Ordering number: EN 2148C

Thick Film Hybrid IC

STK4065

Car Stereo Use Power Amplifier (25W min, THD = 10%)

Applications

- Power amplifier for car stereos
- Home karaoke systems

Features

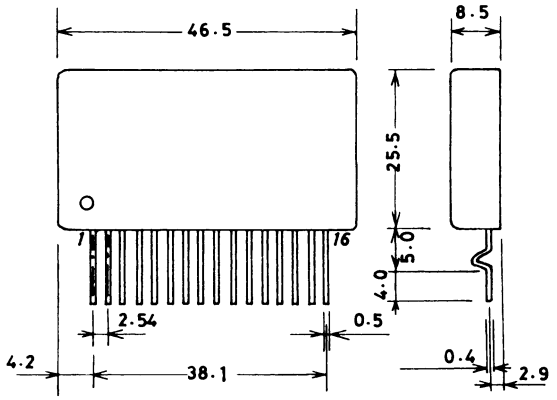
- High output power — Maximum output power 40W or greater (R_L = 2Ω)
  35W typ. (R_L = 2Ω, THD = 10%)
  23W typ. (R_L = 4Ω, THD = 10%)
- Low distortion
- Built-in protectors
  - DC short protector
  - Thermal shutdown protector (Thermal protector)
  - Overvoltage protector (Overvoltage / power supply surge protector)
  - Audio muting circuit (Fast attack time)
- Free from failure caused by load short
- Wide operating supply voltage range

Package Dimensions

unit: mm

4081

[STK4065]



Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC} max(1)	Quiescent (circuit cutoff mode) 30s	30	V
	V_{CC} max(2)	Operating (f = 100Hz, V_{IN} = 1Vrms, t = 100ms)	18	V
Allowable power dissipation	Pd max	Infinite heat sink	100	W
Peak output power	Po max	V_{CC} = 16V, RL = 2Ω, f = 1kHz	65	W
Output current	I_O		12	A
Junction temperature	Tj		150	°C
Thermal resistance	θj-c		1.25	°C/W
Operating temperature	Topr		–30 to +85	°C
Storage temperature	Tstg		–40 to +125	°C
Available time for load shorted	t_s	V_{CC} = ±13.2V, R_L = 2Ω, f = 50Hz, P_O = 25W	2*	s

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		13.2	V
Load resistance	R_L		2	Ω

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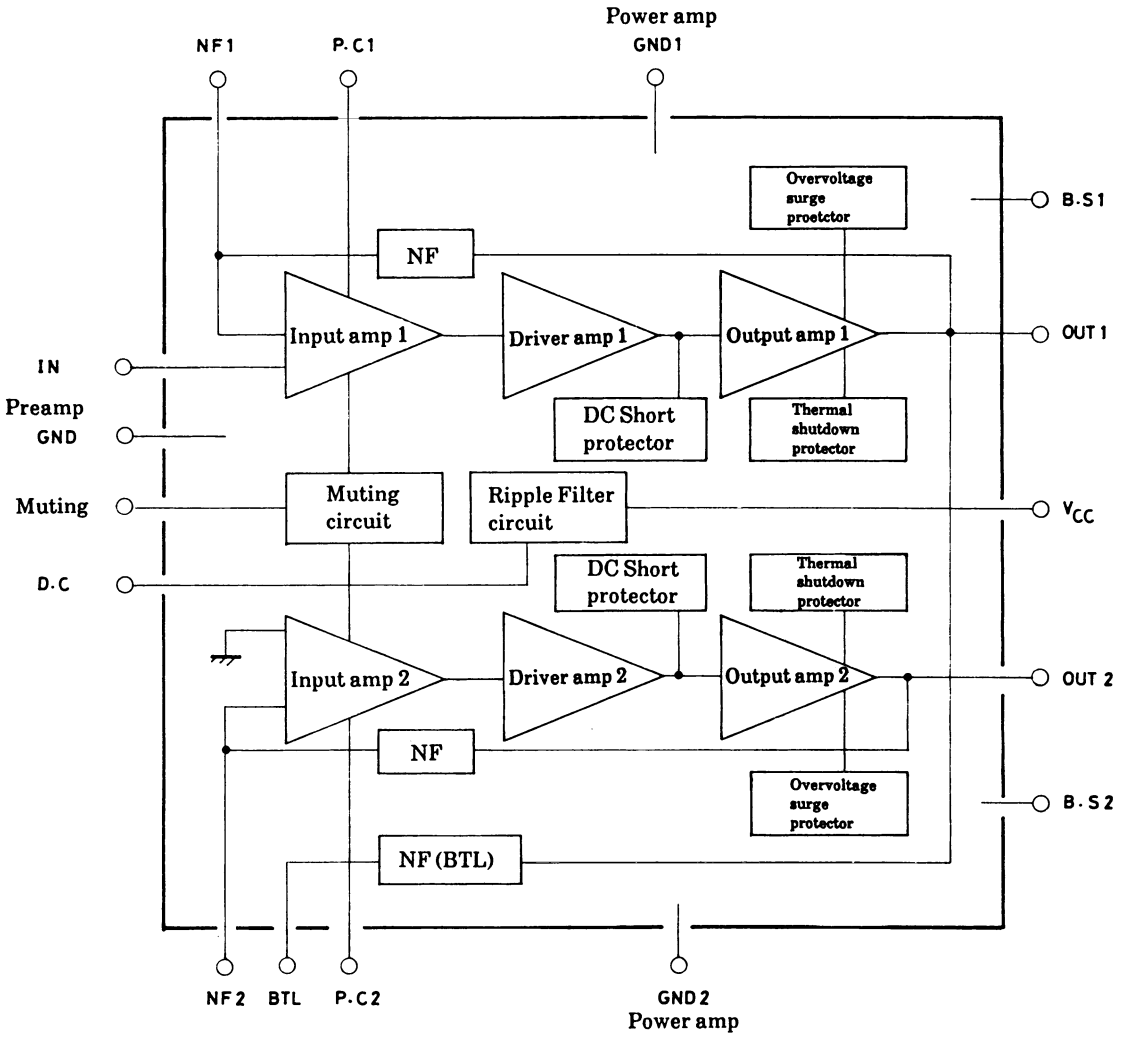
Operating Characteristics at Ta = 25°C, R_L = 2Ω, Rg = 600Ω, VG = 46dB, V_{CC} = 13.2V

