Ordering number: EN2202B

Thick Film Hybrid IC

STK4152II

AF Power Amplifier (Split Power Supply) (30W + 30W min, THD = 0.4%)

Features

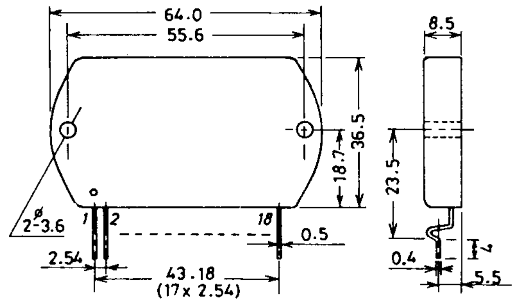
- The STK4102II series (STK4152II) and STK4101V series (high-grade type) are pin-compatible in the output range of 6W to 50W and enable easy design.
- Small-sized package whose pin assignment is the same as that of the STK4101II series
- Built-in muting circuit to cut off various kinds of pop noise
- Greatly reduced heat sink due to substrate temperature 125°C guaranteed
- Excellent cost performance

Package Dimensions

unit: mm

4040

[STK4152II]



Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		±42	V
Thermal resistance	θj-c		2.1	°C/W
Junction Temperature	Tj		150	°C
Operating substrate temperature	Tc		125	°C
Storage temperature	Tstg		–30 to +125	°C
Available time for load short-circuit	ts	V_{CC} = ±27.5V, R_L = 8Ω, f = 50Hz, Po = 30W	2	s

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		±27.5	V
Load resistance	R_L		8	Ω

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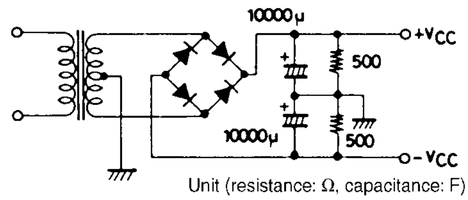
Operating Characteristics at Ta = 25°C, V_{CC} = ±27.5V, R_L = 8Ω, Rg = 600Ω, VG = 40dB, R_L : non-inductive load

Parameter	Symbol	Conditions	min	typ	max	Unit
Quiescent current	Icco	V_{CC} = ±33V	20	40	100	mA
Output power	Po (1)	THD = 0.4%, f = 20Hz to 20kHz	30			W
	Po (2)	V_{CC} = ±25V, THD = 1.0%, R_L = 4Ω, f = 1kHz	35			W
Total harmonic distortion	THD	Po = 1.0W, f = 1kHz			0.3	%
Frequency response	f_L, f_H	Po = 1.0W, $^{+0}_{-3}$ dB		20 to 50k		Hz
Input impedance	r_i	Po = 1.0W, f = 1kHz		55		kΩ
Output noise voltage	V_{NO}	V_{CC} = ±33V, Rg = 10kΩ			1.2	mVrms
Neutral voltage	V_N	V_{CC} = ±33V	–70	0	+70	mV
Muting voltage	V_M		–2	–5	–10	V

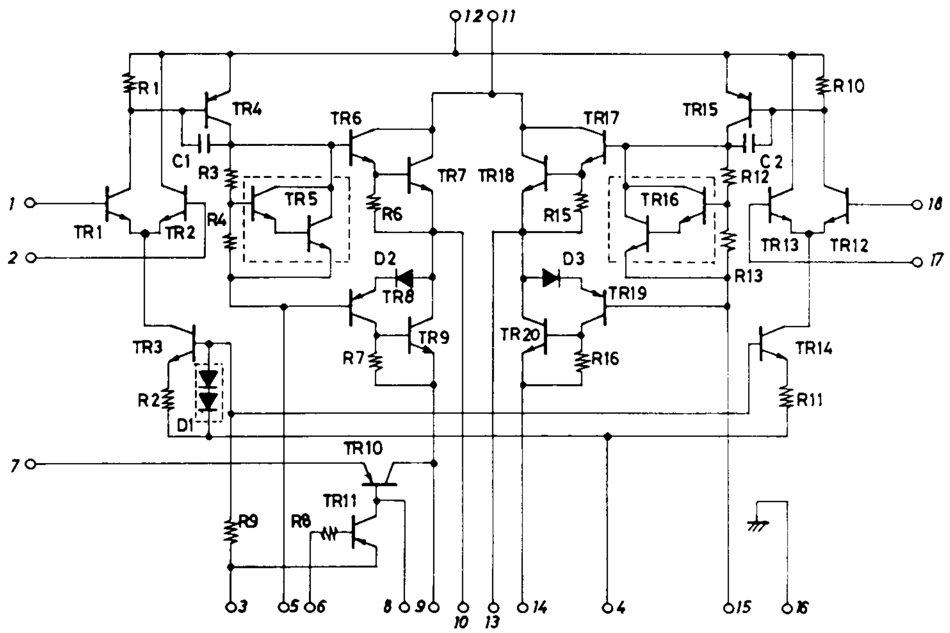
Notes. For power supply at the time of test, use a constant-voltage power supply unless otherwise specified.
For measurement of the available time for load shorte-circuit and output noise voltage, use the specified transformer power supply shown right.
The output noise voltage is represented by the peak value on rms scale (VTVM) of average value indicating type. For AC power supply, use an AC stabilized power supply (50Hz) to eliminate the effect of flicker noise in AC primary line.



