulation | ΔV _{O52} | — | 90 | 180 | mV | I _{O5} =10~120mA |
| Minimum I / O voltage differential | ΔV _{O53} | — | 0.4 | 0.7 | V | I _{O5} =120mA |
| Output current capacity | I _{O5} | 250 | 500 | — | mA | V _{O5} ≥7.60V |
| Ripple rejection ratio | R.R5 | 50 | 60 | — | dB | f=100Hz VRR=-10dBV |
| Output voltage (FM) 6 | V _{O6} | 7.60 | 8.00 | 8.40 | V | I _{O6} =200mA |
| Voltage regulation | ΔV _{O61} | — | 20 | 60 | mV | V _{CC} =10~16V I _{O6} =200mA |
| Load regulation | ΔV _{O62} | — | 90 | 180 | mV | I _{O6} =10~200mA |
| Minimum I / O voltage differential | ΔV _{O63} | — | 0.4 | 0.7 | V | I _{O6} =200mA |
| Output current capacity | I _{O6} | 250 | 500 | — | mA | V _{O6} ≥7.60V |
| Ripple rejection ratio | R.R6 | 45 | 55 | — | dB | f=100Hz VRR=-10dBV |

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|------------------------------------|------------------|------|-------|-------|---------------|---|
| Output voltage (VAR) 7 | V_{O7} | 9.50 | 10.00 | 10.50 | V | $I_{O7}=10\text{mA}$ |
| Voltage regulation | ΔV_{O71} | — | 1 | 15 | mV | $V_{CC}=10\sim 16\text{V}$ $I_{O7}=10\text{mA}$ |
| Load regulation | ΔV_{O72} | — | 30 | 80 | mV | $I_{O7}=0\sim 10\text{mA}$ |
| Minimum I / O voltage differential | ΔV_{O73} | — | 0.3 | 0.7 | V | $I_{O7}=10\text{mA}$ |
| Output current capacity | I_{O7} | 12.5 | 25 | — | mA | $V_{O7}\geq 9.50\text{V}$ |
| Ripple rejection ratio | R.R7 | 50 | 60 | — | dB | $f=100\text{Hz}$ $VRR=10\text{dBV}$ |
| 〈Input (STAND BY)〉 | | | | | | |
| Standby level | V_{TH1-1} | — | — | 1.1 | V | — |
| Active level | V_{TH1-2} | 1.7 | — | — | V | — |
| Input high level current | I_{IN1} | 100 | 175 | 250 | μA | $V_{TH1}=5\text{V}$ |
| 〈Input (MODE 2 SW)〉 | | | | | | |
| Standby level | V_{TH2-1} | — | — | 1.6 | V | — |
| Active level | V_{TH2-2} | 2.4 | — | — | V | — |
| Input high level current | I_{IN2} | 13 | 25 | 37 | μA | $V_{TH2}=5\text{V}$ |
| 〈Input (MODE 1 SW)〉 | | | | | | |
| Level when FM OFF | V_{TH3-1} | — | — | 1.1 | V | — |
| Level when FM ON | V_{TH3-2} | 2.7 | — | — | V | — |
| Input high level current | I_{IN3} | 13 | 25 | 37 | μA | $V_{TH3}=5\text{V}$ |

©Not designed for radiation resistance.

*Set output current to less than the minimum value of output current capacity.

● Input / output timing chart



● Estimate of allowable power dissipation.

Except under transitional conditions, the power dissipation of this IC is 3W per unit at 25°C.

See Fig.3 for thermal derating characteristics, including some cases where heat sinks are used.

