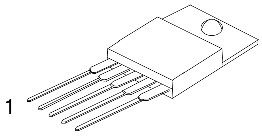
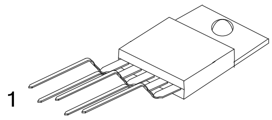
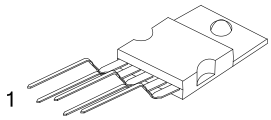
# 10W CAR RADIO AUDIO AMPLIFIER



TO-220-5



TO-220B



TO-220B1

## ■ DESCRIPTION

The UTC **TDA2003** is a monolithic audio power amplifier integrated circuit.

## ■ FEATURES

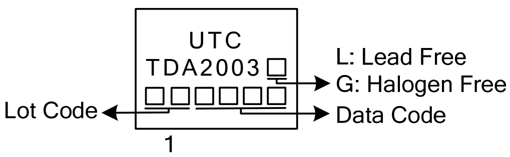
*Very Low External Component Required.
*High Current Output ( up to 3 A).
*Low Harmonic and Crossover Distortion.
*Built-in Over Temperature Protection.
*Short Circuit Protection Between all Pins.

## ■ ORDERING INFORMATION

| Ordering Number | | Package | Packing |
|---|---|---|---|
| Lead Free | Halogen Free | | |
| TDA2003L-TA5-T | TDA2003G-TA5-T | TO-220-5 | Tube |
| TDA2003L-TB5-T | TDA2003G-TB5-T | TO-220B | Tube |
| TDA2003L-TB51-T | TDA2003G-TB51-T | TO-220B1 | Tube |

| TDA2003L-TA5-T | |
|---|---|
| (1) Packing Type | (1) T: Tube |
| (2) Package Type | (2) TA5: TO-220-5, TB5: TO-220B, TB51: TO-220B1 |
| (3) Green Package | (3) L: Lead Free, G: Halogen Free and Lead Free |

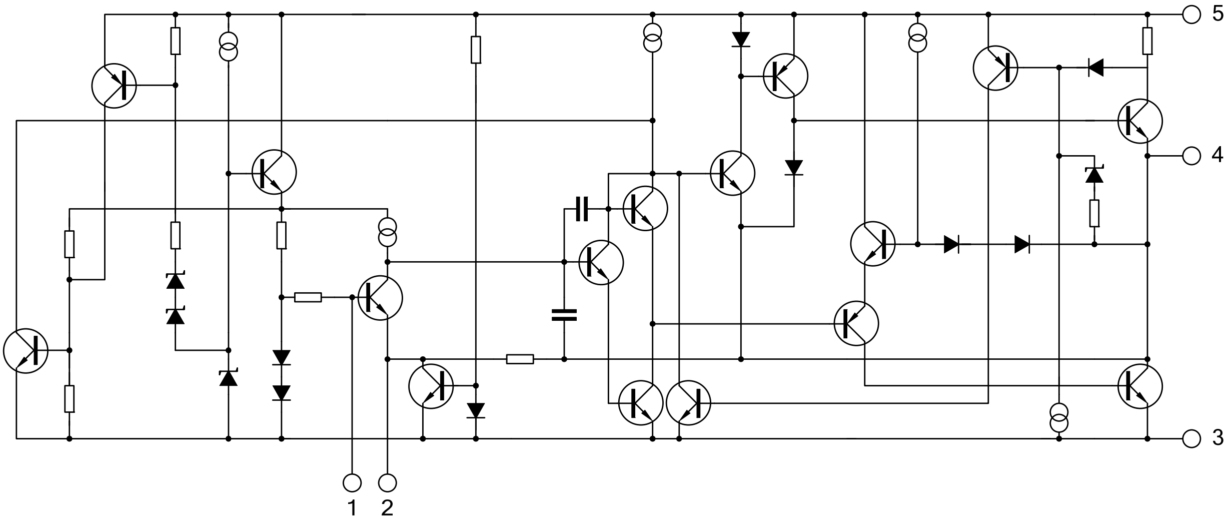
## ■ MARKING



## PIN DESCRIPTION

| PIN NO. | PIN NAME |
|---|---|
| 1 | Non inverting input |
| 2 | Inverting input |
| 3 | Ground |
| 4 | Output |
| 5 | Supply Voltage |

## BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS ($T_A$=25°C, unless otherwise specified)

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Peak Supply Voltage | | $V_{SS}$ | 40 | V |
| DC Supply Voltage | | $V_{SS}$ | 28 | V |
| Operating Supply Voltage | | $V_{SS}$ | 18 | V |
| Output Peak Current | Repetitive | $I_{O(PEAK)}$ | 3.5 | A |
| | Non Repetitive | | 4.5 | A |
| Power Dissipation at $T_C$= 90°C | | $P_D$ | 20 | W |
| Storage and Junction Temperature | | $T_{STG}$ | -40 ~ +150 | °C |

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

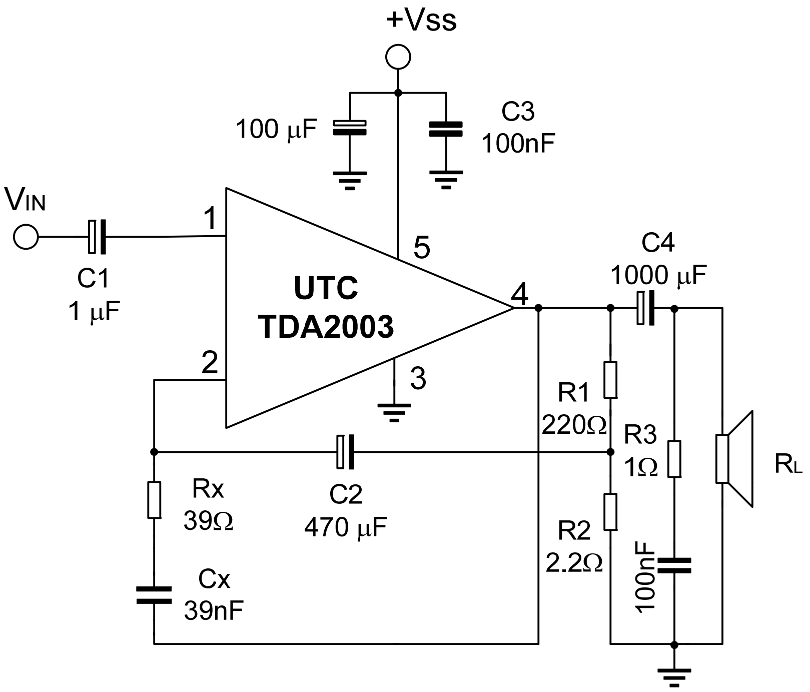
## ■ ELECTRICAL CHARACTERISTICS

($T_A$=25°C, Refer to the test circuit, $V_S$=16V, unless otherwise specified.)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | | |
| Supply Voltage | $V_{SS}$ | | | 8 | | 18 | V |
| Quiescent Output Voltage | $V_{OUT}$ | | | 6.1 | 6.9 | 7.7 | V |
| Quiescent Drain Current | $I_D$ | | | | 44 | 50 | mA |
| **AC CHARACTERISTICS** | | | | | | | |
| Output Power | $P_{OUT}$ | THD=10%, f=1kHz | $R_L$=4Ω | 5.5 | 6 | | W |
| | | | $R_L$=2Ω | 9 | 10 | | |
| | | | $R_L$=3.2Ω | | 7.5 | | |
| | | | $R_L$=1.6Ω | | 12 | | |
