Ordering number: EN2665B

Thick Film Hybrid IC

STK4142II

AF Power Amplifier (Split Power Supply) (25W + 25W min, THD = 0.4%)

Features

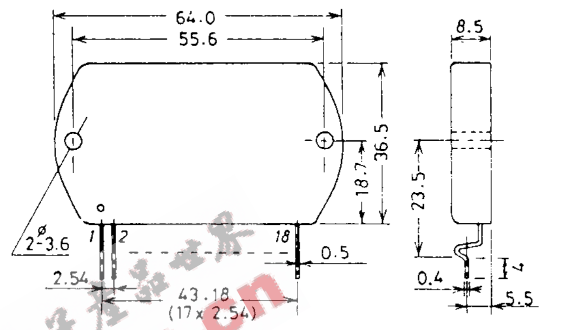
- The STK4102II series (STK4142II) and STK4101V series (high-grade type) are pin-compatible in the output range of 6W to 50W and enable easy design.
- Small-sized package whose pin assignment is the same as that of the STK4101II series
- Built-in muting circuit to cut off various kinds of pop noise
- Greatly reduced heat sink due to substrate temperature 125°C guaranteed
- Excellent cost performance

Package Dimensions

unit: mm

4040

[STK4142II]



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Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		±39	V
Thermal resistance	θj-c		2.6	°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} = ±26V, R_L = 8Ω, f = 50Hz, Po = 25W	2	s

Recommended Operating Conditions at Ta = 25°C

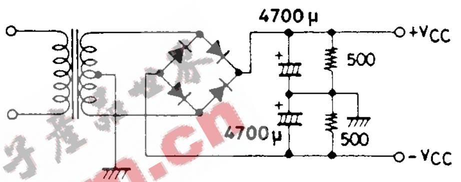
Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		±26	V
Load resistance	R_L		8	Ω

SANYO Electric Co., Ltd. Semiconductor Business Headquarters
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

Operating Characteristics at Ta = 25°C, V_{CC} = ±26V, R_L = 8Ω, Rg = 600Ω, VG = 40dB, R_L : non-inductive load

Parameter	Symbol	Conditions	min	typ	max	Unit
Quiescent current	Icco	V_{CC} = ±31V	20	40	100	mA
Output power	Po (1)	THD = 0.4%, f = 20Hz to 20kHz	25			W
	Po (2)	V_{CC} = ±22V, THD = 1.0%, R_L = 4Ω, f = 1kHz	25			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} = ±31V, Rg = 10kΩ			1.2	mVrms
Neutral voltage	V_N	V_{CC} = ±31V	–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 short-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-22)

