Ordering number : EN*A1245

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SANYO Semiconductors
DATA SHEET

STK412-150C-E — Thick-Film Hybrid IC Two-Channel Power Switching System Audio Power IC, 150W+150W

Overview

The STK412-150C-E is a class H audio power amplifier hybrid IC that features a built-in power supply switching circuit. This IC provides high efficiency audio power amplification by controlling (switching) the supply voltage supplied to the power devices according to the detected level of the input audio signal.

Applications

- Audio power amplifiers.

Features

- High output power by using power MOSFETs.
- Output load impedance: R_L = 8Ω to 6Ω supported
- Using insulated metal substrate that features superlative heat dissipation characteristics that are among the highest in the industry.

Series Models

	STK412-150C-E	STK412-170C-E
Output (0.7%/20Hz to 20kHz)	150W×2 channels (R_L=6Ω)	180W×2 channels (R_L=4Ω)
Max. rated V_H (quiescent)	±95V	±95V
Max. rated V_L (quiescent)	±61V	±60V
Recommended operating V_H	±57V	±54V
Recommended operating V_L	±38V	±37V
Dimensions (excluding pin height)	78.0mm×44.0mm×9.0mm	

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Specifications

Absolute maximum ratings at Ta = 25°C (excluding rated temperature items), Tc=25°C unless otherwise specified

Parameter	Symbol	Conditions	Ratings	Unit
V_H maximum quiescent supply voltage 1	V_H max (1)	When no signal	±95	V
V_H maximum supply voltage 2	V_H max (2)	R_L≥6Ω, 150W, 50ms	±85	V
V_L maximum quiescent supply voltage 1	V_L max (1)	When no signal	±61	V
V_L maximum supply voltage 2	V_L max (2)	R_L≥6Ω, 150W, 50ms	±55	V
Maximum voltage between V_H and V_L *4	V_H-V_L max	No load	60	V
Thermal resistance	θj-c	Per power transistor	1.3	°C/W
Junction temperature	Tj max	Both the Tj max and Tc max conditions must be met.	150	°C
IC substrate operating temperature	Tc max		125	°C
Storage temperature	Tstg		-30 to +125	°C
Allowable load shorted time *3	ts	V_H=±57V, V_L=±38V, R_L=6Ω, f=50Hz, P_O=150W, 1-channel active	0.3	s

Electrical Characteristics at Tc=25°C, R_L=6Ω, Rg=600Ω, VG=30dB, VZ=18V, non-inductive load R_L

Parameter	Symbol	Conditions *1						Ratings			unit
		V_{CC} (V)		f (Hz)	P_O (W)	THD (%)		min	typ	max	
Output power	P_O (1)	V_H V_L	±57 ±38	20 to 20k		0.7		150			W
Total harmonic distortion	THD (1)	V_H V_L	±57 ±38	20 to 20k	150				0.4		%
Frequency characteristics	f_L, f_H	V_H V_L	±57 ±38		1.0		+0 -3dB	20 to 50k			Hz
Input impedance	ri	V_H V_L	±57 ±38	1k	1.0				55		kΩ
Output noise voltage *2	V_{NO}	V_H V_L	±68 ±46				Rg=2.2kΩ			1.0	mVrms
Quiescent current	I_{CCO}	V_H	±68				R_L=∞			70	mA
		V_L	±46							100	
Output neutral voltage	V_N	V_H V_L	±68 ±46					-70	0	+70	mV

[Remarks]

*1: Unless otherwise specified, use a constant-voltage power supply to supply power when inspections are carried out.

*2: The output noise voltage values shown are peak values read with a VTVM. However, an AC stabilized (50Hz) power supply should be used to minimize the influence of AC primary side flicker noise on the reading.

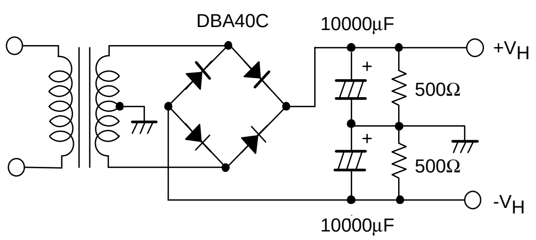
*3: Use the designated transformer power supply circuit shown in the figure below for the measurements of allowable load shorted time and output noise voltage.