| Input Sensitivity | $V_I$ | f=1kHz | $P_{OUT}$=0.5W, $R_L$=4Ω | | 14 | | mV |
| | | | $P_{OUT}$=6W, $R_L$=4Ω | | 55 | | |
| | | | $P_{OUT}$=0.5W, $R_L$=2Ω | | 10 | | |
| | | | $P_{OUT}$=10W, $R_L$=2Ω | | 50 | | |
| Input Saturation Voltage | $V_{I(RMS)}$ | | | 300 | | | mV |
| Frequency Response(-3dB) | F | $P_{OUT}$=1W, $R_L$=4Ω | | 40 | | 15000 | Hz |
| Total Harmonic Distortion | THD | f=1kHz | $P_{OUT}$=0.05 ~ 4.5W, $R_L$=4Ω | | 0.15 | | % |
| | | | $P_{OUT}$=0.05 ~ 7.5W, $R_L$=2Ω | | 0.15 | | |
| Input Resistance(Pin 1) | $R_I$ | Open Loop, f=1kHz | | 70 | 150 | | kΩ |
| Input Noise Current | iN | | | | 60 | 200 | pA |
| Input Noise Voltage | eN | | | | 1 | 5 | μV |
| Open Loop Voltage Gain | Gvo | f=1kHz | | | 80 | | dB |
| | | f=10kHz | | | 60 | | dB |
| Closed Loop Voltage Gain | Gvc | f=1kHz, $R_L$=4Ω | | 39.3 | 40 | 40.3 | dB |
| Efficiency, f=1kHz | η | $P_{OUT}$=6W, $R_L$=4Ω | | | 69 | | % |
| | | $P_{OUT}$=10W, $R_L$=2Ω | | | 65 | | |
| Supply Voltage Rejection | SVR | f=100Hz, $V_{RUPPLE}$=0.5V $R_G$=10kΩ, $R_L$=4Ω | | 30 | 36 | | dB |

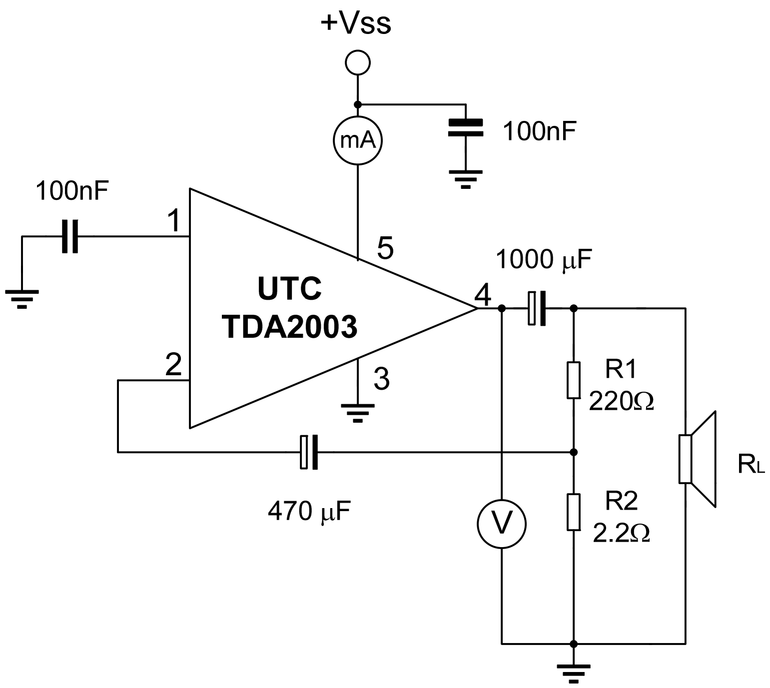
## ■ TEST CIRCUIT

AC Test Circuit




Rx=20*R2 Cx=1/(2 πB*R1)