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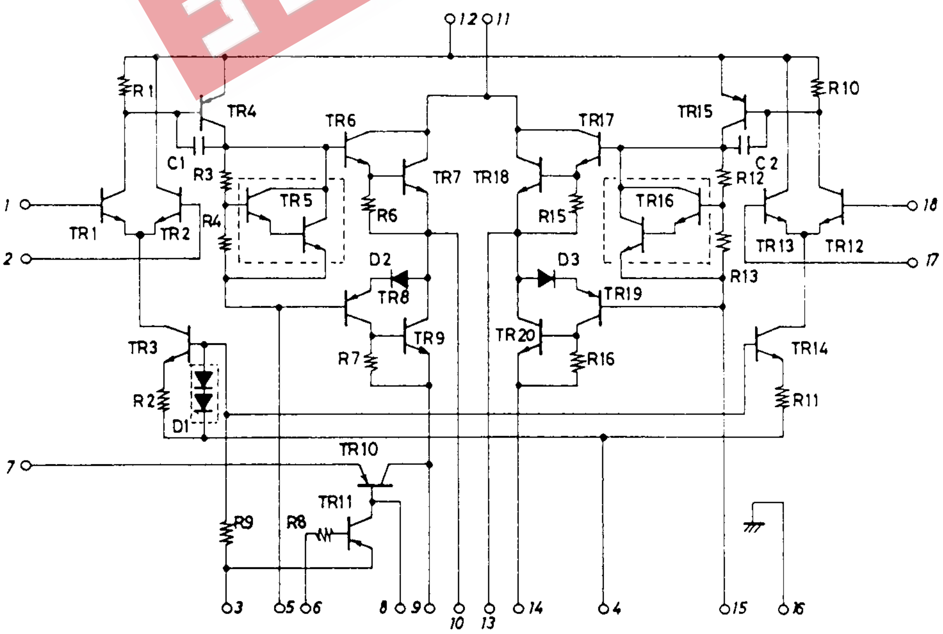
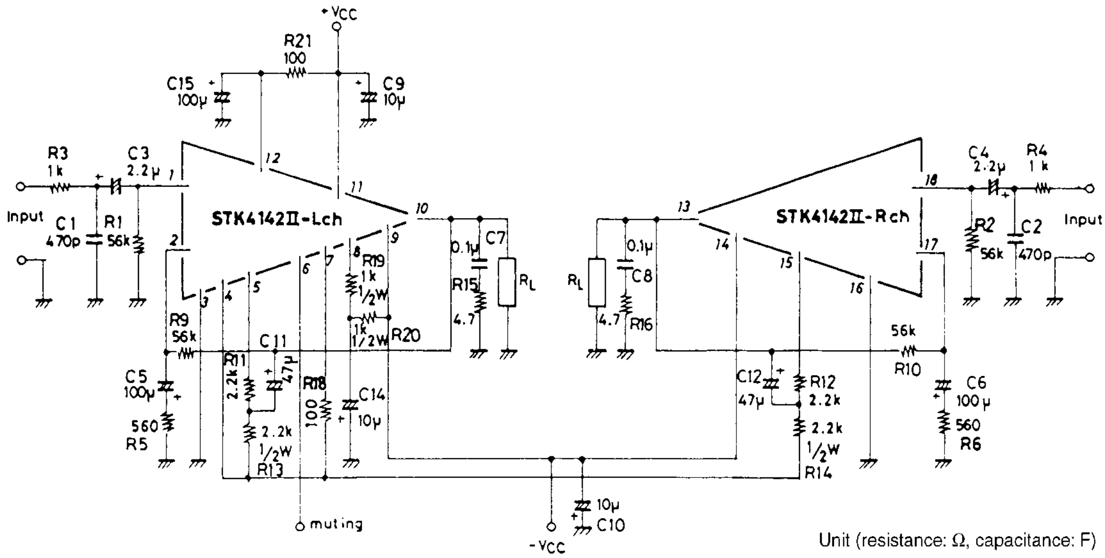
Equivalent Circuit



Sample Application Circuit : 25W min 2-channel AF power amplifier



Unit (resistance: Ω, capacitance: F)