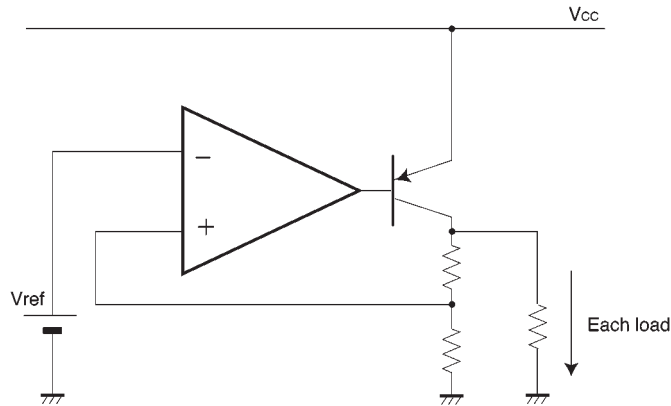


Fig.1

A = maximum output voltage for V_{CC}

I₁ = maximum output current for V_{DD}

I₂ = maximum output current for COM

I₃ = maximum output current for AMP

I₄ = maximum output current for ANT

I₅ = maximum output current for RADIO

I₆ = maximum output current for FM

I₇ = maximum output current for VAR

• Power consumed by V_{DD} 5.8V

• Power consumed by COM 8.0V

• Power consumed by AMP

• Power consumed by ANT

• Power consumed by RADIO 8.0V

• Power consumed by FM 8.0V

• Power consumed by VAR 10.0V

• Power consumed internally by each circuit P₇ = V_{CC} × supply current (about 13mA)

$$P_1 = (A - 5.8V) \times I_1 + (I_1 / 20 + I_1 / 10) \times A$$

$$P_2 = (A - 8.0V) \times I_2 + (I_2 / 30 + I_2 / 10) \times A$$

$$P_3 = 1V \times I_3 + (22mA) \times A$$

$$P_4 = 1V \times I_4 + (22mA) \times A$$

$$P_5 = (A - 8.0V) \times I_5 + (I_5 / 60 + I_5 / 10) \times A$$

$$P_6 = (A - 8.0V) \times I_6 + (I_6 / 60 + I_6 / 10) \times A$$

$$P_8 = (A - 10.0V) \times I_7 + (I_7 / 10 + I_7 / 10) \times A$$

$$P_{Max.} = P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 + P_8$$

● Operation notes

(1) Although the quality of this IC is rigorously controlled, the IC may be destroyed when supply voltage or operating temperature exceeds its absolute maximum rating. Because short mode or open mode cannot be specified when the IC is destroyed, be sure to take physical safety measures such as fusing if special mode is expected.

(2) Example of application

The application circuit of Fig. 2 is recommended for use. Make sure to confirm the adequacy of parts characteristics. When using the circuit with changes to external circuit constants, make sure to leave sufficient margins in consideration of fluctuations in the IC and external components including static and transitional characteristics. Note that ROHM has not carried out extensive survey regarding the patent right of this application.

(3) Operating power supply voltage

When operating within proper ranges of power supply voltage and ambient temperature, most circuit functions are guaranteed. Although the rated values of electrical characteristics cannot be absolutely guaranteed, characteristic values do not change drastically within the proper ranges.

(4) Power dissipation (Pd)

Refer to the heat reduction characteristics and the rough estimation of IC power dissipation given on separate pages. Make sure your design allows the maximum required power within the operating temperature range.

(5) Overvoltage protection circuit

The overvoltage protection circuit turns OFF each output when the potential difference between V_{CC} (pin 7) and GND (pin 12) is more than about 26V at normal temperature. Make sure to use the IC within this voltage limit.

(6) Preventing oscillation at each output

To stop oscillation of output, make sure to connect a capacitor having a capacitance of 10 μ F or greater between GND and each of the V_{DD} (pin 5), COM (pin 9), RADIO (pin 10), FM (pin 11), and VAR (pin 1) output pins. We recommend using a tantalum electrolytic capacitor whose capacitance is unsusceptible to temperature.

(7) Overcurrent protection circuit

An overcurrent protection circuit is installed on the V_{DD} (pin 5), AMP (pin 6), ANT (pin 8), COM (pin 9), RADIO (pin 10), FM (pin 11), and VAR (pin 1) outputs, based on the respective output current. This prevents IC destruction by overcurrent, by limiting the current with a curve shape of "7" in the voltage-current graph. The IC is designed with margins so that current flow will be restricted and latching will be prevented even if a large current suddenly flows through a large capacitor. The circuit should be carefully set because output current is further restricted when output voltage is less than 1 V_F (considered as short mode).

(8) Thermal shutdown circuit

The thermal shutdown circuit prevents thermal damage to the IC. All outputs except V_{DD} are switched OFF when the circuit operates, and revert to the original state when the chip temperature drops to a certain level.

(9) Output circuit configurations

Each of the V_{DD} (pin 5), COM (pin 9), RADIO (pin 10), FM (pin 11), and VAR (pin 1) output circuits has a PNP power transistor. A measure is taken to protect the IC in case the voltage of V_{CC} (pin 7) drops and the output-side voltage becomes greater than the V_{CC} -side voltage due to the output-side external transistor.

