# BA3520
# BA3520F

# 3 V dual pre- and power amplifier

The BA3520 and BA3520F ICs are dual channel preamplifier and power amplifiers that contain all basic signal circuits necessary for a tape player.

The preamplifiers are direct coupled and the power amplifiers have a built-in fixed-gain NF circuit, making an output coupling capacitor unnecessary.

## Features

- available in DIP18 and SOP18 packages
- low voltage operation (1.8 ~ 4.0 Vdc)
- preamplifier has high voltage gain (78 dB), low noise (1.1 $\mu V_{rms}$) and low distortion (0.03%).
- power amplifier has high output (30 mW × 2), low noise (50 $\mu V_{rms}$) and low distortion (0.5%)
- has a built in EVR. A-curve characteristics for EVR obtained are from the VR of the B-curve
- no oscillation protector required for power amplifier
- built in muting circuit

## Applications

- 3 V tape player
- 3 V radio cassette player

## Dimensions (Units : mm)

### BA3520 (DIP18)
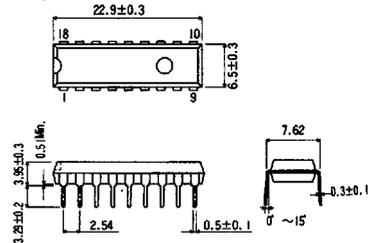


### BA3520F (SOP18)



## Block diagram

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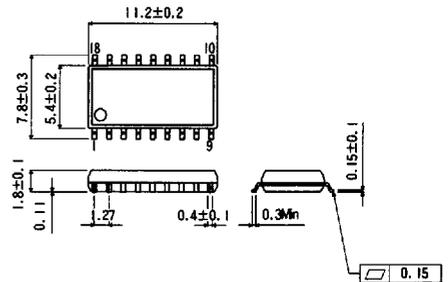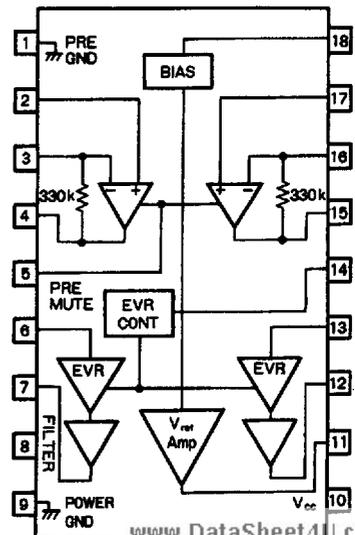
## Absolute maximum ratings ($T_a$= 25°C)

| Parameter | | Symbol | Limits | Unit | Conditions |
|---|---|---|---|---|---|
| Power supply voltage | | $V_{CC}$ | 6.0 | V | |
| Power dissipation | BA3520 | $P_d$ | 1000 | mW | Reduce power by 10 mW for each degree above 25°C. |
| | BA3520F | | 550 | | Reduce power by 5.5 mW for each degree above 25°C. Mounted on a $50 \times 50 \times 1.6$ mm glass epoxy PCB. |
| Operating temperature | | $T_{opr}$ | $-25 \sim +75$ | °C | |
| Storage temperature | | $T_{stg}$ | $-55 \sim +125$ | °C | |

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

| Parameter | Symbol | Min | Typ | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| Power supply voltage | $V_{CC}$ | 1.8 | 3.0 | 4.0 | V | |

