# DYNAMIC SPEAKER DRIVE AMPLIFIER

## FEATURES

- **Very Wide Operating Voltage ($V_{CC}$ = 1.8 to 5.5 V)**
- **Very Low Supply Current**
- **Very Low Standby Current**
- **Miniature Package (SOT23L-6)**
- **Adjustable Voltage Gain ($V_{G1}$ = 0 to 40 dB)**
- **Needs No Output Coupling Capacitor**

## APPLICATIONS

- **Speaker Driver for Portable Equipment**
- **Headphone Driver**
- **Toys**

## DESCRIPTION

The TK10416M is a very low operating voltage and current audio power amplifier to drive dynamic speakers.

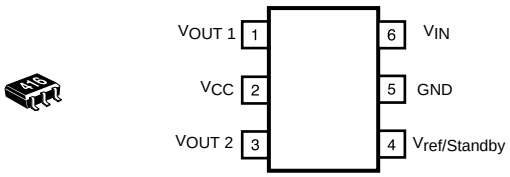
The TK10416M drives the speaker directly, because the device has a differential output that does not need an output coupling capacitor.

The voltage gain is adjustable by two external resistors.

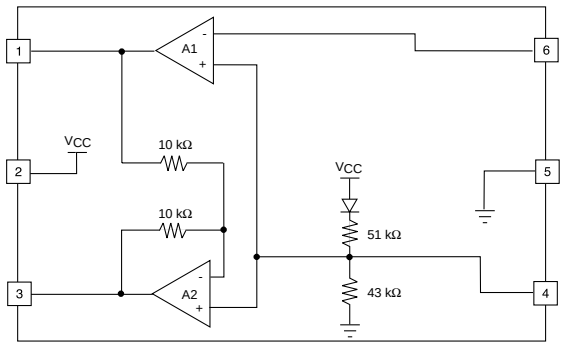
The TK10416M is available in the very small SOT23L-6 surface mount package.

The small package in conjunction with few external components save printed circuit board space.

**TK10416M**




**BLOCK DIAGRAM**




## ORDERING INFORMATION

TK10416M □□

Tape/Reel Code

TAPE/REEL CODE
TL: Tape Left

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage ..... 6 V
Operating Voltage ..... 1.8 to 5.5 V
Power Dissipation (Notes 1 and 2)..... 400 mW
Storage Temperature Range ..... -55 to +150 °C
Operating Temperature Range .....-20 to +70 °C

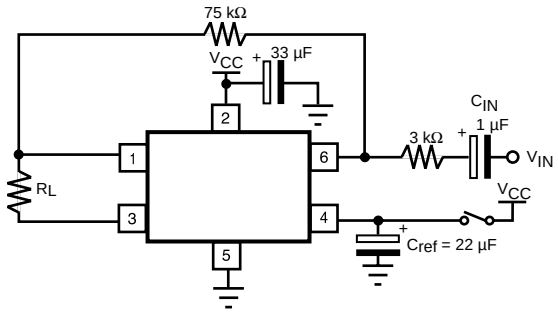
## TK10416 ELECTRICAL CHARACTERISTICS

Test Conditions: $V_{CC}$ = 3.6 V, f = 1.0 kHz, $R_L$ = 32 Ω, $T_A$ = 25 °C, unless otherwise specified.