*4: Design circuits so that (|V_H|-|V_L|) is always less than 40V when switching the power supply with the load connected.

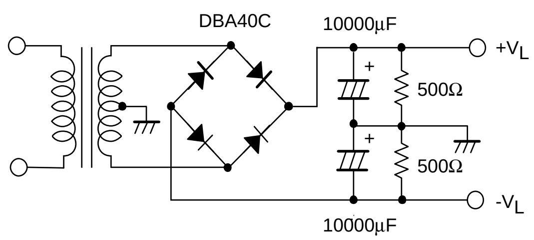
*5: Set up the V_L power supply with an offset voltage at power supply switching (V_L-V_O) of about 8V as an initial target.

*6: Weight of independent IC: 38.6g

Package dimensions (length×width×height): 429mm×245mm×275mm



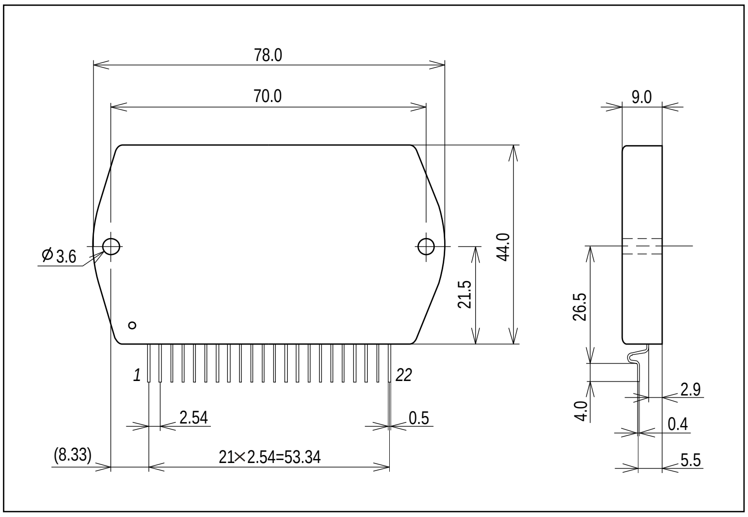
Designated transformer power supply
(MG-250 equivalent)



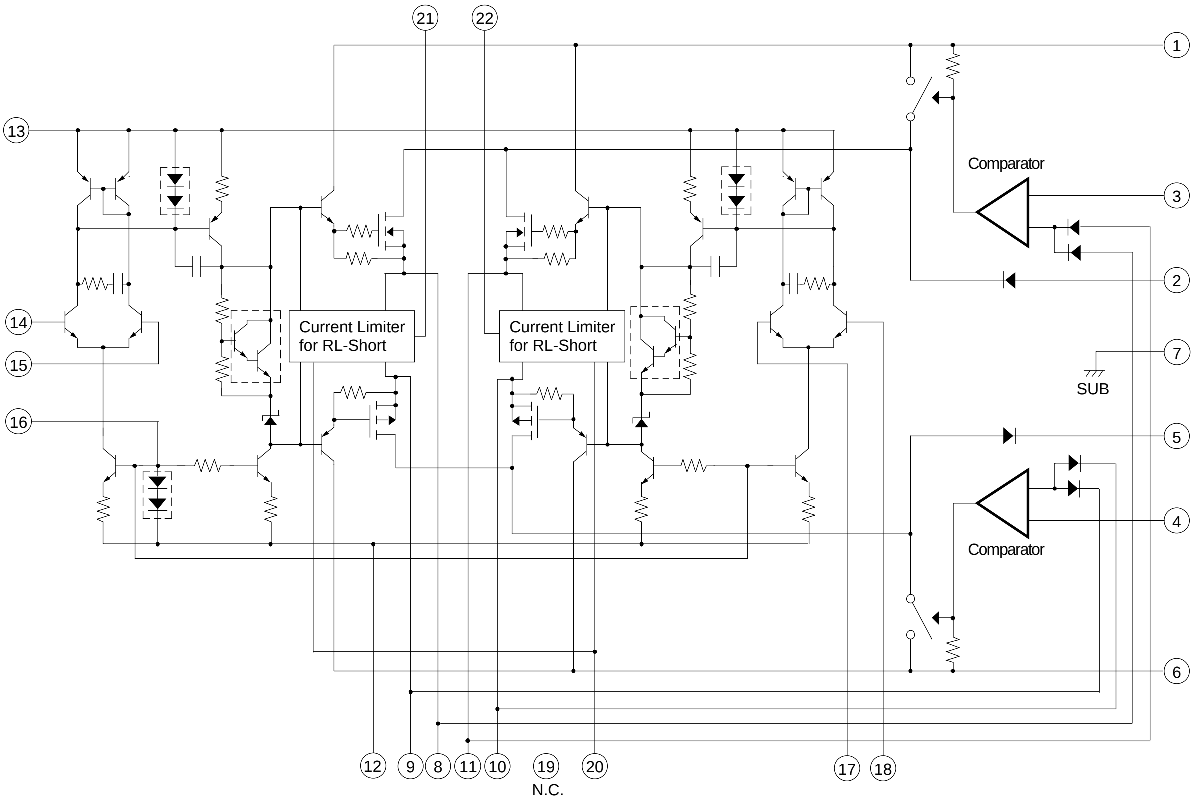
Designated transformer power supply
(MG-200 equivalent)