## Electrical characteristics (unless otherwise noted, $T_a$ = 25°C, $V_{CC}$ = 3 V, f = 1 kHz) (Sheet 1 of 2)

| Parameter | Symbol | Min | Typical | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| Quiescent current | $I_Q$ | 10 | 15 | 20 | mA | $V_{IN} = 0$ $V_{rms}$ |
| Channel separation | CS | 30 | 40 | | dB | $R_G = 2.2$ k$\Omega$, $R_L = 32$ $\Omega$ |
| **Preamplifier ($R_L = R_{IN}$ (EVR))** | | | | | | |
| Open loop voltage gain | $G_{VO}$ | 72 | 78 | | dB | $V_O = 200$ m$V_{rms}$ |
| Closed loop voltage gain | $G_{VC1}$ | 28 | 31 | 34 | dB | $V_O = 100$ m$V_{rms}$ |
| Output voltage | $V_{OM}$ | 300 | 500 | | m$V_{rms}$ | THD = 1% |
| Total harmonic distortion | $THD_1$ | | 0.03 | 0.15 | % | $V_O = 0.2$ $V_{rms}$ |
| Input bias current | $I_{B1}$ | | 100 | 300 | nA | $V_{IN} = 0$ $V_{rms}$ |
| Input conversion noise voltage | $V_{NIN}$ | | 1.1 | 1.8 | $\mu V_{rms}$ | $R_g = 2.2$ k$\Omega$, BPF = 20 Hz ~ 20 kHz |
| Ripple rejection | $RR_1$ | 59 | 65 | | dB | $V_{RR} = -20$ dBV, $f_{RR} = 100$ Hz |
| **Power amplifier ($R_L = 32\Omega$) (except $P_{OUT1}$)** | | | | | | |
| Rated output 1 | $P_{OUT1}$ | 25 | 30 | | mW/ch | $R_L = 16$ $\Omega$, THD = 10% |
| Rated output 2 | $P_{OUT2}$ | 15 | 18 | | mW/ch | $R_L = 32$ $\Omega$, THD = 10% |
| Closed loop voltage gain | $G_{VC2}$ | 33 | 36 | 39 | dB | $V_O = 300$ m$V_{rms}$ |
| Total harmonic distortion | $THD_2$ | | 0.5 | 1.5 | % | EVR = max, $P_O = 5$ mW |
| Output noise voltage | $V_{NO}$ | | 50 | 80 | $\mu V_{rms}$ | EVR = min, BPF = 20 Hz ~ 20 kHz |

## Electrical characteristics (unless otherwise noted, $T_a$ = 25°C, $V_{CC}$ = 3 V, f = 1 kHz) (Sheet 2 of 2)

| Parameter | Symbol | Min | Typical | Max | Unit | Conditions |
|-----------|--------|-----|---------|-----|------|------------|
| Ripple rejection | $RR_2$ | 60 | 65 | | dB | $V_{RR}$ = −20 dBV, $f_{RR}$ = 100 Hz, |
| EVR input resistance | $R_{IN}$ | 21 | 30 | 39 | kΩ | |
| EVR attenuation ratio | ATT | 70 | 80 | | dB | 0 dB = −10 dBV, EVR = max<br>When EVR = max, set the input so<br>power amp output $V_0$ = −10 dBV.<br>Measure the attenuation of V when<br>EVR = min in that state. |