| SYMBOL | PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| $I_{CC}$ | Supply Current | $V_{CC}$ = 3.6 V, $R_L$ = ∞ | | 2.7 | 4.0 | mA |
| | | $V_{CC}$ = 5.0 V, $R_L$ = ∞ | | 2.8 | 4.2 | mA |
| $I_{CC(STBY)}$ | Standby Supply Current | $V_{CC}$ = 3.6 V = Pin 4, $R_L$ = ∞ | | 0.0 | 2.0 | µA |
| $I_{CONT}$ | Control Terminal Current | Pin 4 Sink Current, $V_{Pin4}$ = $V_{CC}$ | | 90 | 140 | µA |
| $V_{THS}$ | Standby Threshold Voltage | Pin 4 | $V_{CC}$ -0.4 | | | V |
| $G_{VO}$ | Open Circuit Voltage Gain | AMP1 | | 71.0 | | dB |
| $G_V$ | Voltage Gain | AMP1 | 25.0 | 28.0 | 30.0 | dB |
| | | AMP2 | -3.0 | 0.0 | +3.0 | dB |
| | | AMP1 + AMP2 | 31.0 | 34.0 | 36.0 | dB |
| THD | Total Harmonic Distortion | $V_{CC}$ = 3.6 V, $P_{OUT}$ = 60 mW | | 0.5 | 1.0 | % |
| | | $V_{CC}$ = 5.0 V, $P_{OUT}$ = 120 mW | | 0.5 | 1.0 | % |
| $P_{OUT(MAX)}$ | Maximum Output Power | $V_{CC}$ = 3.6 V, THD ≤ 10% | 80 | 120 | | mW |
| | | $V_{CC}$ = 5.0 V, THD ≤ 10% | 170 | 280 | | mW |
| RR | Ripple Rejection Ratio | $C_{ref}$ = 22 µF | | 42.5 | | dB |
| $V_{OUT(DC)}$ | DC Voltage at Output Terminal | $V_{OUT1}$ | 1.20 | 1.40 | 1.60 | V |
| | | $V_{OUT2}$ | 1.20 | 1.40 | 1.60 | V |
| $V_{OUT(OS)}$ | Output Offset Voltage | $V_{OUT2}$ + $V_{OUT1}$ | -30.0 | 0.0 | +30.0 | mV |
| $R_L$ | Load Resistance | | 8 | 32 | | Ω |

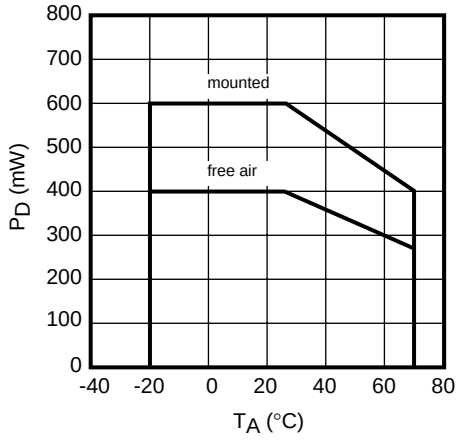
Note 1: Power dissipation is 400 mW in free air. Derate at 3.2 mW/°C for operation above 25 °C.
Note 2: Power dissipation is 600 mW when mounted. Derate at 4.8 mW/°C for operation above 25 °C.