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

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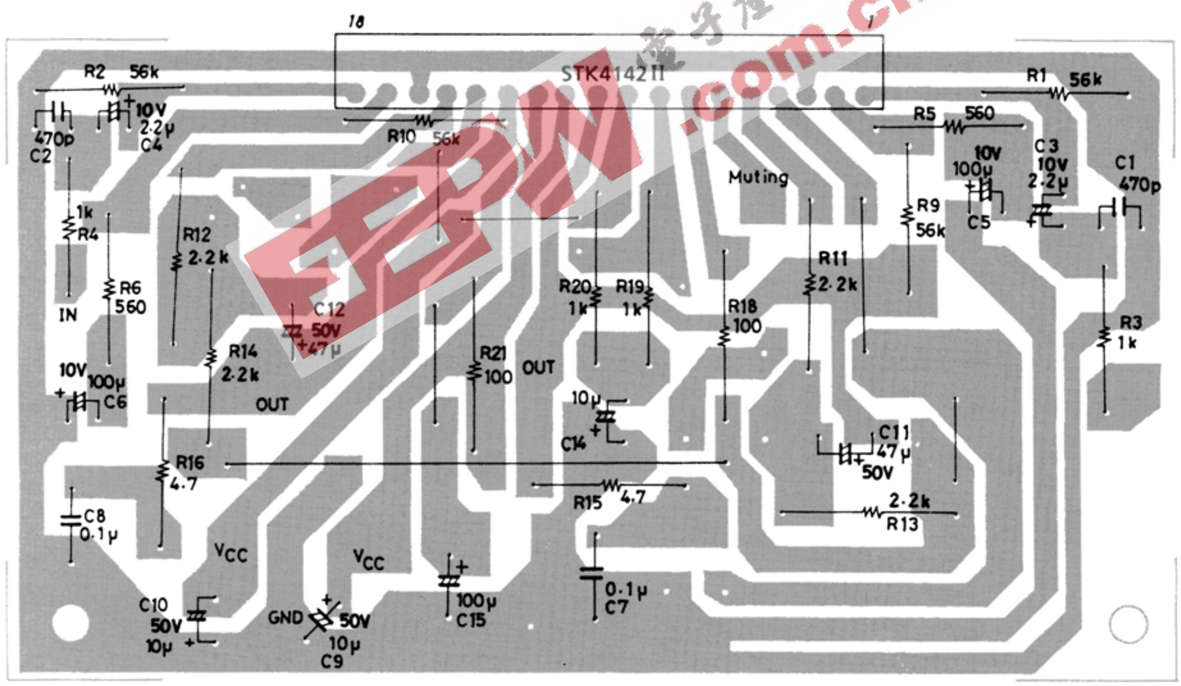
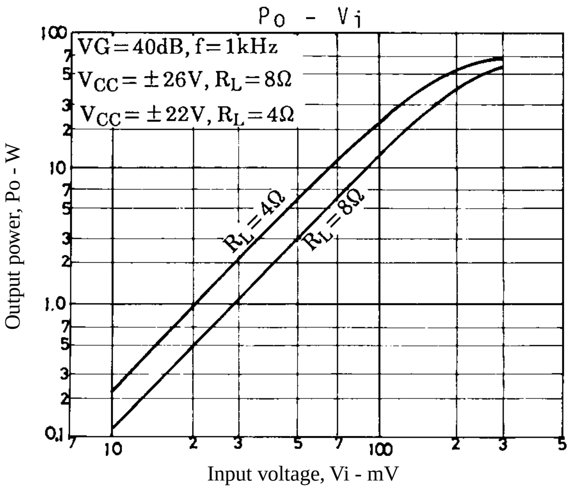
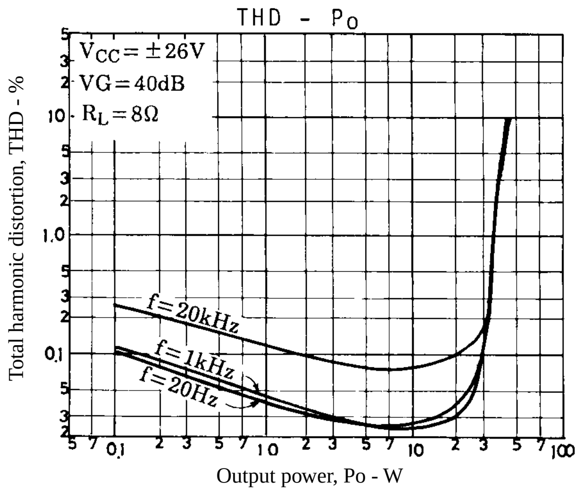
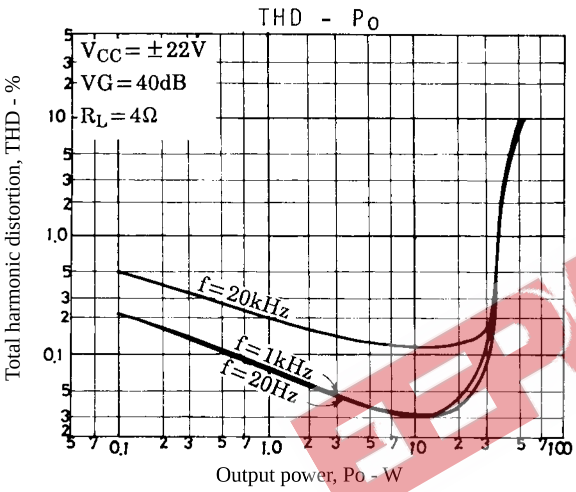
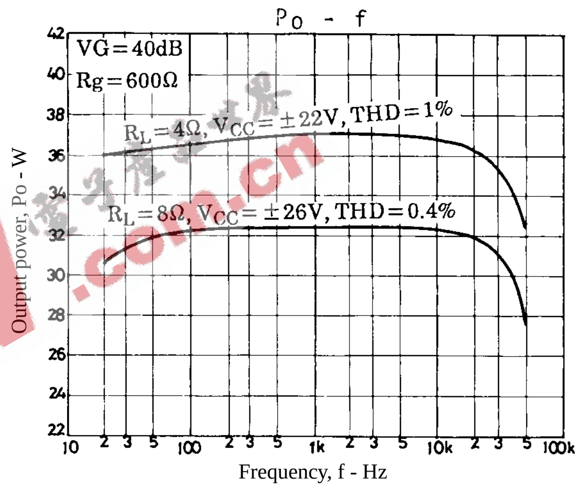