## Figure 1  Test circuit

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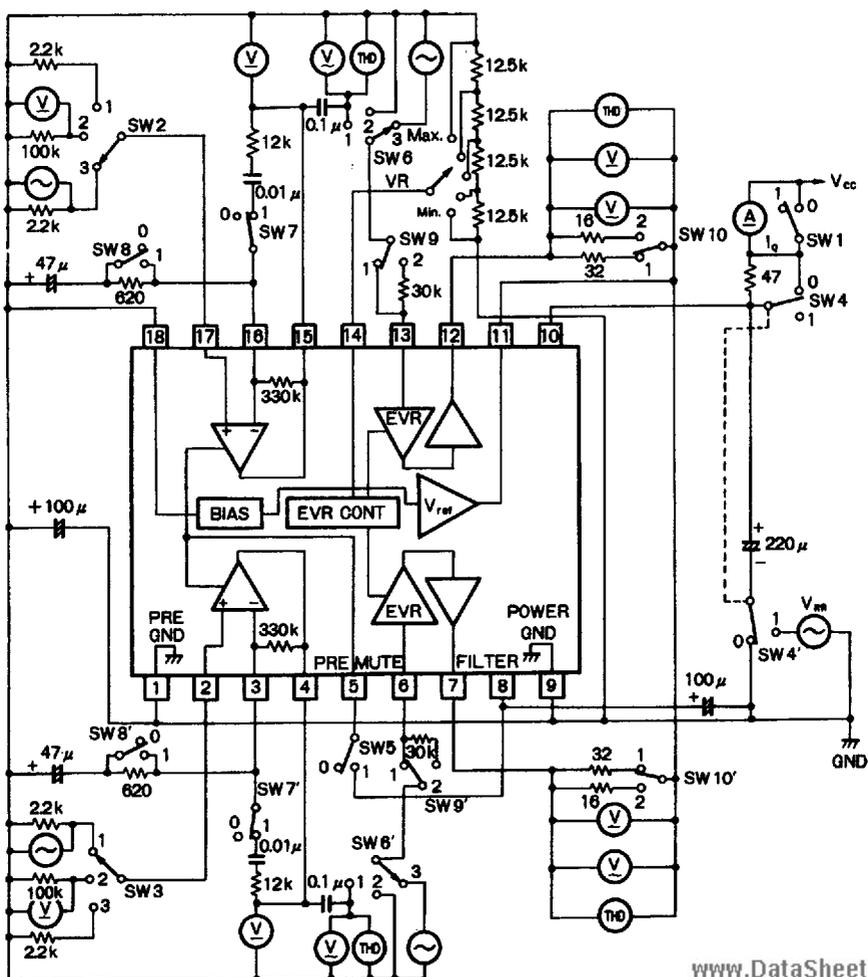
## Figure 2  Application example
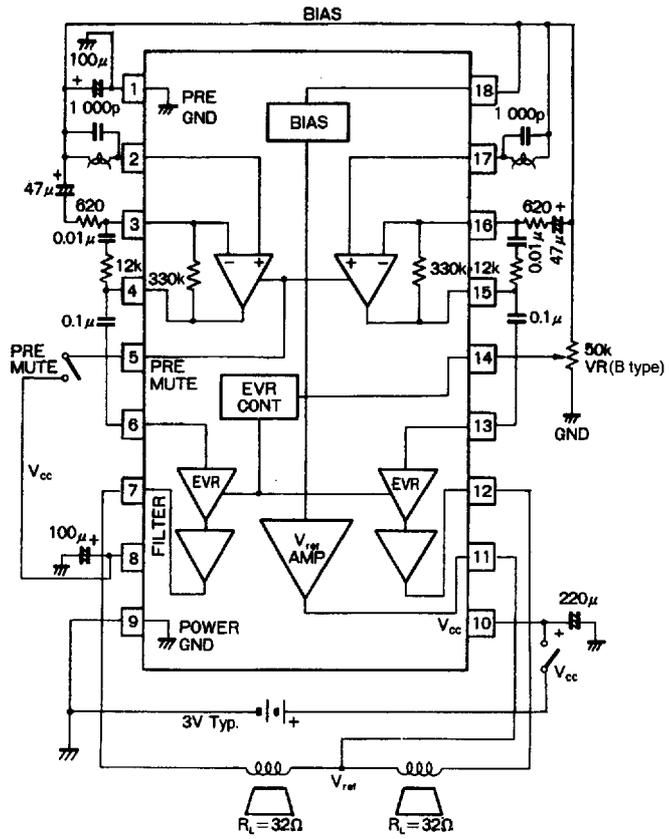
## Gain and the dynamic range with EVR IN

### Figure 3  EVR equivalent circuit diagram
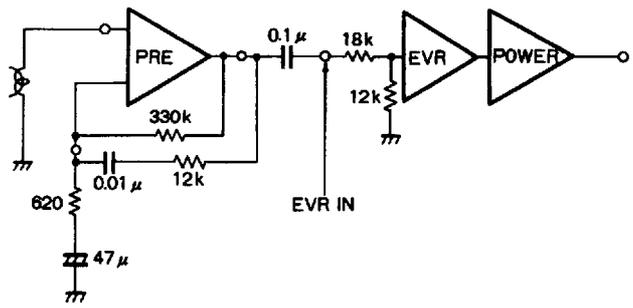
### Figure 4 Gain distribution
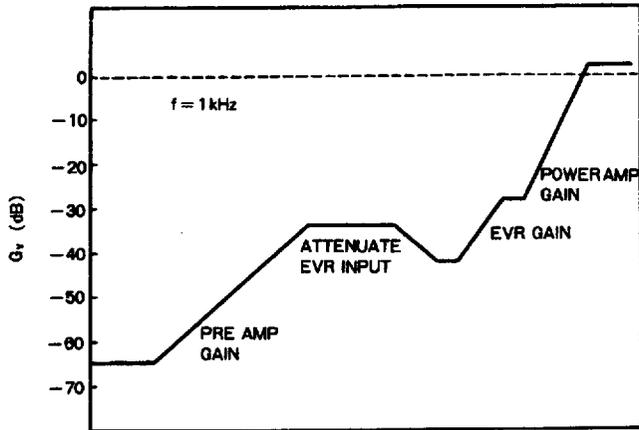


The total harmonic distortion for the input dynamic range is a minimum for $V_{IN} = -30.4$ dBV as shown in Figure 7. A gain distribution for the application example is shown in Figure 4.