## TEST CIRCUIT

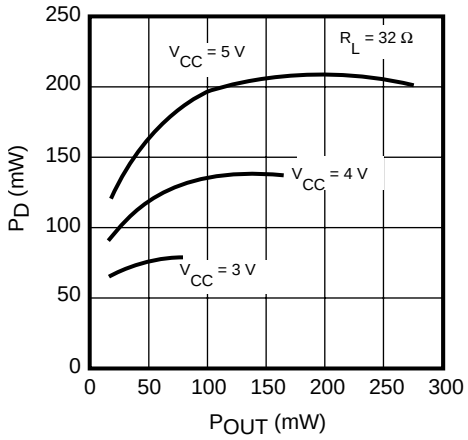



## TYPICAL PERFORMANCE CHARACTERISTICS

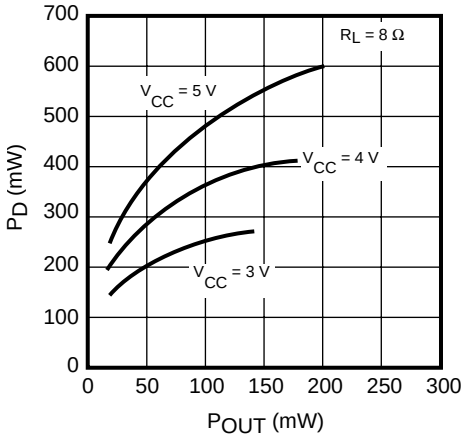
**POWER DISSIPATION vs. TEMPERATURE**



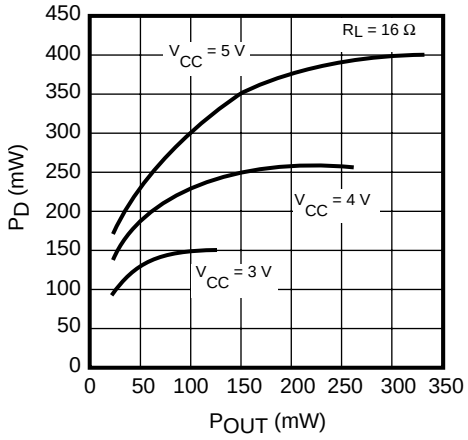

**POWER DISSIPATION vs. OUTPUT POWER**




**POWER DISSIPATION vs. OUTPUT POWER**

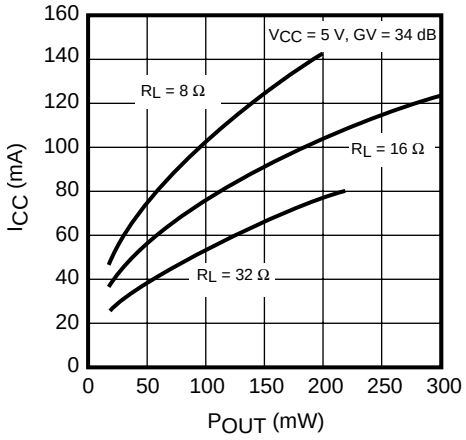



**POWER DISSIPATION vs. OUTPUT POWER**

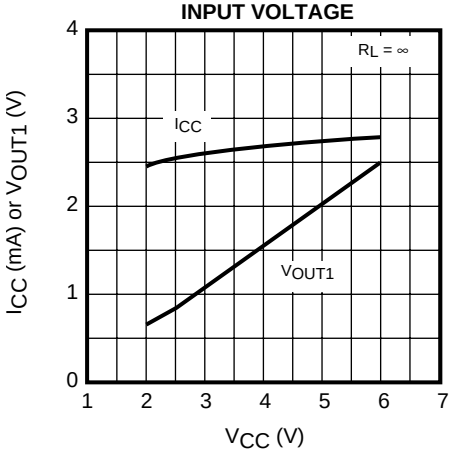


## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

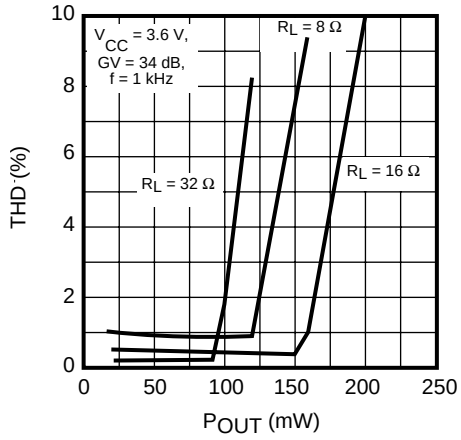
**SUPPLY CURRENT vs. OUTPUT POWER**



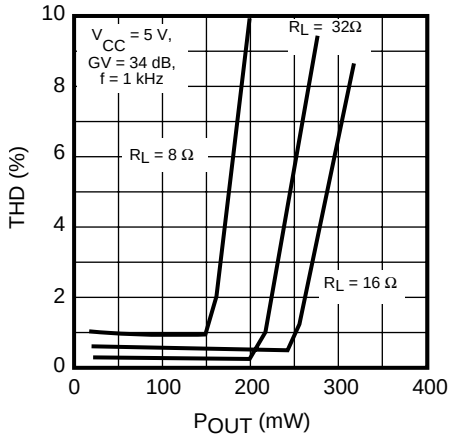