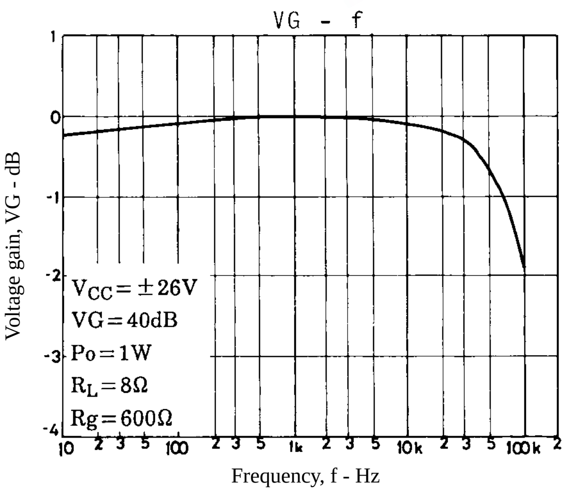
Unit (resistance: Ω, capacitance: F)

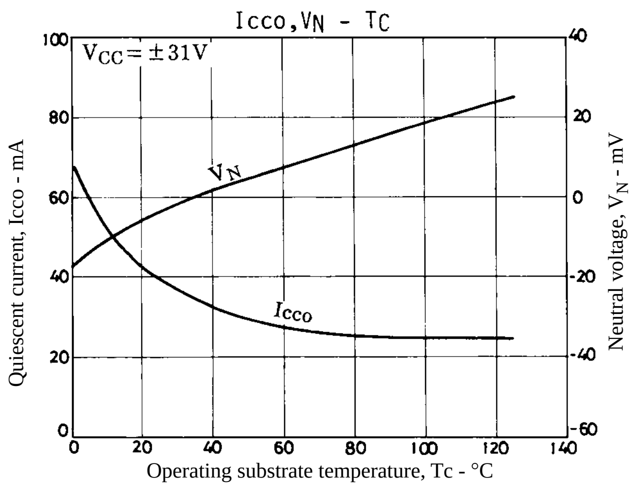

Po - Vi
VG = 40dB, f = 1kHz
VCC = ±26V, RL = 8Ω
VCC = ±22V, RL = 4Ω
RL = 4Ω
RL = 8Ω
Output power, Po - W
Input voltage, Vi - mV