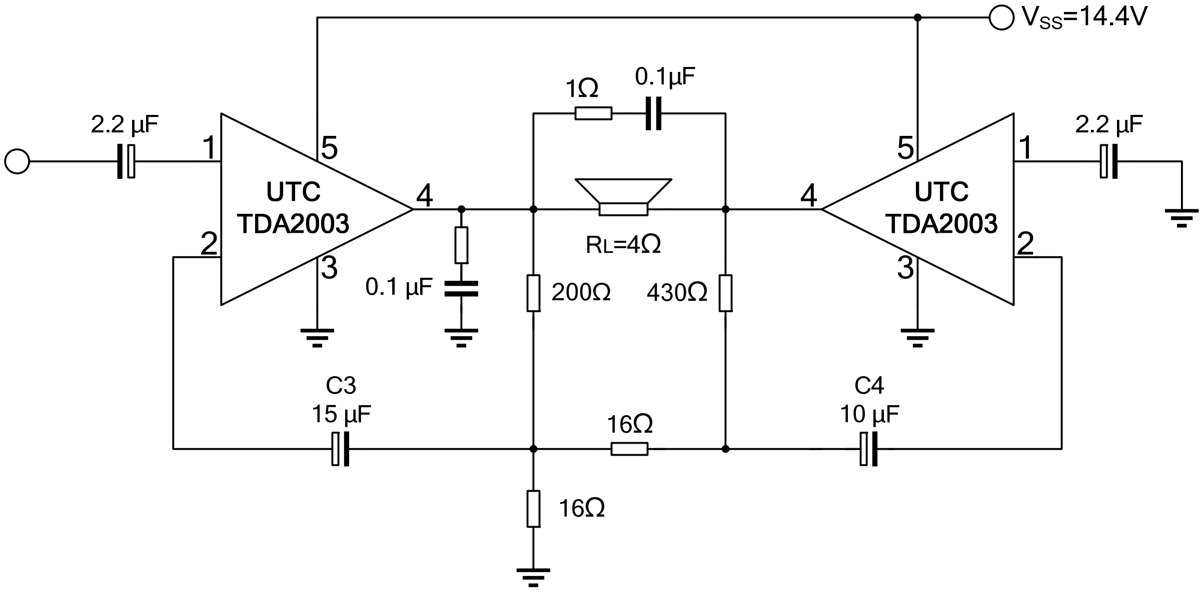
DC Test Circuit



## ■ TYPICAL APPLICATION CIRCUIT

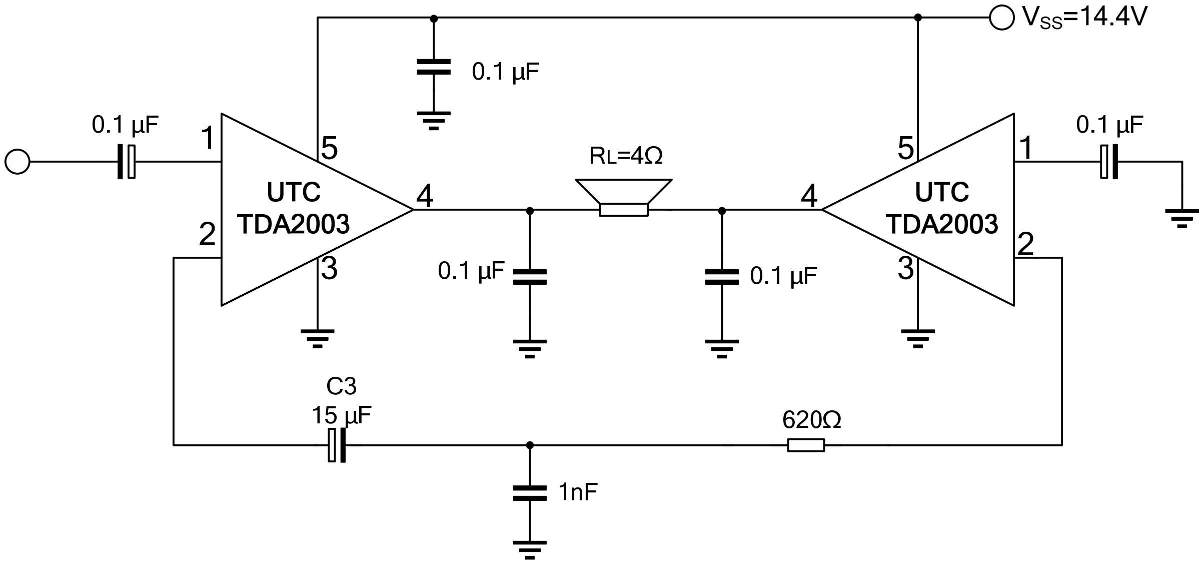
20W Bridge Configuration Application

The Values of the capacitors C3 and C4 are different to optimize the SVR (Typ. 40dB)