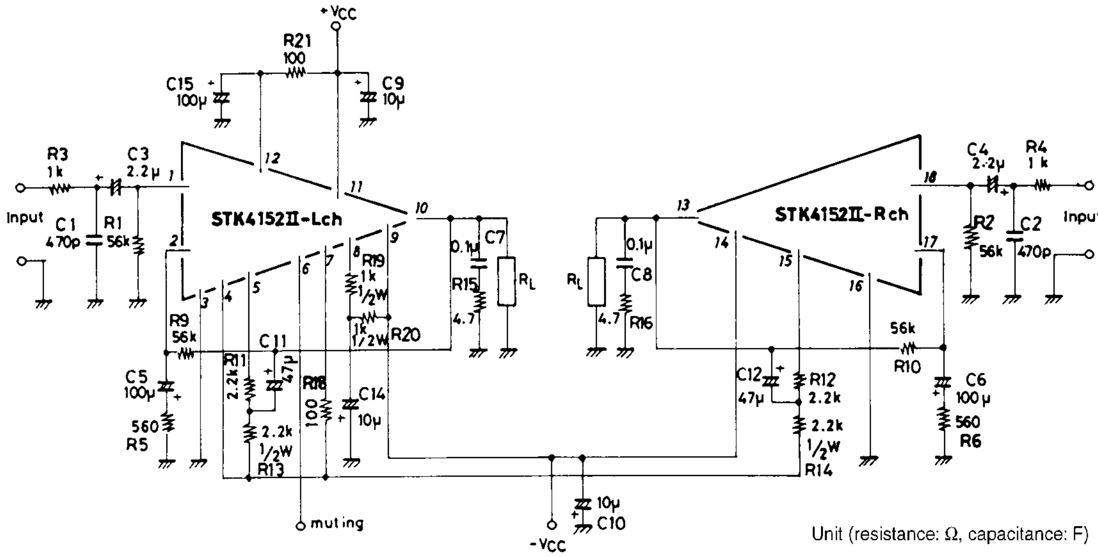
Unit (resistance: Ω, capacitance: F)

Specified Transformer Power Supply
(Equivalent to RP-25)