Package Dimensions

unit:mm (typ)



Internal Equivalent Circuit



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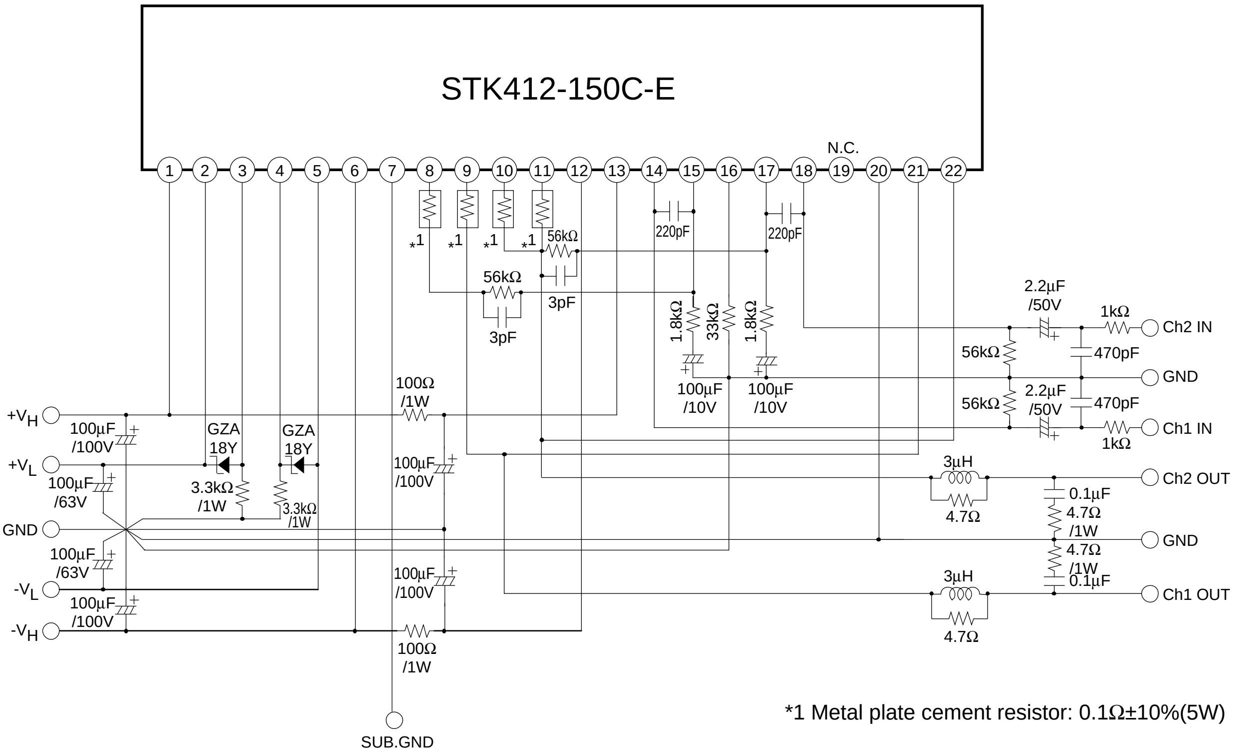
Application Circuit Example