**SUPPLY CURRENT AND OUTPUT VOLTAGE vs. INPUT VOLTAGE**



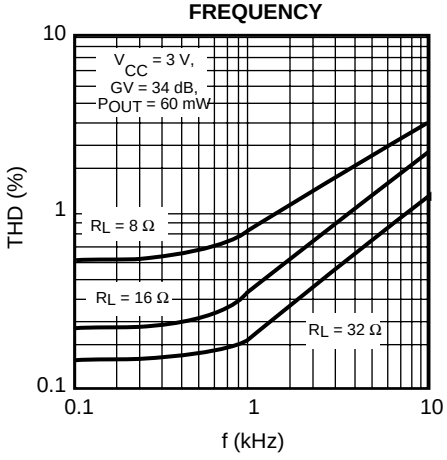

**TOTAL HARMONIC DISTORTION vs. OUTPUT POWER**



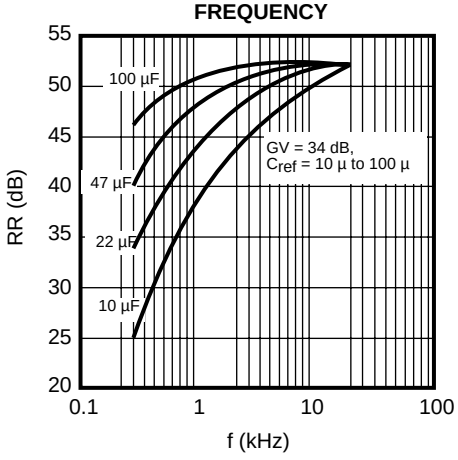

**TOTAL HARMONIC DISTORTION vs. OUTPUT POWER**




**TOTAL HARMONIC DISTORTION vs. FREQUENCY**

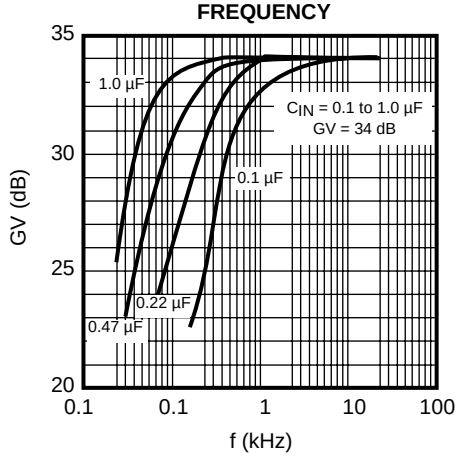



**RIPPLE REJECTION RATIO vs. FREQUENCY**

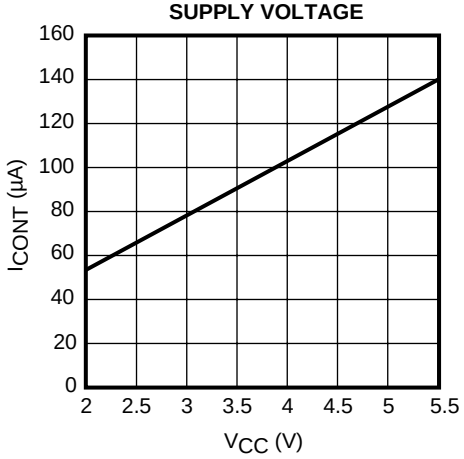


## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

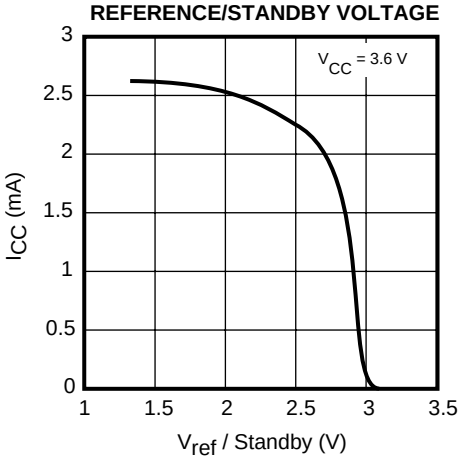
**VOLTAGE GAIN vs. FREQUENCY**



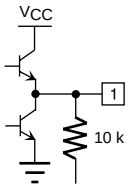
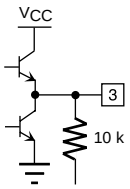
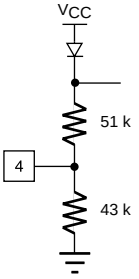
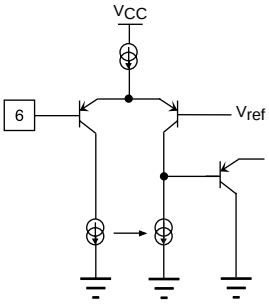