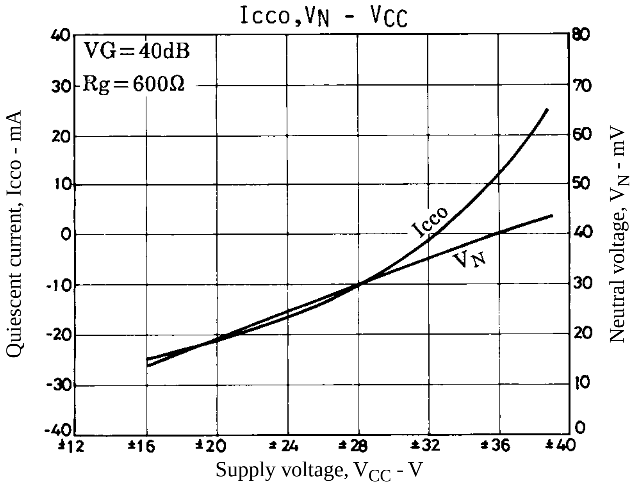

THD - Po
VCC = ±26V
VG = 40dB
RL = 8Ω
f = 20kHz
f = 1kHz
f = 20Hz
Total harmonic distortion, THD - %
Output power, Po - W

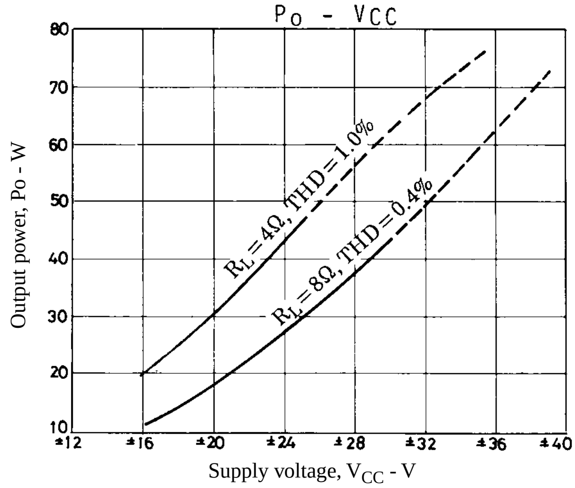

THD - Po
VCC = ±22V
VG = 40dB
RL = 4Ω
f = 20kHz
f = 1kHz
f = 20Hz
Total harmonic distortion, THD - %
Output power, Po - W

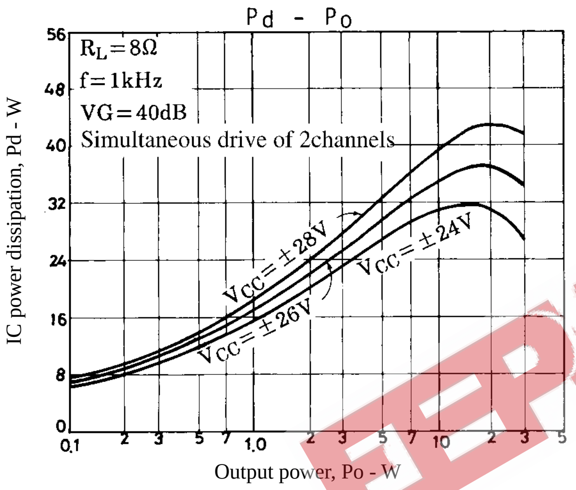

Po - f
VG = 40dB
Rg = 600Ω
RL = 4Ω, VCC = ±22V, THD = 1%
RL = 8Ω, VCC = ±26V, THD = 0.4%
Output power, Po - W
Frequency, f - Hz

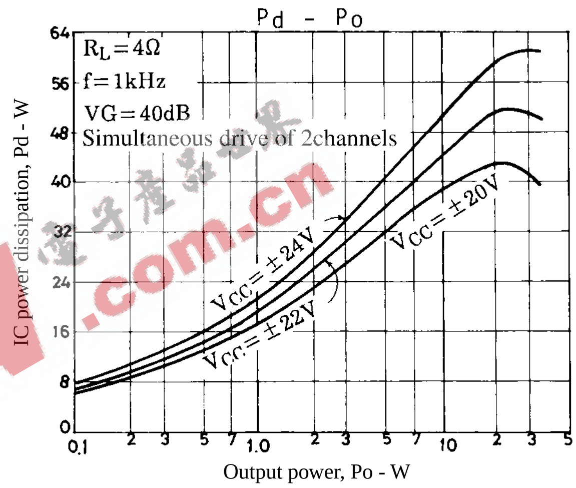

VG - f
VCC = ±26V
VG = 40dB
Po = 1W
RL = 8Ω
Rg = 600Ω
Voltage gain, VG - dB
Frequency, f - Hz