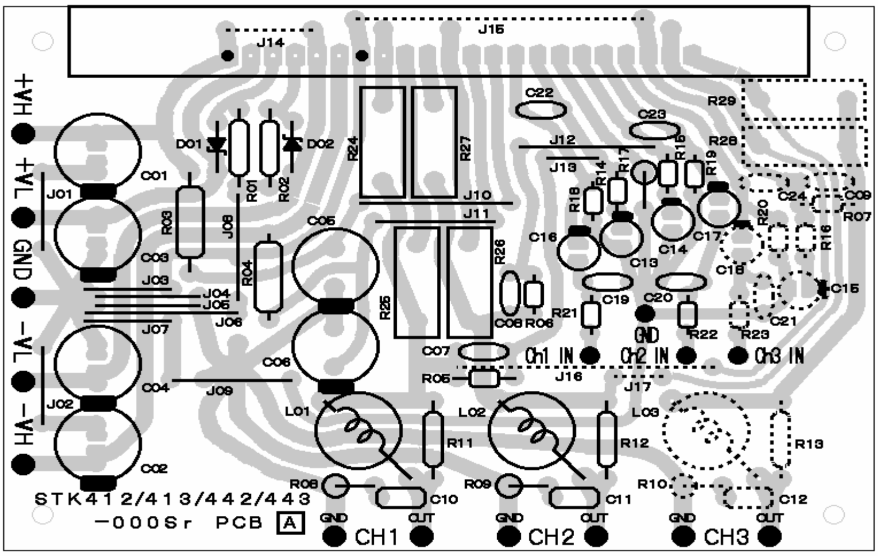
*1 Metal plate cement resistor: 0.1Ω±10%(5W)

Pin Assignments

STK412-150C-E PIN Assignment

PIN No.	PIN Symbol	PIN Assignment
1	$+V_H$	$+V_H$ Power Supply Voltage
2	$+V_L$	$+V_L$ Power Supply Voltage
3	+Vref	+Side Shift Voltage Reference
4	-Vref	-Side Shift Voltage Reference
5	$-V_L$	$-V_L$ Power Supply Voltage
6	$-V_H$	$-V_H$ Power Supply Voltage
7	SUB GND	H-IC Sub GND
8	Ch1 +RE	Ch1 +Side Emitter Output
9	Ch1 -RE	Ch1 -Side Emitter Output
10	Ch2 -RE	Ch2 -Side Emitter Output
11	Ch1 +RE	Ch1 +Side Emitter Output
12	-Pre V_H	-Side Pre. Supply Voltage
13	+Pre V_H	+Side Pre. Supply Voltage
14	Ch1 IN	Ch1 Input
15	Ch1 NF	Ch1 Negative Feedback
16	Bias	Bias
17	Ch2 NF	Ch2 Negative Feedback
18	Ch2 IN	Ch1 Input
19	N.C.	No. Component
20	GND	GND
21	Ch2 FB	Ch2 Feedback for Protection
22	Ch1 FB	Ch1 Feedback for Protection