**CONTROL TERMINAL CURRENT vs. SUPPLY VOLTAGE**




**SUPPLY CURRENT vs. REFERENCE/STANDBY VOLTAGE**



## PIN FUNCTION DESCRIPTION

| PIN NO. | SYMBOL | TERMINAL VOLTAGE (V) | INTERNAL EQUIVALENT CIRCUIT | DESCRIPTION |
|---|---|---|---|---|
| 1 | $V_{OUT1}$ | $V_{OUT}$ (Note 1) |  | A1 amplifier output terminal |
| 2 | $V_{CC}$ | $V_{CC}$ | | Supply input terminal |
| 3 | $V_{OUT2}$ | $V_{OUT}$ (Note 1) |  | A2 amplifier output terminal |
| 4 | $V_{ref}$ / Standby | $V_{OUT}$ (Note 1) |  | Reference voltage terminal. When this terminal is $V_{CC}$, the device is in the standby mode and the supply current is down to under 0.1 µA. |
| 5 | GND | 0 V | | Ground terminal |
| 6 | $V_{IN}$ | $V_{OUT}$ (Note 1) |  | A1 amplifier input terminal |

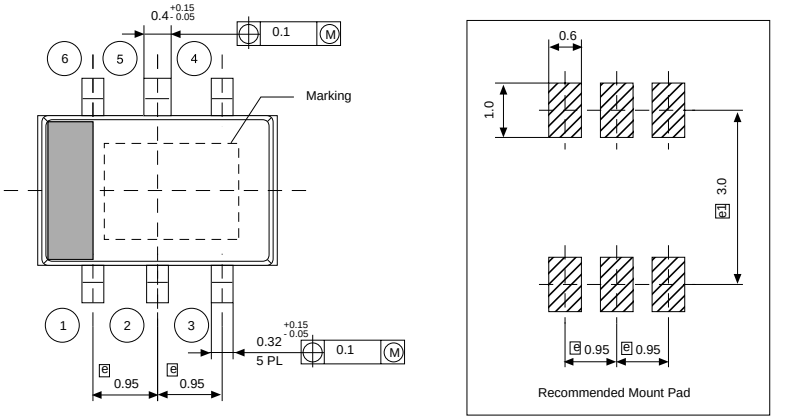
Note 1: Terminal voltage with no input signal is calculated by the following equation:

$$V_{OUT} = (V_{CC} - 0.56)\ X\ \frac{43\ k}{43\ k + 51\ k}$$

## NOTES

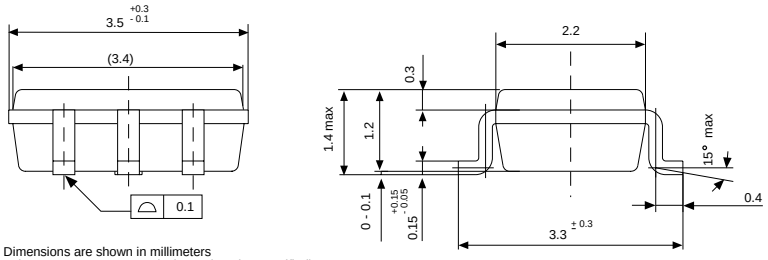
# PACKAGE OUTLINE

## SOT23L-6










Dimensions are shown in millimeters
Tolerance: x.x = ± 0.2 mm (unless otherwise specified)

### Marking Information

| | Marking |
|---|---|
| TK10416 | 416 |

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IC-231-TK11031
0798O0.0K

December 1999 TOKO, Inc.
Printed in the USA