(10) Grounding

Each ground line in the application circuit of Fig. 2 must be adequately short from GND (pin 12). Make sure to arrange the ground traces in a pattern that prevents mutual interference.

●Electrical characteristic curves

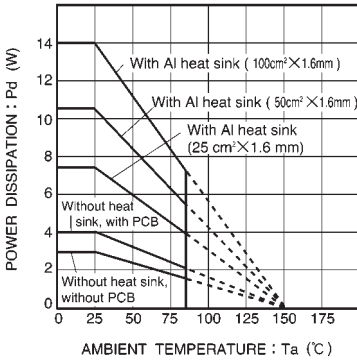


Fig. 3 Thermal derating characteristic

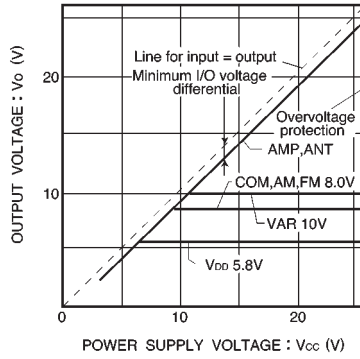


Fig. 4 Output voltage vs. power supply voltage

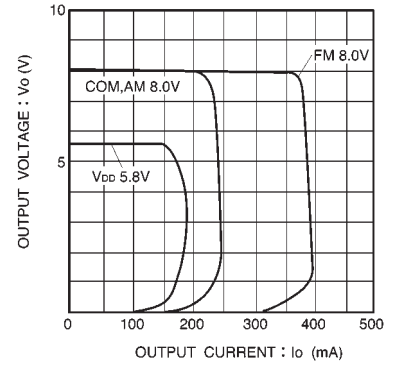


Fig. 5 Output voltage vs. output current

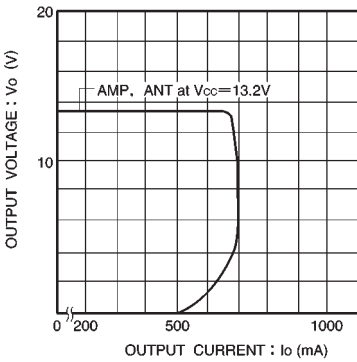


Fig. 6 Output voltage vs. output current

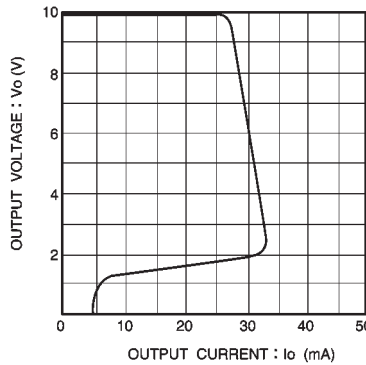


Fig. 7 VAR output voltage vs. output current

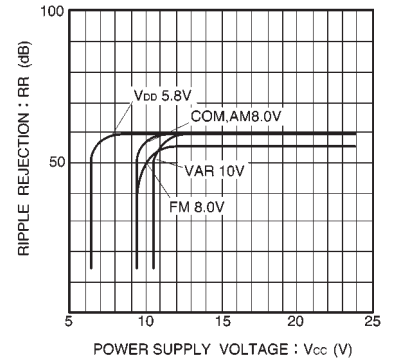
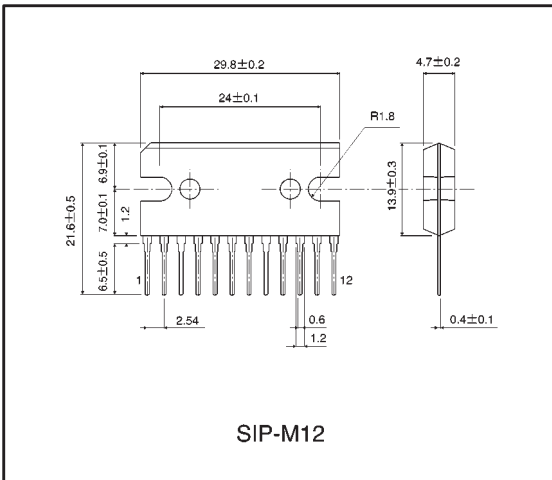


Fig. 8 Ripple rejection ratio vs. power supply voltage

●External dimensions (Units: mm)



SIP-M12