Sample PCB Trace Pattern

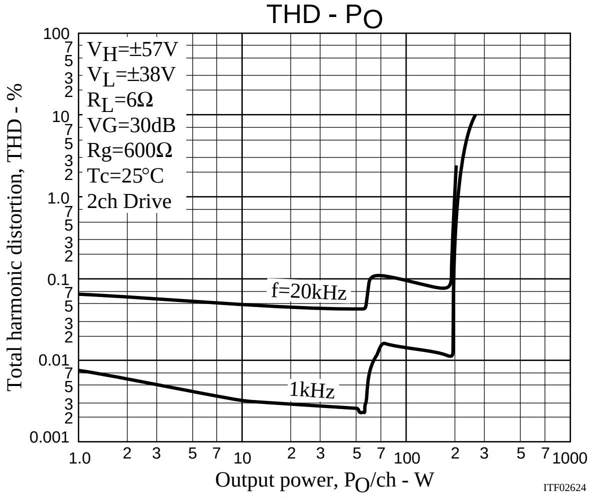


Parts List

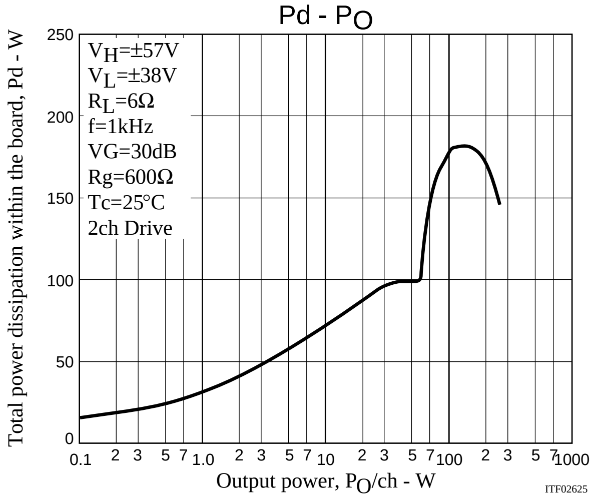
P.C.B. No.	STK412-150C-E/STK412-170C-E
R 01, 02	3.3kΩ 1W
R 03, 04	100Ω 1W
R 05, 06, 18, 19, (07, 20)	56kΩ 1/6W
R 08, 09, (10)	4.7Ω 1W
R 11, 12, (13)	4.7Ω 1/4W
R 14, 15, (16)	1.8kΩ 1/6W
R 17	33kΩ 1/4W
R 21, 22, (23)	1kΩ 1/6W
R 24, 25, 26, 27, (28, 29)	0.1Ω ± 10% 5W
C 01, 02, 05, 06	100µF/100V
C 03, 04	100µF/63V
C 07, 08, (09)	3pF
C 10, 11, (12)	0.1µF/100V
C 13, 14, (15)	100µF/10V
C 16, 17, (18)	2.2µF/50V
C 19, 20, (21)	470pF
C 22, 23, (24)	220pF
L 01, 02, (03)	3µH
D 01, 02	GZA18Y (SANYO)
J 01, 02, 03, 07	10mm
J 04, 05	12mm
J 06, 10	17mm
J 08, 09, 11, 12	14mm
J 13	5mm
J 14	N.C
J 15	33mm
J 16	30mm
J 17	5mm