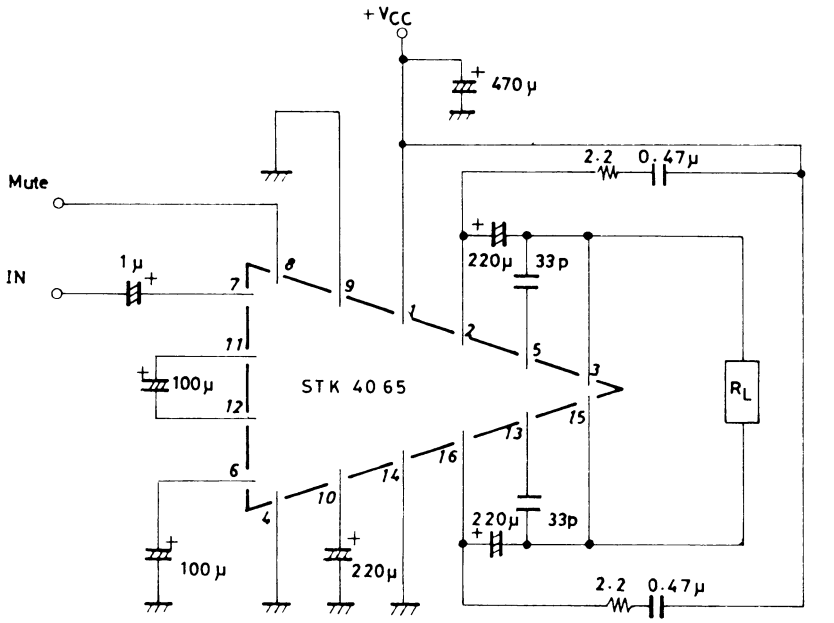
Parameter	Symbol	Conditions	min	typ	max	Unit
Quiescent current	I_{CCO}	Rg = 10kΩ	–	70	140	mA
Output power	P_O(1)	THD = 10%, f = 1kHz	25	35	–	W
	P_O(2)	THD = 1%, f = 1kHz	–	25	–	W
	P_O(3)	THD = 10%, R_L = 4Ω, f = 1kHz	20	23	–	W
Total harmonic distortion	THD(1)	P_O = 10W, f = 1kHz	–	0.06	0.1	%
	THD(2)	P_O = 1W, f = 20Hz to 20kHz	–	–	0.3	%
Voltage gain	VG	P_O = 1W, f = 1kHz	43.8	46.0	48.2	dB
Frequency response	f_L, f_H	P_O = 1W, $^{+0}_{-3}$ dB	–	10 to 30k	–	Hz
Input impedance	r_i	P_O = 1W, f = 1kHz	20	30	–	kΩ
Output noise voltage	V_{NO}	Rg = 10kΩ, without BPF	–	0.6	1.2	mVrms
Output offset voltage	ΔV_N	Rg = 10kΩ	–200	0	+200	mV
Muting suppression level	ATT	V_M = +5V	–	∞	–	dB
Ripple rejection	SVRR	f_R = 100Hz, Rg = 0Ω, V_R = 0dBm	–	–47	–	dB

* It is guaranteed that load short causes no damage for 2 seconds. In actual applications, the thermal shutdown protector provides sufficient guarantee against load short. However, refer to “Notes for Applying the STK4065”, because the saturation current varies with the thermal resistance of the heat sink.