## ■ TYPICAL APPLICATION CIRCUIT

Low Cost Bridge Configuration Application Circuit($P_{OUT}$=18W)



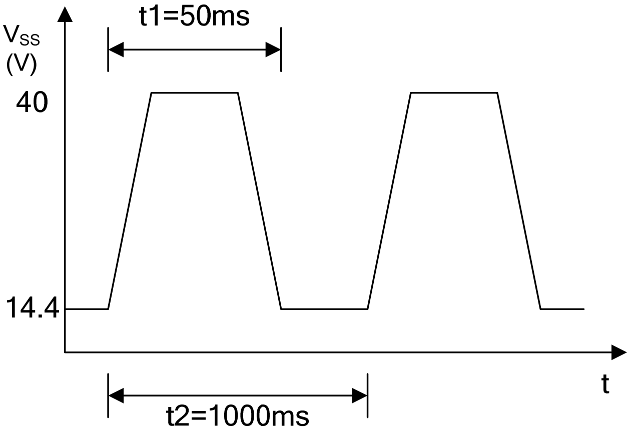
## BUILT-IN PROTECTION SYSTEMS

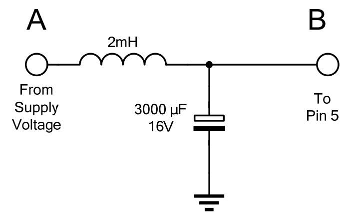
**LOAD DUMP VOLTAGE SURGE**

The UTC **TDA2003** has a circuit which enables it to withstand a voltage pulse train, on pin 5.

If the supply voltage peaks to more than 40V, then an LC filter must be inserted between the supply and pin 5, in order to assure that the pulses at pin 5 will be head within the limits.

A suggested LC network. With this network, a train of pulses with amplitude up to 120V and width of 2ms can be applied at point A. This type of protection is ON when the supply voltage(pulsed or DC) exceeds 18V. For this reason the maximum operating supply voltage is 18V.




**SHORT CIRCUIT (AC and DC Conditions)**

The UTC **TDA2003** can withstand a permanent short-circuit on the output for a supply voltage up to 16V.

**POLARITY INVERSION**

High current (up to 5A) can be handled by the device with no damage for a longer period than the blow-out time of a quick 1A fuse(normally connected in series with the supply).

The feature is added to avoid destruction if, during fitting to the car, a mistake on connection of the supply is made.

**OPEN GROUND**

When the radio is in the ON condition and the ground is accidentally opened, a standard audio amplifier will be damaged. On the UTC **TDA2003** protection diodes are included to avoid any damage.

**INDUCTIVE LOAD**

A protection diode is provide between pin 4 and pin 5(see the internal schematic diagram) to allow use of the UTC TDA2003 with inductive loads. In particular, the UTC TDA2003 can drive a coupling transformer for audio modulation.

**DC VOLTAGE**

The maximum operating DC voltage on the UTC **TDA2003** is 18V.

However the device can withstand a DC voltage up to 28V with no damage. This could occur during winter if two batteries were series connected to crank the engine.

**THERMAL SHUT-DOWN**

The presence of a thermal limiting circuit offers the following advantages:

(1) An overload on the output (even if it is permanent),or an excessive ambient temperature can be easily withstood.

(2) The heat-sink can have a smaller factor compared with that of a conventional circuit. There is no device damage in case of excessive junction temperature: all that happens is that Po ( and therefore $P_D$) and Id are reduced.