Evaluation Board Characteristics

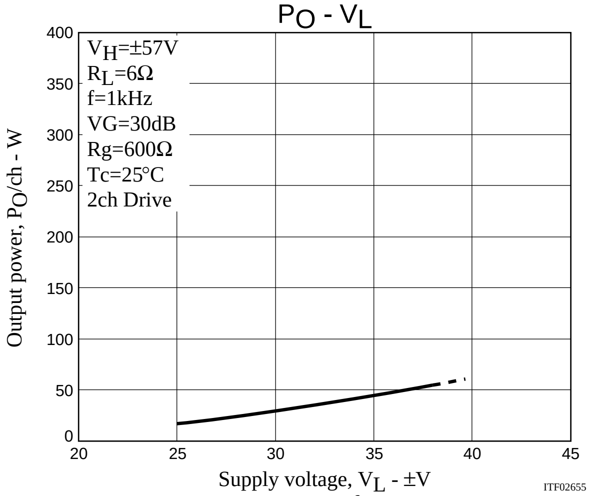
THD - P_O



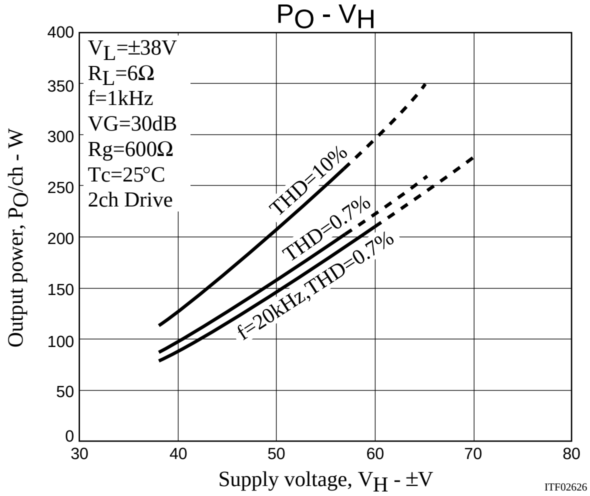
Pd - P_O



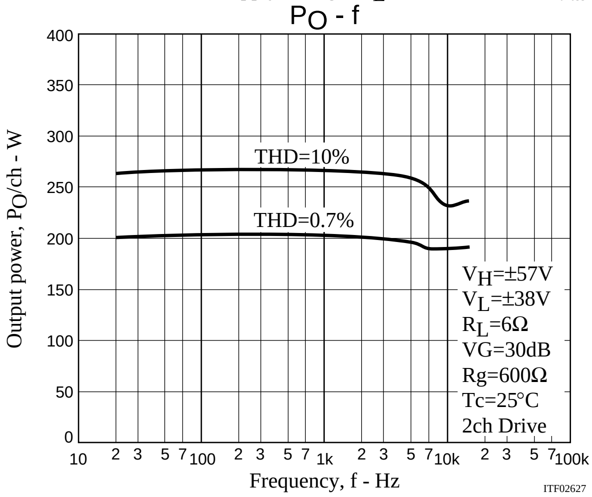
P_O - V_L



P_O - V_H



P_O - f



[Thermal Design Example for STK412-150C-E]

The thermal resistance, θc-a, of the heat sink for total power dissipation, Pd, within the hybrid IC is determined as follows.

Condition 1: The hybrid IC substrate temperature, Tc, must not exceed 125°C.

$Pd \times \theta c\text{-}a + Ta < 125°C$ .... (1)

Ta: Guaranteed ambient temperature for the end product

Condition 2: The junction temperature, Tj, of each power transistor must not exceed 150°C.

$Pd \times \theta c\text{-}a + Pd/N \times \theta j\text{-}c + Ta < 150°C$ .... (2)

N: Number of power transistors

θj-c: Thermal resistance per power transistor

However, the power dissipation, Pd, for the power transistors shall be allocated equally among the number of power transistors.

The following inequalities result from solving equations (1) and (2) for θc-a.

$\theta c\text{-}a < (125 - Ta)/Pd$ .... (1)'

$\theta c\text{-}a < (150 - Ta)/Pd - \theta j\text{-}c/N$ .... (2)'

Values that satisfy these two inequalities at the same time represent the required heat sink thermal resistance.

When the following specifications have been stipulated, the required heat sink thermal resistance can be determined from formulas (1)' and (2)'.

- Supply voltage V_H, V_L
- Load resistance R_L
- Guaranteed ambient temperature Ta

[Example]

When the IC supply voltage, V_H=±57V, V_L=±38V and R_L is 6Ω, the total power dissipation, Pd, within the hybrid IC, will be a maximum of 180W at 1kHz for a continuous sine wave signal according to the Pd-Po characteristics. For the music signals normally handled by audio amplifiers, a value of $1/8P_O$ max is generally used for Pd as an estimate of the power dissipation based on the type of continuous signal. (Note that the factor used may differ depending on the safety standard used.)

This is:

$Pd \approx 85W$ (when $1/8P_O$ max. = 19W).

The number of power transistors in audio amplifier block of these hybrid ICs, N, is 4, and the thermal resistance per transistor, θj-c, is 2.1°C/W. Therefore, the required heat sink thermal resistance for a guranteed ambient temperature, Ta, of 50°C will be as follows.

From formula (1)' $\theta c\text{-}a < (125 - 50)/85$

< 0.88

From formula (2)' $\theta c\text{-}a < (150 - 50)/85 - 1.4/4$

< 0.82

Therefore, the value of 0.82°C/W, which satisfies both of these formulae, is the required thermal resistance of the heat sink.

Note that this thermal design example assumes the use of a constant-voltage power supply, and is therefore not a verified design for any particular user’s end product.