Equivalent Circuit

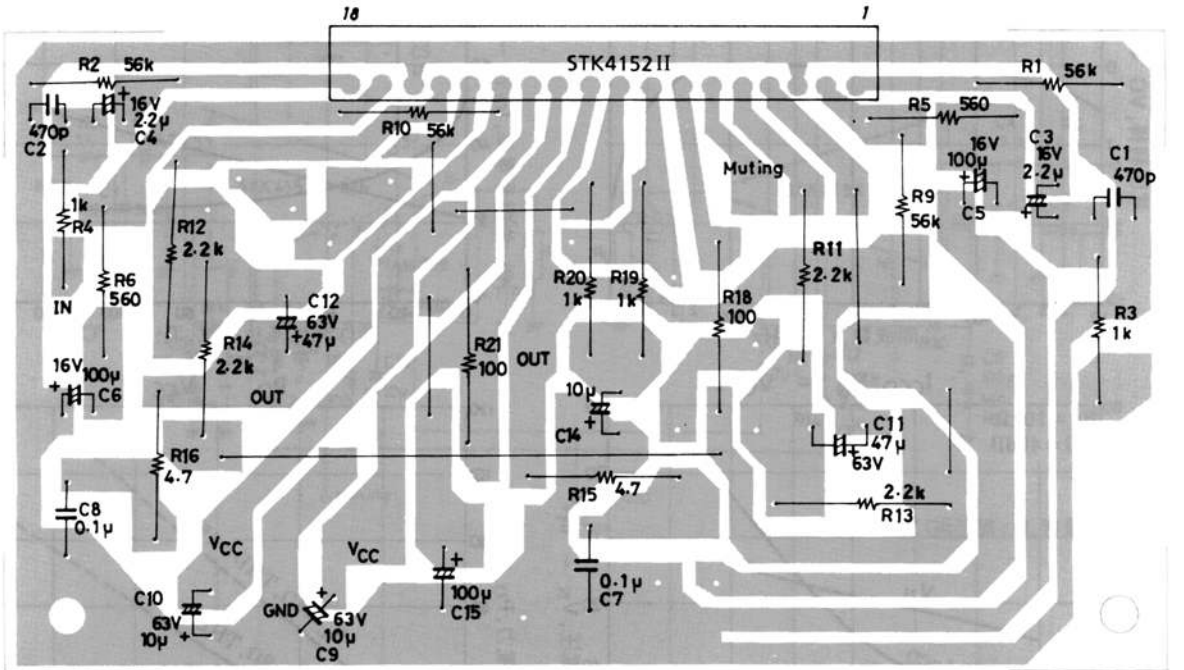


Sample Application Circuit : 30W min 2-channel AF power amplifier

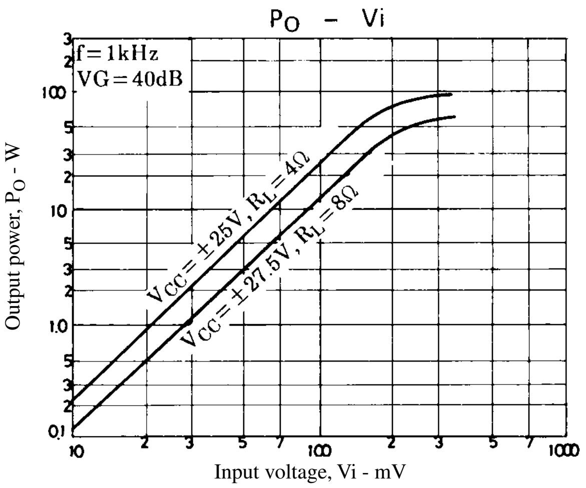


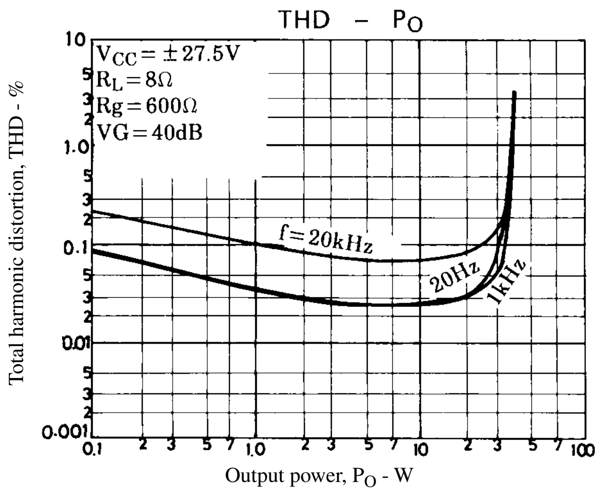
Unit (resistance: Ω, capacitance: F)

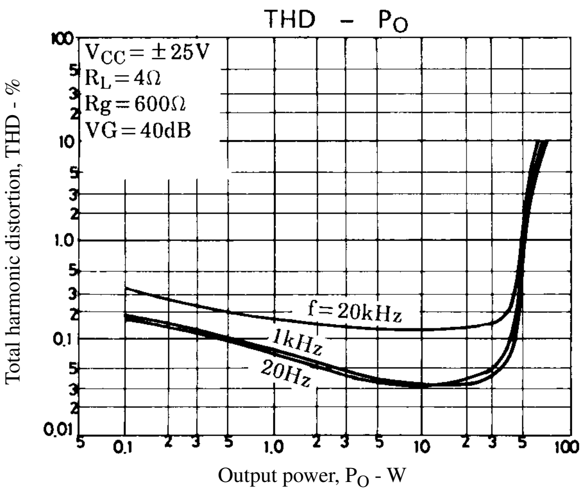
Sample Printed Circuit Pattern for Application Circuit (Cu-foiled side)