Equivalent Circuit Block Diagram



Test Circuit



Unit (resistance: Ω, capacitance: F)

Notes for Applying the STK4065

(1) V_{CC} max

The STK4065 is designed as an amplifier for car use and its V_{CC} max at the operating mode is set to 18V. When this voltage is exceeded, the overvoltage protector will work to bring the circuit to OFF-state, delivering no output. The overvoltage protector is so designed as to work at a voltage of 18V to 28V. The protector works 100% at 28V. When designing an audio set, such as home stereo, using a transformer power supply, consider AC line regulation and be careful that 18V must not be exceeded at the quiescent mode. If 18V is exceeded, the overvoltage protector will work, generating an abnormal sound.

(2) Protectors

a) Output pin-to-V_{CC} short, output pin-to-GND short protectors

The STK4065 contains protectors against output pin-to-V_{CC} short and output pin-to-GND short.

The output pin-to-V_{CC} short protector works effectively to protect the IC when the power switch is turned ON at the output pin-to-V_{CC} short state, but does not work to protect the IC when output pin-to-V_{CC} short is forced to be provided at the normal operation mode after the power switch is turned ON.

The output pin-to-V_{CC} short protector is intended to protect the IC against damage when pin-to-pin short occurs in the assembly process.

If there is possibility that output pin-to-V_{CC} short is caused by the user, the auxiliary output pin-to-V_{CC} short protector shown on page 5 must be connected externally. The output pin-to-GND short protector works effectively to protect the IC against damage when the power switch is turned ON at the output Pin-to-GND short state and also when output pin-to-GND short is forced to be provided at the normal operation mode after the power switch in turned ON.

b) Thermal shutdown

The STK4065 contains thermal protectors.

The thermal protector detects abnormal temperature rise caused when the IC operates abnormally (load short, etc.), limits the input signal, and prevents temperature from rising, preventing the IC from breaking down in a short time. The thermal protector starts working at approximately 135°C of substrate temperature Tc and turns OFF the input signal at approximately 175°C.

In normal applications, since a heat sink is mounted on the IC, the substrate temperature does not rise up to a temperature at which the input signal is turned OFF completely, but is saturated at a certain temperature. When load short occurs with a heat sink of 4.5°C/W mounted, the substrate temperature is saturated at approximately 160°C.

Tj in this state is as high as 170°C, which obviously exceeds the maximum rating.

As mentioned above, the thermal protector is designed to prevent the IC from breaking down in a short time when abnormal temperature rise occurs, but is not intended to protect the IC from damage for a long time when abnormal temperature rise occurs.

(3) Others

a) Excessive input

When an excessive input of 1.5 Vrms (f = 1kHz) or greater is applied to the input pin, the input channel DC balance of the input monolithic amplifier is disturbed, the output is cut off, and DC voltage is developed on the output pins, damaging the speaker. Be careful not to permit an input of 1.5Vrms (f = 1kHz) or greater to be applied.

b) Parasitic oscillation

The STK4065 has 2.2Ω, 0.47μF across the V_{CC} line and the bootstrap pins for phase compensation. This makes it necessary for the power line to be extended close to the bootstrap pins for both the inverting amplifier and the non-inverting amplifier. Too long a power line may cause parasitic oscillation to occur at low temperatures. If so, connect a capacitor of approximately 0.1μF across the tip of the power line and GND to decrease AC impedance of the power line.

c) Inverse application of supply voltage

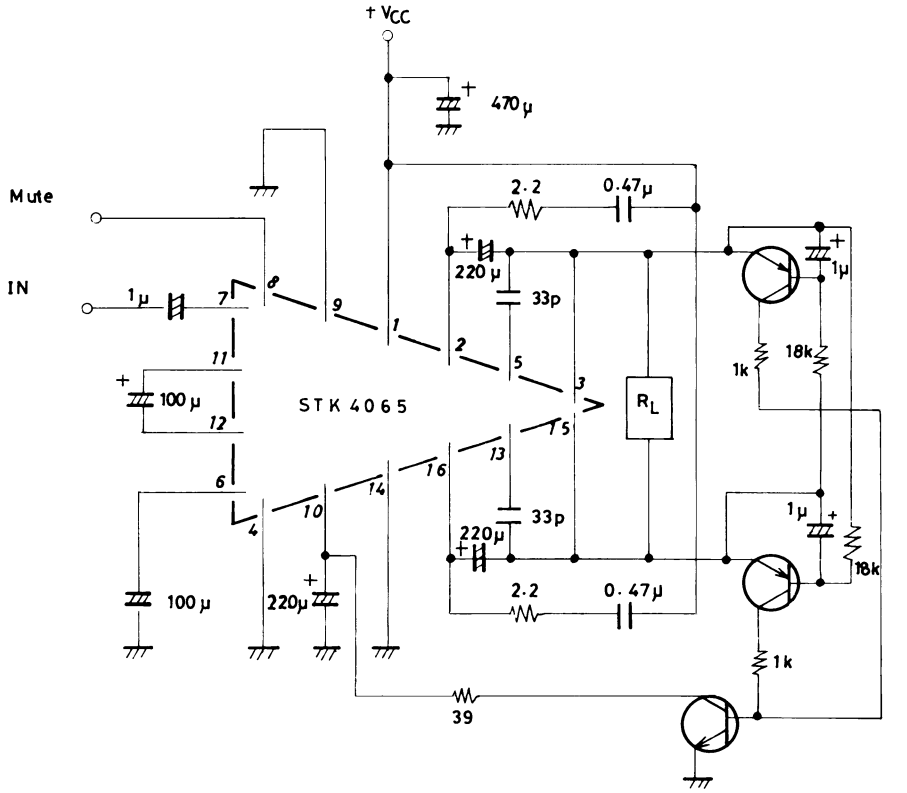
The STK4065 contains no protector against inverse application of supply voltage. If there is a possibility that inverse application of supply voltage may occur, connect the protector externally.