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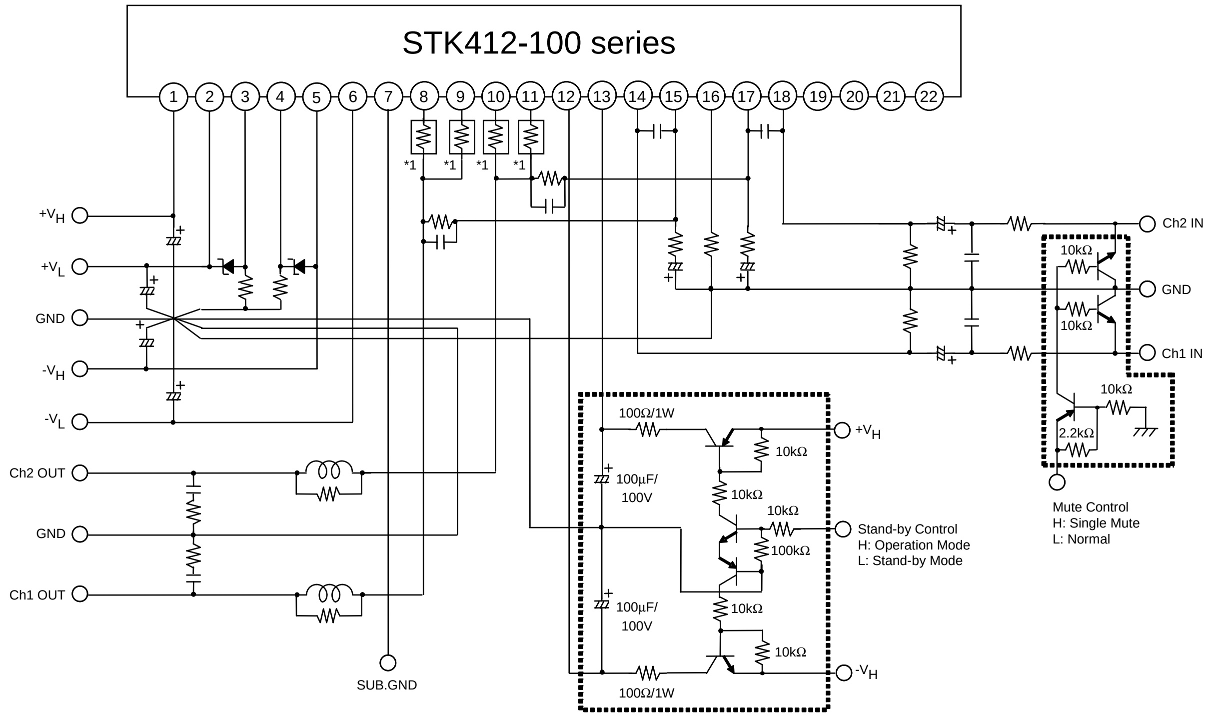
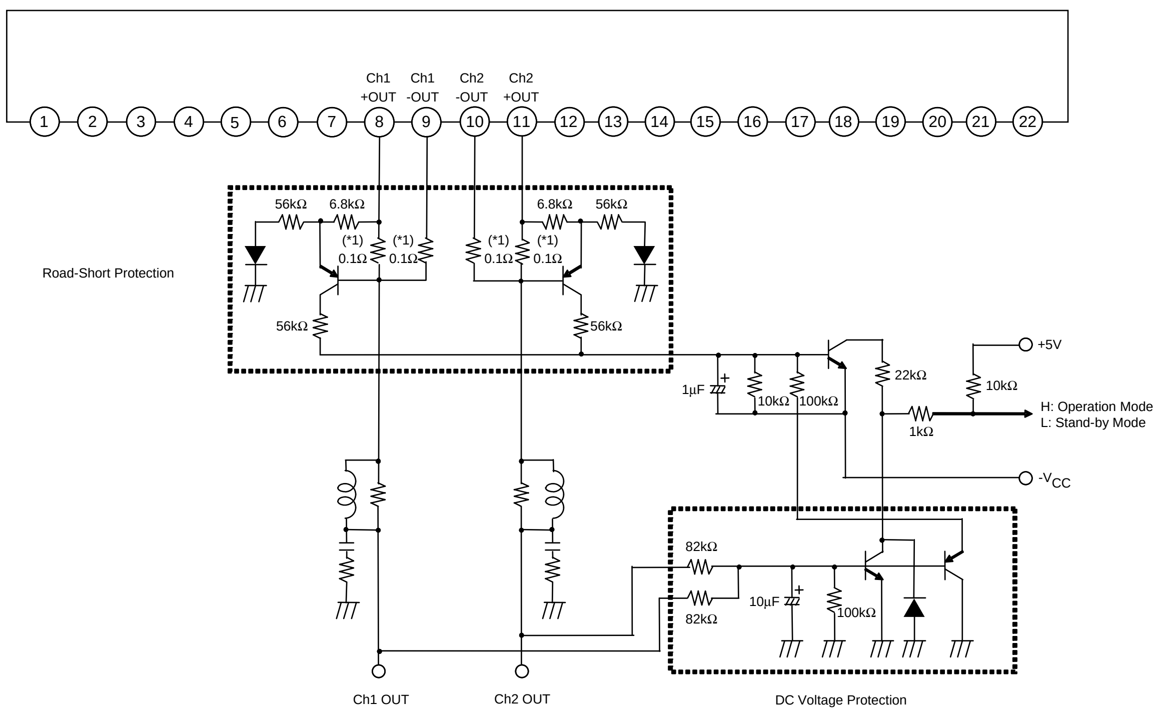
STK412-100 Series Stand-by Control & Mute Control Application