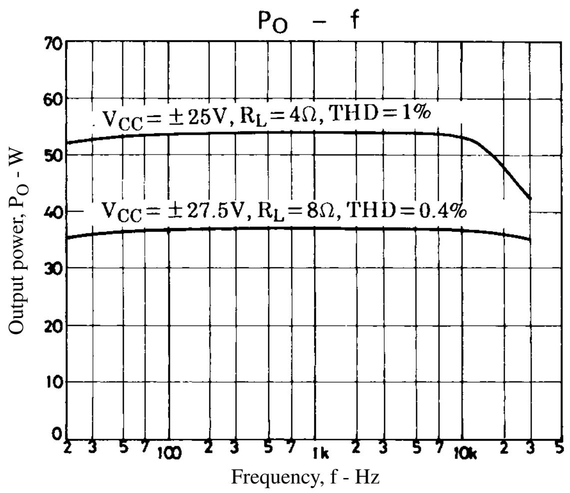


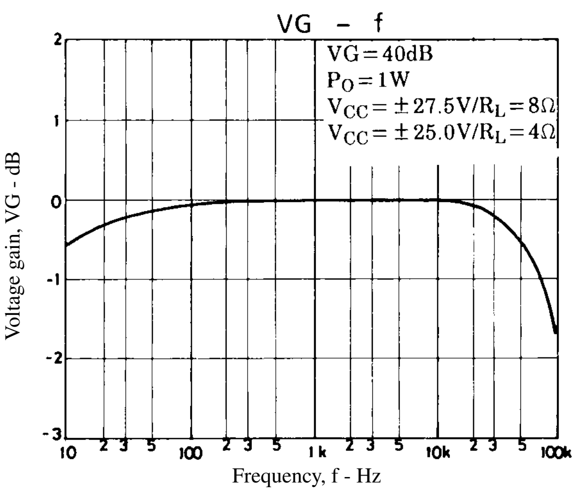
Unit (resistance: Ω, capacitance: F)

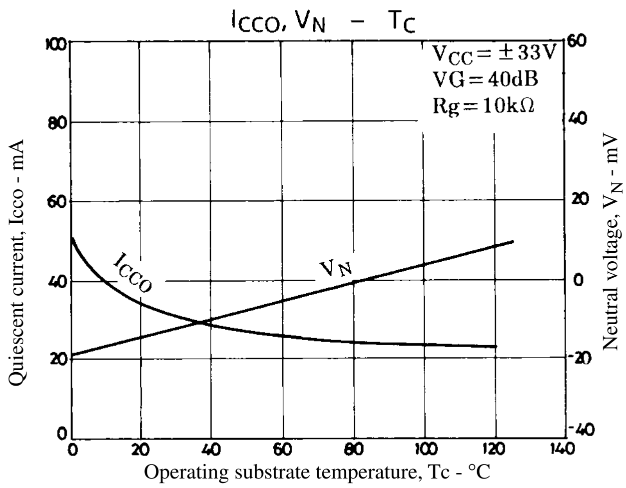

P_O – Vi
f = 1kHz
VG = 40dB
V_{CC} = ±25V, R_L = 4Ω
V_{CC} = ±27.5V, R_L = 8Ω
Output power, P_O - W
Input voltage, Vi - mV

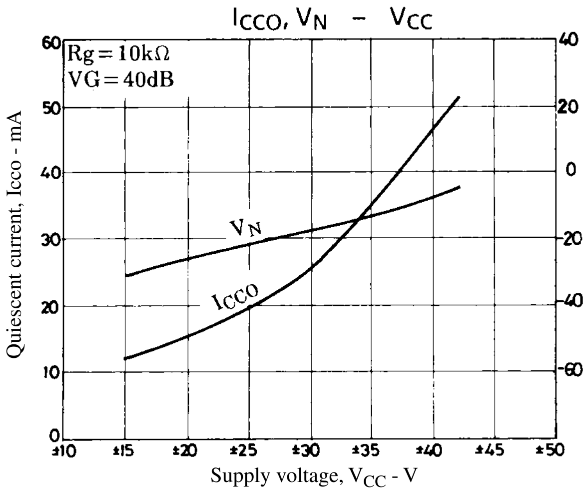

THD – P_O
V_{CC} = ±27.5V
R_L = 8Ω
Rg = 600Ω
VG = 40dB
f = 20kHz
20Hz
1kHz
Total harmonic distortion, THD - %
Output power, P_O - W

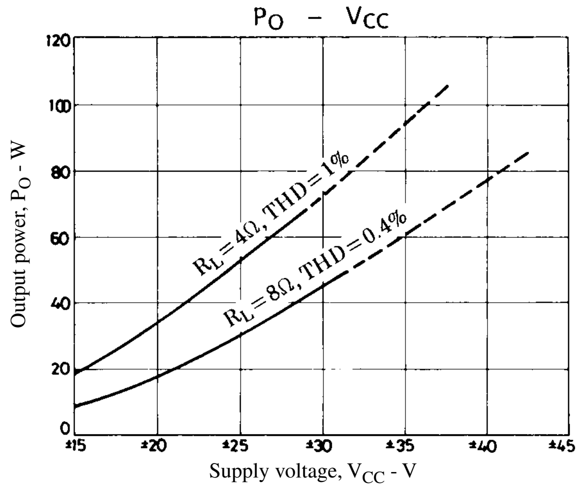

THD – P_O
V_{CC} = ±25V
R_L = 4Ω
Rg = 600Ω
VG = 40dB
f = 20kHz
1kHz
20Hz
Total harmonic distortion, THD - %
Output power, P_O - W