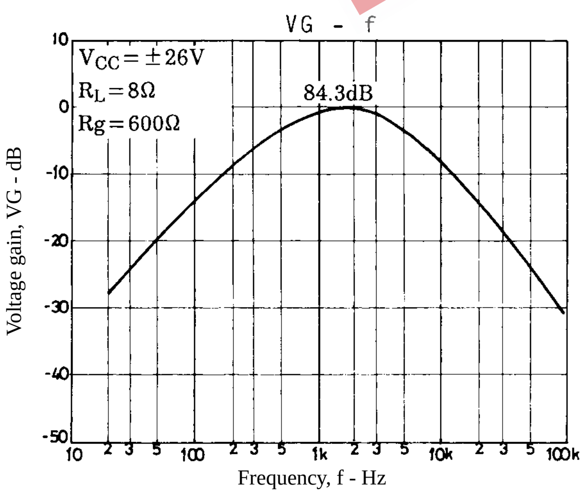

Icco, VN - TC
VCC = ±31V
VN
Icco
Quiescent current, Icco - mA
Neutral voltage, VN - mV
Operating substrate temperature, Tc - °C


Icco,VN - VCC
VG=40dB
Rg=600Ω
Icco
VN
Quiescent current, Icco - mA
Neutral voltage, VN - mV
Supply voltage, VCC - V

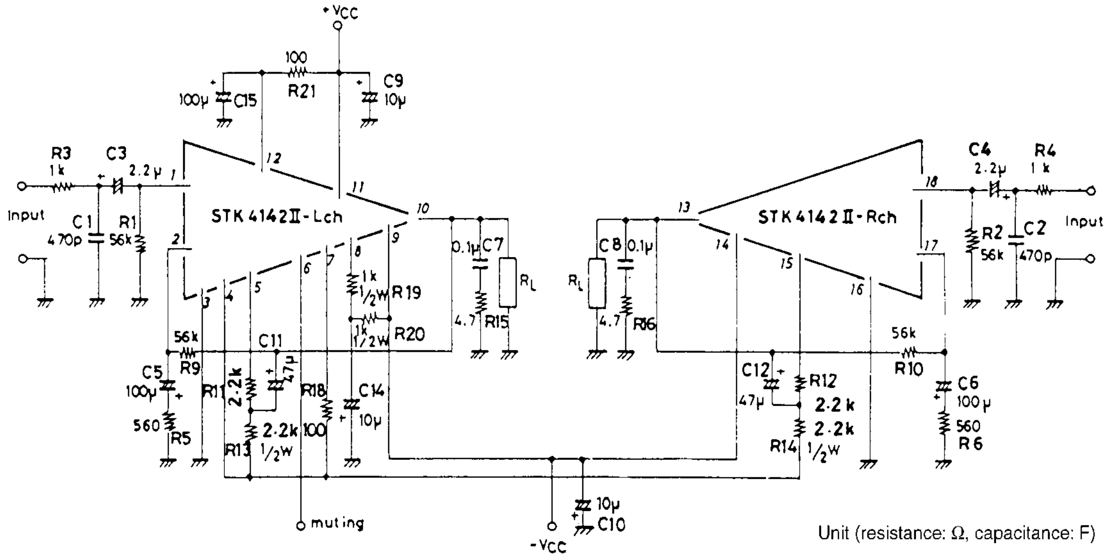

Po - VCC
RL=4Ω, THD=1.0%
RL=8Ω, THD=0.4%
Output power, Po - W
Supply voltage, VCC - V


Pd - Po
RL=8Ω
f=1kHz
VG=40dB
Simultaneous drive of 2channels
VCC=±28V
VCC=±24V
VCC=±26V
IC power dissipation, Pd - W
Output power, Po - W


Pd - Po
RL=4Ω
f=1kHz
VG=40dB
Simultaneous drive of 2channels
VCC=±24V
VCC=±20V
VCC=±22V
IC power dissipation, Pd - W
Output power, Po - W