*Note:* When connecting to a graphic equalizer it is necessary to set the signal level so that it does not exceed the limitations to the EVR IN.

## Electrical characteristic curves



**Figure 5**



**Figure 6**

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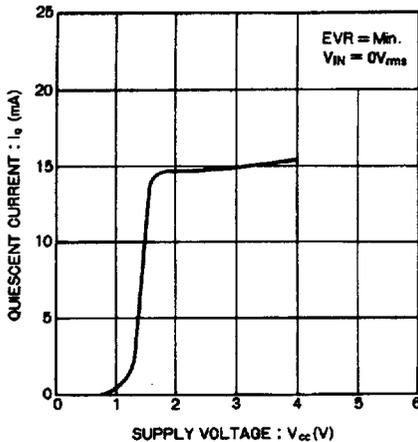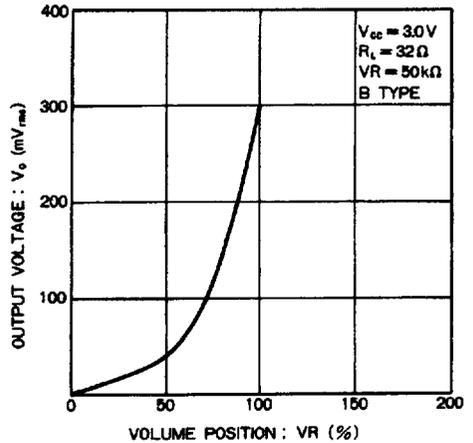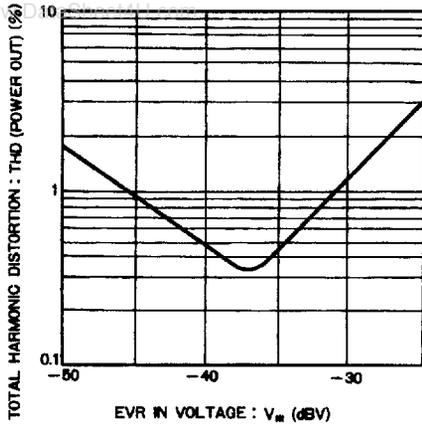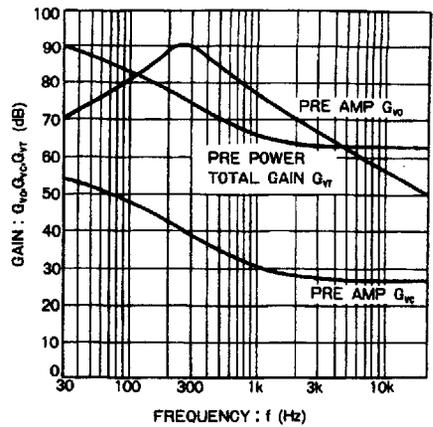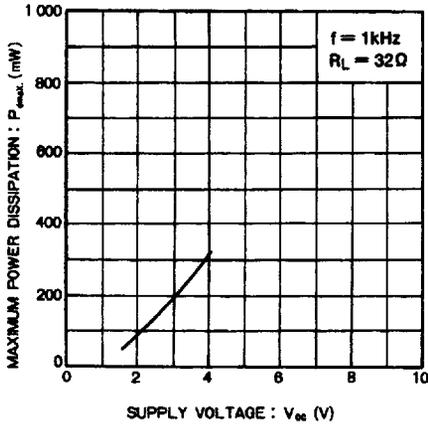
Figure 7



Figure 8



Figure 9
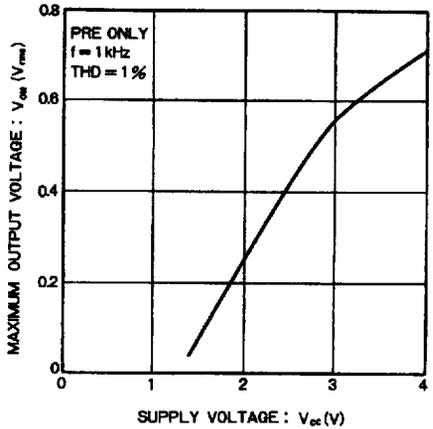


Figure 10



Figure 11



Figure 12