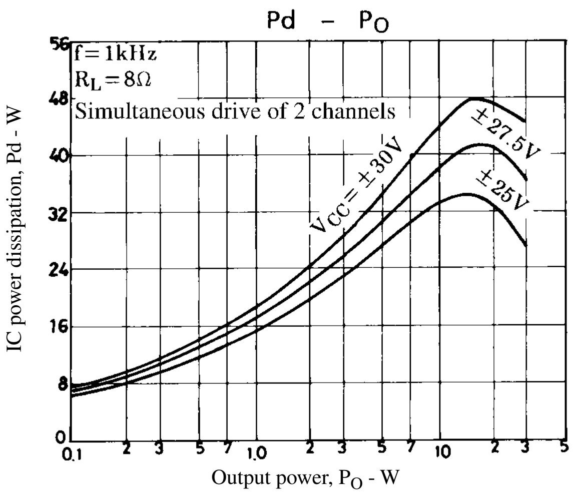

P_O – f
V_{CC} = ±25V, R_L = 4Ω, THD = 1%
V_{CC} = ±27.5V, R_L = 8Ω, THD = 0.4%
Output power, P_O - W
Frequency, f - Hz

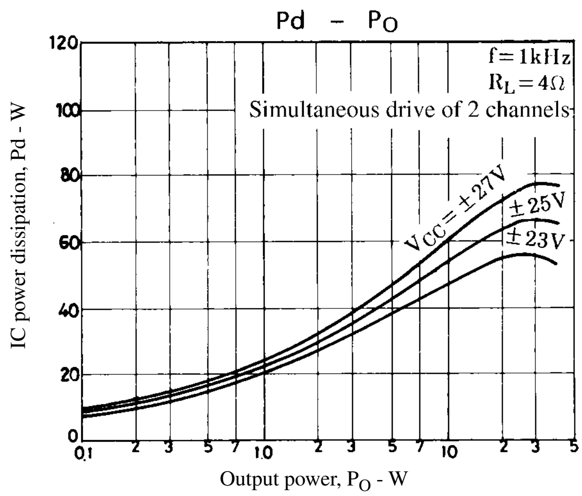

VG – f
VG = 40dB
P_O = 1W
V_{CC} = ±27.5V/R_L = 8Ω
V_{CC} = ±25.0V/R_L = 4Ω
Voltage gain, VG - dB
Frequency, f - Hz

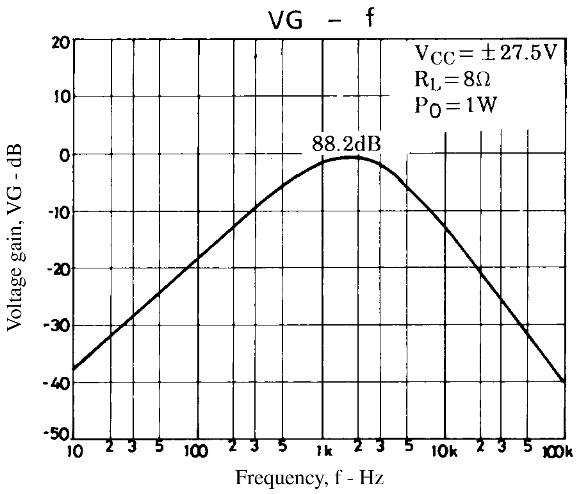

I_{CCO}, V_N – Tc
V_{CC} = ±33V
VG = 40dB
Rg = 10kΩ
I_{CCO}
V_N
Quiescent current, Icco - mA
Neutral voltage, V_N - mV
Operating substrate temperature, Tc - °C


ICCO, VN – VCC
Rg = 10kΩ
VG = 40dB
VN
ICCO
Quiescent current, Icco - mA
Neutral voltage, VN - mV
Supply voltage, VCC - V