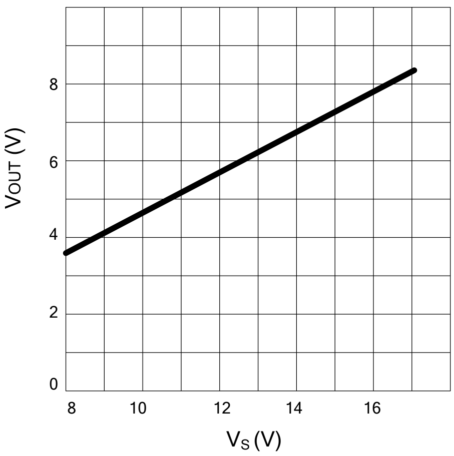
## ■ COMPONENTS USAGE SUGGESTION

The recommended values of the components are those shown on typical application circuit Different values can be used. The following table can help the designer.

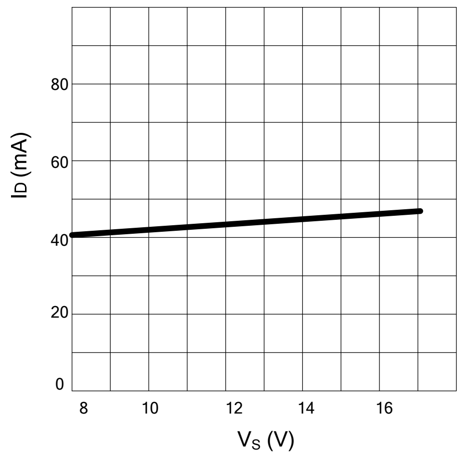
| COMPONENT | RECOMMENDED VALUE | PURPOSE | LARGE THAN RECOMMENDED VALUE | SMALLER THAN RECOMMENDED VALUE |
|---|---|---|---|---|
| R1 | (Gv-1)×R2 | gain setting. | | increase of drain current |
| R2 | 2.2Ω | gain and SVR setting. | Decrease of SVR | |
| R3 | 1Ω | Frequency stability | Danger of oscillation at high frequencies with inductive loads. | |
| Rx | ≈20R2 | Upper frequency cutoff | Poor high frequencies attenuation | Danger of oscillation |
| C1 | 2.2μF | Input DC decoupling | | Noise at switch-on switch-off |
| C2 | 470μF | Ripple rejection | | Decrease of SVR |
| C3 | 0.1μF | Supply voltage bypass | | Danger of oscillation |
| C4 | 1000μF | Supply voltage bypass | | Higher low frequency cutoff |
| C5 | 0.1μF | Frequency stability | | Danger of oscillation at high frequencies with inductive loads. |
| Cx | ≈1/(2π×B×R1) | Upper frequency cutoff | Lower bandwidth | Larger bandwidth |

## ■ TYPICAL CHARACTORISTICS

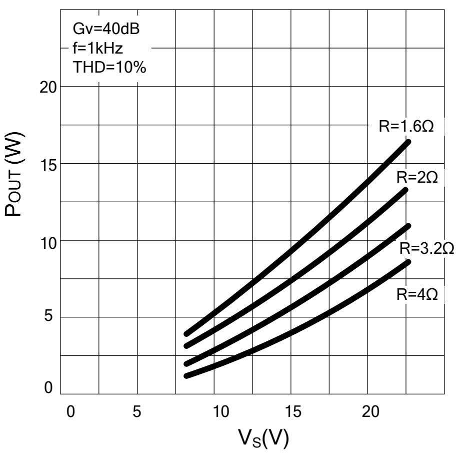
Quiescent output voltage vs.Supply voltage