d) Power switch-OFF mode

Do not connect pin 1 direct to GND, otherwise the IC may be broken down.

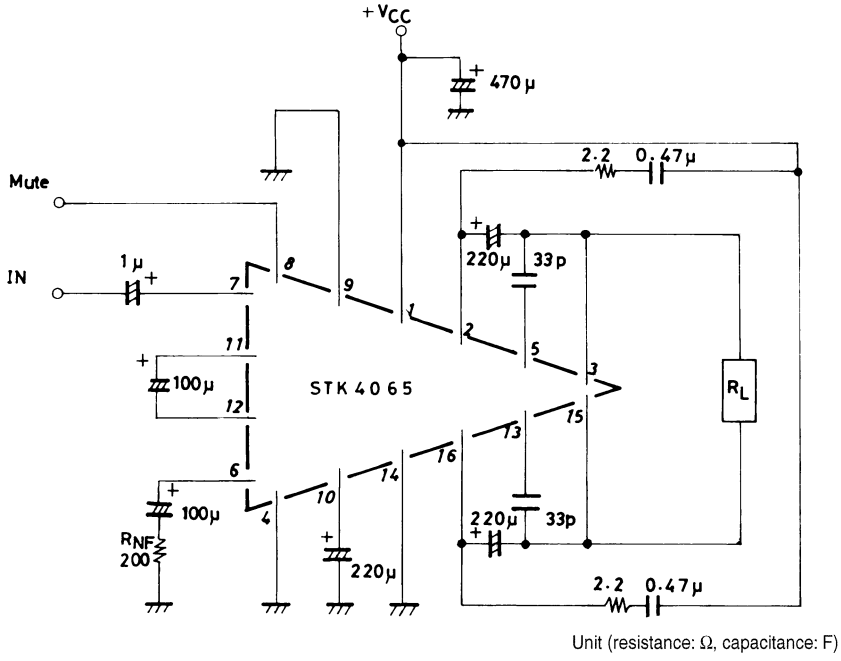
When connecting pin 1 to GND, connect a resistor of 100Ω or greater in series with pin 1 or connect a diode across pin 10 and pin 1.

Sample Application Circuit of STK4065 Output Pin-to-V_{CC} Short Protector

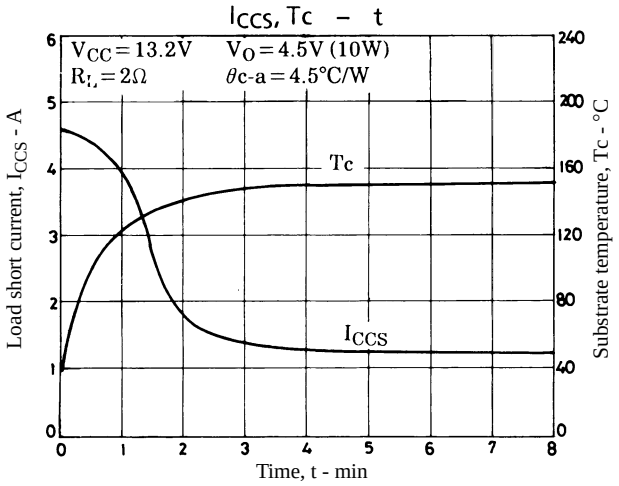


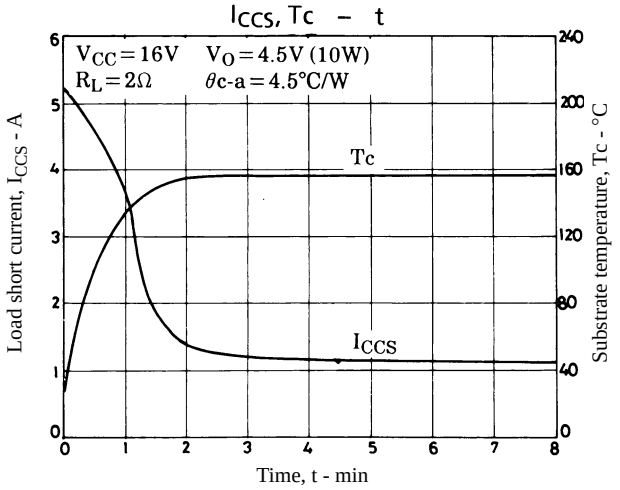
Unit (resistance: Ω, capacitance: F)