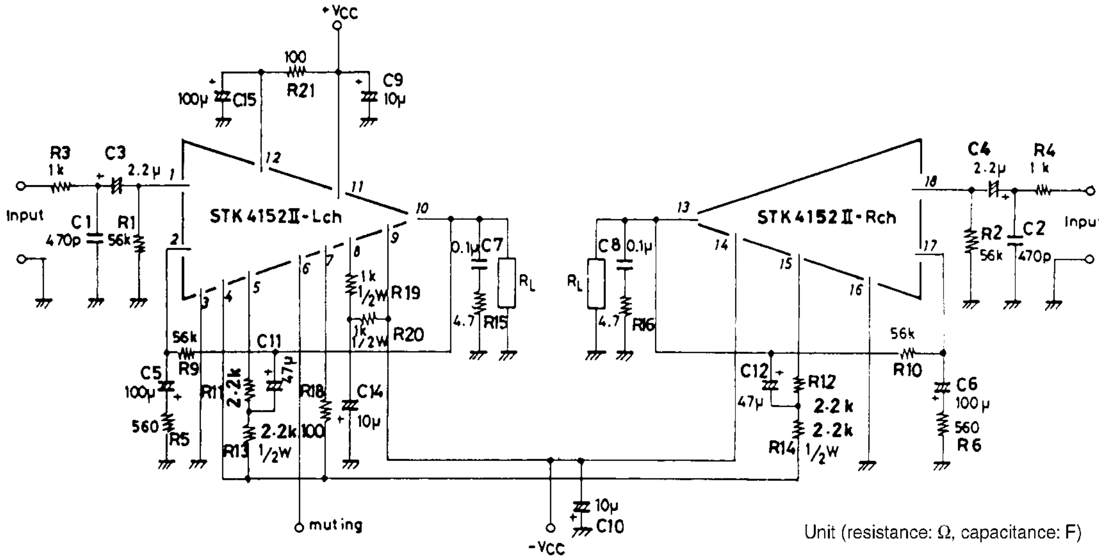

PO – VCC
RL = 4Ω, THD = 1%
RL = 8Ω, THD = 0.4%
Output power, PO - W
Supply voltage, VCC - V


Pd – PO
f = 1kHz
RL = 8Ω
Simultaneous drive of 2 channels
VCC = ±30V
±27.5V
±25V
IC power dissipation, Pd - W
Output power, PO - W


Pd – PO
f = 1kHz
RL = 4Ω
Simultaneous drive of 2 channels
VCC = ±27V
±25V
±23V
IC power dissipation, Pd - W
Output power, PO - W