VG - f
VCC=±26V
RL=8Ω
Rg=600Ω
84.3dB
Voltage gain, VG - dB
Frequency, f - Hz

Description of External Parts



Unit (resistance: Ω, capacitance: F)

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 R5 (or R6). • When R5 (or R6) 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

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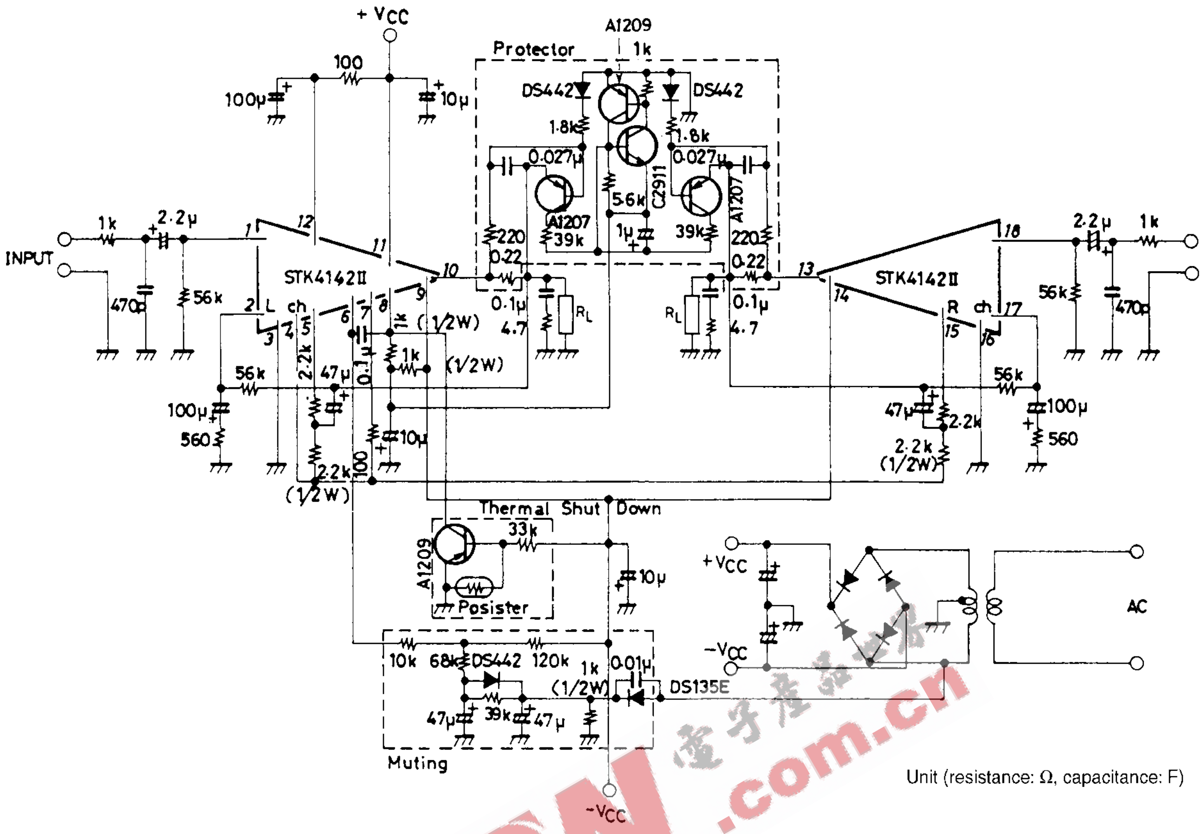
Sample Application Circuit (protection circuit and muting circuit)



Unit (resistance: Ω, capacitance: F)

Thermal Design

The IC power dissipation of the STK4142II at the IC-operated mode is 37.2W max. at load resistance 8Ω and 51.8W max. at load resistance 4Ω (simultaneous drive of 2 channels) for continuous sine wave as shown in Figure 1 and 2.