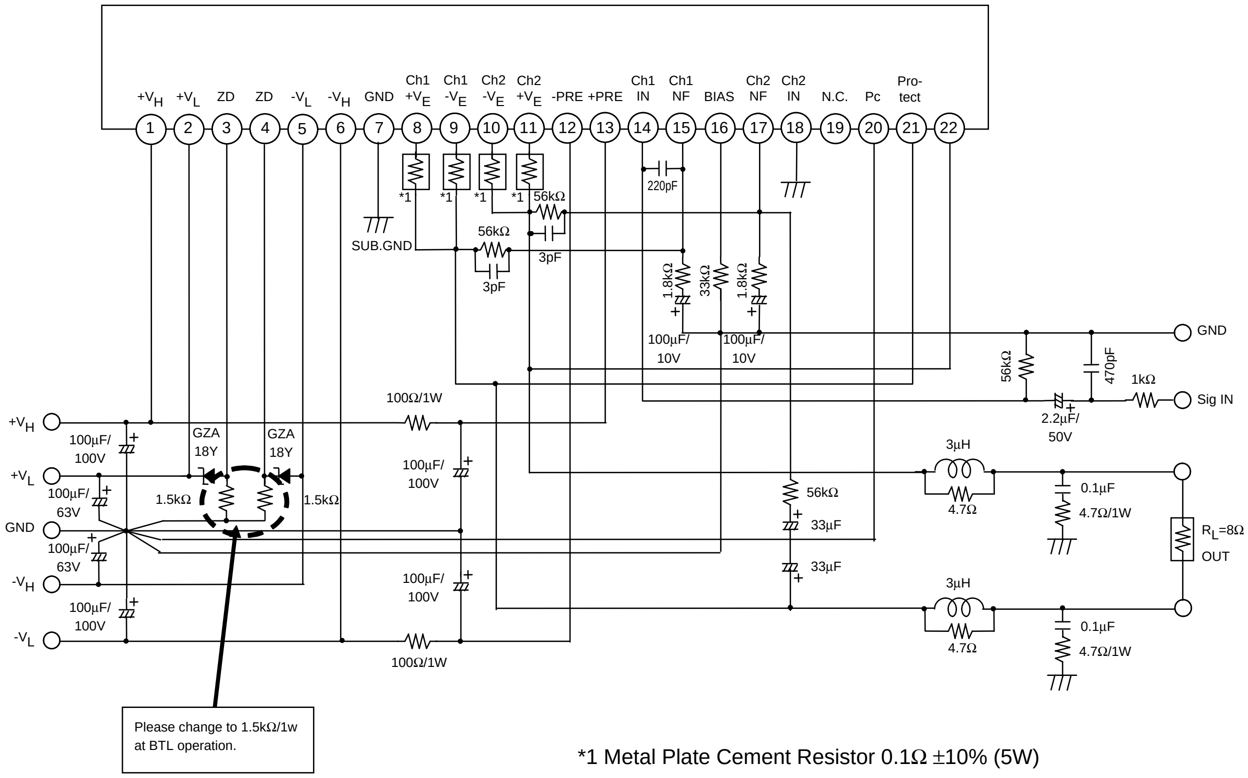
*1 Metal Plate Cement Resistor 0.1Ω ±10% (5W)

STK412-100 Series Load-Short & DC Voltage Protect Application



*1 Metal Plate Cement Resistor 0.1Ω ±10% (5W)

STK412-150C-E/STK412-170C-E BTL Application



*1 Metal Plate Cement Resistor 0.1Ω ±10% (5W)

This catalog provides information as of March, 2009. Specifications and information herein are subject to change without notice.