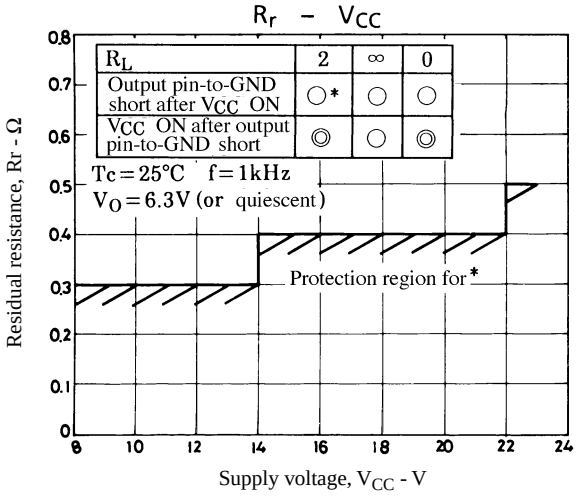
Sample Application of STK4065 VG = 40dB

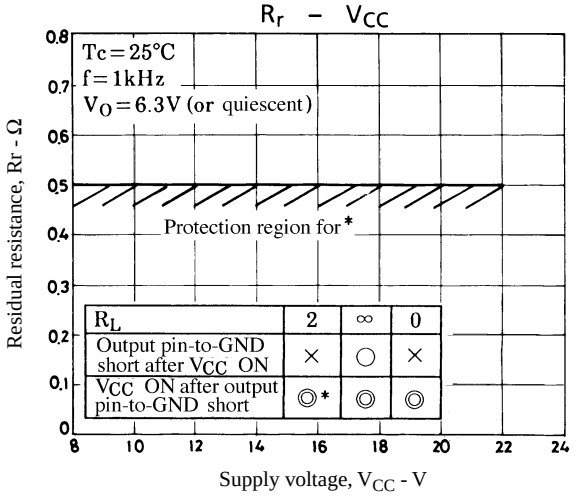


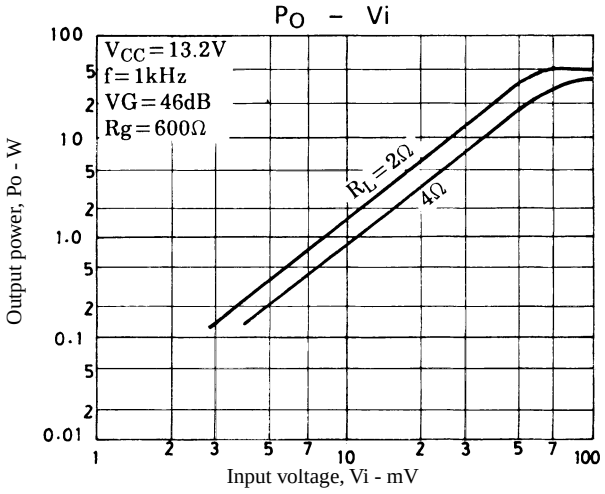
Unit (resistance: Ω, capacitance: F)

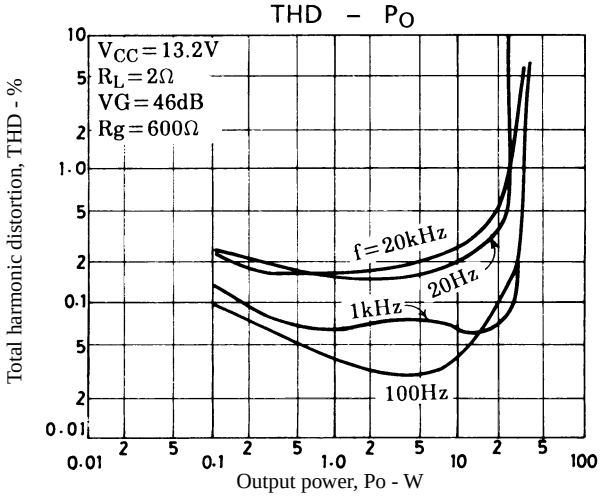

ICCS, Tc – t
VCC = 13.2V VO = 4.5V (10W)
RL = 2Ω θc-a = 4.5°C/W
Tc
ICCS
Load short current, ICCS - A
Substrate temperature, Tc - °C
Time, t - min