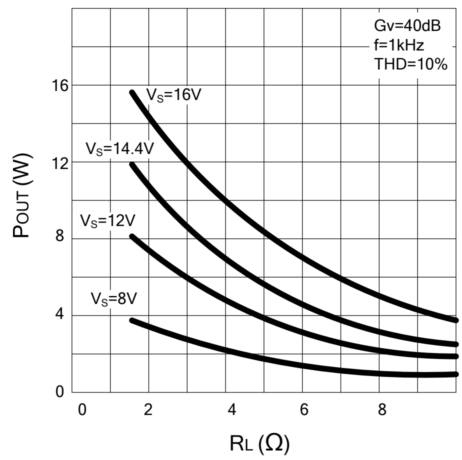

Quiescent drain current vs.Supply voltage



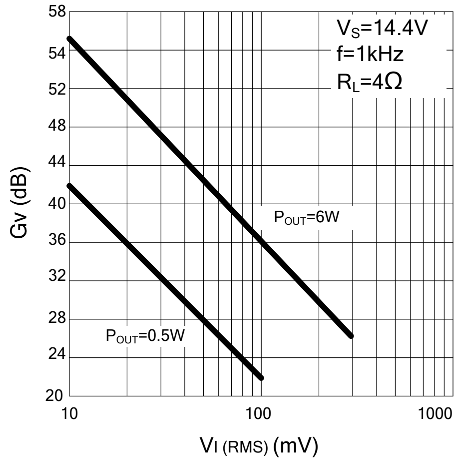

Output power vs.Supply voltage



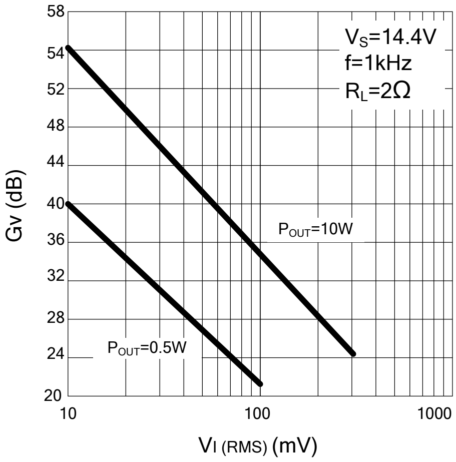

Output power vs.load resistance




Gain vs. Input sensitivity

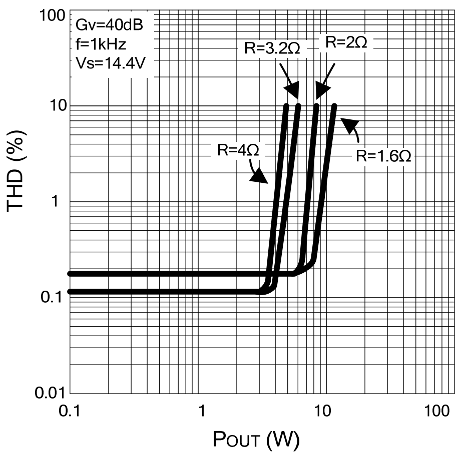



Gain vs. Input sensitivity

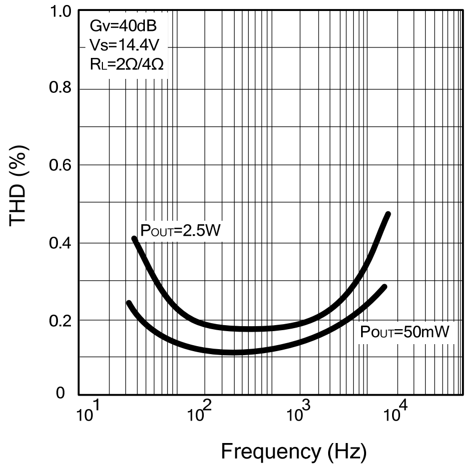


■ TYPICAL CHARACTERISTICS (Cont.)