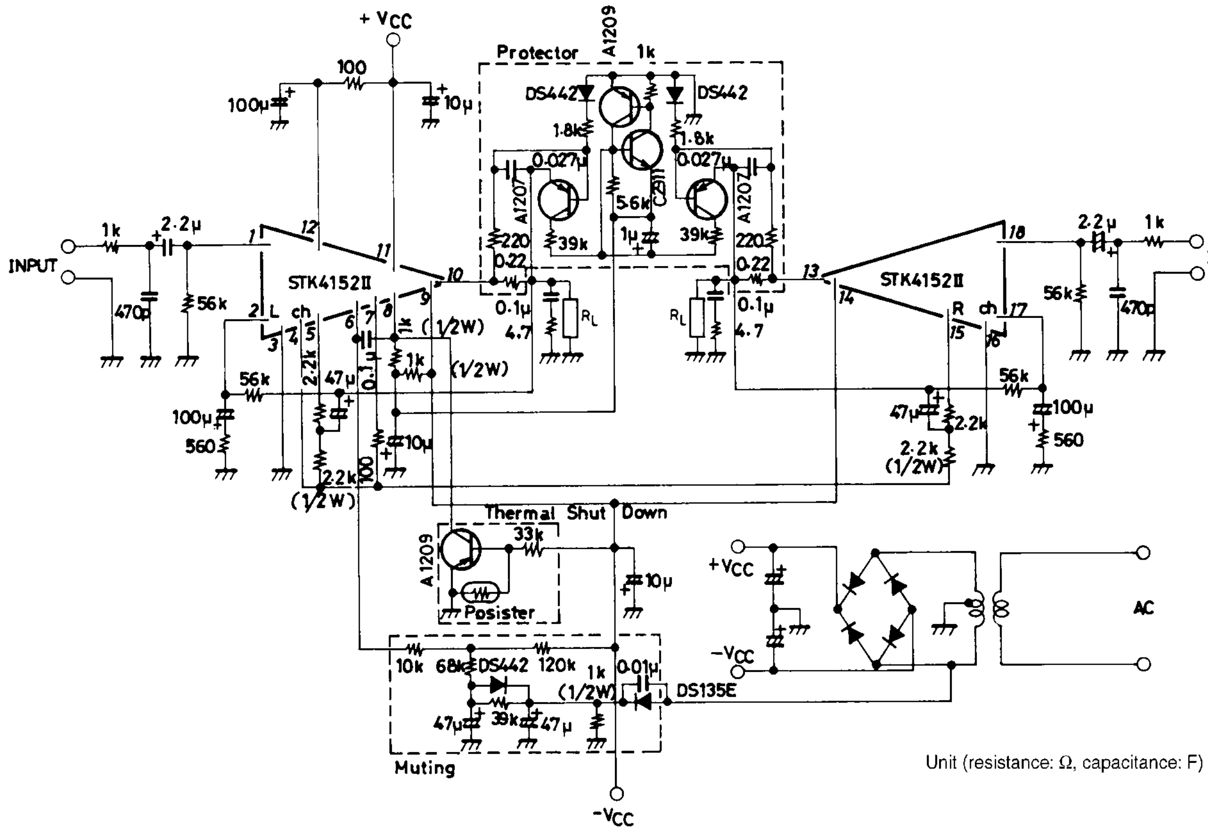

VG – f
VCC = ±27.5V
RL = 8Ω
PO = 1W
88.2dB
Voltage gain, VG - dB
Frequency, f - Hz

Description of External Parts



C1, C2	Input filter capacitors • A filter formed with R3 or R4 can be used to reduce noise at high frequencies.
C3, C4	Input coupling capacitors • Used to block DC current. When the reactance of the capacitor increases at low frequencies, the dependence of 1/f noise on signal source resistance causes the output noise to worsen. It is better to decrease the reactance. • To reduce the pop noise at the time of application of power, it is effective to increase C3, C4 that fix the time constant on the input side and to decrease C5, C6 on the NF side.
C5, C6	NF capacitors • These capacitors fix the low cutoff frequency as shown below. $f_L = \frac{1}{2\pi \cdot C5 \cdot R5}$ [Hz] To provide the desired voltage gain at low frequencies, it is better to increase C5. However, do not increase C5 more than needed because the pop noise level becomes higher at the time of application of power.
C15	Decoupling capacitor • Used to eliminate the ripple components that mix into the input side from the power line (+V_{CC}).
C11, C12	Bootstrap capacitors • When the capacitor value is decreased, the distortion is liable to be higher at low frequencies.
C9, C10	Oscillation blocking capacitors • Must be inserted as close to the IC power supply pins as possible so that the power supply impedance is decreased to operate the IC stably. • Electrolytic capacitors are recommended for C9, C10.
C14	Capacitor for ripple filter • Capacitor for the TR10-used ripple filter in the IC system
C7	Oscillation blocking capacitor • A polyester film capacitor, being excellent in temperature characteristic, frequency characteristic, is recommended for C7.
R3, R4	Resistors for input filter
R1, R2	Input bias resistors • Used to bias the input pin potential to zero. These resistors fix the input impedance practically.
R5, R9 (R6, R10)	These resistors fix voltage gain VG. It is recommended to use R5 (R6) = 560Ω, R9 (R10) = 56kΩ for VG = 40dB. • To adjust VG, it is desirable to change R9 (or R10). • When R9 (or R10) is changed to adjust VG, R1 (=R2) =R9 (=R10) must be set to ensure V_N balance.
R11, R13 (R12, R14)	Bootstrap resistors • The quiescent current is set by these resistors 2.2kΩ + 2.2kΩ. It is recommended to use this resistor value.
R21	Resistor for ripple filter • (Limiting resistor for predriver transistor at the time of load short)
R18	Used to ensure plus/minus balance at the time of clip.
R19, R20	Resistor for ripple filter • When muting TR11 is turned ON, current flows from ground to -V_{CC} through TR 11. It is recommended to use 1kΩ (1/2W) + 1kΩ (1/2W) allowing for the power that may be dissipated on that occasion.
R15, R16	Oscillation blocking resistors

Sample Application Circuit (protection circuit and muting circuit)



Unit (resistance: Ω, capacitance: F)

Thermal Design

The IC power dissipation of the STK4152II at the IC-operated mode is 41.4W max. at load resistance 8Ω and 67W max. at load resistance 4Ω (simultaneous drive of 2 channels) for continuous sine wave as shown in Figure 1 and 2.