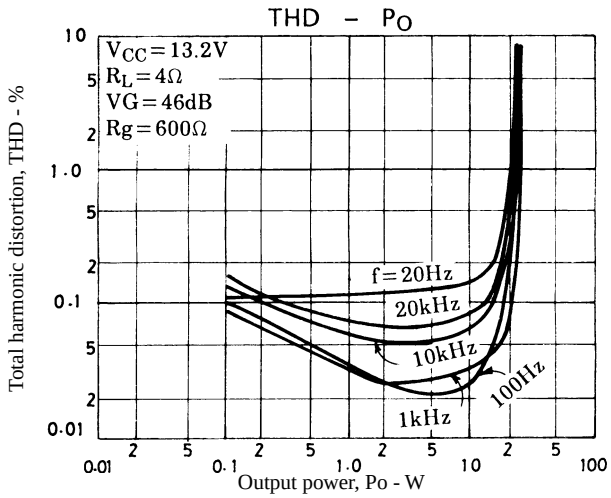

ICCS, Tc – t
VCC = 16V VO = 4.5V (10W)
RL = 2Ω θc-a = 4.5°C/W
Tc
ICCS
Load short current, ICCS - A
Substrate temperature, Tc - °C
Time, t - min

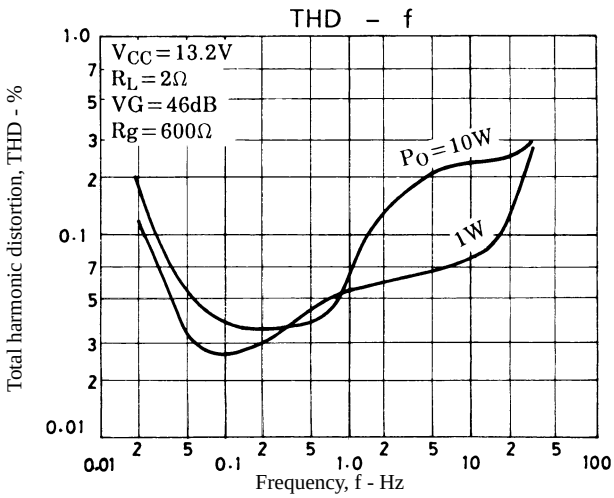

Rr – VCC
RL | 2 | ∞ | 0
Output pin-to-GND short after VCC ON | ○* | ○ | ○
VCC ON after output pin-to-GND short | ◎ | ○ | ◎
Tc = 25°C f = 1kHz
VO = 6.3V (or quiescent)
Protection region for *
Residual resistance, Rr - Ω
Supply voltage, VCC - V

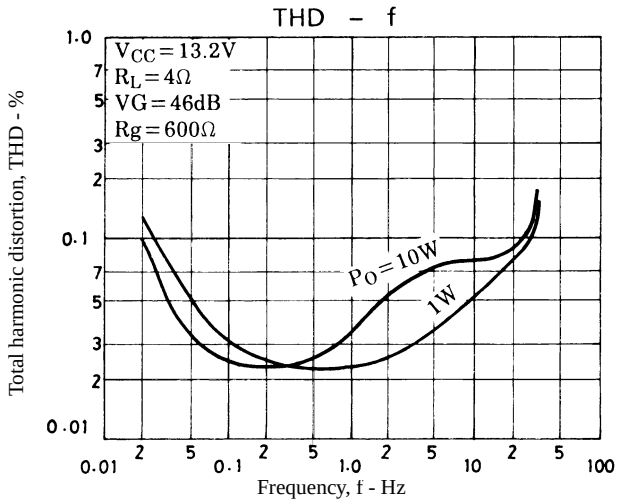

Rr – VCC
Tc = 25°C
f = 1kHz
VO = 6.3V (or quiescent)
Protection region for *
RL | 2 | ∞ | 0
Output pin-to-GND short after VCC ON | × | ○ | ×
VCC ON after output pin-to-GND short | ◎* | ◎ | ◎
Residual resistance, Rr - Ω
Supply voltage, VCC - V

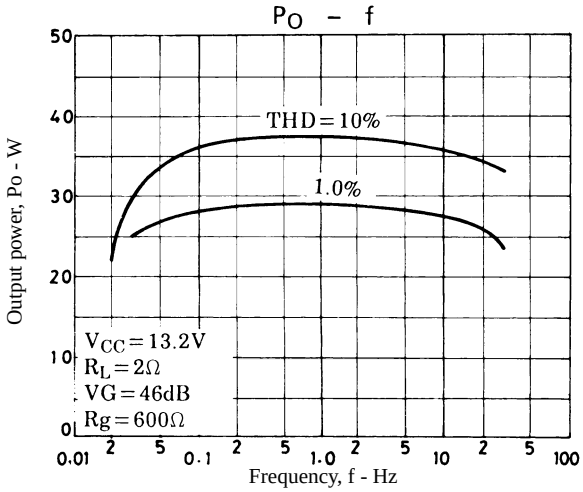

PO – Vi
VCC = 13.2V
f = 1kHz
VG = 46dB
Rg = 600Ω
RL = 2Ω
4Ω
Output power, Po - W
Input voltage, Vi - mV