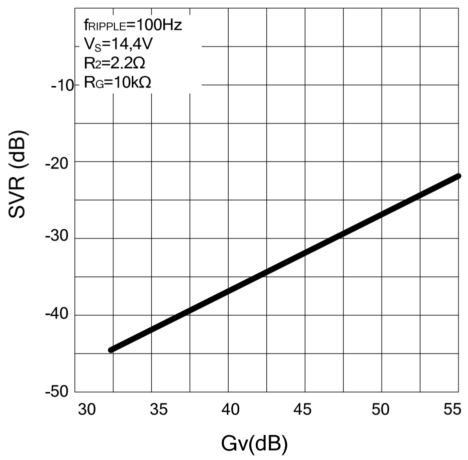
Distortion vs. output power



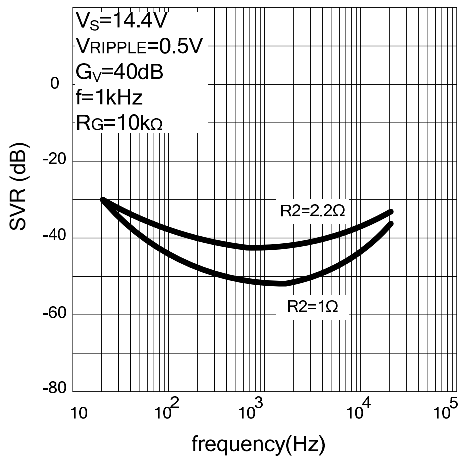

Distortion vs.frequency



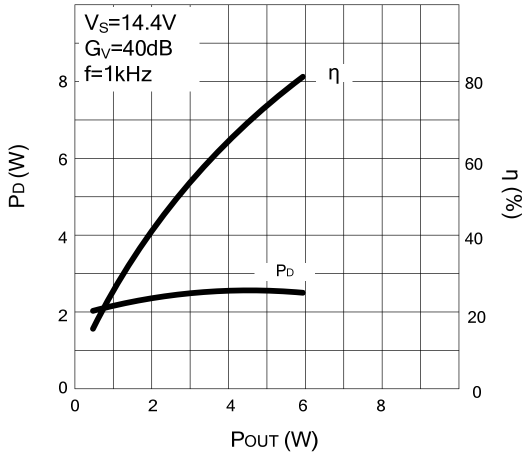

Supply voltage rejection vs. voltage gain



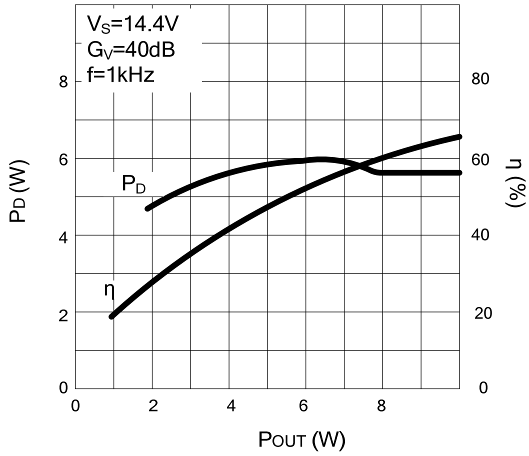

Supply voltage rejection vs.frequency




Power dissipation and efficiency vs. output power (RL=4Ω)

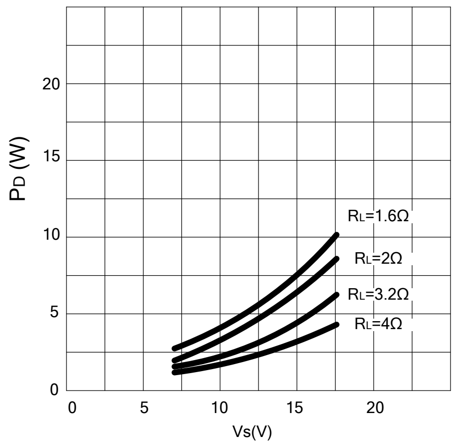



Power dissipation and efficiency vs. output power(RL=2Ω)

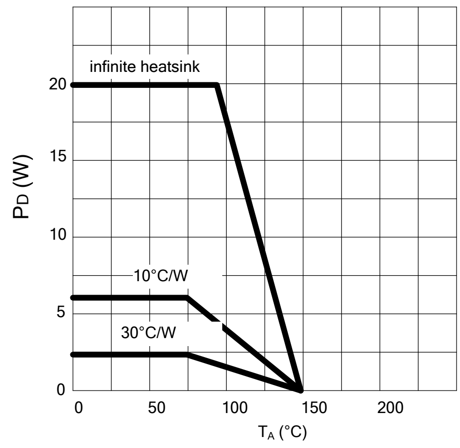


■ TYPICAL CHARACTORISTICS (Cont.)

Maximum Power dissipation and supply voltage(sine wave operation)




Maximum allowable dissipation and ambient temperature




Typical values of capacitor(Cx) for different values of frequency response