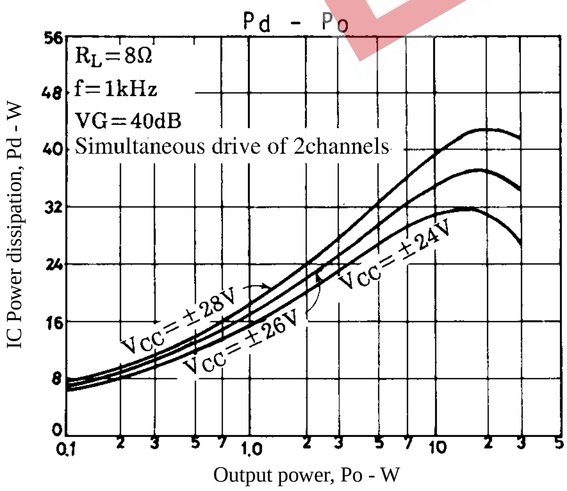


Figure 1. STK4142II Pd – Po (R_L = 8Ω)

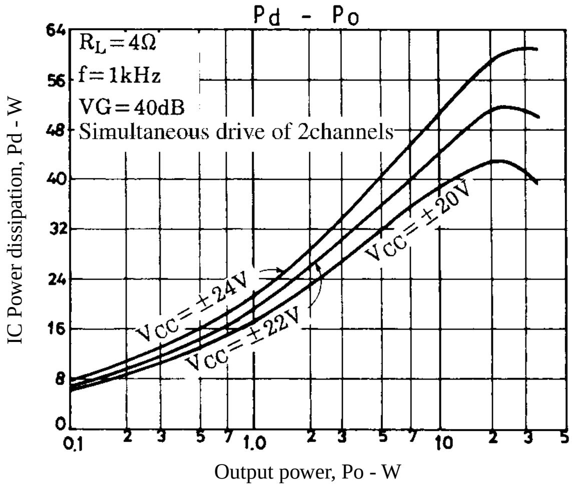


Figure 2. STK4142II Pd – Po (R_L = 4Ω)

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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 = 23.6W at 8Ω, Pd = 28.2W 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: $Tc = Pd \times \theta c\text{-}a + Ta \leq 125°C$ .... (1)
where Ta : Specified ambient temperature
Tc : Operating substrate temperature

Condition 2: $Tj = Pd \times (\theta c\text{-}a) + Pd/4 \times (\theta c\text{-}a) + Ta \leq 150°C$ .... (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 2.6°C/W and

$Pd \times (\theta c\text{-}a + 2.6/4) + Ta \leq 150°C$ .... (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.

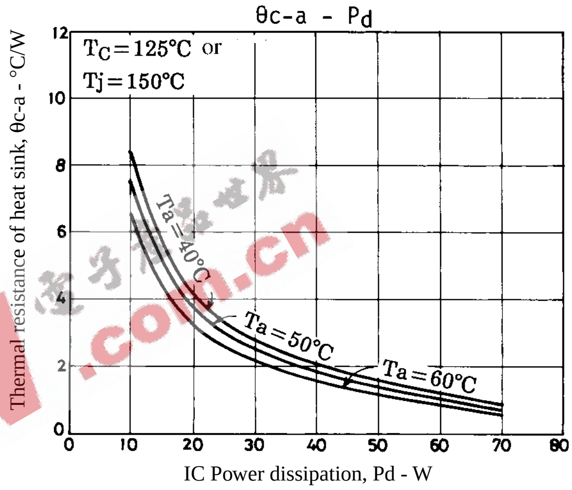

Figure 3. STK4142II θc-a – Pd

[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} = ±26V, R_L = 8Ω,
V_{CC} = ±22V, R_L = 4Ω,
R_L = 8Ω : Pd1 = 23.6W at 1/10 Po max.
R_L = 4Ω : Pd2 = 28.2W at 1/10 Po max.
The thermal resistance of a heat sink is obtained from Figure 3.
R_L = 8Ω : θc-a1 = 3.18°C/W
R_L = 4Ω : θc-a2 = 2.66°C/W
Tj when a heat sink is used is obtained from (3).
R_L = 8Ω : Tj = 140.4°C
R_L = 4Ω : Tj = 143.4°C

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