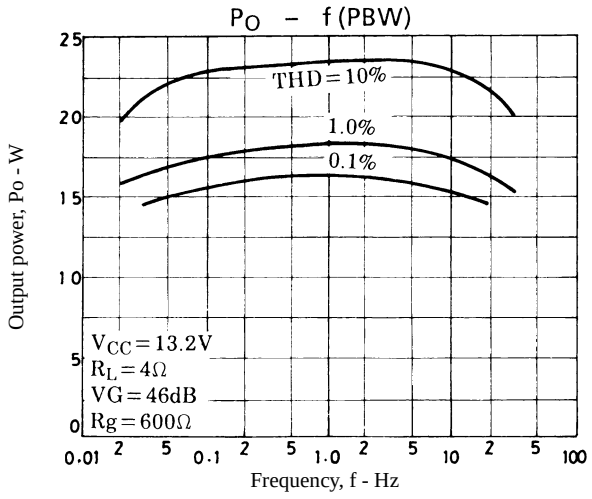

THD – PO
VCC = 13.2V
RL = 2Ω
VG = 46dB
Rg = 600Ω
f = 20kHz
20Hz
1kHz
100Hz
Total harmonic distortion, THD - %
Output power, Po - W

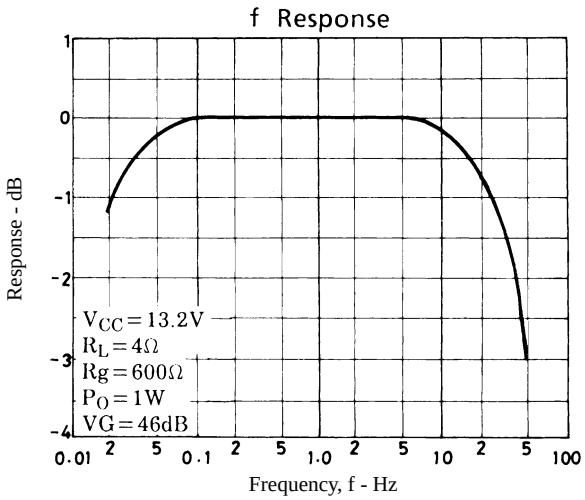

THD – PO
VCC = 13.2V
RL = 4Ω
VG = 46dB
Rg = 600Ω
f = 20Hz
20kHz
10kHz
1kHz
100Hz
Total harmonic distortion, THD - %
Output power, Po - W

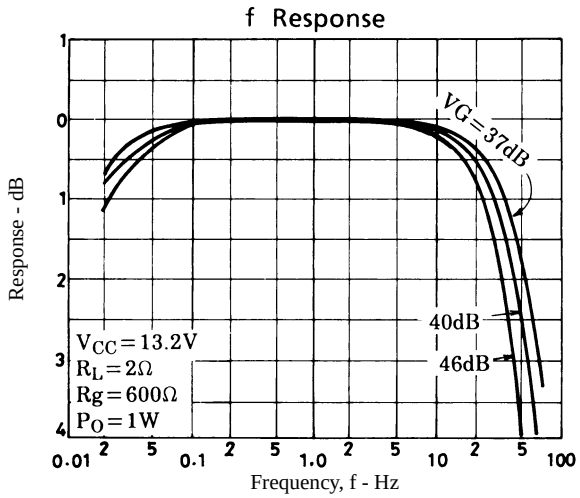

THD – f
VCC = 13.2V
RL = 2Ω
VG = 46dB
Rg = 600Ω
PO = 10W
1W
Total harmonic distortion, THD - %
Frequency, f - Hz

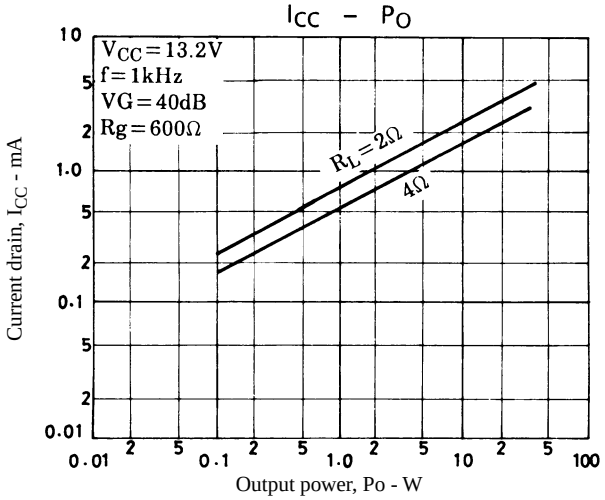

THD – f
VCC = 13.2V
RL = 4Ω
VG = 46dB
Rg = 600Ω
PO = 10W
1W
Total harmonic distortion, THD - %
Frequency, f - Hz