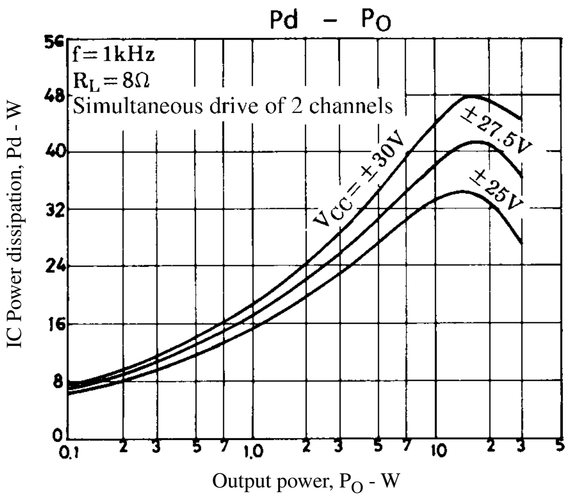


Figure 1. STK4152II Pd – P_O (R_L = 8Ω)

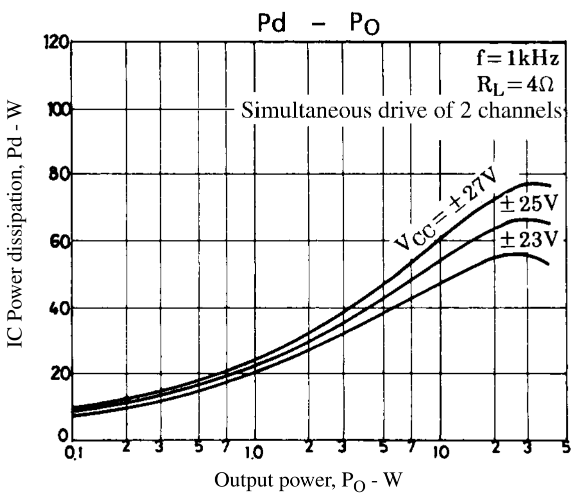


Figure 2. STK4152II Pd – P_O (R_L = 4Ω)

In an actual application where a music signal is used, it is impractical to estimate the power dissipation based on the continuous signal as shown above, because too large a heat sink must be used. It is reasonable to estimate the power dissipation as 1/10 Po max. (EIAJ).
That is, Pd = 26W at 8Ω, Pd = 38W at 4Ω
Thermal resistance θc-a of a heat sink for this IC power dissipation (Pd) is fixed under conditions 1 and 2 shown below.

Condition 1: Tc = Pd × θc-a + Ta ≤ 125°C... (1)
where Ta : Specified ambient temperature
Tc : Operating substrate temperature

Condition 2: Tj= Pd × (θc-a) + Pd/4 × (θj-c) + Ta ≤ 150°C..................... (2)
where Tj : Junction temperature of power transistor

Assuming that the power dissipation is shared equally among the four power transistors (2 channels × 2), thermal resistance θj-c is 2.1°C/W and

Pd × (θc-a + 2.1/4) + Ta ≤ 150°C.. (3)

Thermal resistance θc-a of a heat sink must satisfy inequalities (1) and (3).
Figure 3 shows the relation between Pd and θc-a given from (1) and (3) with Ta as a parameter.

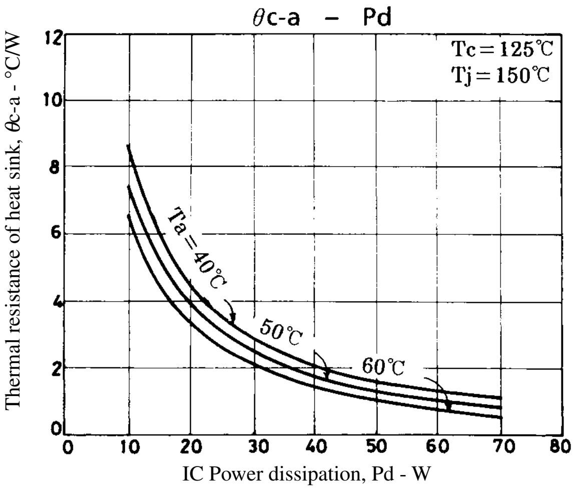


Figure 3. STK4152II θc-a – Pd

[Example] The thermal resistance of a heat sink is obtained when the ambient temperature specified for a stereo amplifier is 50°C.
Assuming V_{CC} = ±27.5V, R_L = 8Ω,
V_{CC} = ±25V, R_L = 4Ω,
R_L = 8Ω : Pd1 = 26W at 1/10 Po max.
R_L = 4Ω : Pd2 = 38W at 1/10 Po max.
The thermal resistance of a heat sink is obtained from Figure 3.
R_L = 8Ω : θc-a1 = 2.88°C/W
R_L = 4Ω : θc-a2 = 1.97°C/W
Tj when a heat sink is used is obtained from (3).
R_L = 8Ω : Tj = 138.7°C
R_L = 4Ω : Tj = 145.0°C