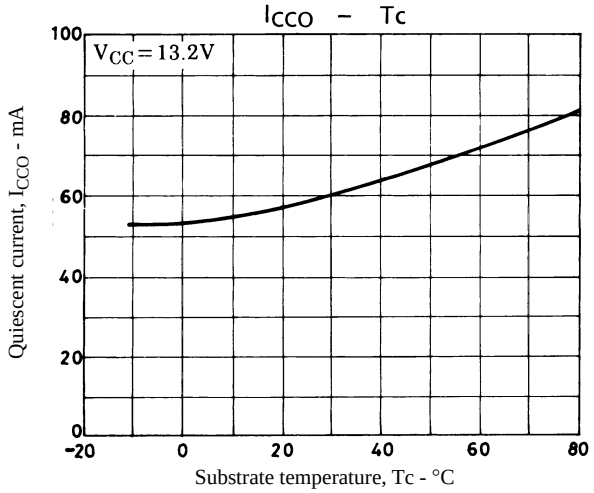

PO – f
THD = 10%
1.0%
VCC = 13.2V
RL = 2Ω
VG = 46dB
Rg = 600Ω
Output power, Po - W
Frequency, f - Hz

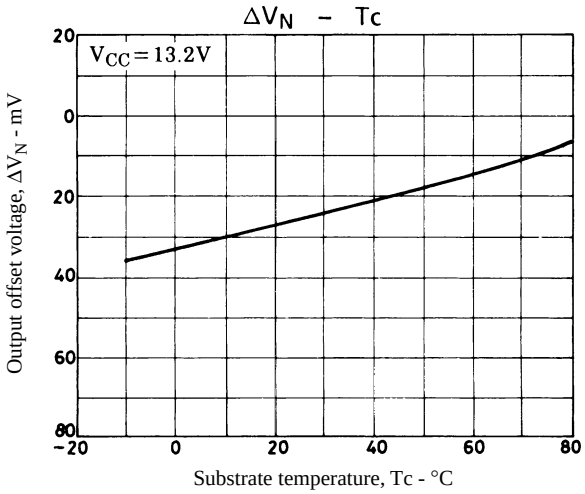

PO – f (PBW)
THD = 10%
1.0%
0.1%
VCC = 13.2V
RL = 4Ω
VG = 46dB
Rg = 600Ω
Output power, Po - W
Frequency, f - Hz

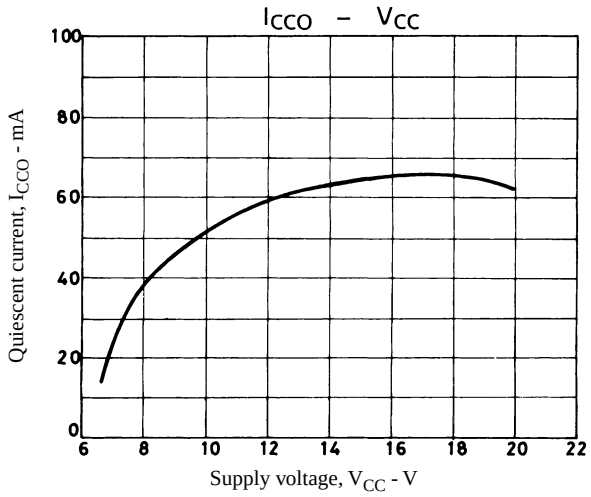

f Response
VCC = 13.2V
RL = 4Ω
Rg = 600Ω
PO = 1W
VG = 46dB
Response - dB
Frequency, f - Hz

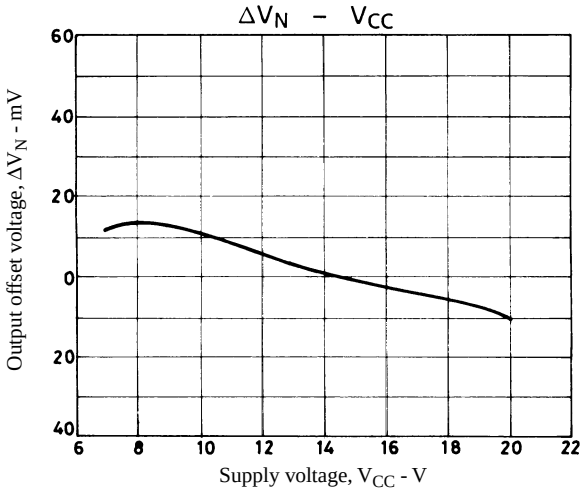

f Response
Response - dB
VG=37dB
40dB
46dB
VCC=13.2V
RL=2Ω
Rg=600Ω
PO=1W
Frequency, f - Hz


ICC – PO
VCC=13.2V
f=1kHz
VG=40dB
Rg=600Ω
RL=2Ω
4Ω
Current drain, ICC - mA
Output power, Po - W


ICCO – Tc
VCC=13.2V
Quiescent current, ICCO - mA
Substrate temperature, Tc - °C


ΔVN – Tc
VCC=13.2V
Output offset voltage, ΔVN - mV
Substrate temperature, Tc - °C


ICCO – VCC
Quiescent current, ICCO - mA
Supply voltage, VCC - V


ΔVN – VCC
Output offset voltage, ΔVN - mV
Supply voltage, VCC - V